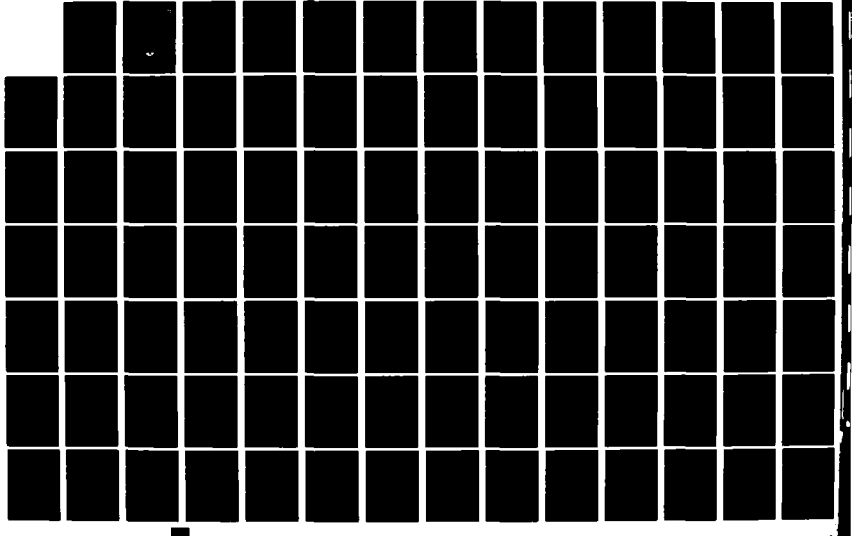
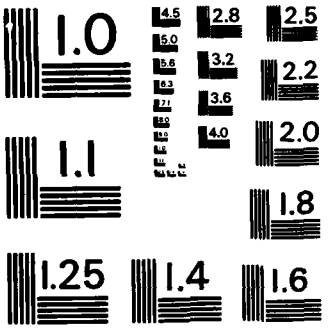
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MAN IN THE COLD ENVIRONMENT

A bibliography
with
Informative Abstracts
(Updated Version)

1 SEPTEMBER 1982

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Undersea Medical Society
9650 Rockville Pike
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MAN IN THE COLD ENVIRONMENT

A Bibliography
with
Informative Abstracts
(Updated Version)

By: Charles W. Shilling
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1 September 1982

UNDERSEA MEDICAL SOCIETY
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U.S.A.

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The present updating and augmentation has been supported by the Research and Development Command, Bureau of Medicine and Surgery, U.S. Navy.

PREFACE

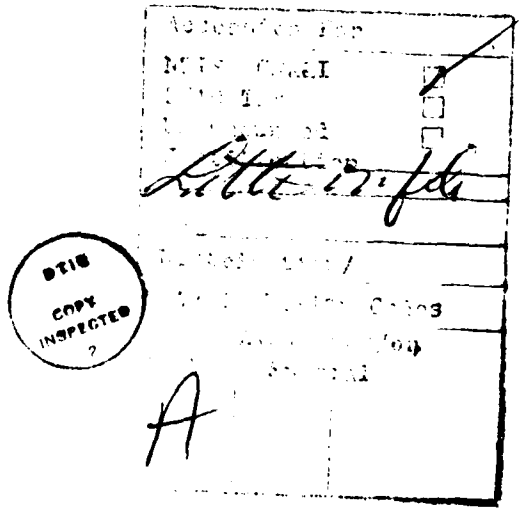
The original report No. 35(CE) 1-15-80 was in response to U.S. Navy Purchase Order N00129-79-M-3196 dated 17 May 1979.

The present report is supported by The Max and Victorial Dreyfus Foundation Inc.

The literature was accumulated, first, by a search of the Undersea Medical Society Information Center holdings dealing with underwater cold exposure and deep sea diving. This Information Center has been supported by the Office of Naval Research, the Research and Development Command of the Navy Bureau of Medicine and Surgery and by the National Oceanic and Atmospheric Administration. In addition, a detailed search was made of the National Library of Medicine holdings dealing with the general subject of hypothermia.

The scope of the literature search for updating was directed toward military applications, particularly those dealing with cold injury, adaptation, therapeutic drugs, and rewarming techniques. Clinical and laboratory findings and applicable case histories dealing with the subject of hypothermia in general are included because of their pertinency to the understanding of the problems in treating hypothermic victims.

Edward Podolak



ACKNOWLEDGMENT

Special credit goes to Pixie Story for searching and creative work in the development of the Bibliography.

Special thanks go to Rosemary Mathias for search of the UMS Information Center for hypothermia abstracts, to Sally T. McAllister for the lay out, to Christine Dutton and Kristine Henriksen for composition, and to Yvette P. Desautels for helping in the final preparation.

ABSTRACTS

The following informative abstracts are arranged alphabetically by the senior author's name.

Many abstracts were added and a few deleted after the numbering and the subject index were completed. Thus, there are numbers in the sequence that are missing and a few numbers have been added as "a", "b", "c", etc.

The augmented version starts alphabetically with abstract number 490.

The author and subject indexes incorporate all of the abstracts in this edition.

1.

ABRAMS, R.M., M. Notelovitz and C.J. Wilcox.

Vaginal blood flow response to immersion of hand in ice water.

Physiologist 19:103; Aug. 1976.

Abstract only. Entire item quoted: Vaginal blood flow was evaluated in seven normal young women who were menstruating regularly and were on no medication. Subjects slept overnight in a quiet, temperature controlled (23C) room. Immediately upon awakening vaginal temperature was measured. A vaginal probe (J. Appl. Physiol. 33:144, 1972) was inserted and heat flow from the vaginal wall to the water-cooled (20-25C) probe was evaluated by recording continuously the mV output of 4 bismuth telluride heat flow discs embedded in the wall of the probe. Parameters evaluated each minute before, during and after a 4 minute period of hand immersion in an icewater slush were: vaginal heat flow (HF) in $\mu V/\Delta T$ (vagina-water), systolic blood pressure (BP) (automatic sphygmomanometer), and pulse rate (PR) (toe photoelectric plethysmograph). Data were analyzed by method of least squares analysis of variance which included patient and time in the statistical model. No recognizable change in pre-immersion values could be detected in any of the response variables. HF, BP and PR mean pre-immersion levels were 266.9 $\mu V/C$, 100.4 mmHg, and 67/min. After immersion, significant increases occurred ($p < .01$); mean peak responses were attained at 2.4, 3.4, and 0.9 minutes and averaged 270.0 $\mu V/C$, 115.8 mmHg, and 69.8/min. In control experiments employing a vaginal thermocouple alone, there were no detectable changes in vaginal temperature during hand immersion. In view of an earlier demonstration that HF bears a qualitative relationship to vaginal blood flow, these results suggest that vaginal blood flow increases in women in response to a standard cold pressor stimulus.

1a.

ACKLES, K.N., M.R. Howat, J.E. Ulrichsen and J.I. Pope.

A hand-held radio pill temperature readout.

Downsview, Ontario, Canada, Def. Civil Inst. Environ. Med., Rep. DCIEM 76-X-50, 15p. June 1976.

A hand-held device has been designed and tested to allow easy direct temperature readout from a human subject who has swallowed a temperature measuring radio pill. The device is held close to the subject's abdomen and moved about until the optimal auditory signal is obtained. The core temperature of the subject is then read from a dial calibrated in °C. Clothing and other equipment such as diving suits, weight belts, etc., do not interfere with the reading. (Authors' abstract)

2.

ADAMS, R.M.

Ice diving–special equipment.

In: Proceedings of the Eighth International Conference on Underwater Education, Nov. 1976, San Diego, Calif., p.20-25. Colton, California, National Association of Underwater Instructors, 1976.

The ice diving equipment discussed in this paper is divided into three categories: Topside equipment for personnel, equipment for opening the hole, and the diver's equipment. The first consists chiefly of warm clothing, and some sort of shelter or windbreak. The second consists of an ice saw (hand or power), shovel, ice chipper, and ice auger (not needed if a power saw is used). Convenient auxiliary equipment would be a toboggan for transporting gear, a chair and foot stand for the safety diver, and an ice piton for anchoring the diver's line to the surface. As to the diver's equipment, it is the same as for other types of diving, except for the addition of thermal underwear. Plastic bags may be used over the socks and under the boots. Neoprene cement applied over the stitching of the boots will prevent breaking. The diver's line is most important. It should be at least 3/8" in diameter fastened to a harness by a secure

clip which can be easily detached if necessary. The double hose regulator is favored for ice diving because it does not freeze up, and the valve tolerances (in some models) are greater. (MFW/UMS)

3.
AIZAWA, Y., A. Shibata, M. Tajiri and Y. Hirasawa.
Reflex vasoconstriction to a cold stimulus for non-invasive evaluation of neurovascular function in man.
Jpn. Heart J. 20(3):301-305; May 1979.

The response of limb blood flow to cold stimulus was determined by venous occlusion technique in 30 healthy subjects. The stress was applied by immersing one hand into ice-floating water for 35 sec, and the blood flow was measured serially in the contralateral upper limb. The change of blood flow at the 15th sec of stress was the largest among the intermittent measurements, and decreased by 48 ± 8% of the control value. A significant rise in plasma dopamine-beta-hydroxylase was found in response to the same stress. This simple cold stress test may be used to evaluate the function of the reflex arc involved in reflex vasoconstriction. A significantly diminished vasoconstriction was observed in 12 uremic patients with a concomitantly smaller rise of plasma dopamine-beta-hydroxylase activity in the test. (Authors' summary)

4.
ALLEN, B.R.
Spasticity and vascular lesions.
Br. J. Dermatol. 99(Suppl. 16):40-2; July 1978. (Frostbite complications).

A case of a boy, age 10, who has had chilblain-like lesions of his hands, feet and ears since the age of two, which are definitely exacerbated by exposure to cold. (CWS/UMS)

5.
ALMQUIST, H., M. Arborelius, Jr., P.O. Barr, B. Jansson and Kayser.
Oxygen toxicity in nitrogen mixtures.
Acta Physiol. Scand. 75:64-68; Jan./Feb. 1969.

Three groups of 20 mice were exposed to 4 atmospheres of oxygen partial pressure with pure oxygen or nitrogen mixtures containing 65 or 45% oxygen. The time was measured for the first 10 oxygen fits and for 50% of the animals to become unconscious. With both parameters, if anything, nitrogen seemed to decrease the sensitivity of the mice for oxygen poisoning. Provided interspecies differences do not exist, this would imply that decompression-free diving down to 23 m would be possible. The reasons are discussed for failures in earlier trials to decrease nitrogen partial pressure by adding oxygen to the breathing medium during diving. (Authors' summary)

5a.
ALEXANDER, J.
Respiratory heat loss.
In: Egstrom, G.H., ed. Thermal problems in diving. Proceedings of a seminar held at Commercial Diving Center, Wilmington, Calif., Mar. 19-20, 1976, p.65-67. Wilmington, Calif., Commercial Diving Center, June 1977.

Respiratory heat loss depends upon the density of the gas, and thus upon the depth of the dive. At depths of 800 to 1000 feet, at high work rates, heat loss of 700 to 800 watts, corresponding to an energy loss equivalent to 2-25 liters of oxygen consumption per minute. This represents the total energy production of a diver at moderate work rate. Decreased mental and muscular function, cardiac arrhythmias and vascular instability have occurred under such circumstances. A table is given indicating the minimum safe inspired gas temperatures. Even when heat loss through the skin is minimized by the

use of a hot water suit, respiratory heat loss can easily outstrip metabolic heat production. To maintain thermal balance, the breathing gas must be heated. (MFW/UMS)

6.

ALTHAUS, U., et al.

Zur Therapie der tiefen akzidentellen Hypothermie mit Kreislaufstillstand. [Treatment of profound accidental hypothermia with circulatory arrest].

Praxis 67(51):1919-1924; Dec. 19, 1978.

Complete recovery after rapid rewarming is described in two tourists buried by a snow-slip, who have been admitted in a state of profound hypothermia with total circulatory arrest (rectal temperature 22°C and 19°C respectively). In both patients respiration and circulation have ceased during the rescue from the avalanche. Following tracheal intubation and institution of artificial ventilation and external cardiac massage patient A was brought to our clinic, where attempts at closed chest defibrillation proved to be unsuccessful. Two hours after the rescue, thoracotomy was performed and rewarming was started by continuous irrigation of the pericardial cavity and of the stomach with warm saline. In patient B measures of resuscitation were not taken before 70 minutes following rescue. Two hours later extracorporeal rewarming of the blood was begun with the use of partial cardiopulmonary bypass via a femoral vein and artery and combined with local warming of the heart. Whereas the heart of patient A could not be defibrillated until 90 minutes following thoracotomy, rewarming of patient B resulted very rapidly, and already 20 minutes after institution of bypass resuscitation of the heart was successful. We conclude that rapid rewarming is the adequate therapy for profound accidental hypothermia with circulatory arrest. If feasible, extracorporeal blood-warming is considered to be the method of choice. It offers an efficient assisted circulation and has the distinct advantages of rapidity and of rewarming the core in advance of the increasing metabolic requirements at the periphery; thus, the "rewarming shock" as a result of premature peripheral vasodilatation may be prevented. (Authors' summary)

7.

AMERICAN ACADEMY OF PEDIATRICS. Committee on Pediatric Aspects of Physical Fitness, Recreation, and Sports.

Accidental hypothermia.

Pediatrics 63(6):926-928; June 1979.

Accidental hypothermia causes newsworthy fatalities at all times of the year. Pediatricians frequently are aware of their patients' involvement in outdoor recreation; therefore, a review of the prevention, clinical features, and treatment of hypothermia is appropriate so preventive guidelines can be instilled in those engaged in such activities as mountain climbing, hiking, backpacking, snowshoeing, cross-country skiing and racing, swimming, scuba diving, water skiing, motor and sail boating, canoeing, kayaking, and cycling. Hypothermia may be characterized as a physiologic state in which body core temperature falls below 35°C (95°F) because of a negative balance between heat production and heat loss. Symptoms progress as core temperature falls. Accidental hypothermia caused by wind chill is a danger to hikers, backpackers, and mountain climbers, particularly when they are wet. Making camp immediately, using the warmth afforded by a sleeping bag and the body heat from companions, and drinking warm fluids will help prevent tragedy. Failure to take these measures places the exposed person in a no-return situation where treatment of hypothermia below a core temperature of 30°C (86°F) requires hospital facilities. Unfortunately, these people frequently are in areas where evacuation is difficult.

7a.

AMINI-SERESHKI, Latifeh.

Brainstem control of shivering in the cat. I. Inhibition.

Am. J. Physiol. 232(5):R190-R197; 1977 or Am. J. Physiol.:Regulatory Integrative Comp. Physiol. 1(3):R190-R197; 1977.

Regions containing heat gain tonic inhibitory areas in mesencephalon and upper pons were studied using

topical microinjection of a local anesthetic. This inhibition was compared in the mesencephalic decerebrated and intact animals. In mesencephalic animals that failed to shiver, bilateral injections of procaine into the ventromedial pontine tegmental areas released some heat gain responses and in intact anesthetized cats injections in the same regions increased intensity of shivering. These effects on inhibitory areas are reversible and can be repeated in the same preparation several times. Permanent effects were obtained by electrolytic lesions or by the local microinjections of 1% osmic acid. In summary, it is shown, by means of microinjection of local anesthetic, that a tonic inhibitory area located in the ventromedial pontine reticular formation completely inhibits shivering in the mesencephalic decerebrate preparation and partially inhibits shivering in the intact anesthetized preparation.

7b.

AMINI-SERESHKI, Latifeh.

Brainstem control of shivering in the cat. II. Facilitation.

Am. J. Physiol. 232(5):R198-R202; 1977 or Am. J. Physiol.:Regulatory Integrative Comp. Physiol. 1(3):R198-R202; 1977.

Regions containing areas and pathways mediating heat gain responses in the mesencephalon and upper pons and in the medulla were studied using topical microinjection of a local anesthetic. These facilitatory areas and pathways were compared in the decerebrated and intact cats. In lower pontine preparations shivering was abolished by bilateral injections of procaine into the lateral medullary reticular formation. Injections into the same areas in the intact anesthetized cat resulted in the cessation of shivering. These effects on facilitatory areas are reversible and can be repeated in the same preparation several times. Permanent effects were obtained by electrolytic lesions or by the local microinjections of 1% osmic acid. In summary it is shown, by means of microinjection of local anesthetic, that the pathways mediating shivering in the intact and lower pontine cats are located in the same area in lateral reticular formation of pons and medulla.

8.

ANDERSEN, B.G.

Diving equipment and human performance during undersea operations in the high arctic. In: The working diver–1974. Symposium proceedings, March, 1974, Columbus, Ohio, p.325-340. Washington, D.C., Marine Technology Society, 1974.

This paper describes the research findings of a diver performance program which was conducted in the high arctic during December 1972 as part of the Arctic III expedition at Resolute Bay, NWT, Canada. A primary objective of the diver performance program was to add to the limited body of knowledge regarding underwater operations and diver performance in arctic waters. Focus of the program was an evaluation of construction of the manned underwater work station Sub-Igloo which was assembled at a depth of 40 feet. During the period of the project, ice cover over Resolute Bay was 37 inches with a constant water temperature of 28.5°F. Surface temperatures ranged between -5° and 45°F with wind velocities of up to 35 MPH. The performance program also examined the effects of physiological stress on the divers working under the ice. Measures of diver heart rates and deep body temperatures were obtained using an acoustical telemetry system. . . . The data obtained concerning the direct effects of cold water exposure on body temperature showed a relatively small heat loss in most of the divers. The ability of the divers to retain their body heat is attributed to the excellent thermal properties of the variable volume dry suit. . . . It was anticipated that somewhat lower heart rates would be experienced by the divers due to the extremely cold water. However, here again the efficient thermal protection provided by the Unisuit may have had some influence on the heart rate data. . . . An evaluation was also made of the diver and support equipment used during the expedition including diver apparel, communications equipment, life support systems, ice cutting apparatus, and portable surface structures. (Author)

9.

ANDERSEN, B.G.

Equipment and human performance during diving operations in the high Arctic. Landover, Md., Oceanautics, Inc., Final Rep. on ONR Contract N00014-74-C-0383, 29p. Dec. 1974. (Also published as Volume VIII of the James Allister MacInnis Foundation Arctic diving expeditions).

The author discusses the following aspects of the Arctic IV expedition: Logistical support: (a) aircraft services, (b) surface transportation; Surface operations: (a) base camp, (b) maintenance and service facilities, (c) dive site facilities and structures, (d) diver support equipment; Diving operations: (a) general conditions, (b) dive sites, (c) diving procedures; Diver performance; Scientific programs: (a) underwater construction, (b) physiological monitoring, (c) saturation dive, (d) deep dive project; Human adaptation and performance: (a) group compatibility, (b) group motivation, (c) group achievement, (d) conclusions and recommendations. As to the last, the author emphasizes the need for extensive pre-expedition indoctrination and training, cross-training of personnel in projects other than their own, and limitation of any consecutive sojourn in the Arctic environment to a maximum of six weeks. (MFW/UMS)

10.

ANDERSEN, P.K. and D. Theilade.

Overlevelse efter 25 minutters drukning. [Survival after submersion for 25 minutes]. Ugeskr. Laeger 140(27):1620-1621; July 3, 1978.

A child aged six years survived submersion for 25 minutes and resuscitation for 40 minutes without sequelae. On arrival in hospital, clinical cardiac arrest was present together with hypothermia (rectal temperature approximately 31°C). During resuscitation, the hypothermia was utilized to protect the brain from anoxia/ischaemia. Active re-warming was not commenced until circulation had been re-established. During respirator therapy in the subsequent 24 hours, normocapnia was aimed at in view of cerebral and cardiac circulation. The child regained consciousness 12-15 hours after resuscitation and could be discharged after 24 days. (Authors' abstract)

10a.

ANDERSON, K.L.

Metabolic and circulartory aspects of tolerance to cold as affected by physical training. Federation Proceedings, 25:1351-1356; 1966.

It has been suggested that improved physical fitness brought about by training in strenuous muscular exercises affects the bodily tolerance to cold (1, 4, 7). The present field study was undertaken in order to investigate this problem and to workout some of the possible physiological mechanisms involved. A group of young men (19 subjects) served as experimental subjects and underwent 6 wks of hard physical training. During this period half of the subjects (later called "warm subjects") slept warmly and comfortably in heated quarters. The other subjects (later called "cold subjects") were exposed by sleeping under defined thermal conditions. The physiological factors underlying their exercise fitness and cold tolerance were assessed prior to and after the experimental period.

11.

ANDREW, P.J. and R.S. Parker.

Treating accidental hypothermia (letter). Br. Med. J. 2(6152):1641; 9 Dec. 1978.

It has frequently been observed that "exposure" develops in walkers who have missed their breakfast or

restricted their food intake for various reasons. It is now beginning to appear that the majority of exposure hypothermia cases occurring in the British hills are in reality a combination of exhaustion presumably with low blood glucose and regeneration of glycogen reserves will be greatly slowed, thus setting up a vicious circle. These findings affect our views on treatment in the mountain rescue service in this area. We feel that unless he is close to a habitation the victim must stop walking and go to ground as soon as the condition is suspected. He should be taken to the nearest sheltered spot and after putting on all available spare clothing, he should be put into a heavy-gauge polyethylene exposure bag to minimise loss of heat by evaporation from wet clothing.

12.

ANNUNZIATO, L., G.F. DiRenzo, G. Schettini, G. Lombardi, F. Scopacasa, U. Scapagnini and P. Preziosi.

Lack of evidence for an inhibitory role played by tuberoinfundibular dopaminergic neurons on TSH secretion in the rat.

Neuroendo. 28(6):435-441; 1979.

The role of dopamine (DA) in the control of thyroid stimulating hormone (TSH) secretion in basal or cold stimulated conditions was investigated by using pharmacological or neurosurgical tools. The intraventricular injection of DA (5 μg/animal) or the s.c. injection of a dopaminomimetic agent failed to induce changes of TSH plasma levels in normal or in cold stimulated conditions. The same results were obtained by intraperitoneal (i.p.) administration of haloperidol, a blocker of dopaminergic receptors. The complete deafferentation of hypothalamus, which causes degeneration of norepinephrinergic nerve endings and leaves the DA tuberoinfundibular system unaffected, prevented the TSH release evoked by cold exposure. α-Methyl-*p*-tyrosine (α-MpT, 250 mg/kg i.p.), which causes a remarkable reduction of DA in the median eminence (ME) of deafferented animals, was unable to restore the TSH response to cold. DA apparently does not play a significant role in the control of TSH secretion in the rat.

13.

ANONYMOUS

Arctic IV: exploring the polar frontier.

Faceplate 5:28-30; Summer 1974.

The main purpose of Arctic IV, carried out under the supervision of Dr. Joseph MacInnis, was to carry on the study of human and equipment performance in Arctic conditions, which had begun in 1970 with Arctic I. SubIgloo, the habitat that had been constructed during Arctic III, was reinstalled, and small hemispherical refuges called Seashells were stationed throughout the area. The Link inflated rubber dwelling was used for a 24-hour saturation dive. Unisuits, with special Arctic underwear, proved fairly comfortable. U.S. Diver's and Poseidon regulators proved dependable, but other makes froze. Several participants from the Navy carried out special studies–such as the evaluation of equipment and techniques (See Jenkins, W.T., A summary of diving techniques used in polar regions, July 1973). Lieut. Comm. David Hall used an acoustically transmitted monitor to study temperature and heart rate. (MFW/UMS)

14.

ANONYMOUS

Does diver use more air in cold water?

Nav. Res. Rev. 27:30; Nov. 1974.

Gas consumption tests are being conducted at the Naval Coastal Systems Laboratory to gather data on the effects of water temperature and dive duration. Six divers operate in pairs. Their heart function, respiration, and body temperature are electrically monitored. They perform light and moderate work loads and exercise tests. There are scheduled rest periods. The eight foot deep water is kept at 40, 60, and

80°F. Operational wet suits are worn. Preliminary results indicate that the diver consumes more air while operating in cold water. (MFW/UMS)

15.
ANONYMOUS
Thermal garment successfully tested at NCSL.
Nav. Res. Rev. 28:27-29; June 1975.

The Naval Coastal Systems Laboratory has developed a thermal suit that will maintain a diver in cold water for up to eight hours. It is heated by an internal tube suit through which warm water is circulated. The garment is inflated to provide an insulating layer of trapped air. The garment was successfully tested in 34°F water for eight hours. It may require less than 2000 BTUs per hour, as compared to the 10,000 to 70,000 required by previous heated suits. A diver carried heater is also being developed. When the interface between the heater and the suit is perfected, the system will be completely self-sustained. (MFW/UMS)

16.
ANONYMOUS
Arctic extremes pose unique diving problems.
Offshore 36:72; Apr. 1976.

An important part of the Arctic IV expedition, performed under the direction of James Allister MacInnis Foundation was the commercial diving study. The principal investigator was Phil Nuytten, president of Can-Dive Oceaneering. A work platform was placed on the sea floor at a depth of 300 feet. Four 20-minute dives were carried out for the purpose of comparing dry, wet, and explosive pipeline welding. Surface decompression techniques were used. Equipment, primarily the Rat Hat, a dry-suit-diving-helmet system, was evaluated. It was demonstrated that if proper breathing apparatus and equipment are used, divers can satisfactorily perform complex technical tasks under Arctic conditions. (MFW/UMS)

17.
ANONYMOUS
Rate of bacterial growth.
Sea Technol. 17:27; Dec. 1976.

Entire item quoted: Under ambient conditions of temperature and pressure in the deep ocean, bacteria should grow more slowly than they do in warmer situations. This theoretical prediction has been confirmed by P.M. Williams and A.F. Carlicci of the Institute of Marine Resources at the University of California at San Diego. A representative bacterium cultured at 200 atmospheres, corresponding to a depth of 2000 meters, at a temperature of 2°C, doubled every 260 hours. From their results, the California investigators conclude that dissolved organic carbon, rather than particulate matter, is the main source of energy for such bacteria.

17a.
ANONYMOUS
Heat pump diver heating system.
Underwater Syst. Design 2(2):31; May 1980.

The aim of the Heat Pump Diver Heating System is to allow lockout times of six hours and more from an independently operating submersible or other diving equipment, where power supply from the surface is impossible or not feasible for any reason. More than half the amount of heat energy generated by the system is drained from the environment (ambient seawater). Thus more than 50% of electrical power can be saved, which means that the operation time can be doubled. (Author) (News item)

18.
ANONYMOUS
Man in cold water.
Aquanotes 6:4; Mar. 1977.

The work of researchers at the University of Victoria, British Columbia, Canada, is briefly discussed. Unconsciousness can occur at 90°F core temperature. Death, usually from heart failure, occurs at 85°F. An individual can probably survive in 50°F water for two and one-half to three hours, depending upon individual body characteristics (size and amount of fat). It is best not to swim, unless shore is within possible reach. Critical areas for heat loss are the head, the cheeks, and the groin. Survival time can be increased 50% by holding the arms across the chest and lifting the knees to the chest; also by huddling, where several people huddle together by putting the arms around each other's shoulders in a circle, so that the sides of the chests touch. The best suit for cold survival is the full survival suit, which has foam legs and which traps water within insulative foam over critical heat loss areas. Consumption of alcohol increases the cooling rate by 20%. (MFW/UMS)

19.
ANONYMOUS
Cold water prolongs survival of drowning victims.
Sport Diver 1:99; Summer, 1977.

Thirteen cases of cold water drownings were studied at the University of Michigan. There exists a reflex in human beings drowned in cold water which "slows down the heart and redistributes the blood flow so that there is a feeble but constant supply of blood to the brain," according to Dr. Martin J. Nemiroff. The 13 cases he studied varied from four to 38 minutes. Nine recovered with no brain damage, including the one who had been submerged in a frozen pond for 38 minutes. The most important factor in survival is immediate resuscitation, external heart massage and ventilation with the purest oxygen available, warmed to 110°F by a humidifier. (MFW/UMS)

20.
ANONYMOUS
Treating accidental hypothermia.
Lancet 1 (8066):701-702; Apr. 1, 1978.

Many speakers [at a one day symposium at the Royal Institute of Aviation Medicine] expressed dissatisfaction with the lack of any concerted effort to gather medical data during hypothermia incidents. Rescue personnel—lifeboatmen, servicemen, and others—ought to be told what to look for and supplied with a simple robust recording equipment as well as a standardized (waterproof) form on which to note their findings. Deep body temperature, shivering response, level of consciousness, blood pressure and, ideally, electrocardiogram seem the most useful. . . . A record of blood pressure is valuable. Victims of hypothermia are at risk of hypotension, and whenever possible they should be kept slightly head-down. . . . The technique of choice is immersion in a bath of stirred water at 40-44°C. This provides a rapid gain of convective heat and an improvement of venous return and hence cardiac output because of "hydrostatic squeeze." The immediate rise of skin temperature also abolishes shivering and reduces the work of the heart, and hence its metabolic demand for oxygen. Inhalation of hot saturated air or oxygen does not significantly speed spontaneous rewarming in shivering subjects at average indoor levels of temperature and humidity. A closed pipework suit or blanket, perfused with hot water from a miniature catalytic heater, is potentially useful in small boats, helicopters, and exposed sites on land. (Author)

20a.
ANONYMOUS
Janus.
Bull. Medsubhyp 3:2; Sept. 1970.

In Janus II, three divers performed difficult tasks at a depth of 253 m, making 13 dives, usually 2 per day, in a diving bell. They completed 35 hours of work in 8 days. The longest period that a diver actually remained in the water was 3 hours, 9 minutes. The deck chamber was kept at 200 m simulated pressure. Decompression took 97 hours; pure oxygen was not used. This represents an improvement over previous decompression times. Emphasis was placed on physiological and technical preparation, with particular attention to protection against cold. It was the first occasion on which breathing gas was reheated, a measure which is considered in large part responsible for the success of the experiment. The project was under the direction of Doctors Delauze, Fructus and Agarate. (MFW/BSCP)

21.
ANONYMOUS
Treating accidental hypothermia (editorial).
Br. Med. J. 2(6149):1383-4; 18 Nov. 1978.

An editorial outlining the ideal method of treating immersion or exposure hypothermia in the hospital situation. It is pointed out that the nursing care is extremely important and that cardiac involvement is one of the dangerous possibilities so the EKG should be checked frequently. Even in the best of care among elderly patients the mortality may be as high as 50%. They die not from hypothermia but from the illness that precipitated it.

22.
ANONYMOUS
Preventing immersion hypothermia.
Br. Med. J. 2(6153):1662-1663: Dec. 16, 1978.

The most obvious protective measure against immersion hypothermia is adequate clothing. The main requirement is that it should keep the diver dry. It should be one piece, and should provide cover for head and feet, and must carry attached mittens. It should be non-inflammable and should allow enough ventilation to prevent overheating in summer. It should not allow air trapping. It should be a conspicuous color, such as orange or yellow. No buoyancy should be incorporated into the suit. Buoyancy devices should be separately supplied. Another important aspect of survival is the provision of easily accessible life rafts or dinghys. Many deaths have occurred because it was impossible to reach a life raft. In the case of helicopters it might be better to place them on the outside of the craft. (MFW/UMS)

23.
ANONYMOUS
French heater for divers.
Offshore Services 12:50; Jan. 1979.

This system is composed of the following parts: an energy storage unit, an extraction unit, a control unit, a co-axial type umbilical, and a special dry suit. The storage unit which is immersed in the sea water is a water and pressure tight can (maximum 30 bars for the standard version); it contains a mixture of salts, capable of storing up and providing an energy of about 600 Wh/kg. This mixture is contained in a sealed and thermically isolated envelope and includes an evaporator which extracts the stored energy on request. Electrical elements account for the recharge of the system and the temperature monitoring. The extraction unit is located inside the hyperbaric locker and linked to the storage unit through a so called 'primary circuit'. The storage unit supplies the extraction unit with a small quantity of high temperature, low pressure (less than 3 bars) dry steam which yields its energy to a sea water buffer tank. This buffer tank feeds the divers suits. . . . The diving suit has been specially designed to optimise the heating performances. It requires in particular a very small flow (1 l/min) which is much less than that of standard hot water suits. Moreover, it is of the dry type for the divers' comfort and the heating water goes out at the fingers level. The suit underwent numerous trials and physiological measurements in French and foreign laboratories. (Author)

24.
ANONYMOUS
Meet "The Copper Man."
SPUMS J., p.43-44; Jan.-Mar. 1979.

The Copper Man is a life size copper manikin with circuits and sensors that allow him to register the effects of cold. The device was used recently to test several dry suits and undergarments. Tests were made with both nitrogen and helium as the gas in the vapor barrier. Findings were: Neoprene-foam dry suits are better at shallow depths than rubber-coated elastomer dry suits, but not so effective at greater depths, especially when helium is present. The composition of the gas layer (vapor barrier) affects the insulation; nitrogen is the best. The insulation value of the rubber coated suit fabric could be increased by improving the undergarment. Compression-resistant undergarments are essential, especially in the lower extremities. (MFW/UMS)

25.
ANONYMOUS
Anatomy of an undergarment.
SPUMS J., p.43; Jan.-Mar. 1979.

The Naval Coastal Systems Center in Panama City has developed, jointly with the Naval Clothing and Textile Research Facility, a layered undergarment that is the main thermal protection of its new dry suit system. It is comfortable, moisture absorbent, compression-resistant, and provides excellent thermal insulation. The comfort liner is next to the diver's skin, then comes a moisture-absorbing layer, then a vapor barrier to prevent any water vapor from passing through, then a compression-resistant insulation (open-cell foam plastic or a fibrous batting). A major thermal failure would occur if water leaked into the suit and became absorbed by the open-cell insulation. A material is being investigated which allows the passage of gas to permit pressure equilibration and prevent crushing as depth increases, but which is impermeable to water. (MFW/UMS)

26.
ANZAI, T., M.D. Turner, W.H. Gibson and W.A. Neely.
Organ blood flow distribution in hypothermia and rewarming: redistribution by ATP.
Surg. Forum 28:266-268; 1977.

During hypothermia, studies of blood flow distribution and improvement of the circulation to low-flow areas are essential. Information of this type will ultimately lead to the prolongation of circulatory arrest, the acceleration of the recovery after hypothermia, and the long-term maintenance of hypothermic condition. In the present study, blood flow distribution during normothermia, hypothermia, posthypothermia, and during adenosine triphosphate (ATP) or adenosine infusion was determined. (Authors)

27.
ANZAI, T., M.D. Turner, W.H. Gibson and W.A. Neely.
Blood flow distribution in dogs during hypothermia and posthypothermia.
Am. J. Physiol. 234(6):H706-H710; 1978.

Blood flow distribution in tissues of mongrel dogs during hypothermia was studied with radionuclide-tagged microspheres. The animals were cooled at 21°C and rewarmed under i.v. thiamylal sodium anesthesia. During hypothermia, cardiac output fell to 20% of the control; the highest rate of blood flow relative to normothermic values was observed in the subendocardium of the left ventricle, and the lowest in the hypophysis. Each tissue showed specific reactions to hypothermia. During hypothermia the myocardial and brain-stem blood flows were about 40% of the control; almost all of the digestive tract, striated muscle, adrenal gland and hypophysis blood flows were maintained at 20% or less of the control. After rewarming, cardiac output recovered to values significantly lower than control. The myocardium, brain, renal cortex and striated and smooth muscle recovered to control levels; however, blood flow to the digestive organs, bronchial artery flow to the lung, and flow to the endocrine organs did not completely recover by 2 h after rewarming.

28.

ASMUSSEN, G. and U. Gaunitz.

The contractile properties of the striated muscle fibers of the esophageal muscle in comparison to skeletal muscles of the rat.

Acta Biol. Med. Ger. 37(2):335-346; 1978.

The contractile properties of the striated esophageal rat muscle were studied in vitro at 35°C and 25°C. They were compared with those of the slow-twitch soleus muscle and the fast-twitch extensor digitorum longus (EDL) muscle. The contraction time of the esophageal muscle is 30 msec (± 2.5 msec SE) at 35°C. It is small but significantly longer than those of the soleus muscle. It is remarkable that the twitch-tetanus ratio of the esophageal muscle fibers is approximately 2 X that of the skeletal muscles. Immediately after a tetanic stimulation the amplitude of a single twitch of the fast EDL is increased (posttetanic potentiation); in the slow soleus muscle it is unchanged or decreased. The muscle fibers of the esophagus exhibit a post-tetanic-potentiation, but this is smaller than in EDL. A decrease of the temperature of the bathing solution causes in preparations of the fast EDL a higher tension developed by a single twitch (cold potentiation). This is not detectable in preparations of the slow soleus muscle. The esophageal muscle shows also a remarkable cold potentiation, but it is smaller than in EDL. An increase of the extracellular K^+-concentration evokes a short-lasting contracture in the rat muscles. The mechanical thresholds of the esophageal muscle fibers are clearly higher than those of the soleus muscle but lower than those of the EDL. The striated esophageal muscle fibers of the rat in spite of their low speed of contraction show some properties of muscle fibers of the fast twitch type.

28a.

AUDET, N.F., G.M. Orner and Z. Kupferman.

Thermal insulation materials for diver's underwear garment.

U.S. Navy Clothing and Textile Research Facility, Tech. Rep. 139, 28p. Feb. 1980.

The Navy Clothing and Textile Research Facility (NCTRF) conducted studies on commercially available foam and fibrous thermal insulating materials to determine those which would be effective in a diver's dry-suit underwear garment. An effective insulation had to allow the pressurized gaseous environment existing within the diver's dry suit to permeate the insulation, have good compressional resistance at hydrostatic pressures up to 2 psi (13.8 kPa), and provide an intrinsic thermal insulation value of 1.0 to 1.5 clo. To establish potential candidate materials, NCTRF studied a number of open-cell polyurethane foams having different pore sizes, densities, and thicknesses, and a low-density-polypropylene microfiber batt material for both thermal insulation and compressional resistance properties. Evaluations of candidate materials and comparisons with existing materials used in diver's dry-suit underwear indicated that a fine pore open cell foam and the polypropylene microfiber batt material having densities of approximately 0.12 gr/cm^3 and 0.05 gr/cm^3 and thermal insulation resistances of 1.8 and 2.11 clo/cm at 2 psi (13.8 kPa), respectively, would meet the thermal requirements for the underwear garment and would be superior to those presently being used. The foam compressed less than 30% at 2 psi (13.8 kPa). The fibrous material compressed 60% at 2 psi (13.8 kPa) but had such a high specific clo value uncompressed (2.27 clo/cm) that thermal resistance at 2 psi (13.8 kPa) was still estimated to be 2.11 clo/cm. (DD abstract)

28b.

AULD, C.D., I.M. Light and J.N. Norman.

Accidental hypothermia and rewarming in dogs.

Clin. Sci. 56:601-606; 1979.

Twenty lightly anesthetized dogs were cooled to 29°C by cold-water immersion. Ventilation was spontaneous and the animals were allowed to shiver freely. Metabolic heat production and respiratory heat exchange were measured during rewarming. The animals were divided into four groups each of five dogs and each group was rewarmed by a different technique. The control group was allowed to rewarm spontaneously; a second group was given warm (45-50°C) fully humidified air to breathe in addition; a third group was rewarmed in a hot-water bath (42-44°C) and the remaining group was given a muscle

relaxant to abolish shivering and rewarmed by warm inspired air only. The group rewarmed in hot water achieved normal core temperature most rapidly but there was no difference in the rewarming rates of the group rewarmed spontaneously and of the group given warm air to breathe in addition. The group given a muscle relaxant and rewarmed with warm inspired air required 12 h to achieve the same core temperature as the shivering groups achieved in 2 h. Compared with the heat produced by shivering the amount of heat which it was possible to transfer across the respiratory tract was so small that it did not materially influence the rate of rewarming. (Authors' summary)

28c.

AULD, C.D., I.M. Light, and J.N. Norman.

Cooling responses in shivering and non-shivering dogs during induced hypothermia.
Clin. Sci. 58:501-506; 1980.

Hypothermia to a temperature of 30°C was induced in both shivering and non-shivering groups of dogs. There was a sustained increase in oxygen consumption in the dogs allowed to shiver and this was up to 300% greater than the oxygen consumption in the relaxed dogs. The increased tissue requirement for oxygen was met both by increased cardiac output and increased oxygen extraction from hemoglobin. Oxygen utilization remained adequate in hypothermia, as shown by the absence of hypoxic acidosis. Heart rate fell during cooling and stroke volume increased to meet the increased oxygen demands associated with shivering during the induction of hypothermia.

28d.

AXELROD, D.R., and D.E. Bass.

Electrolytes and Acid Base Balance in Hypothermia.
Am. J. Physiol. 186:31-34; 1956.

Dogs were cooled in an ice-water bath, and plasma electrolytes were measured at heart temperatures of 38°C, 28°C and 25°C. A 'cold acidosis' occurred during hypothermia that is attributable largely to temperature-influenced physico-chemical factors related to the buffer systems. A slight respiratory depression is of greater importance in decreasing plasma pH at lower body temperature than at normal body temperature.

29.

AZHAEV, A.N., A.M. Dobrunov and O.S. Kosheleva.

Substantiating the clothing heat insulation in conduction cooling of the body surface.
Gig. Tr. Prof. Zabol. (11):12-6, Oct. 1978.

Under local action of low temperature on the human body surface 3 degrees of cooling are observed. The I, II and III degrees of cooling correspond to permissible, maximally permissible and maximally impermissible conditions of cooling. The required heat insulation of clothing to protect the parts of the body and proximal sections of lower extremities was determined, as found by investigations carried out. (Authors' summary)

30.

AZNAUR'IAN, P.A. and E.A. Bardakhchian.

Ultrastructural basis of cerebral cortex sensomotor changes in general hypothermia.
Zh. Eksp. Klin. Med. 18(5):43-50; 1978.

The authors made the analysis of ultrastructural and electrophysiologic changes in cerebral cortex in dynamics of general hypothermia. It was revealed that lowering of body temperature to 35°C brings about ultrastructural rearrangement of capillaries, pointing to the development of hypoxia. Progressive lowering of body temperature is accompanied by decrease of dystrophic and degenerative changes of cerebral neurons and synaptic apparatus. Disturbances of microcirculatory hemodynamics appeared to be the leading ones in the development of ultrastructural changes.

31.

BACHRACH, A.J. and G.H. Egstrom.

Human performance underwater.

In: Strauss, R.H., ed. Diving medicine, p.183-196. New York, Grune and Stratton, 1976.

The principal factors affecting performance under water are environment, breathing mixture, equipment, training and diver condition. Water as a medium in which to work exerts a deterrent on performance because of its viscosity, its effect of buoyancy and its motion. Cold is a prime cause of impaired performance. Cold stress does not significantly affect vigilance or reasoning ability, but it does affect memory unfavorably. Some adaptation occurs with repetition. Direct effects of pressure–barotrauma–affect the ears, sinuses, lungs, and other body components. Indirect effects of pressure are nitrogen narcosis and oxygen toxicity. The high pressure nervous syndrome occurs generally at depths below 31.3 ata. Breathing mixture, no matter what it is, appears to be involved in physiological changes affecting performance. It now appears that trimix (helium-nitrogen-oxygen) will enable divers to go deeper without suffering hpns. Human factors engineering in the design of equipment and tools has lagged, but with the increasing demands being made on commercial oil field divers, this situation should improve. Training should consist of actual experience for the trainee rather than demonstration by the instructor. Training of sports divers should place emphasis upon the hazards of tachypnea, hyperpnea, and air embolism. Predive condition of the individual is the most crucial factor affecting performance. A combination of good physical condition and effective training is essential. Also, the diver should be trained to recognize signs of fatigue. Most sports diving accidents involve panic, which is irreversible loss of control. The best agents of panic prevention are good training and good physical condition. (MFW/UMS)

32.

BACK, O. and A. Larsen.

Delayed cold urticaria.

Acta Der. Venereol. 58(4):369-371; 1978.

Five patients with delayed cold urticaria were described. The urticarial skin response was present between 24 and 72 h after ice challenge. In 2 patients the cold sensitivity was of clinical relevance. Some patients displayed low α1-antitrypsin and increased C4 [complement component 4] levels in their serum. The introduction of cold provocation as a routine procedure in the investigation of a patient with chronic urticaria may be justified.

33.

BADDELEY, A.D., W.J. Cuccaro, G.H. Egstrom, G. Weltman and M.A. Willis.

Cognitive efficiency of divers working in cold water.

Hum. Factors 17:446-454; Oct. 1975.

The cognitive efficiency of 14 divers was studied during 1-hour exposure to water of 40°F (4.4°C) and 78°F (25.6°C). Reasoning ability was tested using a sentence comprehension task presented at the be-

ginning and end of each test session. Vigilance was tested by requiring subjects to detect the onset of a faint peripheral light during the performance of two-man pipe assembly task. Memory was tested by requiring subjects to learn a number of "facts" during the dive, with retention tested by recall and recognition on land, after a 40-min delay. Despite a mean drop in rectal temperature of 1.3°F (0.72°C), neither reasoning nor vigilance may reflect a peripheral context-dependent memory effect. It is concluded that a well-motivated subject may be cognitively unimpaired despite a marked drop in deep body temperature. (Authors' abstract)

34.

BAEV, V.I., Z.A. Volkova and N.A. Maksimov.

Significance of glycolysis in tissues during the combined action of hypercapnia, hypoxia and hypothermia.

Fiziol. Zh. Sssr. Im. I M. Sechenova 64(6):858-863; 1978.

The content of metabolites of glycolysis and the activity of some enzymes were studied in brain, myocardium, liver, skeletal muscle and blood of rats subjected to cooling under conditions of gradually increasing concentrations of CO_2 and decreasing concentrations of O_2. Single or repeated applications of these conditions produced changes in the metabolites and enzymes which revealed a moderate intensification of glycolysis during adaptation to hypoxia under the above conditions.

35.

BALLANTYNE, J.S. and J.C. George.

An ultrastructural and histological analysis of the effects of cold acclimation on vertebrate skeletal muscle.

J. Therm. Biol. 3(3):109-116; 1978.

The effect of cold acclimation on the fiber size of several skeletal muscles of rats [*Rattus norvigicus*], mice [*Mus musculus*], pigeons [*Columba livia*], frog [*rana pipiens*] and goldfish [*carassius auratus*], was determined. Significant decrease in fiber size was noted in the pectoralis major (superficial part) and gastrocnemius of the rat and the pectoralis (superficial part) of the pigeon. No significant change in fiber size was observed in any of the poikilotherm muscles examined. Ultrastructural analysis of red muscle fibers of the rat and the pigeon showed no significant change in mitochondrial content of a given fiber size. In the frog triceps brachii, a significant increase in the mitochondrial content was observed. A relationship was established between red fiber size and mitochondrial content for several species of homeotherms which suggested that with decreased muscle fiber size, mitochondrial content increase. Cold acclimation resulted in decreased fiber size in several homeotherms with a concomitant increase in mitochondrial content. In the poikilotherms examined no change occurred in muscle fiber size but mitochondria increased significantly. The significance of these results in terms of the requirements of homeotherms and poikilotherms during cold acclimation was discussed.

36.

BALMUKHANOV, S.B. and R.K. Karakulov.

Cellular mechanisms of the radiomodifying effect of hypothermia.
Neoplasma 25(5):585-93; 1978.

The irradiation of experimental tumors with a dose of 2000-2500 rad (20-25 J/kg) under hypothermia promoted an inhibition of the growth to a greater degree than the irradiation under normal conditions. In Guerin's tumor the inhibition of DNA and RNA synthesis was more expressed after the irradiation under hypothermic conditions than under the irradiation, and/or hypothermia alone. After the irradiation of the Guerin's tumor under hypothermia the cells were synchronized during the presynthetic phase of the cycle (block G_1-S), and the effect of synchronization was more expressed in the tumor than in the normal tissue. The irradiation under hypothermia decreased the proliferative pool to a greater degree than the irradiation and/or hypothermia alone.

37.

BANET, M., H. Hensel and H. Liebermann.

The central control of shivering and non-shivering thermogenesis in the rat.
J. Physiol. 283:569-84; Oct. 1978.

To test whether the preoptic area controls only non-shivering and the spinal cord only shivering thermogenesis, ten rats were chronically implanted with a preoptic and a spinal cord thermode each. The following were then studied: a) the effect of propranolol (8 mg/kg hr) on the metabolic response to cooling the preoptic area, and the spinal cord, b) the effect of exogenous noradrenaline (0-5 mg/kg) on the metabolic response to cooling the preoptic area, and the spinal cord, and c) the effect of warming the preoptic area on the metabolic response to cooling the spinal cord, and vice versa. Administration of propranolol inhibited the metabolic response to cooling each of the thermosensitive areas, but the response to cooling the preoptic area was more strongly inhibited than that to cooling the spinal cord. Administration of exogenous noradrenaline did not prevent the metabolic response to cooling either the preoptic area or the spinal cord. Warming the spinal cord completely inhibited the metabolic response to cooling the preoptic area, and warming the preoptic area fully inhibited the metabolic response to cooling the spinal cord. It is concluded that exogenous noradrenaline underestimates the capacity for non-shivering thermogenesis, and that both thermosensitive areas can control both forms of thermogenesis, but that the preoptic area threshold of non-shivering thermogenesis is probably lower than that of shivering, while the spinal cord threshold of shivering is probably lower than that of non-shivering thermogenesis.

38.

BARAT, A.K., H.C. Puri and N. Ray.

Cold injuries in Kashmir, December 1971.
Ann. R. Coll. Surg. Engl. 60(4):332-335; 1978.

Cases of cold injury (847) occurred within 2 wk during the Indo-Pakistan conflict in Kashmir in Dec. 1971. The management of these cases and their end results were described. A combination of drugs consisting of low-MW dextran, an anti-inflammatory agent, and a vasodilator was tried with encouraging results. A conservative attitude towards ablation of necrosed tissues yielded good results.

39.

BARNETT, S.A., W.E. Hocking and J.L. Wolfe.

Effects of cold on activity and exploration by wild house mice in a residential maze.
J. Comp. Physiol. A. Sens. Neural. Behav. Physiol. 123(1):91-96; 1978.

Wild house mice, *Mus musculus*, were bred in environments kept at 23°C (warm-reared) or 3°C (cold-reared). Males of the 4th generation in each condition were observed for 4 days in a residential maze with a central nest box and 4 arms radiating from it. One maze arm contained food, one contained water, and two were empty until day 4, when 1 had soft (balsa) wood. Mice of each type were run in a

maze at each temperature. Mice of all classes responded to the novel environment of the maze with a high rate of visiting the arms on day 1. The novel presence of balsa wood also provoked extra visits to the arm that contained it, and a longer stay in that arm on day 4 than on day 3. Visits to the arms were fewer in the cold than in the warm, and time spent in the arms was less. Cold-reared mice in the cold environment spent more time outside the nest on day 1, i.e., were more responsive to novelty than were the warm-reared. For the cold-reared mice the competitive balance between exploring and energy conservation was altered. This difference may be an aspect of cold-adaptation.

39a.

BARSOUM, A.H.

Some observations on blood in relation to cold acclimatization in the Antarctic. Reprinted from Military Medicine, 127(9):719-722; September 1962.

A study of the blood cells was done on ten men out of a group of forty isolated for fourteen months on the Filchner ice-shelf in the Antarctic. The study was done to find out what changes occurred in the blood cellular elements due to chronic exposure to cold and what changes, if any, would occur during acute exposure following the chronic exposure. It was found that maximal changes in the white count, mainly lymphocytic, occurred following chronic exposure with little further change on acute exposure. The red cell count rose only moderately in 50% of the men following chronic exposure but 70% of the men reacted sharply to acute exposure, the remaining 30% showing a hemolytic reaction instead. The sudden rise in the red cell count, with concomitant rise in hemoglobin and hematocrit, can probably be explained on the basis of the hemo concentration which is postulated to occur on exposure to cold due to a shift of blood fluid elements to the extracellular tissue spaces. The eosinophil count showed elevation (50 to 100%) in all cases following chronic exposure and this remained so throughout the entire period. However, on further acute exposure no further change was noted.

40.

BASYCHAROV, Y.P., V.V. Bozhedonov, G.N. Klintsevich and V.G. Popov.

Acute renal insufficiency in cold trauma. Vestn. Khir. 121(9):78-80; Sept. 1978.

The authors observed 10 cold trauma cases who developed an acute renal insufficiency. Only one patient survived. The rest died within the first week after sustaining cold trauma. Changes in the kidneys and other organs are described.

41.

BAYEV, V.I., G.A. Valeyeva and Ye.I. Bulakh.

[Correlation between the nitrous, carbohydrate, and lipid metabolism indices in rats under conditions of hypothermia in an altered gaseous medium]. Ukr. Biokhim. Zh. 46(5):596-601; Sept./Oct. 1974.

An experimental study was conducted of free amino acids in the brain and in the blood serum of male albino rats subjected to conditions of a single and repeated joint influence of hypoxia, hypercapnia, and hypothermia. It was attempted to correlate these changes with some indices of nitrous, lipid, and carbohydrate metabolism. The technique used is briefly described, and results are presented in three tables, which show that in the case of a single cooling under conditions of increasing hypercapnia and hypoxia, energy is supplied to tissues at the expense of carbohydrate resources, with simultaneous catabolic processes in the free amino acid metabolism. As a result of repeated impact, glucose content in the brain, heart, and blood serum was found to increase with a simultaneous decrease of free amino acids in the brain and blood serum. Free fatty acid content decreased in the brain, liver, and myocardium, indicating that free amino acids took part in glyconeogenesis. In short, the repeated impact is characterized by intensified utilization of lipids by tissues during sufficiently intense use of carbohydrates. (S & T Alert)

42.

BAYEV, V.I. and M.A. Drukina.

[Content of pyridine nucleotides in the brain and myocardium under the combined effects of hypercapnia, hypoxia and exposure to cold.]

Vopr. Med. Khim. 22:37-41; Jan./Feb. 1976.

It is attempted to relate the fast reaction (to various extreme states) of pyridine nucleotides (NAD, NADP, $NAD.H_2$) to the fact that the body's resistance to acute hypoxia can be increased by a combined short-duration (1½ to 2 hrs.) effect of slowly increasing CO_2 and decreasing O_2 concentrations during the external cooling. In experiments with rats subjected to a single and repeated combined effect of hypercapnia, hypoxia, and cooling, this was done by determining pyridine nucleotide content in the brain and myocardium. The NADP was not found in the brain, and its increase was found in the heart after the first and second treatment. The $NADP.H_2$ content decreased in both tissues after single treatment, while it increased in the myocardium after repeated treatment. These changes are compared with changes in the content of macroergic substances, particularly ATP, and a possible connection is discussed. (S & T Alert)

42a.

BEAGLES, J.A., and E.F. Coil.

Divers' body heat loss.

U.S. Navy Electronics Laboratory, San Diego, CA 92152 Research Report 1408; October 10, 1966.

A study was made primarily to obtain data applicable to the design of an optimum protective suit for divers in arctic environments. The experimental method employed swimmers who performed shallow dives in the NEL Arctic Pool at 30-32°F. Skin temperature was recorded by the use of suitably located thermistors, and other data were obtained from blood samples drawn immediately before and after each dive. Results suggest that a four-piece foam neoprene wet suit consisting of a 1/8-inch tight-fitting inner suit and a 1/4-inch snug-fitting outer suit along with two pairs of neoprene socks and mittens would provide the optimum combination of protection and mobility for divers in arctic waters.

43.

BEATTIE, D.

Physiological changes in rats exposed to cold/restraint stress.

Life Sci. 23(23):2307-2314; 1978.

The effects of cold/restraint stress in rats on renal function, plasma constituents, blood count and endocrine function were investigated. Cold/restraint caused an increased volume of urine output, with increased K^+ and urea excretion and decreased Na^+ and Cl^- excretion. There was a fall in plasma glucose and a rise in plasma urea. A marked leucopenia was found and the blood pH was significantly lowered. Cold/restraint caused marked increases in corticosterone and thyroxine levels and a fall in the insulin level.

44.

BECKMAN, E.L. and E. Reeves.

Physiological implications as to survival during immersion in water at 75°F.

Aerosp. Med., 37:1136-1142; 1966.

It has been determined in previously reported experiments that immersion at water temperatures of 75°F (23.8°C) may be limited by failure of the body's physiological compensatory mechanisms. This investigation was designed to study the physiological responses of subjects immersed to neck level in 75°F water for periods up to 12 hours. Measurements relating to the body loss of heat, energy, fluids, and electrolytes were obtained. It was found that a 12 hour period of immersion could not be tolerated by all of the subjects for various reasons: 1) loss of body heat with a reduction in deep body tempera-

ture to below the predetermined limiting temperature of 95°F; 2) extreme discomfort with muscle cramps following prolonged shivering; and, 3) decrease in blood glucose to levels below the predetermined limiting value of 60 mg percent. The changes in blood morphology, blood electrolytes, oxygen utilization and urinary excretion during the period of immersion, in addition to the physiological changes which caused the termination of some experiments are directly related to tolerance of immersion. It was also found that some subjects experienced a significant adrenocortical stress response with subsequent adrenocortical insufficiency. These factors are of importance in survival from the involuntary immersion associated with disasters at sea. (Authors' summary)

45.

BECKMAN, E.L.

A review of current concepts and practices used to control body heat loss during water immersion.

In: Hardy, J.D., ed. Thermal problems in aerospace medicine, p.191-209. Maidenhead, England, Technivision Services, 1968.

Discussion of methods to control the heat loss of the human body during water immersion. Such methods are of great significance to downed aviators and underwater swimmers. Fundamental aspects concerning the heat loss of the human body during water immersion are discussed. Advances in clothing and textile technology suggest that improved insulative garments might be useful. In addition, the newer technologies of direct energy conversion systems, thermoelectrics, electrochemistry, and thermionics suggest that systems for replacement of body heat may be available at an acceptable weight penalty which would simplify the problem of keeping the immersed swimmer in thermal balance. (GR) (IAA)

45a.

BECKMAN, E.L., E. Reeves and R.G. Goodman.

Current concepts and practices applicable to the control of body heat loss in aircrew subjected to water immersion.

Aerospace Med. 37(4); Apr. 1963.

The problem of providng adequate clothing for personnel who either accidentally or otherwise are immersed in cold water has continued to challenge clothing manufacturers for the past decade. The development of foamed plastics and other clothing materials offers new possibilities. Likewise new advances in energy conversion systems offer new solutions to this critical operational problem. The basic physical and physiological concepts which pertain to the problem of limiting thermal loss from the immersed human are reviewed. The newer technical developments in insulative clothing and supplemental heating systems are reviewed and discussed with relation to these basic concepts.

45b.

BECKMAN, E.L.

Physiological implications as to survival during immersion in water at 75°F.

Aerosp. Med. 37:1136-1142; 1966.

It has been determined in previously reported experiments that immersion at water temperatures of of 75°F (23.8°C) may be limited by failure of the body's physiological compensatory mechanisms. This investigation was designed to study the physiological responses of subjects immersed to neck level in 75°F water for periods up to 12 hours. Measurements relating to the body loss of heat, energy, fluids, and electrolytes were obtained. It was found that a 12 hour period of immersion could not be tolerated by all of the subjects for various reasons: (1) loss of body heat with a reduction in deep body temperature to below the predetermined limiting temperature of 95°F; (2) extreme discomfort with muscle cramps following prolonged shivering; and, (3) decrease in blood glucose to levels below the predetermined limiting value of 60 mg percent. The changes in blood morphology, blood electrolytes,

oxygen utilization and urinary excretion during the period of immersion, in addition to the physiological changes which caused the termination of some experiments are directly related to tolerance of immersion. It was also found that some subjects experienced a significant adrenocortical stress response with subsequent adrenocortical insufficiency. These factors are of importance in survival from the involuntary immersion associated with disasters at sea.

46.

BEGIN, R., M. Epstein, M.A. Sackner, R. Levinson, R. Dougherty and D. Duncan.

Effects of water immersion to the neck on pulmonary circulation and tissue volume in man.

J. Appl. Physiol. 40:293-299; Mar. 1976.

Utilizing the rebreathing of a gas mixture containing C_2H_2, $C^{18}O$, He, O_2, and N_2, we obtained serial measurements of the pulmonary capillary blood flow ($\dot{Q}_c$), diffusing capacity per unit of alveolar volume (D_L/V_A), functional residual capacity (FRC), pulmonary tissue plus capillary blood volume (VTPC) and O_2 consumption ($\dot{V}O_2$) in five normal subjects under the following conditions: 1) 6 h of sitting, 2) 4 h of sitting while immersed in thermoneutral water to the neck, and 3) 4 h of lying in thermoneutral water to the neck. Water immersion (NI) was preceded and followed by 1-h prestudy and 1-h recovery periods. The measurements were made at 30-min intervals. Seated NI produced a fourfold increase in sodium excretion ($U_{Na}V$), a 25-36% increase in $\dot{Q}_c$, a 45-59% increase in D_L/V_A, and a 30-36% decrease in FRC. This occurred as early as the 1st h of NI and persisted throughout the 4-h period of study. Throughout the seated control and NI periods, $\dot{V}O_2$, heart rate, and VTPC remained constant. During supine NI, $\dot{Q}_c$, HR, D_L/V_A, FRC, and $\dot{V}O_2$ did not differ significantly from supine prestudy. These data demonstrate that seated NI causes a significant increase of $\dot{Q}_c$ and D_L/V_A which persists throughout the immersion period. Furthermore, the lack of change of VTPC suggests that the central vascular engorgement induced by seated NI is not accompanied by extravasation of fluid into the pulmonary interstitial space. (Authors' abstract)

47.

BEGIN-HEICK, N., I. Noland, M. Dalpe and H.M.C. Heick.

Altered effect of insulin and catecholamines in brown adipose tissue of cold-acclimated rats.

Can. J. Physiol. Pharmacol. 57(3):320-324; 1979.

In brown adipose tissue (BAT) of cold-acclimated (CA), but not cold-exposed (CE) rats, there was apparently an alteration in the relative response to catecholamines and insulin as evidenced by increased binding of alprenolol and decreased binding of insulin to plasma membrane enriched fractions. The stimulatory effect of insulin on glucose incorporation into glycogen and its inhibitory action on adenylate cyclase activity were both blunted in the CA tissues. Shifts in the capacity of BAT to respond to catecholamines and insulin may possibly be involved in the mechanism of cold acclimation.

47a.

BEHNKE, A.R.

Temperature and comfort in pressurized environments.

In: Egstrom, G.H., ed. Thermal problems in diving. Proceedings of a seminar held at Commercial Diving Center, Wilmington, Calif., March 19-20, 1976, p.89-93. Wilmington, Calif., Commercial Diving Center, June 1977.

Three types of hyperbaric environment are discussed: the dry hyperbaric facility such as compression chambers, the hazardous environment of tunnel workers, and the wet hyperbaric environment of the diver. With regard to the first, pressures to 31 atm. are compatible with satisfactory mental and physical function, provided temperature (85° to 90°F) and humidity are controlled. In the second, there exist problems of high humidity and temperature, inadequate ventilation, and the presence of contaminants.

A reasonable degree of safety rather than comfort is the goal. Hazards include flooding and fire, plus certain surreptitious hazards such as hypoxia. Problems of the diver became complicated by the advent of saturation diving, during which thermal balance is absolutely essential to satisfactory diver performance. Electrically heated suits have proved unsatisfactory, but hot water heated suits have proved successful. In SEALAB II, temperature was maintained at 85° - 89°F, with 76% relative humidity. The latter was found to be excessive. A diver would rewarm after water exposure with a hot shower, then cover himself with an electric blanket. Active sweating accompanied by violent shivering followed. This paradoxical phenomenon is not understood. (MFW/UMS)

47b.

BEHNKE, A.R., and C.P. Yaglou.

Responses of human subjects to immersion in ice water and to slow and fast rewarming.
Naval Med. Res. Inst., National Naval Med. Ctr. Report No. 11, Project X-189; March 23, 1950.

(1) Two nude subjects were immersed shoulder deep in ice water for about one hour until the toes became numb, then the exposure was terminated. The average water temperature varied from about 42°F in the winter to as high as 50°F in the summer. Following this drastic chilling the subjects were rewarmed by exposure to air at 73° to 100°F or to water at 100° to 102°F. A third subject dressed in outdoor winter clothing was chilled in a cold chamber at −20°F for about three hours until his toes became numb. He was then rewarmed in air at 100°F without changing clothes. (2) Rectal, gastric and oral temperatures following initial rise fell linearly during the cold exposure period. (3) The conclusive finding in these tests was the abrupt fall of deep body temperatures in a comparatively warm environment (air temperature 73° to 100°F) following immersion in the iced water or exposure to cold air. (4) In one experiment the fall of deep body temperature was greater during a period of 20 minutes with the individual in air (73°F) than it was during the previous one hour immersion in cold water (50°F). (5) There were no untoward effects from the exposures to cold. The reduction or absence of pain after the initial immersion shock (except in the toes and at the waterline skin areas protruding from the water) was noted. The feeling of intense cold occurred during the initial period of rewarming despite a high surface temperature. (6) The onset and maintenance of shivering was associated not with the cooling of the skin but with the fall in deep body temperature. (7) The need for rapid rewarming of the chilled body, to prevent the precipitous "after drop" of deep temperatures under the conditions of chilling in these experiments, is emphasized.

47c.

BELL, D.G., and G.R. Wright.

Energy expenditure and work stress of divers performing a variety of underwater work tasks.
Ergonomics 22(3):345-356; 1979.

Although systems have been devised for grading the physical effort required in industrial work (Christensen 1953), most methods are not suitable for underwater work. Elevated body temperature and sweating rate are certainly not applicable to those individuals diving in Canada's cold waters, while the direct measurement of oxygen consumption is difficult for the free-flow breathing systems frequently used by divers. Fortunately, an estimate of energy expenditure can be made by comparing the heart rate obtained during underwater work with the oxygen consumed during different bicycle ergometer work loads. In addition, if the maximum oxygen consumption ($V_{O2\ max}$) is known, it is possible to evaluate the degree of physical strain imposed by a given work task. This is particularly relevant to underwater work, where the diver must be sufficiently fit to cope with the work task and still have a sufficient physiological reserve to handle an emergency situation should it arise. The aim of this report is to measure the energy expenditure of divers performing a variety of underwater work tasks. It is then possible to suggest maximum time limits for each work task, as well as the desirable ratio of work to rest pauses.

48.

BENTLEY-PHILLIPS, C.B., R.A.J. Eady and M.W. Greaves.

Cold urticaria: inhibition of cold-induced histamine release by doxantrazole.
J. Invest. Dermatol. 71(4):266-268; 1978.

Thirteen patients with cold urticaria were studied to assess the effect of the systemic drug doxantrazole, which has actions resembling disodium cromoglycate, on cold evoked histamine release. The patients, all of whom developed an immediate local whealing response after cooling of the forearm, demonstrated release of histamine into venous blood draining that forearm. Following doxandrazole treatment, significant suppression of histamine release occurred. In some patients this was accompanied by diminution of urtication in response to cooling. A double-blind study was carried out in 3 subjects, all of whom showed diminished cold-stimulated histamine release after doxantrazole. Two of these showed clinical improvement. Doxantrazole had no effect on erythema due to intradermal histamine, but did suppress the erythematous reaction to intradermal injection of compound 48/80 [*p*-methoxy-phenethyl methylamine formaldehyde product]. Doxantrazole or related anti-allergic agents might be useful in the treatment of cold urticaria.

49.

BERAN, A.V., K.G. Proctor and D.R. Sperling.

Hypothermia and rewarming induced by surface and He-O_2 inhalate temperature control.
J. Appl. Physiol. 39:337-340; Aug. 1975.

Hypothermia and rewarming were induced by a combination of temperature-controlled surface and inhalate methods in rabbits. To facilitate respiratory heat exchange, inhalate-respiratory tract temperature and humidity gradients and thermal conductivity were increased. In addition, the upper respiratory tract was bypassed by an endotracheal tube. To aid in maintaining satisfactory circulatory dynamics, hypercapnia and hypoxia were induced. The combined surface and inhalate method produced a markedly more effective rate of cooling than surface temperature-controlled method alone. Animals survived core temperatures as low as 20.9°C with no complications. The non-invasive simplicity of this method suggests its potential applicability in many clinical situations. (© BA)

50.

BERAN, A.V. and D.R. Sperling.

An improved method for inducing hypothermia and rewarming.
Aviat. Space Environ. Med. 50:844-846; Aug. 1979.

A hypothermia and rewarming system combining body surface and ventilatory heat exchange is described. The method utilizes body surface heat exchange through conduction, convection, and black body radiation, and ventilatory heat exchange across the lung surface through conduction, convection, and water evaporation. The system consisted of a chamber in which the temperature was maintained at a desired level (± 2.5°C) using a refrigeration-heat pump unit. Chamber temperatures during cooling and rewarming were -15.5 ± 2.7°C and 43.2 ± 2.3°C, respectively. Inhalate temperatures during cooling were -8.2 ± 6.5°C and during rewarming they were 41.5 ± 0.3°C. Helium (100%) was supplied to the chamber, while the animal was ventilated with 20% O_2 + 80% He. Under these conditions, the cooling and rewarming rates were 0.33 ± 0.06°C/min and 0.20 ± 0.04°C/min, respectively, at 38-21°C. The system provided for rapid cooling and rewarming with no evidence of any untoward effects. (Authors' abstract)

51.

BERSHADSKY, A.D., V.I. Gelfand, T.M. Svitkina and I.S. Tint.

Cold-stable microtubules in the cytoplasm of mouse embryo fibroblasts.
Cell Biol. Int. Rep. 3(1):45-50; Jan. 1979.

Treatment of cultured mouse embryo fibroblasts with Triton X-100 after prolonged incubation at 0°C

reveals a network of microtubules in the cytoplasm of cooled cells. This network of cold-stable microtubules was demonstrated by immunofluorescence microscopy, using a monospecific antibody against tubulin and by electron microscopy. The cold-stable microtubules, as well as the ordinary cytoplasmic microtubules, were sensitive to Ca ions and were not observed in the cells pretreated with colchicine or vinblastine. The cold-stable microtubules do not seem to be in equilibrium with the pool of depolymerized tubulin at 0°C.

52.

BETTS, J.

But they wouldn't lie down.

Diver 23:478; Oct. 1978.

Several cases of recovery from near drowning in very cold water are cited. The most spectacular of which was an 18-year-old male who was trapped in an automobile under ice for 38 minutes. He was pronounced dead when brought to the surface, then gave indication of life. Recovery was complete. Cold water increases the likelihood of survival in several ways. First it triggers the diving reflex, which shuts off general circulation and saves oxygen for the heart, lungs, and brain. Second, cold tissues require much less oxygen to survive than tissues at normal temperature. Children lose heat quickly and also have a more pronounced diving reflex than adults. Third, cold water entering the respiratory tract may cause spasm of the glottis, thus preventing water from entering the lungs. (MFW/UMS)

53.

BEVAN, J.

Deep body and skin temperatures of divers in cold water at a simulated depth of 310 m. (1000 ft).

In: Flemming, N.C., ed. Science diving international. Proceedings of the 3rd scientific symposium of CMAS, p.156-162. London, British Sub Aqua Club, 1973.

Two R.N. and one U.S.N. divers undertook a simulated dive to 310 m. (1000 ft) lasting 20 days. During six days at maximum depth the divers logged over 24 hours diving time in seawater at 0 to 11°C using the U.S.N. Mark 10 Mod. 4 U.B.A. and the U.S.N. Diving Unlimited Hot Water Suit. Temperature data were collected from miniature thermistors at four skin sites and in ambient water whilst deep body temperature was monitored employing a temperature sensitive radio pill. The results indicate that the divers derived adequate thermal protection from the diving system as shown by the maintenance of high skin temperatures and normal deep body temperatures. (Author's abstract)

54.

BHATIA, B., G.S. Chhina and B. Singh (ed.)

Selected topics in environmental biology.

XXVI. International Congress of Physiological Science, New Delhi, India, Oct. 1974.

The 74 papers by contributing authors in this book discuss physiological and pathological aspects of the environmental biology of mammal and humans. Separate sections include papers on thermoregulation, cold and heat stress, hypothermia and thermal injury, adaptation to stress and physical work, and prolonged and short term exposure to hypoxia. Subsequent sections are devoted to pulmonary edema, constitution and body functions in different ethnic groups, environmental pollution, cyclic variations in body functions, and noise, hyperbaric and emotional stress. Of interest to research and clinical physiologists and physicians and environmental scientists, this book also includes author and subject indexes. Many diagrams and tables complement the text and individual papers are indexed in Bioresearch Index.

55.
BIERSNER, R.J.
Motor and cognitive effects of cold water immersion under hyperbaric conditions.
Hum. Factors 18:299-304; June 1976.

Motor and cognitive tests were administered to four Navy divers under dry baseline conditions, in warm and cold shallow water, and again in cold water at 183 m. It was found that water resistance, cold water, and prolonged exposure to cold water at depth resulted in significant decrements in motor performance. None of these factors, however, consistently or reliably impaired cognitive performance. Those cognitive impairments which were found could probably be accounted for by impaired motor performance. The motor effects of prolonged exposure to cold water at 183 m may be related to either severe heat debt or CO_2 retention. These results indicate that present heating techniques are inadequate to protect divers from significant motor impairments after entering cold water at any depth, and from additional decrements after exposure to cold water for an hour at 183 m. (Author's abstract)

55a.
BIERSNER, R.J.
Motor and cognitive effects of cold water immersion under hyperbaric conditions.
Human Factors. 18(3):299-304; 1976.

Motor and cognitive tests were administred to four Navy divers under dry baseline conditions, in warm and cold shallow water, and again in cold water at 183 m. It was found that water resistance, cold water, and prolonged exposure to cold water at depth resulted in significant decrements in motor performance. None of these factors, however, consistently or reliably impaired cognitive performance. Those cognitive impairments which were found could probably be accounted for by impaired motor performance. The motor effects of prolonged exposure to cold water at 183 m may be related to either severe heat debt or CO_2 retention. These results indicate that present heating techniques are inadequate to protect divers from significant motor impariments after entering cold water at any depth, and from additional decrements after exposure to cold water for an hour at 183 m.

55b.
BIGELOW, W.G., J.A. Hopps, and J.C. Callaghan.
Radio frequency rewarming in resuscitation from severe hypothermia.
Canada J. Med. Sci. 30:185-193; 1952.

Twenty-seven dogs and monkeys were restored to normal body temperature from near-lethal limits of cold, using a radio-frequency rewarming technique. Induction cable applicators were chosen for their facility of arrangement and comparative safety. There was no evidence of optimum frequency among the three radio frequencies used. However, the rate of rewarming was dependent upon the spacing of coils from the body, with most satisfactory rewarming resulting from the use of ½ in. thick rubber pads. Dogs were rewarmed at an average rate of 11.1°C per hour, using the ½ in. spacing and a frequency of 13.56 megacycles per second.

55c.
BIGELOW, W.G., W.K. Lindsay, and W.F. Greenwood.
Hypothermia, its possible role in cardiac surgery: An investigation of factors governing survival in dogs at low body temperatures.
Ann. Surg. 132:849-866; 1950.

Hypothermia was induced in dogs, with shivering controlled by anesthetic, in order to study the

physiology of the cardiovascular system and learn something of the mechanism of death at low body temperatures. This was investigated to improve our method of cooling with a view to excluding the heart from the circulation for longer periods. Rewarming was accomplished by means of a water bath at 40°C. There was a gradual fall of blood pressure, heart rate and cardiac output to very low levels as cooling progressed, with a comparable rise on rewarming. Intense vasoconstriction was observed in the gross, and vascular statis with erythrocyte agglutination observed microscopically at low body temperatures. Venous pressures proved a valuable guide to the condition of the heart. An increase in venous pressure over too long a period was often followed by "cardiac crisis" and it could be temporarily forestalled by venesection. Electrocardiographic studies during cooling and rewarming are summarized. Ventricular fibrillation usually caused death between 16° and 22°C. Return of the heart from ventricular fibrillation to normal with revival has been accomplished by venesection and immediate rewarming. Cardiac resuscitation was attempted through a thoracotomy incision. A table of the possible causes of death has been drawn up and the various factors discussed.

55d.

BIGELOW, W.G., W.K. Lindsay, R.C. Harrison, R.A. Gordon, and W.F. Greenwood.
Oxygen Transport and Utilization in Dogs at Low Body Temperatures.
Am. J. Physiol. 160:125-137; 1950.

Hypothermia to 18°C. was induced in dogs by exposure to cold air. They were anesthetized sufficiently to control all shivering and increased muscle tonus. Full arterial blood oxygen saturation was maintained by artificial respiration when necessary. Measurements of oxygen consumption were taken during cooling and rewarming. Oxygen consumption fell consistently with reduction in body temperature down to 18°C. and rose in proportion during rewarming in a way that was parallel. Evidence is presented that under the conditions of these experiments a tissue oxygen deficit did not develop during the period of cooling. The authors express their appreciation and thanks to Professor J.A. Dauphinee, Head of the Department of Pathological Chemistry, for his interest and advice; to Wing Commander W.R. Franks and Wing Commander Brock Brown of the Division of Aviation Medical Research, R.C.A.F., for granting full use of their controlled cold room; to Professor C.H. Best of the Banting-Best Research Foundation for the supply of technical apparatus; and to Professor R.M. Janes, Head of the Department of Surgery, for his advice and co-operation; and to the members of the Department of Art as Applied to Medicine for the drawing of the graphs.

56.

BLACK, S.A. and S.S. Sergev.
A self-contained experimental diver heater.
U.S. Nav. Civ. Eng. Lab., Rep. CEL-TN-1501, 76p. Sept. 1977.

Free-swimming divers working in cold water for extended periods of time require a self-contained, active heat source to maintain their physiological thermal equilibrium. Previously, the accelerated reaction of magnesium with seawater was shown to be a suitable heat source for diving applications. The magnesium heat cell was configured as a short-circuited battery with alternate electrodes of magnesium and steel spaced closely together; the unit is activated by immersion in a seawater electrolyte. An experimental heater was fabricated that incorporated known improvements in the cell. The self-contained unit provided 1,000 watts for up to 8 hours. A human factors study was made that identifies heater configurations for closed-circuit scuba divers. (DD abstract)

56a.

BLACK, S.A. and S.S. Sergeu.
Development of a self-contained heater for military divers.
In: Ocean 75, San Diego, California, Sept. 22-25, 1975, p.258-262. IEEE Publication 75 CHO 995-1 OEC, 1975.

Divers in cold water require supplemental heat to function effectively for extended periods. Described

is the design, fabrication and testing of a self-contained diver-worn heater that supplies hot water to closed circuit thermal protection suits. Heat is produced by the electrochemical reaction of magnesium in seawater. The reaction is accelerated by shorting the magnesium anode to an iron cathode. Up to two kilowatts for eight hours endurance have been produced. Characteristics of the reaction are discussed. A test of a one kilowatt eight hour heater with a diver immersed in 2°C water confirmed that the magnesium reaction is a feasible means of supplying heat.

56b.

BLATTEIS, Clark M., and Thomas M. Gilbert.

Hypoxia and shivering thermogenesis in cold-acclimatized miniature pigs.
J. of Appl. Physiol. 36(4):453-456; 1974.

Previous studies have suggested that the reduction by moderate hypoxic hypoxia of the metabolic response to cold might be accounted for by the selective depression of nonshivering thermogenesis (NST). Miniature pigs, even when cold-acclimatized, are alleged to lack NST. Their metabolic response to cold, therefore, should not be affected by moderate hypoxia. To test this hypothesis, four adult cold-acclimatized miniature pigs were exposed to 7°C for 2 h while breathing either room air or 10% O_2 (in N_2). The results showed that the increase in O_2 consumption produced by this duration and degree of cold was not different in both gaseous environments. The intensity of shivering which accompanied the increase in metabolic rate also was not different under both conditions. Colonic temperature remained unchanged throughout the cold exposure in both environments. The inability of these animals to develop large amounts of NST was inferred from their weak calorigenic response to the iv infusion of norepinephrine (2 μg/kg for 20 min). These results would support, therefore, the earlier suggestion that shivering thermogenesis is not depressed by moderate hypoxia, whereas NST might be.

57.

BLIGH, J., A. Silver, M.J. Bacon and C.A. Smith.

The central role of a cholinergic synapse in thermoregulation in the sheep.
J. Therm. Biol. 3(3):147-152; 1978.

The evidence for the involvement of a cholinergic synapse in the central control of body temperature in the sheep was reinvestigated. Intracerebroventricular (ICV) injections of atropine sulfate attenuated the thermoregulatory reactions to a low ambient temperature and those caused by ICV administration of carbachol and prostaglandin E_1 and by TAB (typhoid and paratyphoid A and B) vaccine given i.v. A cholinergic synapse (or synapses) exists on the hypothalamic pathway from cold-sensors to thermoregulatory effectors.

58.

BLIX, A.S., L.K. Miller, M.C. Keyes, H.J. Grav and R. Elsner.

Newborn northern fur seals (*Callorhinus ursinus*)--do they suffer from cold?
Am. J. Physiol. 236(5):R322-R327; 1979.

Several hundred thousand northern fur seals (*C. ursinus*) are born each summer during July at St. Paul Island in the Bering Sea. The weather in the area is usually cold, wet, and windy during the breeding season. At birth the pups are small (5-6 kg) and insulated only by a partly wettable pelt and a 2- to 4-mm layer of blubber. In air, the pups' lower critical temperature appears to be below the 6°C 50-yr record low July temperature for the islands. During rainy weather much of the insulative value of the pelt is lost, and the pups, which already have a high resting metabolic rate of 3.5 $W \cdot kg^{-1}$, must increase heat production by shivering and/or nonshivering thermogenesis to maintain deep body temperature. The high level of metabolism (up to 18 $W \cdot kg^{-1}$) is supported by a very rich milk. The pups will, nevertheless, become hypothermic if their insulation is not improved through peripheral vasoconstriction and shedding of water from the pelt by periodic shudder. Even with these protections the newborn and very young pups are brought close to their limit of tolerance during rainy and windy days. Unfit pups are likely to succumb under such circumstances.

59.

BLIX, A.S. et al.

Temperature regulation in newborn polar homeotherms.
Physiol. Rev. 59(2):285-304; Apr. 1979.

Although notorious for a hostile climate, the polar regions impose different degrees of thermal stress on the young of the different species that inhabit these areas. This is partly due to wide differences in the time and location for birth or hatching, but the great difference in parental care of the offspring is also an important factor. Some are born immature in tents, dens, or nests and are completely dependent on maternal care during their first period of life. Such forms only slowly develop thermal independence and often pass through an initial stage of hypothermia. Others are born or hatched unsheltered in a more mature state on the barren tundra, on ice floes during midwinter storms, or even in the cold polar seas. Such animals exhibit high metabolic rates and only need high-energy food from their parents in order to get through. Thus, the newborn polar forms show a variety of mechanisms for thermal protection that invite investigation. Unfortunately, such creatures are difficult to obtain for sophisticated physiological studies and few reports on the topic are available at the moment. It is our hope, however, that this review might stimulate the creation of a more extensive literature in the near future.

60.

BLIX, A.S. and J.W. Lentfer.

Modes of thermal protection in polar bear cubs at birth and on emergence from the den.
Am. J. Physiol. 236(1):R67-R74; 1979.

At birth in late Dec. the polar bear [*Ursus maritimus*] is small (700 g), uninsulated and helpless. It probably has a modest capacity for metabolic heat production and depends on the female and a snow den in which it is born for thermal protection. The microclimate of an artificial polar bear den was investigated at Point Barrow, AK, and the temperature therein staying around 0°C provided a heat source (200 W) equivalent to an adult polar bear was introduced. When the bears desert the den in early April the cub has grown to about 10 kg and has a well-developed fur insulation, but almost no subcutaneous fat. The cub has a high resting metabolic rate (4.5 $W \cdot kg^{-1}$), which is supported by the fat polar bear milk. Its lower critical temperature is about -30°C, and an ambient temperature of -45°C results in only a 33% increase in metabolism. The cub can tolerate a wind chill of 2.3 $kW \cdot m^2$ without apparent stress or drop in rectal temperature. If the cub is immersed in ice water rectal temperature drops 11°C in 30 min. The cub can tolerate extremely low temperatures in air due to fur insulation and high metabolic heat production, but is unable to cope with the chill of ice water for any prolonged period of time.

60a.

BLOCH, M.

Cerebral Effects of Rewarming Following Prolonged Hypothermia: Significance for the Management of Severe Cranio-cerebral Injury and Acute Pyrexia.
Brain, 90:769-784; 1967.

Evidence of central nervous system involvement (drowsiness, convulsions, coma, papilloedema, increase in CSF pressure, paresis) developed during rewarming following 63 (90 per cent) of 70 episodes of prolonged hypothermia (30-198 hours at 29-30°C.), induced in 25 patients in the treatment of cerebral astrocytoma. Acute neurogenic pulmonary oedema developed in a small number of instances, and CSF protein concentration increased twice during rewarming. Severity of complications was related to duration of hypothermia and rate of body temperature rise. Central nervous system involvement was considered to result from change in body-water distribution associated with increase in body temperature, leading to increase in blood volume, in cerebral blood and interstitial fluid volume, and in venous and CSF pressure. Reducing CSF pressure resulted in decrease in drowsiness, in relief of coma and of acute neurogenic pulmonary oedema, in decrease in paresis, and in subjective as well as objective evidence of clinical improvement. Blood glucose concentration was

measured during nine episodes of hypothermia and rewarming. Although this decreased during rewarming there was no correlation between blood glucose concentration and level of consciousness. Decrease in CSF glucose concentration was proportionately less than that in blood, possibly accounting for this result. It is suggested that: (i) return of cerebral complications during rewarming, in patients with severe cranio-cerebral injury in whom improvement has occurred during treatment by prolonged hypothermia, might be due to the direct effects of rewarming. Attention to these might contribute to a higher survival rate amongst this group of patients. (ii) cerebral involvement complicating acute pyrexia might result from change in body-water distribution secondary to body temperature rise, leading to increase in intra-cranial pressure. Reduction of CSF pressure might be important in the management of this condition, particularly of febrile convulsions in infants and young children.

61.

BOCK, E., N. Colavita, V. DiDonna and A. Iannaccone.

Working pathology due to cold: A preliminary study: A. Radiological aspects of the osteoarticular apparatus in subjects employed in the refrigerating rooms.

Acta. Med. Romana 15(6):375-382; 1977.

The modifications of the structures and morphologies of the osteoarticular apparatus in 27 subjects employed in refrigerating rooms are described. The elementary alterations of the bone and of the soft parts, not being pathognomical, must be sought in particular areas—hands, small and medium sized joints—by a rigorous radiographical technique.

62.

BODEY, A.S.

Structural changes in the skin occurring in Antarctica.

Clin. and Exp. Dermatol. 3:417; 1978.

Skin biopsies were taken from ten men from Melbourne before and after wintering in Antarctica. The epidermis from the dorsum of the hand showed a significant increase in cellularity and an increased thickness of the granular cell layer after 6 months in Antarctica, but epidermis from the abdomen showed no such change. Skin from the hand showed a reduction of elastica after wintering in Antarctica. It is concluded that a cold environment was responsible for these direct effects to the skin of the hand.

63.

BODEY, A.S.

Changing cold acclimatization patterns of men living in Antarctica.

Int. J. Biometeorol. 22(3):163-176; 1978.

Responses to a standard cold stress of 10°C for 2 h applied before (Melbourne) and 4 times during a year in Antarctica were observed in 10 adult male Caucasians, 7 of whom were retested after returning from Antarctica. An early form of cold acclimatization developed within a mo. of arriving in Antarctica in which the cold stress response was characterized by cooler peripheral temperatures than in the pre-Antarctic series. This was replaced by a late form in which the rectal temperature was cooler and peripheral temperatures warmer than in Melbourne. Maintenance of rectal temperature was equal in both forms and superior to that obtained before going to Antarctica. An improved peripheral rewarming rate was associated with the late form. The reduction in plasma cortisol concentration at the end of the cold stresses in Antarctica compared with those in Melbourne was a further indication of the establishment of cold acclimatization. An increased delay in the onset of shivering, a lowered skin temperature at the onset of shivering and a reduced noradrenaline [norepinephrine] response was observed in the late Antarctic series. Adrenaline [epinephrine] excretion during the cold stress increased in the later series but the rise from the pre-stress level remained fairly constant. This increase did not appear related to climate. Similarities with cold-adapted rodents and newborn infants suggest that the infantile mechanism of non-shivering thermogenesis mediated by noradrenaline was partially re-established.

64.
BODEY, A.S.
Structural changes in the skin occurring in Antarctica.
Clin. Exp. Dermatol. 3(4):417-424; 1978.

Skin biopsies were taken from 10 men from Melbourne (Australia) before and after wintering in Antarctica. The epidermis from the dorsum of the hand showed a significant increase in cellularity and an increased thickness of the granular cell layer after 6 mo. in Antarctica, but epidermis from the abdomen showed no such change. Hand skin showed a reduction of elastica after wintering in Antarctica. Apparently, a cold environment was responsible for these direct changes in hand skin.

65.
BODNAR, R.J., D.D. Kelly, A. Spiaggia, C. Pavlides and M. Glusman.
Stress-induced analgesia: Effect of naloxone following cold water swims.
Bull. Psychon. Soc. 12(2):125-128; 1978.

Rats exposed to novel stressful events subsequently display increased nociceptive thresholds while chronic exposure produced adaptation. Whether the analgesia induced by 1 such stressor, a brief, forced cold water swim, could be eliminated by an opiate receptor blockade induced by a narcotic antagonist was investigated. Naloxone at 10 mg/kg was partially able to attenuate stress-induced analgesis, but it had no effect upon normal nociceptive thresholds in unstressed control subjects. Since a high dose of naloxone only partially attenuated stress-induced analgesia, this type of analgesia might not be identical to that induced by opiates.

66.
BODNAR, R.J., D.D. Kelly, A. Spiaggia and M. Glusman.
Stress-induced analgesia: adaptation following chronic cold water swims.
Bull. Psychon. Soc. 11(6):337-340; 1978.

Rats exposed to novel stressful events subsequently display increased nociceptive thresholds for up to 2 h. The present study investigated whether the analgesia induced by 1 such stressor, a brief, forced, cold water swim would show adaptation with repeated exposures in the same manner that other stress-induced physiological responses adapt. Acutely exposed rats displayed profound postswim elevations in flinch-jump thresholds, but rats that were chronically exposed to 14 daily cold water swims displayed thresholds similar to unstressed rats when tested 30 min after the final swim condition, indicating adaptation of pain thresholds to continued stress. Peripheral and core hypothermia could not account for analgesic effectiveness, since both the nonanalgesic chronic and analgesic acute groups displayed significantly lower rectal and skin temperatures throughout the testing period. (© BA)

67.
BODNAR, R.J., D.D. Kelly, A. Spiaggia, C. Ehrenberg and M. Glusman.
Dose-dependent reductions by naloxone of analgesia induced by cold-water stress.
Pharmacol. Biochem. Behav. 8(6):667-672; 1978.

Animals exposed to cold-water swims, rotation or inescapable shocks, display analgesia comparable to that of 10 mg/kg of morphine. Whether a narcotic antagonist would eliminate analgesia induced by cold-water swims was investigated. In 1 group of 12 rats, naloxone at 0, 1, 5, 10 and 20 mg/kg was administered at weekly intervals immediately preceding forced cold-water swims (2°C for 3.5 min) and alterations in flinch-jump thresholds were determined 30 min thereafter. In a 2nd group of 6 rats, the effects of the same dose range of naloxone were determined upon normal flinch-jump thresholds. Naloxone dose-dependently attenuated the cold-water swim-induced analgesia up to a maximal reduction of 50% at 20 mg/kg. In contrast, all doses of naloxone had no effects upon normal flinch-jump thresholds. Since low doses of naloxone completely abolished morphine-induced analgesia, the analgesia induced by stress was not identical to that of opiates. (© BA)

67a.

BOGGS, B.L.

Silent Enemy: Hot tips for cold weather.
Soldier of Fortune, p.38; March 1981.

The civilian who anticipates going into an arctic or subarctic environment can be selective about his equipment. He can study the types of environment he will encounter and the temperature ranges he will meet. He can study the outdoor equipment market and acquire the best clothing and personal gear for protection against relentless cold and hostile winter terrain. Active-duty line units, be they Army or Marine, do not have the civilian option. They must be able to function over a broad spectrum of temperature changes, but must use available GI gear, GI clothing, while warm, is cumbersome and heavy. A standard outfit will weigh almost 74 pounds, and the individual who must manipulate both his clothing and equipment – and put his weapon in play – may have difficulty reacting efficiently to an ambush. Furthermore – as was noted at Fort Drum – GI equipment is inadequate for wet cold although suitable for dry cold. To compensate for the limitations of regular-issue gear and clothing, the combat leader must prepare for potential problems before they occur. Remember to check the troops' equipment – from socks to sleeping bags – and stress the principle of layering. Controlling those factors that you can will help you defeat the relentless, silent enemy – cold weather.

68.

BONSER, R.S.A., B.H. Knight and R.R. West.

Sudden infant death syndrome in Cardiff, association with epidemic influenza and with temperature–1955-1974.
Int. J. Epidemiol. 7(4):335-340; 1978.

The effects of social class, season, low temperature and sudden falls in temperature are investigated in 286 cases of Sudden Infant Death Syndrome in Cardiff, Wales, UK, in 1955-1974. The association with low temperature was striking; unsuspected hypothermia may be an important feature of these deaths. Sudden infant death incidence was associated with influenza A but not influenza B epidemics.

69.

BOODA, L.L.

Tragedy in the Johnson-Sea-Link.
Sea Technol. 14:17, 28, 58; July 1973.

An account is given of the disaster of the Johnson-Sea-Link, in which two lives were lost after the submersible had become jammed against a sunken destroyer. The cause of the accident appeared to be an underestimation of the strength of the current, or a failure to appreciate the possible consequences of operating under such conditions. The current also hampered rescue attempts, and the delay resulted in the death of the two men who were in the lock-out ambient pressure compartment. The cause of death is not discussed here, but from the facts given, it would seem to be either carbon dioxide poisoning due to the Baralyme scrubbers becoming less effective as the temperature decreased, or cold exposure, or a combination of both. An investigating board has been convened. (MFW/SCD)

70.

BOUTELIER, C., J. Colin and J. Timbal.

Determination du coefficient d'echange thermique dans l'eau en ecoulement turbulent. [Determination of the coefficient of thermal exchange in turbulent water].
J. Physiol. (Paris) 63:207-209; May 1971.

The authors have attempted to determine the coefficient of heat exchange by convection, using the method of fractional calorimetry. Thirty-six experiments, involving nine male subjects, were carried out in a 3 m^3 tank of water maintained at a constant temperature of 32.5-33.5°C. The subjects, clad in swimming trunks and equipped with thermocouples, were almost totally immersed in turbulent water for 90 to 180 minutes. Ten cutaneous and one rectal temperature readings were taken every minute, and

the metabolisms of the subjects were regularly monitored. The coefficient of transfer h_c was calculated as:

$$h_c = 53.3 + 0.8 \text{ K Ca/m}^2\text{h.}^\circ\text{C.}$$
$$\text{or } 62.9 + 0.93 \text{ W/m}^2\text{.}^\circ\text{C.}$$

The calculations are given in detail on pp. 208-209. (MEH/BSCP)

71.

BOUTELIER, C., J. Colin and J. Timbal.

Determination de la zone de neutralite thermique dans l'eau.

[Determination of the zone of thermal neutrality in water].

Rev. Med. Aeronaut. Spatiale 10:25-29; 1st quart. 1971.

Study of heat exchange between the human body and water, in order to determine the zone of thermal neutrality. Knowledge of this zone and the laws of reduction of body temperature as a function of ambient temperature and metabolism make it possible to determine limits of tolerance in cold water and to devise protective equipment. Many experiments are reported which were carried out on nude subjects almost totally immersed in rough water. (Aerosp. Med.)

72.

BOUTELIER, C., J. Timbal and J. Colin.

Conductance thermique du corps humain en immersion a la neutralite thermique et en ambiance froide.

[Thermal conductance of the human body in immersion at thermal neutrality and in cold].

Arch. Sci. Physiol. 27:A189-A205; 1973.

At thermal neutrality in water, the thermal conductance of the body is near that observed in air and the individual variability is reduced. The difference in the layer of subcutaneous fat does not seem to have a noticeable effect. In cold water, body conductance diminishes rapidly because of the cutaneous vasoconstriction which interposes between the core and the surface of the body an isolating layer of subcutaneous fat. In these conditions, the values of the conductance are extremely variable from one individual to another and depend upon the thickness of this layer. Analysis of the evolution, as a function of the water temperature, of the various components of the global conductance shows that vasoconstriction alone plays a limited role. The cooling attacks the most superficial area of the muscles, which takes part in the peripheral isolation, a phenomenon formerly considered an aspect of adaptation to cold. The increase in conductance shown particularly in thin subjects is due to an increase of the conductance of the muscular core region, provoked probably by increased circulation and an augmentation of heat production at the muscle level. Considering the complex nature of the thermal conductance of the body, it is dangerous to attempt to extract from its development in a cold environment an index of the peripheral circulation. From the complementary degrees of the deep temperatures (muscular and subcutaneous) it should be possible, considering the variation of the partial conductances as a function of the thermal load, to evaluate the convective component due to the circulation in the different zones. (Authors' conclusions translated by MFW/UMS)

73.

BOUTELIER, C., L. Bougues and J. Timbal.

Experimental study of convective heat transfer coefficient for the human body in water.

J. Appl. Physiol. 42:93-100; Jan. 1977.

The steady-state convective heat transfer coefficient in water has been determined by partitional calorimetry for 17 nude subjects. Four water velocities were investigated: 0, 0.05, 0.10, and 0.25 $m \cdot s^{-1}$; and the water temperature ranged from 33.7 to 18°C. In still water, hc varied from 43 $W \cdot m^{-2} \cdot {}^\circ C^{-1}$ in the thermoneutral conditions and a shivering rate < 90 $W \cdot m^{-2}$ to 54 $W \cdot m^{-2} \cdot {}^\circ C^{-1}$ in cold water

with a shiver rate > 110 W • m^{-2}. The equation, $h_c = 0.09\ (Gr \cdot Pr)^{0.275}$, give a good approximation of this coefficient. In stirred water and for the same limits of shivering, h_c can be expressed as a power function of the velocity: $h_c = 272.9\ v^{0.5}$ and $h_c = 497.1\ v^{0.65}$, respectively. These equations show that the flow is laminar in the thermoneutral conditions and intermediate between laminar and turbulent in cold water. A study of the influence of skinfold on the magnitude of h_c shows that higher values of this coefficient were obtained for thin subjects than for fat ones, concomitant with more intense shivering. The utilization of a theoretical physical model for computations of h_c gave excessively high values because such methods do not embody the body shape factor and reduction of water flow adjacent to the skin. (Authors' abstract)

73a.

BOUTELIER, C.

Survival and protection of aircrew in the event of accidental immersion in cold water.
Defense Technical Information Center, Defense Logistics Agency, AGARD-AG-211 (Eng.); February 1979.

The survival of aircrews in the case of accidental cold water immersion is limited by the extent of thermal losses. In the AGARDograph, the physical laws governing thermal exchanges in both air and water are described. The state-of-the-art in the fields of physiological reactions, tolerance, acclimatization, cold induced accidents and their treatment is reviewed. Finally, the major items of protective equipment used in aeronautics and the methods applied to test their effectiveness are described. This AGARDograph was prepared at the request of the Aerospace Medical Panel of AGARD, and is published in English and French.

74.

BRAND, J.J.

Spectral changes in membrane fragments and artificial liposomes of *Anacystis* induced by chilling.
Arch. Biochem. Biophys. 193(2):385-391; Apr. 1979.

Isolated membrane fragments from *Anacystis nidulans* grown at 39°C undergo visible spectral changes on chilling, suggesting a carotenoid component is altered. No such changes are seen when cells are grown at 25°C. The magnitude of the decreased absorbance is a function of the chilling temperature and the media in which membrane fragments are suspended. The spectral decrease following chilling develops relatively slowly and is a function of the cooling rate and final temperature. The absorbance change is reversed if the fragments are heated to near 50°C subsequent to chilling. Liposomes prepared from a total lipid extract of *Anacystis* undergo a spectral change on chilling which closely resembles that occurring in whole cells or isolated membrane fragments. Liposomes prepared from an extract of cells grown at 25°C show only about 30% as great a spectral change as those from cells grown at 39°C. The spectral bleaching is freely reversible when the liposomes are reheated, but shows a pronounced hysteresis. It is suggested that specific phase changes occur in *Anacystis* membranes and artificial liposomes on cooling which alter the environment of carotenoid. These changes may relate to previous observations that cells grown at 39°C cannot survive a cold shock while those grown at 25°C do.

74a.

BRAMHAM, E.

Diver heating by a liquid loop hot water system.
Underwater Syst. Design 1(6):8-12, 14; Dec. 1979/Jan. 1980.

The currently used open circuit hot water heating systems for deep diving have certain disadvantages. It is impossible to regulate the temperature accurately. Also, as the depth increases, the amount of pressure required to pump the water increases, and eventually the system becomes unviable due to unwieldiness of the umbilical which must be made larger or stronger to accommodate the increased pressure. The solution is to place the heat source on the diving bell rather than at the surface, so that

the hot water is pumped via the excursion umbilical, using a liquid loop suit. Divematics has developed the Submersible Diver's Heating Unit, which consists of a centrifugal pump driven by a glandless cage-type induction motor, and is designed to operate at maximum depths of 600 msw. The control system consists of a surface control unit, an external bell control system, and a bell manifold system. This can be operated manually by the bell man if there is a control failure. Liquid loop suits, originally designed for space missions, have been especially designed for diving. The distribution pipes, more rugged than those in other liquid loop suits, are supported by closed-cell neoprene. The heat distribution is such that not only is the core temperature maintained, but also the skin temperature of the entire body. A Shallow Water Diver's Heating Unit has been developed that is powered by propane gas. Its maximum depth capability is 200 fsw. Also, an Emergency Bell Heating Unit capable of depths of 1000 fsw and using ethane gas has been developed. All systems are now patented. (MFW/UMS)

74b.

BREBBIA, D.R., R.F. Goldman, and E.R. Buskirk.

Water vapor loss from the respiratory tract during outdoor exercise in the cold.
J. Appl. Physiol. 11(2):219-222; 1957.

The water vapor contained in oral expired air was collected during rest and exercise in a subarctic environment in 26 experiments on three men. Heat loss via this route was about 9% of the total energy expenditure. Water vapor loss was directly proportional to ventilation volume. An average (β coefficient) of 32 mg of water was collected from each liter of expired air.

75.

BRENNAN, D.M.A. and S.J. Brumleve.

Measurement of oxygen consumption in scuba divers breathing various gas mixtures at open water depths of 1, 2, and 3 ATA.
In: Aerospace Medical Association, Preprints, 1975 Annual Scientific Meeting, p.168-169. Washington, D.C., published by the Association, 1975.

The purpose of this research was to measure the VO_2 of scuba divers breathing ten different gas mixtures which have various concentrations and partial pressures of He, N_2, and O_2, at 1 ATA, 2 ATA, and 3 ATA of fresh water at 50°F. . . . Within the limited scope of this research, a few important trends can be outlined with respect to VO_2 as affected by gas concentrations, partial pressures, and densities due to depth. . . . It appears that small concentrations of N_2 in a He-O_2 based mixture can help negate the thermal effect and density effect. . . . When used in combination, the interdependence of thermal conductivity, density, and potentially toxic effects due to partial pressure appear to exert a synergistic effect on the VO_2 of a diver. (Authors)

76.

BRENNAN, D.M.A., B.K. Ross and S.J. Brumleve.

Electrocardiographic responses of ice diving scuba divers.
Proc. North Dakota Acad. Sci. 29(1):3; 1975.

Abstract only. Entire item quoted: Diving mammals exhibit an adaptive mechanism referred to as the diving reflex or diving bradycardia. It has been observed to occur reflexly for the duration of apneic dives. The exact mechanism for this diving reflex has not been elucidated. However, it is thought to be an oxygen conserving mechanism. In this project six scuba divers of both sexes participated in laboratory and under-ice experiments. Each diver's EKG was recorded individually with a clinical, 4-lead EKG machine. The experimental sequence was a control in air, face only submerged in ice water with mask on, face submerged with mask off. Subjects were asked to hold their breath for 45 seconds for each trial. Preliminary data suggest that there is a marked bradycardia when the face is unprotected. With the mask on, the diving reflex is significantly inhibited.

77.

BRENNAN, D.M.A. and J.W. Weelihan.

Thermal protection: Effect on static grip strength at various depths.

In: Proceedings of the Eighth International Conference on Underwater Education Nov. 1976, San Diego, Calif., p.64-70. Colton, Calif., National Association of Underwater Instructors, 1976.

The data presented indicate that significant ($p < 0.01$) grip strength decrements occurred in divers wearing full ¼" neoprene wet suits or dry suits, including mitts or gloves, at depths of 2.0 ATA or less. The observed grip strength decrements were attributed to the uncompressed neoprene resisting the divers' ability to grip at control levels values and to the slippery, exterior surface of the Nylon II mitts or gloves. At depths of 3 ATA the mitts or gloves appeared to have compressed to the extent, where thickness no longer interfered with the divers' grip strength ability. In addition, the mitts or gloves at 3 ATA provided protection and grip stability which made it possible to achieve significantly ($p < 0.01$) increased grip strength recordings. The thermal protection currently available to divers working in cold, shallow water significantly ($p < 0.01$) decreases their grip strength ability. An investigation of new types of hand thermal protection for divers, who need to perform manual skills in cold, shallow water, should certainly be undertaken. By improving mitt and glove design it may be possible to increase a diver's performance by reducing fatigue and the resulting grip strength decrement. (Authors)

78.

BRENNAN, D.M.A. and J.W. Wheelihan.

Ice diving: A practical reality.

In: Proceedings of the Ninth International Conference on Underwater Education. p.46. Colton, Calif., National Association of Underwater Instructors, 1977.

Abstract only. Entire item quoted: The sport diving world generally shudders at the thought of ice diving. Major opposition to sport ice diving revolves around: 1) the fact that it is cold and thus "physiologically unsound," or, 2) that it is otherwise "dangerous." At the University of North Dakota, ice diving has become a practical reality. During the past 5 years, ice diving has enabled us to extend our diving program and diving season from a 6-month year to a 10-month year. In addition to being fun, the ice diving program has considerable practical value in the realm of safety awareness and team cooperation.

78a.

BROWN, C.

The medical editor's column diving lore: Common misconceptions.

NDA NAUI News, p.19; June 1975.

The author continues his discussion of common misconceptions in the field of diving, which may constitute safety hazards. He points out that, contrary to popular belief, alternobaric vertigo is a more serious hazard than is chest squeeze. In the case of the use of drugs, nothing should be taken for granted. Some sedatives predispose to nitrogen narcosis, while others block it. In cases of shock, application of heat is commonly believed to be the thing to do. This is incorrect, as application of heat to the skin causes vasodilation, thus making less blood available to the vital organs. Application of heat for hypothermia is likewise wrong unless you can maintain the heat. Recommended treatment is immersion in water maintained at 105° - 110°F, a warm enema, warm drinks if conscious, or dry blankets. Alcoholic drinks, as they cause vasodilation, are absolutely out.

79.

BROWN, C.V.

Cold–Part I.

NAUI News, p.16; July 1976.

During exposure to cold water, skin temperature drops first, resulting in vasoconstriction, which protects

the body core. The extremities can become quite chilled while the body core remains near normal. The danger is decrement in manual performance. Any task requiring manual dexterity should be performed early in the dive. When hypothermia (a body core temperature of 95° or below) occurs, both mental and muscular function deteriorate circulation shows. At around 90° unconsciousness sets in. Sometimes fatal ventricular fibrillation sets in. There is a great individual variability in the ability to tolerate exposure to cold water. In addition to obesity, build, nutrition, and aerobic capacity are important. A thin athlete may be able to withstand cold better than a plump sedentary type. The axilla and groin are areas of fast heat loss. Assuming a fetal position is protective. The head is the site of fastest heat loss, so a warm hood should be worn. Resting quietly with the head out of the water is the best tactic to adopt. (MFW/UMS)

80.
BROWN, C.V.
Cold–Part II.
NAUI News, p.6; Aug. 1976.

Exercise and shivering (which is involuntary exercise) are not helpful in cold water, as they are on land or in moderate water, in the prevention of heat loss. The flow of warm core blood through muscles just below the skin causes a waste of body heat, which is rapidly drained off by the high conductivity of the surrounding water. Different individuals require different degrees of protection, and the factor of adaptation is important. In case of hypothermia, even if only suspected, rapid rewarming is indicated. Place the patient in a 104° to 108° bath, if it is possible to maintain this temperature. If not, wrap him in blankets. Warming for a short time only often does more harm than good, since it drives the chilled blood back to the core. Warmed breathing air, a warm enema, something sweet to provide quick calories are all helpful. Severe cases should be removed to a hospital. In repetitive diving, it is most important to warm up thoroughly between dives. If the diver sweats following exercise, he is adequately rewarmed. Since cold may cause muscle cramps, a buoyancy device should be used. It also predisposes toward decompression sickness, so leeway must be taken in judging decompression limits. (MFW/UMS)

81.
BROWN, C.V.
Cardiovascular comments.
NAUI News, p.10-12; Sept. 1977.

The author describes the cardiovascular system in terms understandable to the layman, and then discusses alterations in the system that occur as a result of diving: shift of blood to the chest, increased cardiac output, bradycardia, and raised blood pressure and lowered pulse brought on by cold. Cold-induced vasoconstriction and the squeeze of the wet suit contribute to the blood shift to the chest, as does the negative pressure of inhaling through a regulator. Positive pressure during exhalation somewhat counteracts this effect. Several factors contribute to bradycardia: face immersion, cold stimulation of the face, breath-holding, and exercise. Vasoconstriction and raised blood pressure are brought on by hyperoxia, while hypercapnia has the opposite effect. Valsalva maneuver slows the heart, as does diver's reflex. Dysrhythmias often occur during diving. They are dangerous because they reduce the cardiac output. A diver with hypertension is at great risk, because cold and hyperoxia can elevate his blood pressure, and eventually bring on heart failure. Any indication of heart irregularity, such as pain or dysrhythmia, is a contraindication for diving. (MFW/UMS)

82.
BROWN, C.V.
Cold allergy.
Skin Diver 27:23; July 1978.

Cold allergy is not a true allergy, but in some people cold brings on a reaction that mimics allergy. Vessels in the skin dilate, producing urticaria. Nasal congestion, wheezing, coughing, and shock may also occur. The mechanism is related to the release of histamine from most cells in the skin. It appears

to be hereditary and sometimes reflects an underlying disease. Medication that combats most allergies is not effective. Desensitization (exposure to gradually increasing degrees of coldness over a period of months) sometimes works. If it does not, cold must simply be avoided. Any evidence of cold intolerance warrants a thorough medical investigation. (MFW/UMS)

83.

BUCHER, O. and R. Krstic.

Scanning electron microscopic study of the changes of the liminal surface of rat thyroid epithelial cells following exposure to cold for 6 to 48 hours.

Anat. Embryol. 153(1):85-94; 1978.

Scanning electron microscopic observations of thyroid follicle cells of rats exposed to 4°C for 6-48 h showed an increased number of apical microvilli in comparison to controls kept at 22°C. These ultrastructural differences, statistically significant 48 h after start of the experiments, were related to stimulation of thyroid gland activity by exposure to cold.

83a.

BUEHRING, M. and H.F. Spies.

[Sympathoadrenal activity in acute cold exposure: Mechanisms of sudden death in water immersion].

Z. Rechtsmed: 83(2):121-128; 1979.

In addition to other mechanisms of sudden death following water immersion, predominantly vagal cardio-depressive reflexes are discussed. The pronounced circulatory centralization in diving animals following exposure to cold water indicates additional sympathetic activity. In cold water baths of 15°C there is an increase in plasma catecholamine levels by more than 300% in humans. This may lead to cardiac arrhythmias by the following mechanism: Cold water essentially induces sinus bradycardia. Brady- and tachyarrhythmias may supervene as secondary complications. Sinus bradycardia may be enhanced by sympathetic hypertonus. Ectopic dysrhythmias may be induced by the strictly sympathetic innervation of the ventricle. Myocardial ischemia following a rise in peripheral blood pressure is another arrhythmogenic factor. Some of these reactions are enhanced by alcohol intoxication. (©BA)

84.

BUGUET, A.G.C., B.H.E. Roussel, W.J. Watson and M.W. Radomski.

Cold-induced diminution of paradoxical sleep in man.

Electroencephalogr. Clin. Neurophysiol. 46(1):29-32; 1979.

Prolonged exposure to cold produced a chronic diminution in PS [paradoxical sleep] (PS-hyposomnia) primarily in the tonic component of PS. No significant change occurred in the REM [rapid eye movement] (phasic or obligatory) component of PS. An inverse correlation was found in the activity of the pituitary-adrenal cortical system and the level of PS. The classical rebound phenomenon that occurs after PS deprivation was not observed. The rebound effect characteristic of PS deprivation is apparently related not to total PS but to its phasic (obligatory) component.

85.

BUKOWIECKI, L., N. Follea, J. Vallieres and J. Leblanc.

β-Adrenergic receptors in brown-adipose tissue: Characterization and alterations during acclimation of rats to cold.

Eur. J. Biochem. 92(1):189-196; 1978.

The capacity of brown adipose tissue [BAT] to respond calorigenically to catecholamines increases markedly during cold-acclimation of adult rats. To investigate this phenomenon, the potent radioactive ligand (-)-[^{3}H]dihydroalprenolol was used to directly estimate the number, the density and the affinity

of β-adrenergic receptors in BAT membranes from control, cold-exposed and cold-acclimated rats. Binding of (-)-[^{3}H]dihydroalprenolol to unfractionated membranes was rapid, stable, saturable and reversible. It displayed the affinity, specificity and stereoselectivity expected of binding to adenylate cyclase-coupled β-adrenergic receptors. β-Adrenergic agonists competed for binding sites with an order of potency typical of the β1 subtype of adrenergic receptors: (-)-Isoproterenol > (-)-norepinephrine ≥ (-)-epinephrine. Binding exhibited a remarkable stereoselectivity, the (-)-isomers of β-isomers of β-adrenergic agonists and antagonists being 34-280 times more potent than the (+)-isomers in competing for (-)-[^{3}H]dihydroalprenolol binding sites. Total interscapular BAT of the adult, warm-acclimated rat contained 1.12 ± 0.08 pmol of (-)-[^{3}H]dihydroalprenolol binding sites. During cold-acclimation, growth of the tissue was accompanied by a 4-5 fold increase in the total number of receptor sites. However, this increase did not keep pace with the increase in BAT cellularity (as estimated by total tissue DNA content), resulting in a 40%-50% reduction in receptor density. The decrease in receptor density was associated with cold exposure rather than with cold-acclimation. The affinity of (-)-[^{3}H]dihydroalprenolol receptor sites was not significantly altered by cold-acclimation. Apparently, catecholamines released via activation of the sympathetic nervous system regulate both the density and the number of their own receptors in BAT of cold-exposed animals. The development of the hyperadrenergic response of this thermogenic tissue during cold-acclimation may result from a marked organ hyperplasia associated with an increased number of β-adrenergic receptor sites. This cannot be explained by alterations in receptor density or affinity.

85a.

BULLARD, R.W. and G.M. Rapp.

Problems of body heat loss in water immersion.

In: Lambertsen, C.J. and R.W. Bullard, eds. Symposium on undersea-aerospace medicine. Temperature limitations in manned undersea and aerospace operations, St. Louis, Missouri, April 30, 1970.

Aerosp. Med. 41:1269-1277; Nov. 1970.

A simple model is utilized for development of the concepts involved in body heat loss in water immersion. In the model, metabolically produced heat and heat stores from the core are transferred down the thermal gradient (T_e-T_s) to the skin surface. The fixed resistance to heat flow of subcutaneous fat and body structural components is discussed as well as the more complex resistance varied by alteration in skin and extremity blood flow. Extremely high resistance to heat flow or minimal conductance is developed by a marked reduction in extremity blood flow and establishment of countercurrent heat exchange. The highest attainable resistance to heat flow is quite dependent on subcutaneous fat deposits. Transfer of heat from body surface to water encounters a very low resistance. This problem is treated herein by utilizing classical heat transfer physics and non-dimensional quantities derived from the thermal physical properties of water. (Authors' abstract)

85b.

BURSE, R.L.

Sex differences in human thermoregulatory response to heat and cold stress.

Human Factors 21(6):687-699; 1979.

The current literature on male-female differences in response to thermal stress has been reviewed. Morphologically, women average 20% smaller body mass, 14% more body fat, 33% less lean body mass, but only 18% less surface area than men. Women have greater body insulation when vasoconstricted (except hands and feet) and a larger peripheral heat sink, but at the cost of (1) greater body fat burden, (2) less muscle mass and strength, and (3) smaller circulating blood volumes which requires greater physiological strain to balance heat production and loss. Under heat stress, women generally show (1) relatively more peripheral blood pooling, (2) greater heart rate increases, (3) more frequent circulatory embarassment, (4) lower maximal sweat rates, (5) higher skin temperatures with greater body heat storage, and (6) poorer maintenance of circulating blood volume with more impact from dehydration.

Proportionately fewer women than men can be successfully heat acclimated. In the cold, women generally have (1) less capability for maximum heat production by either exercise or shivering, (2) a more extensively vasoconstricted periphery, (3) lower foot, hand, and mean skin temperatures, (4) greater surface heat losses, especially from the geometrically thinner extremities, (5) increased rates of extremity, but not core, cooling, and (6) relatively greater risk of cold injury.

85c.

BURSE, R.L., R.F. Goldman, and A.E. Stubbmann.

Differences between males and females of military age in their physiological responses to cold and hot environments.

U.S. Army Res. Inst. of Environ. Med., Military Ergonomics Division, Natick, MA; February 2, 1976.

It is not unfair to generalize females in their physiological responses to heat and cold as being somewhat similar to their less-fit, unacclimatized, and fatter male counterparts. Such a comparison, unflattering though it may be, seems useful as a guideline in the development of women's field clothing to permit safe operations under a greater range of environmental extremes than is now possible.

86.

BURTON, R.

Cold-water survival.

Sea Frontiers 19:240-249; July-August 1973.

The author is concerned mainly with shipwreck survival, but there are observations on heat loss in water that apply to any underwater activity. The physiology of heat loss in water is discussed, with emphasis on the importance of protective clothing. It is stated that in dangerously cold water, "the average man should not exercise, otherwise increased blood flow and conductance will lead to greater heat loss." After-drop, which has caused many deaths, is probably due to the return of limb blood to the core following recirculation. Attempts should be made to rewarm the core without stimulating peripheral circulation; the best method is immersion of the trunk in a hot bath. One possible fatal danger of cold water swimming is ventricular fibrillation. (MFW/SCD)

87.

BUSKIRK, E.R.

Cold stress: a selective review.

In: Folinsbee, L.J., et al., ed. Environmental stress. p.249-266. New York, Academic Press, 1978. QT 140 E61 1977.

The literature on the physiology of cold exposure is vast and no attempt was made to prepare a thorough review. The temperature regulation model of Gordon et al. (13) is presented because it represents not only one of the latest attempts to model heat exchange in man exposed to cold, but also a sophisticated effort by the group hosting this honorary symposium. Some of the experiments associated with demonstration of an altered body temperature threshold for the metabolic response to cold were presented. It is conceivable that the temperature threshold does indeed shift to lower values with repeated cold exposure and improved physical condition. The increase in cardiac output found during two-hour exposures to cold air was largely accounted for by an increase in stroke volume. Breathing extremely cold air during jogging or cross-country skiing has little effect on the respiratory tract, particularly if some simple thermal protection is worn. Wetted clothing loses considerable insulation and places the wearer at risk for thermal injury. Swimming in cold water can lower core temperature drastically in lean, slow swimmers. In this brief compendium it should be readily apparent that Horvath and his colleagues have contributed measurably to our knowledge of man in the cold.

87a.

BUTSON, A.R.C.

Acclimatization to cold in the Antarctic.
Nature 163(4134); January 1949.

In a study of eleven men for a year in the Antarctic, he found the expected increase in basal metabolic rate, increase in adrenal function, and increase in blood sugar. There was a marked variation in the ability to work with exposed hands. (CWS/UMS)

88.

CAPUTA, M. and M. Cabanac.

Bradycardia during face cooling in man may be produced by selective brain cooling.
J. Appl. Physiol. 46:905-907; May 1979.

In human subjects, bradycardia was produced by immersing the subjects' faces in water at 15°C when they were hyperthermic. When they were hypothermic, the same face cooling produced tachycardia. It is suggested that the difference in cardiac response originates in selective brain cooling during hyperthermia, by venous return from the face to the brain, via ophthalmic veins. (Authors' abstract)

89.

CARDEN, T.S., Jr.

Saving the hypothermic patient (editorial).
JAMA 240(25):2761; 15 Dec. 1978.

Both the young, healthy ski enthusiast and the skid-row derelict share the risk of hypothermia when they are exposed to the elements for a sufficient period without adequate protection. The most important message is that a graded community response should be worked out in advance so that patients suffering from exposure can have the greatest possible chance of being saved. This involves a need for emergency physicians to be aware of the potential for salvage of what appear to be hopeless cases and for community physicians and institutions to cooperate in developing a workable plan for the transport or transfer of such patients to facilities where optimum care is available. Lest it be overlooked, it also requires emergency facilities to have available the clinical thermometers which can accurately document the degree of the patient's hypothermia.

89a.

CARDONE, B.J.

Warm up with WABA.
Skin Diver 28:104-105; Feb. 1979.

WABA is an acronym for Warm Air Breathing Apparatus, manufactured by Underseas Environmentals, Inc., of Baltimore, Md. The device, which is attached between the first and second stages of a regulator, consists of a canister made of structural foam with a high pressure hose and fittings of anti-corrosion plated brass. It weighs four pounds empty and seven pounds when filled with hot liquid. The warm air warms the copper tubing inside the unit, through which the breathing air passes on its way to the second stage. *Skin Diver* has checked out the WABA in water of 64°F during a 35-minute dive to 50 feet and in 60°F water during a 35-minute dive to 40 feet. The breathing air was noticeably warmer than that in similar dives without the WABA. It has positive buoyancy and creates minimal drag. It provides warm air for up to two hours with each filling. (MFW/UMS)

90.

CARTER, S.A.

Voluntary increase in finger temperature in man in a cooling environment.
Can. J. Physiol. Pharmacol. 56(6):993-998; 1978.

To test whether man can voluntarily increase skin temperature in a cool environment, 14 subjects (age 15-51) were studied. They came once or twice a wk for 5-8 sessions of 1 h. The room temperature of various sessions varied from 21.2-15.6°C. Temperatures of 6 fingers were recorded using thermocouples. During trials to increase temperature, subjects were shown a dial indicating temperature of an index finger and were instructed to warm their hands. The trials were begun when skin temperatures were stable or were falling, indicating that vasoconstriction was occurring. They were preceded and followed by a rest period. The differences between changes in temperature during the trials and the rest periods were significant for the group of 14 subjects ($P < 0.01$). In 10 subjects with individually significant results, differences between the trial and rest periods averaged 5.0°C for the best and 3.9°C for the worst finger. The maximum temperatures during the trials averaged 30.9 ± 1.0°C (mean ± SE) in the best finger. During later sessions, subjects increased temperatures without seeing the dial. Humans are able to voluntarily increase cutaneous finger blood flow in a cool environment.

90a.

CENA, K. and J.A. Clark.

Transfer of heat through animal coats and clothing.
Int. Rev. Physiol. 20:1-42; 1979.

One short section of this paper deals with clothing insulation in hyperbaric and hypobaric environments and in water. At 30 atm, respiratory convection alone demands the whole normal metabolic heat production. The temperature of the breathing mixture must therefore be controlled. Changes may take place in both the intrinsic insulation of the clothing layer and in the external insulation. In a helium atmosphere, a diver who would be clothed comfortably in air would find his total insulation approximately halved. The best solutions would be alternative gases of higher molecular weight than helium, or an increase in the ambient temperature. Water offers virtually no external insulation, so that the immersed individual must depend upon his tissues and clothing for protection. The most efficient way to preserve comfort and maintain mobility is to heat the layer next to the skin in order to maintain the skin temperature within the medium range. Water penetrates the fur of seals and polar bears, but a water layer adjacent to the skin acts as an insulator, as in the neoprene wet suit. In contrast, the penguin retains an air layer under its feathers during immersion. (MFW/UMS)

91.

CETTA, T.W. and R. Radecki.

Testing of Biomarine CCR 1000 closed circuit U.B.A.
U.S. Navy Exp. Diving Unit, Rep. NEDU 7075, 16p. Sept. 1975.

Upon request from the U.D.T. and S.E.A.L. Liaison Officer Lt. T. Hawkins, the Test and Evaluation Dept. of NAVXDIVINGU performed breathing resistance and CO_2 scrubber duration tests. The maximum breathing resistance measured at 198 FSW during a breathing rate of 30 breaths per minute with a 2.0 Liter Tidal Volume breathing through a Mk VI mouthpiece was -15 centimeters of H_2O during inhale and +14.5 centimeters of H_2O during exhale. The CO_2 scrubber duration was determined under three conditions; they were all at 200 FSW: first in 32 degree F water with 0.85 SLPM CO_2 add rate with a duration of 2 hours 40 minutes, second in 32 degree F water with a 1.2 SLPM CO_2 add rate and a duration of 1 hour 57 minutes, and finally in 72 degree F H_2O with a 0.85 SLPM CO_2 add rate and a duration of 7 hours, 10 minutes. . . . In conclusion the Biomarine CCR 1000 performed as well as any of the closed circuit mixed gas rebreathers tested at N.E.D.U. to date. When subjected to cold water the performance did not deteriorate with the exception of CO_2 scrubber duration. The scrubber performed only 37% as long in cold water as it did in warm water. This is a normal occurrence in baralyme CO_2 scrubbers. (Authors)

92.

CHEN, R.Y.Z. and S. Chien.

Hemodynamic functions and blood viscosity in surface hypothermia.
Am. J. Physiol. 235(2):H136-H143; 1978.

Hemodynamic functions and blood viscosity changes in hypothermia (core ≈ 25°C) were studied in 14 pentobarbital-anesthetized dogs subjected to surface cooling. The viscosity of blood (ηB) increased progressively to 173% of that at 37°C when body temperature was lowered to 25°C. The increase in blood viscosity was caused by the direct effect of low temperature on plasma viscosity, hemoconcentration as a result of plasma loss, and the low-flow (low-shear) state induced by hypothermia. A larger portion of the increased blood viscosity was caused by the low-flow state in hypothermia. The systemic flow resistance (SFR) increased to 271% of control, and this was attributable about equally to the increases in blood viscosity and systemic vascular hindrance (SFR/ηB). The viscosity of blood contributed significantly to raising the pulmonary flow resistance. The relative constancy of mixed venous O_2 saturation suggested that the cardiac output at low body temperature is generally adequate to meet the metabolic needs.

93.

CHINARD, F.P.

Hypothermia (letter).
Ann. Intern. Med. 90(2):273-274; Feb. 1979.
Hypothermia treatment needs controlled studies (letter).
Ann. Intern. Med. 90(6):990-991; June 1979.

There is a great deal of disagreement about whether to use CORE rewarming and how it should be accomplished. This letter to the editor suggests that it would be appropriate to set up a control study to determine the answers to this problem.

94.

CHITWOOD, W.R., Jr., et al.

Ann. Surg. 190(1):106-116; July 1979.

Hypothermia remains the primary adjunct employed to lower cellular metabolism during various cardiac procedures. In these experiments, left ventricular myocardial oxygen consumption (MVO_2) and transmural blood flow (TBF) were measured during cardiopulmonary bypass with the range of temperatures used clinically. Determinations were made in empty beating normothermic hearts and after potassium cardioplegia at 37, 32, 28, 22, 18, and 15° (K^+ = 15–37 meq/L:Hct 25 volumes %). Oxygen content of the total coronary sinus collection was compared with a large volume arterial sample using a Lex-O_2-Con-TL analyzer (vs Van Slyke, R = 0.98). Transmural blood flow was measured at each temperature using microspheres (8 μ), and perfusion was maintained at 80 mmHg. Asystole (37°) alone decreased MVO_2 from 5.18 ± 0.55 to 1.85 ± 0.20 ml O_2/min/100 g of left ventricle or approximately 65% ($p < 0.001$). With progressive cooling to 15° an additional 82% decrement in oxygen uptake occurred during asystole ($p < 0.001$). During asystole at 37° the decrease in MVO_2 was reflected mainly by a large decrement ($p < 0.01$) in TBF (1.27 ± 0.19 to 0.74 ± 0.17 ml/min/g of mean left ventricular flow). However, with cooling below 32°, the arteriovenous oxygen difference narrowed progressively ($p < 0.001$) while TBF paradoxically returned to control levels. Endocardial/epicardial flow ratios were not altered by cooling. These data not only confirm earlier reports describing a sequential drop in MVO_2 with incremental myocardial cooling, but also establish MVO_2 levels for perfused hearts arrested by potassium at lower temperatures (18-15°). Moreover, as transmural blood flow becomes independent of metabolic necessity during hypothermia, coronary autoregulation appears to be impaired, possibly affecting detrimental tissue over perfusion.

95.

CHUSOV, Y.N.

Hum. Physiol. 4(1):132-136; Jan.-Feb. 1978.

The following conclusion can be drawn from these data. Tolerance to cooling in ice-cold water for most people does not exceed 2 min. and only in certain individuals may it reach 11 min. Excessive strain is

placed on the mechanisms of increasing heat formation under these circumstances. Voluntary muscular activity (swimming) during a short period of cooling in water helps to increase the safe period of immersion. The duration of the safe period of immersion in cold water is determined by the result of close interaction between voluntary regulation of behavior—the regulation of the duration of cooling and performance of the optimal quantity of muscular work—and the physiological mechanisms of thermoregulation proper.

96.

CHUSOV, Yu. N.

Research on human tolerance to cooling in water.
Fiziol. Chel. 4(1):158-162; 1978.

Tolerance to cooling in ice water did not exceed 2 min in most people. It reached 11 min only in individual cases. Extreme stress on the mechanisms of intensification of heat formation occurred. Voluntary muscle activity (swimming) facilitated an increase in the time the subjects could safely remain in the water.

97.

CIASTKO, A.

More on the diving reflex and supraventricular tachycardia.
J. Pediatr. 93:721-722; Oct. 1978.

Referring to a previous communication (Whitman, V., et al. J. Pediatr. 91:304; 1977) concerning the immersion of an infant's head in cold water as a method of treating supraventricular tachycardia, the author recommends as an alternative the application of a cold wet cloth to the infant's face. This method was successful on several occasions in arresting tachycardia in a four-month old infant. The method was used successfully upon two different infants. It is noted, however, that a colleague used it without success upon a third. (MFW/UMS)

97a.

CLARK, R.E.

The limiting hand skin temperature for unaffected manual performance in the cold.
J. Appl. Psych. 45:193-194; 1961.

The hands of 12 enlisted men were cooled to 55°F and 60°F surface temperature on different experimental days. Performance times to complete a standard knot-tying task were obtained when S's hands first reached the appropriate hand skin temperature, after 20 minutes' exposure at the criterion temperature, after 40 minutes' exposure, and after 60 minutes' exposure. It was found that performance was severely hindered when hand skin temperature fell to 55°F, and that performance decrements at this skin temperature level were increasing exponential functions of duration of exposure, becoming asymptotic after about 40 minutes' exposure. In contrast, performance at 60°F hand skin temperature remained unaffected throughout the exposure period.

97b.

CLARK, R.E., and C.F. Flaherty.

Contralateral effects of thermal stimuli on manual performance capability.
J. Appl. Physiol. 18(4):769-771; 1963.

The performance capability of one hand was studied as a function of its surface temperature and that of the contralateral hand. Three findings were determined to be statistically reliable for the subject sample tested: a) when the performing hand itself was cooled to a surface temperature of 40°F, performance decrements appeared which were independent of the temperature of the contralateral hand; b) when the performing hand was kept warm, cooling of the nonperforming hand resulted in an average reduction of 33% in the time typically needed for the completion of the manual task; and c) the surface

temperature of a hand not exposed to the cold was found to fall an average of 2°F below its normal level when the contralateral hand was cooled to surface temperatures of 55°F or lower.

97c.

CLARK, R.E., and C.E. Jones.

Manual performance during cold exposure as a function of practice level and the thermal conditions of training.

J. Appl. Psych. 46:276-280; 1962.

Three groups of 10 Ss each were given varied thermal experience (warm or cold hands) during 3 weeks of training on a standard manual task. The results were as follows: (a) one day of cold-hand training significantly reduced the size of a manual decrement usually associated with cold exposure, but continued cold experience did not; (b) skill level on the task per se did not interact with the cold induced performance decrements; and (c) the thermal conditions associated with performance on the task appeared to become part of the stimulus complex eliciting correct manual responses when these thermal conditions were maintained for a large number of trials, i.e., the Ss learned, not merely to perform on the task, but to perform with warm, or cold, hands specifically.

97d.

CLASEN, R.A., S. Pandolfi, and G.M. Hass.

Interrupted hypothermia in experimental cerebral edema.

Neurology 20:279; 1970.

The application of systemic hypothermia to monkeys with cerebral freezing lesions one hour after injury resulted in a diminished weight increment in the damaged hemisphere at twenty-four hours, even though the hypothermia was not sustained. The damaged hemisphere also showed a diminished concentration of water, sodium, chloride, iron, RISA, and dye uptake, when compared with data obtained from untreated animals, but these differences were not statistically significant. It is suggested that the diminished weight increment was a cumulative effect resulting from a decrease in both hemorrhage and edema, and that interrupted hypothermia is an effective means of therapy for this form of cerebral injury.

98.

CLINGMAN, B. and E. Evonuk.

Comparisons of metabolic, thermal, and cardiovascular responses of acclimated and unacclimated Navy divers.

In: Shilling, C.W. and M.W. Beckett, eds. Underwater physiology VI. Proceedings of the sixth symposium on underwater physiology, p.117-121. Bethesda, Md., Federation of American Societies for Experimental Biology, 1978.

This study was designed to investigate and compare some of the physiological responses of divers exposed to cold water while under increased pressure. Eight Naval salvage divers were chosen from groups of volunteers to participate in this study. Four of the subjects were considered to be acclimated to cold water diving and the remaining four men picked for their unacclimated characteristics to thermal stress. The study was conducted inside a recompression chamber at Keyport, WA with the subjects submerged in a metal tub of ice water for fifteen minutes at pressures of two and three atmospheres absolute. During these exposures body heat content and debt, oxygen consumption, respiratory minute volume, heart and respiratory rates were monitored. Heat debt was determined from six skin thermistors and one rectal lead. No significant difference between the acclimated and unacclimated groups was found. However, the two to threefold increase in oxygen consumption and three to fivefold increase in respiratory minute volume of the unacclimated in comparison to the acclimated group lead to an assumption of greater metabolic activity in the experimental diving group. It appears likely this metabolic increase is an attempt to maintain the normal level of core heat, therefore concluding that the unacclimated subjects

were experiencing greater cold stress and heat drain. The cold and/or increase in pressure was observed to have a direct relationship upon the heart rate of both groups; i.e., an increase in the magnitude of bradycardia for the acclimated and tachycardia for the unacclimated. Reason and mechanism for this override is unknown but appears to be symptomatic of physiological stress caused by being unacclimated to the cold water. (From Sixth symposium program and abstracts)

99.

CLOSE, W.H. and L.E. Mount.

The effects of plane of nutrition and environmental temperature on the energy metabolism of the growing pig: 1. Heat loss and critical temperature.

Br. J. Nutr. 40(3):413-422; 1978.

The heat losses and energy balances of 38 individually housed pigs (initial body weight 21-38 kg) were measured continuously for periods of 14 days when they were maintained at environmental temperatures of 10, 15, 20, 25 or 30°. At each temperature 4 levels of feeding were given, approximating to once, twice and 3 times the maintenance energy intake and the ad lib level. The minimal maintenance energy requirement (M) was calculated to be 440 kJ metabolizable energy (ME)/$kg^{0.75}$ per day at 25°. ME intake at the ad lib level decreased from 1965 kJ/$kg^{0.75}$ per day at 10° to 1202 at 30°. Heat loss calculated from multiple regression analysis decreased to minimum levels between 20 and 25°; 30° was within the hyperthermic zone at each plane of nutrition. The partition of heat loss into its sensible and evaporative components showed that evaporation increased from 25% at 10° to 78% at 30°. Critical temperature was dependent upon food intake and decreased from 23.1° at M to 20.7° at 2M, 18.0° at 3M and 16.7° at 4M. The extra food required to meet extra thermoregulatory heat production per 1° below the effective critical temperature was 0.65 g/kg body wt per day.

100.

CLOSE, W.H., L.E. Mount and D. Brown.

The effects of plane of nutrition and environmental temperature on the energy metabolism of the growing pig: 2. Growth rate, including protein and fat deposition.

Br. J. Nutr. 40(3):423-432; 1978.

Measurements of energy and N balances were made on 38 individually housed pigs (initial body wt 21-38 kg) at environmental temperatures of 10, 15, 20, 25 and 30° with 4 levels of feeding at each temperature. Values for energy retention (ER), protein (P) and fat (F) deposition and body weight gain (ΔW) were calculated at each temperature at metabolizable energy (ME) intakes equivalent to once (M; 440 kJ/$kg^{0.75}$ per day), twice (2M), 3 (3M) and 4 (4M) times the thermoneutral maintenance energy requirement. ER at each plane of nutrition increased with temperature to maximal values between approximately 20 and 25°; ER was negative at 4 of the 5 environmental temperatures at M. P increased significantly with increase in ME intake but was dependent on environmental temperatures only at intakes of M and 2M. The increase in P per unit increment in ME intake decreased from 0.16 at 10° to 0.12 at 30°. The net efficiency of protein utilization also decreased with increase in environmental temperature from 0.54 at 10° to (39 at 30°. F increased significantly with increase in ME intake, but was more temperature-dependent than P, increasing to maximum values estimated to be between 20 and 25° at each level of intake. F at 30° was less than that at 25°. The increase in F per unit increment in ME intake decreased from 0.63 at 10° to 0.51 at 30°. The optimum temperature for ΔW was dependent upon ME intake, varying from above 30° at M to less than 20° at 4M. The reduction in ΔW per 1° at 15° was also dependent upon the level of intake decreasing from 1.63 g/$kg^{0.75}$ per day at M to -0.09 at 4M. For a 35 kg pig the reduction in P, as a result of a 1° decrease in temperature at 15° at an intake corresponding to 2.5M, was equivalent to a 4 g/day reduction in food intake. The corresponding equivalent for F was 28 g/day.

101.
CLOSE, W.H.

The effects of plane of nutrition and environmental temperature on the energy metabolism of the growing pig: 3. The efficiency of energy utilization for maintenance and growth.

Br. J. Nutr. 40(3):433-438; 1978.

From the relation between metabolizable energy (ME) intake and heat loss (H), energy retention (ER), protein (P) and fat (F) deposition the energy costs of maintenance (ME_m) and the partial efficiencies of energy retention (k) and protein (k_P) and fat (k_F) retention were determined in growing pigs at environmental temperatures of 10, 15, 20, 25 or 30°. Energy retention k decreased with increase in environmental temperature from 0.79 at 10° to 0.63 at 30° with 0.67 at the thermally-neutral temperature of 25°. Each 0.04 decrease in k was associated with a 100 $kJ/kg^{0.75}$ per day decrease in ME_m. Analysis, within several ranges of environmental temperature, suggested a curvilinear relation between ER and ME intake indicating a decrease in k with increase in level of feeding, particularly at thermally-neutral temperatures. Both k_P and k_F were similar at each environmental temperature and decreased from 0.78 at 10° to 0.63 at 30°. These values were discussed in relation to those predicted from experimentation. The wide range of predicted estimates of k_P could be attributed to differences in the rate of protein turnover.

102.
COLLINS, K.J. and A.N. Exton-Smith.

Oral temperature and hypothermia (letter).

Br. Med. J. 1(6167):887; 31 Mar. 1979.

Oral temperature readings are prognised to be notoriously misleading when taken in either low or high ambient temperature conditions. The diagnosis of hypothermia must be based on measurement of the deep body temperature. This can be carried out by recording urine temperature, as has been shown in domiciliary studies in the elderly.

103.
COLLIS, M.L.

Cold water survival techniques advanced by Canadian researchers.

Ocean Ind. 10:46-49; Nov. 1975.

A team of three doctors at the University of Victoria in Canada initiated a study of the physiological responses of the body of long-term immersion under actual ocean conditions in northern waters. Subjects were monitored so that the investigators had a second-by-second picture of the body's responses to cold stress. A thermography scanning technique was used to show the areas of high heat loss, which were the neck, the sides of the trunk, and the groin. Clothing was designed to give added protection to these areas. This new jacket is called the UVic Thermofloat and it will provide 9 to 10 hours survival time in 50°C water. Another line of research carried on in this project is the development and testing of a science of cold water survival. Various techniques of surviving in cold water--treading water, drown proofing, holding still in a life jacket, heat escape lessening position (HELP) and huddling are described. Holding still in a life jacket gives twice as much survival time as drown-proofing, while the HELP or huddle techniques increase survival time another 50%. As to rewarming, the key is to provide an external source of heat. The two best methods are hot air inhalation and hot whirlpool baths. When these methods are not available, hot drinks, hot water bottles, and electric blankets help. An old effective method is taking off the clothes of both the victim and the rescuer, covering up together, and warming the former with the body of the latter. (MFW/UMS)

104.
COLLIS, M.L.
Survival behaviour in cold water immersion.
In: Proceedings of the cold water symposium, Toronto, May 8, 1976, p.25-27. Toronto, Royal Life Saving Society Canada, 1976.

An immersion victim without a flotation device has two alternatives–treading water and drownproofing. He loses heat much faster with the latter method, largely because his head is submerged. With a flotation device, there are two effective techniques. The first is the Heat Escape Lessening Posture (HELP) position, with the knees drawn toward the chin and the arms pressed to the sides. In groups of three or more, huddling is effective. Life jackets are tied on the back, then the sides of chests, and the groin and lower body areas are pressed together, decreasing the surface area available to the water. Children lose heat in cold water much faster than adults. If they can be placed between adults in a huddling group, they might be saved. The UVIC Thermofloat, a cold water survival suit, looks like an ordinary jacket. A flap of closed cell foam neoprene, which encompasses the groin area like a diaper provides buoyancy during immersion. The jacket comes with an orange hood. (MFW/UMS)

105.
COLLIS, M.L.
Treatment of the hypothermic subject.
In: Proceedings of the cold water symposium, Toronto, May 8, 1976, p.31-32. Toronto, Royal Life Saving Society Canada, 1976.

Various methods of rewarming were tested–warm baths, body-to-body warming, and a torso-rewarming suit of the U.S. Navy. The most effective method of rewarming for controlling afterdrop (the lowering of the core temperature after rewarming has begun, brought on by the return of the colder blood to the body core when vasodilation begins) was found to be heated, saturated oxygen delivered through a small mask to the body core. Afterdrop usually amounted to only a fraction of a degree. (MFW/UMS)

106.
COLLIS, M.L., A.M. Steinman and R.D. Chaney.
Accidental hypothermia: An experimental study of practical rewarming methods.
Aviat. Space Environ. Med. 48:625-632; July 1977.

Five rewarming techniques, appropriate for first-aid use in the nonhospital setting, were applied to each of nine subjects whose body temperatures had been lowered to 35°C in a stirred tank of 7.5°C water. The rewarming techniques were: a) inhalation of heated, water-saturated oxygen; b) placement of heating pads over areas of high heat transfer; c) combination of methods a) and b); d) hot whirlpool bath; and e) shivering. Inhalation of heated, water-saturated oxygen was significantly better than the shivering control in minimizing temperature "afterdrop" and is, therefore, preferred over the other techniques as it avoids the physiological hazards of the peripheral vasodilation from external rewarming. (Authors' abstract)

107.
CONDRY, P., A. Jain, R. Marshall and A. Bowyer.
Ventricular tachycardia caused by the diving reflex.
Lancet (1):1263; Dec. 20, 1975.

Entire item quoted: Dr. Wildenthal and his colleagues [see Wildenthal, K., et al., Lancet (1):12-14; Jan. 4, 1975] described the use of the diving reflex to terminate paroxysmal atrial tachycardia. The safety of the technique has been emphasized. We were unable to terminate a paroxysm of atrial tachycardia in a 50-year old woman by either carotid-sinus massage or the Valsalva maneuver. We then immersed her face in a pail of water at 4°C. After 20 seconds ventricular tachycardia occurred and ended as soon as her face was pulled out. A repeat test had the same result. Subsequently, she was treated with

intravenous digoxin and reverted to sinus rhythm. Others have thought that a temperature of 4°C may be too low, since it results in a considerable catecholamine discharge, with consequent risk of ventricular dysrhythmias. Our experience supports this contention. We recommend the use of water less cold than 4°C, and we emphasize the importance of electrocardiographic monitoring of patients during the diving reflex.

108.
CONIAM, S.W.
Accidental hypothermia.
Anaesthesia 34(3):250-256; Mar. 1979.

From this review of the literature, certain main recommendations in the management of hypothermia seem to be agreed. Minimal handling and movement of the patient must be the aim. Rewarming of the trunk in a warm bath in cases of sudden hypothermia following cold water immersion is indicated. In other cases, gradual rewarming via the airway or peritoneum, together with adequate thermal insulation should be undertaken. A rate of temperature rise of ½-1°C per hour is suggested. Fluid overloading should be avoided, especially with dextrose. The ECG should be monitored and antiarrhythmic drugs avoided, but electrical defibrillation may be necessary if ventricular fibrillation develops around 28°C. Added oxygen, airway support and mechanical ventilation may be necessary. A cuffed tracheal tube may be of benefit in reducing the high incidence of aspiration pneumonia. The administration of corticosteroids and antibiotics, if specifically indicated, may be thought necessary.

109.
CONN, A.W.
The role of hypothermia in near drowning.
In: Proceedings of the cold water symposium, Toronto, May 8, 1976, p.33-35. Toronto, Royal Life Saving Society Canada, 1976.

Immersion hypothermia greatly enhances the possibility of recovery in cases of near-drowning. Instances are cited of a 5-year-old boy who had been submerged for 40 minutes, and a 16-year-old boy who suffered accidental hypothermia and cardiac arrest for 5 to 15 minutes. Moderate to deep hypothermia prevents anoxic damage to the brain and other tissues. Anoxic encephalopathy is the most important lesion resulting from near-drowning. During the period 1970-1974, at the Intensive Care Unit of the Hospital for Sick Children in Toronto, 30 cases of near-drowning were admitted. One died, nine had permanent CNS damage. Symptoms and therapy were: hyperhydration–mannitol and steroids; hyperventilation–intermediate positive pressure ventilation; hyperpyrexia–body temperature must be lowered, and chlorpromazine or relaxant drugs given to prevent shivering; hyperexcitability–large doses of sedatives or tranquillizers (phenobarbitol, diazepam); hyperrigidity–relaxants (d-tubocurarine, pancuronium); hypertension–therapy as outlined for the other symptoms. All the measures are designed to reduce anoxic brain damage. A case is outlined of a 3-year-old child who had been accidentally immersed for 8 minutes. Various medications as outlined above were administered. Core temperature was lowered to 32°C. Complete recovery transpired within one week. In normal thermic near-drowning victims the institution of hypothermia may prevent permanent neurological sequelae. (MFW/UMS)

110.
CONN, A.W.
Near-drowning and hypothermia.
Can. Med. Assoc. J. 120(4):397-400; 17 Feb. 1979.

Several mechanisms leading to cardiac arrest may cause death from immersion hypothermia. The usual course of events is a relentless reduction of core temperature, with delirium when it is 35°C, unconsciousness when 32°C and spontaneous ventricular fibrillation when less than 28°C. It is important to appreciate that in this situation cooling precedes the development of bradycardia and subsequent cardiac arrest. The article outlines in detail the measures which should be undertaken in the treatment of a sub-

mersion hypothermic patient. It is essential that all submersion victims, even when they are conscious and alert, be admitted for 24 hours of observation and investigation. Approximately 15% of near-drowning victims who are conscious at the time of admission die of "delayed" drowning from pulmonary and cerebral causes. A recommendation that all unconscious patients, whether hypothermic or normothermic, should receive full "cerebral salvage" treatment appears to be justified. (CWS/UMS)

110a.

CONN, M.L., P.A. Hayes, and J.B. Morrison.

Contribution of Metabolic and respiratory heat to core temperature gain after cold water immersion.

In: Bachrach, Ed. Underwater Physiology VII. p 509-515. Bethesda, MD. Undersea Medical Society, 1981.

The purpose of this study was to quantify the heat delivered by inhalation rewarming and its contribution to core temperature gain. To this end, mild hypothermia was induced in volunteer subjects who were then administred different levels of respiratory heat exchange during rewarming. In conclusion, this study indicates that although inhalation warming in a normal air environment provides 10% of total body heat input, it is more efficient in terms of heat delivery to the core than shivering thermogenesis. Inhalation warming is shown to be a practical method of treating or preventing hypothermia. The potential benefits of this treatment will be enhanced when an oxygen-helium gas mixture is breathed at increased pressure.

110b.

COPPIN, E.G., S.D. Livingstone, and L.A. Kuehn.

Effects on handgrip strength due to arm immersion in a 10°C water bath.
Aviat. Space Environ. Med. 49(11):1322-1326; 1978.

Thirteen male and female human subjects participated in an experiment to determine if cold water immersion of the arm increases post-immersion handgrip strength. The test involved immersion of a subject's fore-arm into a 10°C water bath for 30 min once a week in a 3-week series, involving a control test and two immersion experiments. Handgrip strength was measured 20 min before and then once every 20 minutes after the cold bath immersion for 4 h, for a total of 18 readings. Grip strength significantly decreased as a consequence of immersion of the forearm. However, strength recovery to approximately normal values took place within 40 min. No increases in post-immersion strength were observed.

111.

COOPER, K.E.

Hypothermia.

In: Strauss, R.H., ed. Diving medicine, p.211-226. New York, Grune and Stratton, 1976.

In the case of divers, the best way of tackling the problem of hypothermia is that of preventing it. This involves adequate insulation, the timing of dives, and rewarming following excursion dives during prolonged sojourns in deep-diving chambers. The general principle of rewarming, should hypothermia occur, is the same as when it occurs on the surface. However, the problem may be complicated by the difficulties of decompression. In all instances where hypothermia has occurred, even though it appears that breathing has stopped and there is no cardiac action, it is worth attempting rewarming and resuscitation: for, as mentioned before, there are a number of instances in which patients have recovered when they have apparently been dead in the hypothermic state. The nursing rules that apply to unconscious patients, e.g., prevention of inhaled vomitus, must be applied in cases of hypothermic coma, as they would in any other form of unconsciousness. (Author)

112.

COOPER, K.E.

Respiratory and thermal responses to cold water immersion.

In: Proceedings of the cold water symposium, Toronto, May 8, 1976, p.23-24. Toronto, Royal Life Saving Society Canada, 1976.

In summary, there are a number of things that happen during immersion in cold water. Hyperventilation may be prolonged and may even be severe enough to cause tetany. It could possibly impair the cerebral circumvection. Hyperventilation is attenuated by raising the skin temperature (pre-cooling) and by the wearing of clothing (although the effect here is reduced if coupled with exercise). The heart rate for a given rate of work is increased in cold water and grip strength falls. To date, research has centered on documenting responses and very little practical advice is available at present. Two points emerge as crucial for the preservation of life: the wearing of a lifejacket is essential, and abstention from alcohol before cold water immersion is a must. (Author)

113.

COPPIN, E.G., S.D. Livingstone and L.A. Kuehn.

Effects of handgrip strength due to arm immersion in a 10°C water bath.

Aviat. Space Environ. Med. 49:1322-1326; Nov. 1978.

Thirteen male and female human subjects participated in an experiment to determine if cold water immersion of the arm increases post-immersion handgrip strength. The test involved immersion of a subject's forearm into a 10°C water bath for 30 min once a week in a 3-week series, involving a control test and two immersion experiments. Handgrip strength was measured 20 min before and then once every 20 minutes after the cold bath immersion for 4 h, for a total of 18 readings. Grip strength significantly decreased as a consequence of immersion of the forearm. However, strength recovery to approximately normal values took place within 40 min. No increases in post-immersion strength were observed. (Authors' abstract)

113a.

CORT, J.H., and R.A. McCance.

The neural control of shivering in the pig.

Physiol. 120, 115-121; 1953.

(1) Shivering has been initiated in lightly anesthetized piglets with normal or subnormal temperatures by the introduction of cold air directly into the trachea. (2) The first inspiration of cold air produced a short burst of shivering followed by a pause during the expiratory rest. If the stimulus continued for some time the shivering increased in amplitude and lost its respiratory rhythm. (3) The admission of warmed air into the trachea did not abolish the generalized shivering which lasted until the body temperature had been raised. (4) Cutting the vagus bilaterally obliterated the rhythmic response.

114.

COUCH, R.E., Jr., R.N. Moore and L.J. Berry.

Sensitization of tolerant mice to cold with a serum factor induced by endotoxin.

J. Appl. Physiol: Respirat. Environ. Exercise Physiol. 46(1):14-18; 1979.

Endotoxin-tolerant mice are sensitized to cold (5°C) stress by an injection of 0.4 ml serum collected from zymosan-pretreated mice 2 h after an intravenous (iv) injection of 25 μg endotoxin. Deaths begin after 6 h and most animals die by 10 h. The factor in serum believed to be responsible for this effect is called glucocorticoid antagonizing factor (GAF). Tolerant mice given 10 μg endotoxin live for 10 h and two-thirds survive for 24 h. Serum from endotoxin-poisoned conventional mice reduces survival time significantly but not as dramatically as that from zymosan-primed mice. The latter serum, but not endotoxin, causes a rapid drop in the core temperature of tolerant mice housed at 5°C and inhibits the en-

dogenous induction of phospho*enol* pyruvate carboxykinase (PEPCK) (EC 4.1.1.32) in tolerant mice exposed for 4-5 h to the cold. An injection of 25 μg endotoxin does not have this effect on the enzyme. Serum that produces these responses also sensitizes mice to endotoxin lethality and blocks the protection normally afforded against endotoxin by adrenocorticoids.

115.

COX, R.W., W.M.F. Leat, D. Chauca, M.A. Peacock and J. Bligh.
Adipose tissue cells in cold-acclimatised sheep.
Res. Vet. Sci. 25(1):58-62; July 1978.

The morphology and lipid content of adipose tissue from sheep subjected to cold acclimatisation were examined. In two sheep the perirenal adipose tissue contained virtually no triglyceride (< 2 mg/100 mg wet tissue) and the appearance on electron microscopy was typical of that of a depleted white fat cell. The morphological, chemical and physiological evidence indicates that, in the sheep, white adipose tissue does not revert to brown adipose tissue during depletion resulting from cold acclimatisation.

115a.

CRAIG, A.B., Jr. and M. Dvorak.
Heat exchanges between man and the water environment.
In: Lambertsen, C.J., ed. Underwater physiology V. Proceedings of the fifth symposium on underwater physiology, p.765-773. Bethesda, Md., Federation of American Societies for Experimental Biology, 1976.

Ten subjects were exposed to 24°C water with three different degrees of protection. First with bathing trunks, then with a jacket, then with a full wet suit. A thermistor was inserted in the insulated external auditory canal to measure temperature, and thermistors were attached to measure skin temperature at six other locations. Without protection, the mean skin temperature of the immersed parts decreased rapidly, and at the end of an hour was only 1°C higher than that of the water. With the jacket, even the unprotected areas were 5°C warmer than they were without the jacket. With the full suit, the skin temperature remained even warmer. In all three experiments, the temperature of the insulated external auditory canal decreased by the same amount, but with the full suit the decrease did not occur until the second hour. With full suit, the subject was comfortable until the end of two hours. The results indicate that the suit allows the subject to maintain the blood flow to the periphery at a greater rate. It decreases the rate of heat loss. Even though the core temperature had decreased as much at the end of two hours as in the unprotected experiments, there was no shivering. These studies have important implications regarding the recovery period necessary following cold exposure before undertaking another dive. (MFW/UMS)

116.

CUNNINGHAM, D.J., J.A.J. Stolwijk and C.B. Wenger.
Comparative thermoregulatory responses of resting men and women.
J. Appl. Physiol.: Respirat. Environ. Exercise Physiol. 45(6):908-915; 1978.

Three men and three women were exposed to transients of air temperature (range, 16-48°C). Whole-body sweating rate, local tissue heat flows, and O_2 consumption in the cold were linearly related to a weighted sum of tympanic and mean skin temperatures, called "central drive." During changes in air temperature, changes in subjects' scaled estimates of thermal sensation and discomfort led changes in the physiological responses and central drive. Women's thermoregulatory responses were similar to the men's, but were shifted toward higher (warmer) values of central drive. This shift was about 0.3°C for responses to heat and about 0.6°C for responses to cold. With respect to the women, the men thus showed delayed responses to the cold, and approached steady state in the cold more slowly.

117.

CURNOW, J.S.H.

Stable low temperature source to test for cold urticaria.
Med. and Biol. Eng. and Comput. 16(2):215-216; Mar. 1978.

An instrument is described that can cool an area of skin 50 x 35 mm to a fixed temperature in the range + 10°C with an accuracy of ± 1°C for long periods of time. By applying it at several different temperatures, to different areas of skin, it is possible to obtain a quantitative measure of the severity and range of response of cold urticaria, or also to assess the effects of treatment.

117a.

CURRY, D.L., and K.P. Curry.

Hypothermia and insulin secretion.
Endocrin. 87:750-755; October 1970.

The effect of decreased body temperature on insulin secretion was studied using the isolated perfused rat pancreas. It was found that hypothermia directly inhibits insulin release and that there exists a direct relationship between tissue temperature and total quantity of insulin released (in response to either glucose or tolbutamide stimulation). The temperature coefficient of insulin secretion was found to be extremely high. Partial inhibition of insulin release also occurred in pancreata 30 min after they had been subjected to extreme cold (26°C) and then were brought up to body temperature (38°C). This indicates that hypothermic inhibition is not readily reversible; but instead the tissue requires a period of time greater than 30 min in which to regain its normal secretory process. Lastly, hypothermic inhibition also occurred in the presence of an alpha adrenergic blocking agent, phentolamine, therefore excluding catecholamine inhibition as a sole explanation for the mechanism of this phenomenon.

117b.

CYMERMAN, A., and R.F. Francesconi.

Alteration of circadian rhythmicities of urinary 3-methoxy-4-hydroxyphenylglycol (MHPG) and vanimandelic acid (VMA) in man during cold exposure.
Life Sciences 16(2):225-236; 1974.

Six male subjects (19-23 years old) underwent a 7-day control period with respect to diet, temperature (22°C), and sleep (7.5 hrs), followed by a 2-day exposure to 15°C and a 2-day recovery period (22°C). Urine collections were made every 8 hours commencing at 2300 hours; MHPG and VMA were assayed using gas-liquid chromatography. During the control period a diurnal rhythmicity was demonstrated for MHPG and VMA with maxima at 0700-1500 hours. The mean excretory rates for MHPG and VMA were 0.71 ± 0.04 μg and 2.6 ± 0.2 μg per milligram creatinine (± S.E.), respectively. Cold exposure abolished the rhythms for MHPG and VMA and caused an 18% increase in MHPG excretion. In contrast, VMA excretion was not altered. Significant correlations were obtained with MHPG excretion and both urinary cortisol and rectal temperature. The data suggest that MHPG excretion may be indicative of changes in norephinephrine metabolism in the central nervous system, although alterations in peripheral degradative pathways cannot be ruled out. Careful interpretation of changes in MHPG excretion in clinical studies is emphasized due to the relative ease of altering MHPG metabolism.

118.

DAHMS, T.E., A.R. Lind, C.A. Williams and K.E. Cooper.

Ventilatory response to immersion and isometric exercise in cold water.
Fed. Proc. 38(3,Pt.2):1227; Mar. 1, 1979.

Abstract only. Entire item quoted: Isometric exercise produces hyperventilation (Wiley and Lind, 1971) and immersion in cold water also produces hyperventilation (Cooper et al 1976). The interrelationship between isometric exercise and immersion was investigated on four healthy, trained, male subjects. The subjects were immersed (head out) in a water bath at temperatures of 35, 20 and 15°C. A series of

fatiguing isometric contractions were begun either 1 minute or 10 minutes following immersion. The respiratory responses of minute ventilation, frequency, end-tidal P_{CO_2}, and oxygen consumption were measured continuously. Hyperventilation was determined to be an increase over the resting value of the ratio of minute ventilation/oxygen consumption. Handgrip alone in air resulted in an increase in the group mean $\dot{V}_E/\dot{V}_{O_2}$ ratio from 33.2 at rest to 99.1 during the last 20% of the fatiguing contraction. Immersion alone in 20° and 15°C water resulted in a steady-state increase in this ratio to 38.1 and 44.7 respectively. The combination of the two conditions resulted in an unexpected fall in the ratio with decreasing water temperatures. The group mean values for this ratio near fatigue were 98.8 in 35°C water, 80.8 in 20°C, and 52.5 in 15°C. End-tidal P_{CO_2} decreased as the ratio increased.

118a.

DALGLIESH, D.G.

Cold/Wet Exposure Ashore.

In: Cold/wet survival symposium.

J. Roy. Nav. Med. Serv. 58:177-181; Winter 1972.

A personal description of the effects of exposure and consequent hypothermia, and its dangers. Practical advice on treatment, both curative and preventive, is given.

119.

DALUZEAU, C. and F. Lamisse.

Variations de la temperature corporelle et de la pression arterielle au cours d'immersions en eaux froides.

[Variations of body temperature and arterial pressure during immersion in cold water].

Med. Aeronaut. Spatiale, Med. Subaquat. Hyperbare 62:138-141; 2nd Quart. 1977.

Sixty-one divers of various ages and physical characteristics were monitored during 7 immersions of 30 to 260 min duration in cold water (less than 10°C). Body temperature and arterial pressure measurement show that in every case thermal stress is very important (often associated with clinical symptoms) and that arterial pressure is always modified, as a function of the duration of the dive. It appears that the tolerance limit in water colder than 10°C would not exceed 2.5 hours. (English abstract)

119a.

DANIELS, Farrington, Jr., and P.T. Baker.

Relationship between body fat and shivering in air at 15°C.

J. Appl. Physiol. 16(3):421-425; 1961.

Thirty-one men of widely varying body fat content were exposed to air at 15.2°C for 2 hr. Rectal and skin temperatures and metabolic rates were measured at 10, 40, and 80 min and at the end of the 2 hr. Shivering was rated on a five-interval scale. Under these conditions thick subcutaneous fat provided insulation as indicated by lower skin temperatures, less shivering, and lower oxygen consumption in the fatter men. The findings rule out simple relationships between measured temperatures and shivering, leading to other possibilities and approaches to the study of shivering.

120.

DARNERUD, P.O., M. Olsen and B. Wahlstrom.

Effects of cold stress on rats fed different levels of docosenoic acids.

Lipids 13(7):459-463; 1978.

Male Sprague-Dawley rats, 4 wk old, were subjected to an ambient temperature of 4°C for periods up to 24 days and fed a synthetic diet containing 1 of the following oils: peanut oil (PO), rapeseed oil (RO),

low erucic acid rapeseed oil (LO) and partially hydrogenated marine oil (HO), each at 20%. A parallel experiment using the same oils was performed at room temperature (23°C). During cold stress, animals on the RO diet showed higher mortality than all other groups. All 20 animals in this group died within 5 days. At room temperature all animals survived. The lipid accumulation in the heart reached its peak in all groups after 3 days and then gradually declined. The accumulation was most pronounced in the RO animals and coincided with the high mortality at 4°C. The fatty acid composition of the cardiac triglycerides reflected that of the diet, while the composition of the cardiac lecithin was only marginally modified.

121.

DAUNCEY, M.J. and D.L. Ingram.

Effect of dietary composition and cold exposure on non-shivering thermogenesis in young pigs and its alteration by the β-blocker propranolol.

Br. J. Nutr. 41(2):361-370; 1979.

Young pigs were fed on 3 diets consecutively, each diet being given for 1 wk. The diets were given in random order as (g pig feed/kg body wt): 20, 60, 20 plus a supplement with the energy equivalent of 40 g pig feed/kg. The supplements included dessicated coconut, fish meal and glucose. At the end of each week resting metabolic rate, beginning 12-14 h after feeding, was measured overnight using an open-circuit respiration chamber at thermoneutrality. The O_2 consumption of pigs on the 60 g/kg diet was always higher than on the 20 g/kg diet. The addition of dessicated coconut or fish meal also increased metabolic rate; with added glucose, O_2 consumption tended to be even lower than on 20 g/kg alone. The administration of the β-blocker propranolol to pigs on ad lib food intake reduced the rate of overnight resting O_2 consumption, measured from 10 until 20 h after feeding, by 12%, but it had no effect on O_2 consumption when the intake was 20 g feed/kg. Exposure to mild cold (15°) caused an increase in O_2 consumption and this was reduced by 14% after injection of propranolol.

121a.

DAVIES, D.M., E.J. MILLAR, and I.A. Miller.

Accidental Hypothermia Treated by Extracorporeal Blood-Warming.

Lancet 1:1036-1037; 1967.

Extracorporeal blood-warming in a patient who was admitted in a state of coma and hypothermia rapidly restored her temperature to normal and reduced the depth of unconsciousness. Despite several complicating disorders, she later recovered completely. The method of rewarming from within outwards rather than from without inwards merits further trial.

122.

DAVIS, F.M.

Diver performance: the effects of cold.

In: Fleming, N.C., ed. Science diving international. Proceedings of the 3rd scientific symposium of CMAS, p.185. London, British Sub Aqua Club. 1973.

Abstract only. Entire item quoted: Previous work on cold water performance of divers (Baddeley, 1971; Bowen, 1968; Stang et al., 1970) has shown impairment of a wide variety of manual and intellectual tasks. However, inadequate body temperature monitoring, manual influences on intellectual tasks, and other aspects of experimental design suggest that these effects require reassessment. An experiment is being conducted at present to test manual dexterity, memory, reasoning and arithmetical ability, and digit span in a group of experienced, wet-suited divers in water temperatures of 4 to 5°C and 17-20 C. This has been so designed to minimise the effects on performance of factors other than cold exposure. Deep body and skin temperatures are measured in each subject throughout the dives and other physiological monitoring methods are being assessed as part of the programme.

122a.

DAVIS, F.M.

Diving and hypothermia.

Br. Med. J. 2(6188):494; Aug. 25, 1979.

In this brief letter the author refers to previous studies of immersion hypothermia in which it was established that divers are not always aware of the onset of dangerous hypothermia. Body temperature should be constantly monitored from the surface during extended diving in temperate or cold waters. One method is the use of a temperature-sensitive radio pill. In a recent letter (Hayward and Keatinge, Br. Med. J. 1(6172):1182, May 5, 1979) it is stated that it is standard practice during deep dives in cold water to flood the diver's suit with warm water and to depend upon his subjective sense of comfort or discomfort for the detection of hypothermia. The present author says that the first part of this statement is misleading, because most diving is done on compressed air with scuba equipment with no form of external heating. The problem thus becomes one of educating the diver. (MFW/UMS)

123.

DAVIS, F.M., A.D. Baddeley and T.R. Hancock.

Diver performance: the effect of cold.

Undersea Biomed. Res. 2:195-213; Sept. 1975.

Fifteen divers performed five tasks in water of temperatures 20°C and 5°C, using standard scuba equipment. A significant deterioration of performance occurred under the colder condition in: simple arithmetic 13%; logical reasoning 17%; word recall 37%; word recognition 11%; and manual dexterity 17%. Throughout each dive, rectal and five skin temperatures were monitored. Average fall in rectal temperature was 0.5°C during 20°C dives and 1.1°C during 5°C dives. Average body surface temperature fell by 5°C and 12.5°C respectively. Average heat losses calculated from the data were 95 kcal • m^{-2} • hr^{-1} (20°C dives) and 245 kcal • m^{-2} • hr^{-1} (5°C dives). The impairment in word recognition was significantly correlated with the fall in rectal temperature for 5°C dives. For other tests, the deterioration did not appear to be correlated with body-temperature changes, but rather, occurred rapidly upon cold water immersion. The significance of these findings is discussed in relation to current understanding of the mechanisms by which cold is thought to influence performance underwater. (Authors' abstract)

124.

DAVIS, F.M.

Immersion hypothermia in scuba diving.

In: Gamble, J.C. and R.A. Yorke, eds. Progress in underwater science. Volume 3 (New Series) of the Report of the Underwater Association, p.191-204. London, Pentech Press, 1978.

Loss of body heat is one of the most important hazards facing the diver in cold water. One of the problems in the investigation of hypothermia is to anatomically define the body "core" and hence to subsequently measure its temperature. The "core" is only accessible through a few sites which however do not necessarily agree in their respective temperatures. The rectal temperature is the normally accepted "core" site but values recorded under cold stress are frequently higher than, for instance, ear drum temperature. It is pointed out that the wet suit only really prevents rapid initial heat loss by the diver. *The dry suit is thermally much more efficient but its insulating advantage is balanced by its high cost* and effects on diver mobility. The absolute minimum "core" temperature beyond which the safety of the diver is seriously questioned is 35°C. It is suggested that, in extensive cold water dives, continuous "core" temperature monitoring using radio pills should take place. The review concludes with a synopsis of first aid care for acute hypothermia drawing particular attention to the hazards of "after-drop." It is recommended that this first aid procedure should be taught to all trainee divers. (Author's abstract)

125.

DAVIS, J.R. and A.M. Horowitz.

Effects of hyperthermia and hypothermia on spontaneous contractions of the adult rabbit testicular capsule.

Int. J. Biometeorol. 22(4):303-311; Dec. 1978.

Spontaneous contractions of the isolated testicular capsule of the adult rabbit have been found to be markedly sensitive to heat and cold stress. Testicular capsular contractions may provide a propulsive pumping action for transporting nonmotile sperm out of the testis and into the epididymis where they can then attain motility. An optimal temperature for the amplitude of spontaneous contractions of the rabbit testicular capsule occurred at 32-34°C. An increase in the *in vitro* organ bath temperature from 37 to 40°C caused a marked decrease in the amplitude of spontaneous contractions. A complete and irreversible cessation of spontaneous contractions occurred at 48°C for at least 30 min after cooling to 37°C. A decrease in temperature from 37 to 26°C resulted in a marked decrease in frequency and amplitude progressing to a complete but reversible cessation of spontaneous contractions at 16°C. Marked changes in the frequency and amplitude of spontaneous contractions of the isolated testicular capsule began to be observed when the tissue was exposed to organ bath temperatures of 3°C above and below the normal intra-testicular temperature. These data suggest that exposure of men to fever or excessively hot baths as well as swimming in excessively cold water or extreme cold weather exposure may have inhibitory effects on testicular capsular spontaneous contractions which may interfere with sperm transport.

125a.

DAVIS, Thomas R.A., and J. Mayer.

Nature of the Physiological Stimulus for Shivering.

Am. J. Physiol. 181:669-674; 1955.

The application of two physiologic tools, imperfectly homeothermic mice and electromagnetic waves substituting for chemical thermogenesis previously described, to the study of shivering is described. A description of the progressional characteristics of shivering as recorded by the electromyograph is given with a redefinition based on the progression from inapparent to apparent bursts of reflex muscular activity in relation to time of exposure. Shivering was studied in euthermic, hyperthermic, hypothermic and deeply hypothermic animals. In all conditions except non-physiologic deep hypothermia, it was found that the difference between central and mean surface temperatures was the factor determining the occurrence, intensity and evolution of shivering. The rapidity of changes in reflex muscular activity following changes in reflex muscular activity following changes in the difference between central temperature and the temperature of end-organs in the skin, suggest that the resulting responses admit exclusively of a neurologic mediation.

126.

DEAL, E.C., Jr., E.R. McFadden, Jr., R.H. Ingram, Jr. and J.J. Jaeger.

Effects of atropine on potentiation of exercise-induced bronchospasm by cold air.

J. Appl. Physiol. Respir. Environ. Exercise Physiol. 45(2):238-243; 1978.

The role of vagal efferent activity in the cold air potentiation of exercise-induced asthma was assessed by exercising 9 subjects who breathed air at ambient and subfreezing temperatures before and after cholinergic blockade. Lung volumes and maximal expiratory flow volume curves with air and with 80% He_2-20% O_2 were obtained before and 5-10 min after each challenge. Isovolume comparisons of maximal expiratory flow rates with the 2 gases were used to assess relative contributions of large and small airways to flow limitation. Exercise under ambient conditions resulted in the expected airway obstruction and cold air exaggerated the response. Atropine pretreatment had no effect on the cold air potentiation. After atropine with ambient air exercise, there was an increase in the relative contribution of large airways to flow limitation, whereas exercise with cold air resulted in an increase in the contribution of small airways. The potentiating effects of cold air are probably local and the immediate stimulus is probably related to cooling of intrathoracic airways.

127.

DEBSKI, L., J. Dzierzkowska, Z. Kaleta and S. Maslinski.

Effect of low body temperature on gastric secretory activity in the guinea pig under urethane general anesthesia.

Acta Physiol. Pol. 29(1):61-66; 1978.

The effect of low body temperature on spontaneous and histamine(H)-stimulated or Na-dimethylhistamine(NDMH)-stimulated gastric secretion was investigated in the guinea pig under general anesthesia with urethane. In normothermia NDMH had a stronger action on acid secretion. In hypothermia (30°C and 25°C) only NDMH showed some stimulating effect. The necessity of strict control of body temperature in the experiments performed on animals under general anesthesia is confirmed. The lack of effect at low temperature may be connected with an inhibition of the processes of H side-chain methylation when the rate of metabolic processes in the organism has fallen.

128.

De FREITAS, C.R.

Human climates of northern China.

Atmos. Environ. 13(1):71-78; 1979.

A method for the description of human climates using standard mean climatic data is presented. Atmospheric and physiological variables that affect man's thermal state outdoors are included in a simple scheme that produced a unitary measure of body-atmosphere energy exchange exchanges in familiar terms of clothing, defined as insulation required for equilibrium. The climate of the northern area of China during the cooler half of the year is presented as a case study. Mean minimum and maximum clo [clothing unit] values were calculated for 52 meteorological stations across northern China. Maps presented show that there are 3 climatic zones within which man can expect to experience similar ranges of cold stress during the winter. The Clo maps may simplify interpretation of the thermal demands of the environment and could be useful in regional assessments.

129.

De HANSON, R.G.

Working in cold environments–lessons to be learned from diving.

Ann. Occup. Hyg. 21(2):193-198; Aug. 1978.

The lessons which have been learned from deep diving in cold water are: the importance of heat loss through the respiratory tract; the importance of being able to maintain the living quarters within narrow limits of temperature; the unsuitability of wet suits as insulation for all but the shallowest dives; and the importance of heating the diving bell.

130.

De MENDOZA, D. and R.N. Farias.

Effect of cold exposure on rat erythrocyte membrane-bound acetylcholinesterase: Role of thyrotropin in the thyroid hormones interplay.

J. Biol. Chem. 253(17):6249-6254; 1978.

The influence of cold exposure at 4°C for different periods of time (from 12 h-42 days) on the allosteric inhibition by F- of the rat fed a corn oil diet was studied. The cold exposure decreased the values of the Hill coefficient n from 1.6 to 1.0. When the cold-exposure rat was transferred from the cold environment to 23°C, the values of n reached the control values. The factors that play in the allosteric desensitization phenomenon were characterized as L-triiodothyronine, L-thyroxine and thyrotropin. The relationship between changes in the values of n and physiological concentrations of thyroid hormones and thyrotropin in cold-exposed rat was shown. Thyrotropin showed a facilitatory action on the thyroxine blocking action on the triiodothyronine effect. The i.v. injection of thyrotropin-releasing hormone

(TRH) yields confirmatory results for this regulatory mechanism since the values of n for acetylcholinesterase shifted as predicted.

131.
De ZAN, A., U. Ferrando, G. Sesia and P. Guermani.
Preliminary results of anatrophic bivalve nephrotomy under hypothermia.
Minerva Urol. 30(4):203-216; Oct.-Dec. 1978.

The results of anatrophic bivalve nephrotomy under hypothermia in the treatment of coralliform lithiasis are reported and a personal technique described. Some cases so treated are then reported together with preoperative findings and postoperative documentation up to several months after intervention. The technique is assessed and technical difficulties and results compared with those obtained with other commonly adopted techniques, particularly extracorporeal surgery of the kidney.

132.
DICKINSON, D.F. and J.E. Sambrooks.
Intellectual performance in children after circulatory arrest with profound hypothermia in infancy.
Arch. Dis. Child. 54(1):1-6; Jan. 1979.

Thirty-eight children were assessed 22 months to 6 years after open heart surgery using circulatory arrest with deep hypothermia. The mean IQ of the group was 99.2 (SD 19.5). No correlation was found between IQ and the age or weight at operation or the duration of circulatory arrest. The results suggest that the technique gives effective protection to the brain during periods of circulatory arrest for up to 60 minutes.

133.
DIRCKS, J.W.
The diving reflex in man.
In: National Association of Underwater Instructors. Proceedings of the 7th international conference on underwater education, September 1975, Miami Beach, Florida, p.134-138. Published by the Association, 1976.

The purpose of this presentation is to review the physiology of the diving reflex in man, review the current literature and apply this information to a recent, 30 minute submerged-in-ice-water, near-drowning case treated at our institution. It was felt that the diving reflex with apnea, bradycardia, and selective perfusion of the heart and brain as well as the hypothermia contributed to this patient's recovery. The relevance of the diving reflex to the scuba diver, the basis for splashing cold water on one's face before an ice dive, and the possible attendant medical hazards which could be seen in divers exhibiting this reflex will be discussed. (Author's abstract)

134.
Di RENZO, G.F., A. Quattrone, G. Schettini and P. Preziosi.
Effects of quipazine and D-fenfluramine, two serotonin-like drugs, on TSH secretion in basal and cold stimulated conditions in the rat.
Life Sci. 22(21):1879-1886; 1978.

Effects of 2 serotonin-like drugs, quipazine and D-fenfluramine, on thyroid stimulating hormone (TSH) secretion in basal and cold stimulated conditions were investigated in male rats. Both drugs are able to decrease TSH secretion in basal conditions and to inhibit the TSH rise elicited by cold exposure (CE). These effects were antagonized by pretreatment with metergoline, a serotonin receptor blocker. Serotonin may play an inhibitory role in control of TSH secretion in the rat.

135.

Di SUMMA, M. et al.

Myocardial protection from cardioplegic and hypothermia during aortic cross-clamping.
G. Ital. Cardiol. 9(3):295-301; 1979.

The clinical results with cardioplegic solutions and hypothermia during aortic cross-clamping are compared with the clinical results obtained with hypothermia only. To complete the study myocardial biopsies were obtained during aortic cross-clamping in order to evaluate the concentration of ATP and CPK. The obtained data confirm the effectiveness of the myocardial protection.

136.

DOBER, I., V. Jaszai, T. Heim and R.D.G. Milner.

The effect of racemic, D-, or L-propranolol and practolol on the response to cold by the newborn rabbit.
Pediatr. Res. 12(10):971-976; Oct. 1978.

The newborn rabbit was used as a model to investigate the effects of propranolol, the isomers of propranolol and practolol on the response to cold exposure. Racemic propranolol (1 mg/kg) caused a significant drop in O_2 consumption and higher doses (2.25 and 5.0 mg/kg) abolished the rise caused by cold exposure. This effect was not mimicked consistently by either the D or L-isomer. Practolol had no significant effect at a 1.0 mg/kg dose but in the doses of 2.25 and 5.0 mg/kg completely blocked the cold-induced rise of O_2 consumption. Racemic propranolol caused an increased fall in colonic temperature which was significant when 2.25 mg/kg was used. Neither of the 2 propranolol isomers nor practolol had a significant effect on colonic temperature. Both 2.25 and 5.0 mg/kg racemic propranolol and 2.25 mg/kg practolol caused a significantly greater drop in brown fat temperature than that caused by exposure to 25°C. The isomers of propranolol did not affect brown fat temperature significantly. The rise in serum free fatty acid concentration induced by cold exposure was reduced or abolished by each drug in every dose used. The rise in blood glucose due to cold was abolished by racemic propranolol and practolol in all doses used. L-Propranolol significantly inhibited the rise in blood glucose from 60-90 min and caused a fall below the levels seen at 60 min. D-Propranolol had no effect on blood glucose levels. The β-blockers, propranolol and practolol, apparently seriously compromise the response of the newborn rabbit to thermal stress.

137.

DUDAREV, V.P.

[Seasonal variations in the level of fetal blood hemoglobin under changed gas medium and temperature].
Dopov. Akad. Nauk UKR RSR (Ser. B) (4):362-365; 1978.

The method of alkali denaturation was used to show that the content of fetal Hb in human blood or alkali resistant Hb in blood of rabbits, albino rats and spotted susliks increases in winter and falls in summer. HbF increased under conditions of hypoxia. No increase in the HbF level was observed during rabbits and susliks adaptation to cold. The HbF content in rats also increased under the effect of long-term interrupted hyperbaric oxygenation. (© BA)

137a.

DUGID, H., R.G. Simpson, and J.M Starners.
Accidental Hypothermia.
Lancet 2:1213-1219; 1961.

A series of 23 cases of accidental hypothermia is described. All were elderly patients in whom hypothermia (rectal temperature less than 90°F [32°C]) had developed indoors. In 6 patients—including 3 with myxoedema—hypothermia had developed "spontaneously," without excessive exposure to cold. Predisposing or

precipitating factors included mental impairment and senility (8), myxoedema (5), and bronchopulmonary infection (5). Depth of hypothermia, state of consciousness, and survival were fairly closely correlated. None of the 6 patients with temperatures below 80°F (26°C) was conscious, and only 1 of these survived. Characteristic J waves were seen in the electrocardiogram in 11 out of 19 patients. Laboratory investigations gave some evidence of haemoconcentration and acidosis. Of 15 cases in which serum-amylase was estimated increased values were found in 11; and in 5 of those evidence of pancreatic necrosis was found at necropsy. 7 patients survived the episode of hypothermia; most of the remainder died within twenty-four hour hours of admission. Postmortem examinations were made in 13 cases. Significant findings included visceral microinfarcts, gastric erosions, and pancreatic necrosis. Elderly patients with accidental hypothermia should not be actively rewarmed.

138.

Du RUISSEAU, P., Y. Tache, P. Brazeau and R. Collu.

Pattern of adenohypophyseal hormone changes induced by various stressors in female and male rats.

Neuroendocrinology 27(5/6):257-271; 1978.

Plasma modifications of adenohypophyseal hormones were investigated in groups of female and male rats stressed for 15, 30 min, 1, 2, 4 or 6 h, either by cold (4°C), forced muscular exercise (FME) or immobilization. GH (growth hormone) levels in both female and male rats were consistently decreased by the 3 stressing agents. Immobilization in the female and the 3 stressors in the male elicited an early secretory response of prolactin (PRL), while only in immobilized female rats plasma LH [lutropin] levels showed an early, short-lived increment. A more prolonged exposure to stress had an inhibitory influence on plasma PRL and LH levels in both sexes. FSH [follitropin] concentrations were not modified in females, but were decreased in male rats submitted to either one of the 3 stressors. In both male and female rats plasma TSH [thyrotropin] levels rose during cold exposure, while they were decreased by FME and by immobilization. The character of the hormonal secretory response during stress is nonspecific. To the exception of the specific stimulation of TSH release by cold, stress-induced hormonal changes are not related to the nature but rather to the intensity and duration of the stressing agent.

139.

DUSSUEL, A. and P. Berbigier.

Influence of environmental temperature on body temperature kinetics and thermal comfort in neonate piglets.

Ann. Zootech. 27(1):83-94; 1978.

Skin temperature (Ts) measured by infra-red radiothermometry and rectal temperature (Tr) of 33 large white piglets were recorded continuously during the animal's 1st h of life. Variations in body temperature and evolution of heat losses in the piglets were measured at environmental temperatures (Ta) from 23-40°C. During the 1st h of life, temperature regulation was mainly at the body surface, except in the lightest animals ($P < 850$ g) which had difficulties in maintaining a constant skin temperature (Ts). This regulation is most likely of muscular origin (shivering). The mechanism of surface temperature regulation in the neonate is very different from that of the older homeothermal pig (central regulation). The shape of the thermal comfort curves (heat production according to Ta) is the same. The lower critical temperature of thermal comfort [which was measured by skin temperature (Ts)] is about 35-36°C for animals weighing more than 850 g. From 35-36°C, a large increase in Ts, characteristic for thermal comfort, was observed.

140.

DWYER, J.

Energetics of scuba diving and undersea work.

In: Hong, S.K., ed. International symposium on man in the sea, Honolulu, July 1975, p.II-32 - II-43. Bethesda, Md., Undersea Medical Society, Inc. 1976.

The oxygen uptake of scuba divers while idle or at rest is significantly influenced by cold water, gas

density, pre-work muscular tensing, and the need for muscular efforts to maintain positional stability. The oxygen cost of fin-swimming has been found to vary among different groups of highly trained divers because of differences in equipment drag, fin configuration, and mechanical efficiency. The mechanical efficiency of fin-swimming under these conditions is approximately 3.5%, but it may be as low as 1.0% and as high as 8.0% with highly trained military divers. Divers who are permitted to work and swim at self-paced rates probably experience no more than a moderate work stress at relatively shallow depths. However, slight changes in positional stability, swim attitude, buoyancy, and drag may greatly increase the oxygen cost of a particular task and raise the work stress to high levels. The maximal aerobic power ($VO_{2\,max}$) has received very little attention in diving research. In a pool, divers have reached 78% of their land-exercise $VO_{2\,max}$ by tethered swimming. Other attempts to reach $VO_{2\,max}$ by fin-swimming at maximal effort at 178 fsw were inconclusive due to a lack of comparable land-exercise data. Still other studies of VO_2 during fast or maximal swimming efforts indicate a wide range of oxygen uptake, from 2.45 to 4.15 liter/min. In one open-sea study, a diver was able to work for four minutes at 91% of his land-exercise $VO_{2\,max}$, but this effort resulted in an acute awareness of respiratory impairment, a severe headache and a $PACO_2$ close to 60 mmHg at 99 fsw. The role of $VO_{2\,max}$ in the performance of undersea work has yet to be clearly determined. Furthermore, there is evidence suggesting CO_2 retention as the work-limiting factor during ocean dives rather than cardiovascular factors. (From author's summary)

141.

EADY, R.A., C.B. Bentley-Phillips, T.M. Keahey and M.W. Greaves.
Cold urticaria vasculitis.
Br. J. Dermatol. 99(Suppl. 16):9-10; July 1978.

Vasculitis may be an important histological feature of chronic urticaria associated with systemic disease (Sissons *et al.*, 1974; Soter, Austen & Gigli, 1974). Possibly, vasculitis underlies a variety of more common urticarial reactions, but newer techniques are needed to demonstrate the vascular changes, especially when mild or in the early stages of their evolution. We found that vasculitis could be induced in the skin of several patients with essential acquired cold urticaria, by repeated cold challenge, as performed during cold-tolerance treatment (Bentley-Phillips, Kobza Black & Greaves, 1976).

141a.

EAGAN, C.J.
Introduction and terminology.
Fed. Proc. 22:930-932; 1963.

Terms related to the response to cold stimulation and tissue response are defined. *Adaptation* – or cold adaptation – a non-specific generic term which includes in its meaning all the chronic or established adjustments of organisms to cold environment regardless of the length or type of exposure. *Genetic adaptation* – alterations which favor survival of a species or of a strain in a particular environment, which alterations have become part of the genetic heritage of the particular species or strain. *Acclimatization* –"To a complex of environmental factors, as in seasonal or climatic changes." *Acclimation* – "to a single environmental factor, as in controlled experiments. *Habituation* – Change in physiological response or in sensation resulting from a diminution in the responsiveness of the central nervous system to certain stimuli. (CWS/UMS)

141b.

EAGAN, C.J.
Local vascular adaptations to cold in man.
Fed. Proc. 22:947-952; May-June 1963.

The aim of the experiment was to search for evidence for local vascular cold adaptation in the finger and to compare the responses to finger cooling in groups of subjects in different energy states. It is concluded that a general habituation to the conditions resulted in less vasoconstrictor outflow to fingers

immersed in ice water. And as would be expected, levels of metabolic rate and finger temperature are directly related. (CWS/UMS)

142.

EDMONDS, C., C. Lowry and J. Pennefather.

Diving and subaquatic medicine.

Mosman, N.S.W., Australia, Diving Medical Centre, 1976. 398p.

This book attempts to present the entire picture of underwater medicine in a manner comprehensible to those who are not experts in the field. Its approach is midway between the popular book on diving and the very scientific publications such as the proceedings of the various symposia on underwater physiology. The contents are as follows: *The diving environment:* 1. History of diving; 2. Physics; 3. Physiology; 4. Equipment and safety; 5. Hyperbaric chambers. *Diseases of elevated pressures:* 6. Barotrauma; 7. Decompression sickness; 8. Dysbaric osteonecrosis. *Abnormal gas pressures:* 9. Nitrogen narcosis; 10. The high pressure neurological syndrome; 11. Hypoxia; 12. Oxygen toxicity; 13. Carbon dioxide; 14. Breathing gas contamination. *Aquatic environmental diseases:* 15. Drowning and near drowning; 16. Hypothermia; 17. Infections; 18. Marine animal injuries. *Miscellaneous:* 19. Underwater blast; 20. Hearing loss; 21. Disorientation; 22. *Other disorders:* Psychological disturbances; Psychiatric disorders; Caustic cocktail; Temporo-mandibular joint dysfunction; Brachial plexus injury; Headache; Carotid sinus syndrome; Propeller injuries; Compression arthralgia; Cramp. *Diving accidents:* 23. Unconsciousness; 24. Investigation of diving accidents; 25. First aid and emergency medical treatment; 26. Diving fatalities and statistical interpretations; 27. Medical standards. *Appendices:* A. Decompression procedures and tables from Royal Navy Diving Manual Br. 2806; B. Decompression procedures and tables from the United States Diving Manual; C. Therapeutic recompression procedures and tables from the Royal Navy Diving Manual Br. 2806; D. Treatment of delayed cases of decompression sickness; E. Emergency recompression treatment in the water, using oxygen; F. Guidelines for treatment of mild decompression sickness in saturation diving; G. The use of oxygen with long air recompression tables. (MFW/UMS)

143.

EDWARDS, B.A.

The effects of cold exposure on the activity of the hypothalamoneurohypophysis of the golden hamster (*Mesocricetus auratus*).

Comp. Biochem. Physiol. A Comp. Physiol. 60(4):421-424; 1978.

Cold exposure caused depletion of vasopressin in the neural lobe of *M. auratus* without altering the amount of neurophysin or neurosecretory material. The nuclei of the cell bodies of the supraoptic neurons were enlarged and there was evidence on increased nucleolar margination. The neurosecretory system was activated by low environmental temperatures and despite vasopressin release and free access to water, dehydration in the blood of these animals was evidenced.

143a.

EDWARS, R.D., Jr.

Accidental hypothermia.

JACEP 6(9):426-427; 1977.

Presentation of reports on series of hypothermia patients and various methods of rewarming: active core rewarming, active external rewarming, and passive or spontaneous rewarming. It is well that the ermergency physicians are taking an active role since there are a number of issues that need to be studied "in a prospective manner with variables controlled and treatment modalities under question randomized." (CWS/UMS)

143b.

EDWARDS, R.J., A.J. Belyavin, and M.H. Harrison.
Core temperature measurement in man.
Aviat. Space Environ. Med. 49(11):1289-1294; 1978.

Transient changes in core temperature were induced in 12 subjects—passively by immersion in a hot bath, and actively by light intermittent exercise. Measurements of core temperature were made at four sites—the auditory canal, mouth, rectum, and oesophagus—and, by using the measurements from the first three of these sites, a mathematical model was derived which permits the calculation of a predicted value for oesophageal temperature (T_{oe}). This model—which takes the general form $T_{oe} = AT_x + B\,dT_x/dt = C$ where T_x = amplitude of the temperature change at a specific site, dT_x/dt = rate of change of temperature at that site, and A, B, and C = site constants (different for passive and active heating)—provides an accurate prediction of T_{oe} (to within 0.1°C) from both auditory canal and mouth temperature. For prediction of T_{oe} from rectal temperature, however, two models appear to be necessary—one to predict T_{oe} when core temperature is rising, and another to predict T_{oe} during the return to equilibrium when core temperature is declining.

144.

EGSTROM, G.H. and G. Weltman.
Underwater work performance and work tolerance: Final report.
Los Angeles, Cal., Univ. Cal., Sch. Eng. Appl. Sci., Rep. UCLA-ENG-7427, 179p. June 1974. (ENG-7427, 179p. June 1974.)

In the summary, the authors report the following findings: Performance decrement varies as a function of water temperature, exposure time, and task complexity. Performance decrement fron. hyperbaric air varies in relation to depth, task, training, and environmental factors; in this case, and also in the case of cold, an adaptive factor appears to exist. Memory is affected adversely. The importance of adaptation and training is demonstrated, particularly the importance of training underwater as opposed to dry land training in any given task. Sensory decrements can be significantly lessened by habituation. In determining energy requirements for underwater work, such variables as equipment, environmental factors, and breathing resistance, which affect energy production and force production, must be considered. Further research is needed in this area. The report is copiously illustrated with drawings, diagrams and tables. The bibliography consists of nearly 300 references. (MFW/UMS)

145.

EGSTROM, G.H.
Diver training.
In: Third Joint Meeting of the Panel on Diving Physiology and Technology, Tokyo, Japan, July 18-19, 1975, p.5-8. Published by the United States-Japan Conference on Development and Utilization of Natural Resources, 1975.

The author has conducted a series of studies over a period of nine years which focused on performance changes during underwater work. These changes are related to mechanical restraints, physiological condition, work methods, and psychological capacity for problem solving. Charts are presented which show the effect of cold on mental function, the effect of psychological stress on psychomotor performance, the effect of cold on psychomotor performance, the effect of environmental stress (not specified) on memory, and the effect of nitrogen narcosis on mental function. Training must enable the diver to accept his equipment as part of his body, to function well physically, to employ the proper methods of accomplishing the required tasks, and to be psychologically competent to cope with the environment. (MFW/UMS)

145a.

EGSTROM, G.H.

Thermal regulation in man.

In: Egstrom, G.H., ed. Thermal problems in diving. Proceedings of a seminar held at Commercial Diving Center, Wilmington, California, March 19-20, 1976, p.3-15. Wilmington, Calif. Commercial Diving Center, June 1977.

The mechanisms of the body that function to maintain thermal balance, both in a hot environment and in a cold one, are described at some length. A review is given of various studies in heat loss that have been made. Also, methods or retaining heat in emergency situations are described. Adaptation to cold, and studies done with the diving women of Japan and Korea, the Ama, are discussed. Their basic metabolic rate seems to be cyclic with the seasons. Other studies with Australian bushmen indicate an adaptation to cold. When heat is picked up by the body, cardiac output and vasodilation increase. There will probably be a decrease in respiratory activity. Arterial blood pressure falls, and fainting and weakness are felt. In considering the problem of overheating in chambers, it is stated that one should increase the movement of air in order to increase the convective heat loss. The four degrees of overheating are heat aesthemia, heat cramps, heat exhaustion, and heat stroke. In the last stage, sweat glands stop functioning and the body temperature rises sharply. It can be fatal. Effective heat balance occurs when heat gained or heat lost is zero. (MFW/UMS)

145b.

EGSTROM, G.H. and A. DiChiro.

Emergency thermal protection for saturation diving.

In: 7th symposium on underwater physiology, Undersea Medical Society annual scientific meeting, European Undersea Biomedical Society annual meeting, July 5-10, 1980. Athens, Greece. Programs, abstracts and mini-papers, p.19. Bethesda, Md., Undersea Medical Society, 1980.

Abstract only. Entire item quoted: Loss of power and heat during saturation dives has resulted in casualties in circumstances where breathing gas supplies and CO_2 elimination capability were adequate for an extended period of life support. The loss of environmental control has quickly shifted ambient conditions to 0-2°C, relative humidity 100%, in an HeO_2 environment. Death in a short time is the not unexpected end result. A study conducted in the Commercial Diving Center's saturation facility involved a survival device developed at Kinergetics, Inc. A 24 year old, 178 cm, 75 Kg, male commercial diver and safety diver were saturated at 3 ATA on an 87% He, 13% O_2 gas mix. Overall heat loss was targeted to be kept below 100 watts per hour. During the initial 24 hour exposure, the chamber temperature was kept between 0-3°C with a relative humidity of 83-100%. Comparative data was recorded each 30 minutes for 27½ hours. Monitored diver parameter ranges included: heart rate (42-109), rectal temperature (36.3 - 37.1°C), and skin temperature (35.6 - 36.9°C). Subjective evaluations of comfort indicated "too warm" except during sleep periods when he was "comfortable." Results: 1) A thermal protective device maintained diver comfort during a 24 hour exposure in a HeO_2 environment at 0-3°C ambient temperature. The diver's initial rectal temperature of 36.9°C and the hour 24 rectal temperature of 37°C indicated stable heat balance. 2) Reduced metabolic activity during rest and sleep did not result in hypothermic discomfort or abberations of EKG.

145c.

EISEMAN, B., and C.F. Tidemann.

Cold: friend or foe.

Marine Corps Gazette:39-44; February 1980.

The assignment for the Marine Corps to the left wing of NATO in Norway represents a new challenge to Marine officers and NCOs in training, equipment, discipline, and experience. The Norwegian army has

for centuries trained for operation in this unique environment. It is only reasonable that U.S. Marines scheduled to work alongside these troops, specifically trained and experienced to fight in the cold, should study their methods in a military environment new to most Marines.

146.
ELLIOTT, J.C.
New hope for cold-water drowning victims.
NOAA 8:46-47; Jan. 1978.

In a recent study at the University under NOAA's Sea Grant Program, Dr. Martin J. Nemiroff has studied more than 60 drownings and near drownings in Michigan over the past two years. He has found that cold water exposure increases the possibility of survival, due to the combination of two circumstances: the lowering, by coldness, of the body's requirement for oxygen, and the mammalian diving reflex, which sends blood to the heart, lungs and brain from other, less vital areas. Out of 15 victims of near drownings in cold water, two died of lung infections and two suffered brain damage. One young man was submerged in cold water for 40 minutes. After two hours of cardiopulmonary resuscitation and 13 hours of breathing assistance, he regained consciousness, and suffered no sustained disability. A physician who had undergone a 15 minute submersion was also completely restored and resumed his medical practice. The mammalian diving reflex is most active in young children, who, therefore have the greatest chance of survival. Cold water stimulates the diving reflex. First aid in the case of drowning victims consists of closed chest massage and mouth-to-mouth resuscitation. (MFW/UMS)

147.
ELLIOTT, J.C.
People who drown in cold water may not have to die.
Seagrant 70s 8:3-5; Apr. 1978.

A case of an 11-month old girl who was submerged in cold water for 10 minutes and successfully revived is described. Coast Guard personnel attempted resuscitation, then rushed the child to Ashtabula General Hospital, where a "drown team" had been alerted. This team had been established by two doctors at the hospital who had heard Dr. Martin Nemiroff lecture on saving drowning victims. Dr. Nemiroff has been interested for some years in improving the therapy of drowning victims. During the course of his study, he has learned that cold water potentiates the diving reflex so that it is possible for an individual to remain submerged longer than the four to six minutes that had been considered the limit. This is particularly true of children below the age of three and one half, because the diving reflex is stronger at that age. Several instances of survival after cold water drowning are cited. It is probable that in warm water (over 70°F) the four to six minute limit is valid. Dr. Nemiroff stands ready at all times to give counsel by telephone in case of cold water drowning. He is eager to get information on all such cases to add to his data bank. (MFW/UMS)

148.
ELSEY, D.R.
Construction and evaluation of a manned undersea polar station.
In: The working diver—1974. Symposium proceedings, March, 1974, Columbus, Ohio, p. 71-82. Washington, D.C., Marine Technology Society, 1974.

SUBIGLOO—a transparent manned underwater station was successfully deployed under the Arctic ice during the MacInnis Foundation's "Arctic III expedition." Its usefulness as a refuge and work station, as well as a tool in underwater observation, indicates that such systems definitely have a place in polar scientific diving. The unique advantages of utilizing this system in the Arctic include: 1) The creation of an under ice refuge and communication station for working divers. 2) A protected panoramic view of the ice subsurface, the entire water column and the sea floor. 3) Complete underwater assembly by divers. 4) Full portability of the structure by modification of the ballast system to adapt to various undersea conditions. 5) Low cost.

149.
ELSEY, D.
Arctic IV underwater expedition.
Downsview, Ontario, Canada, Def. Civ. Inst.
Environ. Med., DCIEM Rep. 75-OR-1087, 78p. June 1975.

During the months of April, May and June 1974, DCIEM participated in the MacInnis Foundation's ARCTIC IV Expedition to Resolute Bay, N.W.T. The Expedition's program included saturation diving, deep diving, underwater construction and various underwater scientific studies. This report gives a general overall description of the program and suggestions on how a similar expedition could benefit from the knowledge gained on the Arctic IV mission. (Author's abstract)

149a.
EMSLIE-SMITH, D., Accidental Hypothermia.
Lancet, 2:494-496; 1958.

Accidental hypothermia has recently been diagnosed nine times in elderly patients in circumstances which suggest that it is much commoner than is generally supposed. The electrocardiogram showed a pattern pathognomonic of hypothermia in seven of the eight cases in which it was recorded: in the eighth case the typical features were masked by bundle-branch block. The RR, PR, QRS, and QTC intervals were lengthened. The characteristic J deflection of hypothermia was present in leads related to the left ventricle; when it was conspicuous, T was sometimes inverted. In other leads the base of QRS was widened. These changes were identical with those constantly seen in induced hypothermia in patients with normal hearts and analogous to those found in experimental hypothermia in dogs. Failure to use adequate leads, especially left chest leads, probably explains why this pathogonmonic pattern has not been constantly found in accidental hypothermia. I wish to thank Prof. I.G.W. Hill, Mr. Walter Campbell, Dr. Robert Semple, Dr. J.M Stowers, and Dr. R.R. Andrew for permission to study and report these cases.

150.
ENGLISH, J.G.
Shallow air saturation dive in the high Arctic.
In: Ocean 75, San Diego, California, Sept. 22-25, 1975, p.264-268. IEEE Publication 75 CHO 995-1 OEC, 1975.

Personnel from the faculty of Engineering and Applied Science Memorial University of Newfoundland, conducted a 24-hour dive in conjunction with the Arctic IV expedition of the MacInnis Foundation. The dive was preceded by a simulated dive in the LORA I habitat in Newfoundland. The habitat used in the actual dive was SPID, developed by Link in 1964. The MacInnis habitat SUBIGLOO and three Seashells were used for rest and communication stations. Storage depth was 4.3 meters, with excursions to 16 meters. Water temperature was -1.9°C (28.6°F) and habitat temperature was 27°C (80°F). Standard Unisuits, with no active diver heating, were worn. Nine excursions were made, totaling 6.6 hours per man. Mean excursion time was 43.8 minutes. The divers were fatigued, but not dangerously so. For longer dives, excursions should be limited to 3 to 4 hours a day per man. It was concluded that saturation diving is feasible under Arctic conditions provided it is without question the best mode for the task requirements. Future objectives will center on achieving bottom times of more than one hour at 50 meters, providing adequate refuge for rest and decompression stops. (MFW/UMS)

151.
ENGLISH, J.G.
Arctic IV Expedition saturation dive. James Allister MacInnis Foundation Arctic diving expeditions. Volume VII. Toronto, Canada, James Allister MacInnis Foundation, 1975.

This report is a summary of a 24-hour saturation dive conducted at Resolute Bay between May 12-13, 1974, as part of the Arctic IV Underwater Expedition under Dr. Joe MacInnis. The portable structures

used were SPID, SUBIGLOO and SEASHELL. It was the first saturation dive carried out in the high Arctic. Nine excursions were completed. The total duration of the dive was 24 hours, including decompression. The overall length was curtailed due primarily to the restricted size of the habitats. SPID was the same portable, inflatable habitat designed by Ed Link for the first open-sea saturation dive in 1964. Life support systems are described and illustrated. The main specific mission objective was to support the biological program. The maximum duration of excursions was set at 65 minutes. The last four excursions were omitted due largely to fatigue and to cold discomfort. The depth of the dive was 14 FSW-50 FSW. Given specific structural improvements, as with a larger facility, a dive to 50-60 FSW with excursions to 100-150 FSW would be feasible under the same environmental conditions. The author emphasizes that if such dives were to last more than 24 hours, the workload would have to be reduced and the rest periods increased. For a 24-hour dive, eight excursions totalling 5 to 7 hours per man, with a minimum rest period in between of 2 hours at the early part of the dive increasing to three hours as the diver progressed. (MFW/UMS)

152.

ESTLER, C.J., H.P.T. Ammon and C. Herzog.

Swimming capacity of mice after prolonged treatment with psychostimulants: I. Effect of caffeine on swimming performance and cold stress.

Psychopharmacology 58(2):161-166; 1978.

The effect of a single dose of caffeine (50 μg/g s.c.) and of 6 wk treatment with 150 μg/g [oral] caffeine per day on swimming capacity and resistance to cold exposure were examined in mice. Chronic treatment with caffeine greatly reduced the swimming capacity and diminished the ability of the animals to withstand cold stress. The detrimental effect of the prolonged treatment with caffeine was not due to an accumulation of toxic levels of caffeine. Motor coordination was unaffected. There was no deficiency of metabolic substrates, since glycogen, and fat stores, and blood glucose and fatty acid levels were not lower than in control animals. Caffeine may have interfered with the animals' ability to mobilize and spend metabolic substrates for energy requirements of skeletal muscle.

152a.

FAIRLEY, H.B., W.G. Waddell, and W.G. Bigelow.

Hypothermia for cardiovascular surgery: Acidosis in the rewarming period.

Brit. J. Anesth. 29:310; 1957.

A report has been made of a series of cases in which severe metabolic acidosis arose, during the rewarming period following hypothermia for cardiac surgery. A further series is reported, showing that this syndrome is not encountered when care is taken to avoid (a) shivering, (b) peripheral vasoconstriction, (c) respiratory alkalosis during cooling and operation, and (d) when spontaneous respiration is established at the earliest opportunity, postoperatively. The differential diagnosis of the causes of severe acidosis in the rewarming period and the treatment of the acute acidotic syndrome are discussed.

153.

FALLER, J.-P. and M. Rauscher.

[Severe hypothermia: importance of temporary electrosystolic pacing until the end of the warming].

Nouv. Presse Med. 7(37):3366; Oct. 28, 1978.

An elderly woman was admitted in a state of deep coma from hypothermia. Core temperature was 29.5°C. After three hours of rewarming, when the core temperature had reached 30.4°C, arterial blood pressure went from 160/100 to 100/60, central venous pressure from 10 to 18 cm of water, and the ECG showed an arrhythmia of 25/mn and an absence of P waves. An electrosystolic pacemaker regulated to 80/mn was put in place and kept there for twelve hours, until the reappearance of a sinusal rhythm of

75/mn. The temperature was then 38.5°C. Respiration became normal from the time the pacemaker was put in place. The patient died 12 days later, apparently from a vascular cerebral accident. The authors recommend the use of a temporary electrosystolic pacemaker when ventricular fibrillation at a temperature of around 30°C might bring about an intense paroxysmal bradycardia which could result in an asystole at a temperature of 30-34°C. However, the prognosis remains dominated by the neurological state.

153a.

FAY, T.

Early experience with local and generalized refrigeration of the human brain.
J. Neurosurg. 16:239-259; 1959.

In exchange for relief of pain and free medical care, 124 selected patients with carcinoma, glioblastoma, and Hodgkin's disease (all far advanced with hopeless prognosis) were subjected to 169 episodes of general refrigeration. Nineteen patients (11.2%) died – 2 patients during, 4 in recovery, and 13 within 24 hours after general refrigeration. Of these, 11 died suddenly of cardiac failure; complete autopsies were obtained in 72 cases (57.1%) of the series. Of the 124 patients, 95.7% were relieved of pain. Eight patients with metastatic carcinoma survived more than 5 years. One is still alive today, 20 years later. Our failure to reach 67.5°F (approximately 20°C) by 7.5°F (4°C) still leaves the problem open for subsequent analysis, now that, with our present knowledge, this hypothermic level is potentially obtainable in the human being, and even lower levels are to be anticipated. Finally, certain fascinating problems for investigation in the new field presented themselves, such as the monstrosities caused by critically low temperatures in the chick embryo. The properly controlled use of hypothermia for drug addiction was indicated and its value in selected cases of acute psychopathic states offers real promise.

154.

FELICETTA, J.V. and W.L. Green.

Hypothermia and adrenocortical function [letter].
Ann. Intern. Med. 90(5):855; May 1979.

(To the editor:) In his review of hypothermia in the October 1978 issue, Reuler includes a diagram that suggests cold exposure stimulates the pituitary gland, which in turn stimulates secretion by the thyroid and adrenal glands. Although increased thyroid-stimulating hormone output in response to cold has been demonstrated in other species and in the human neonate, several investigators have been unable to document this phenomenon in the adult human. Acute cold exposure does stimulate cortisol secretion. In hypothermic patients, however, we have found that adrenal responsiveness to ACTH is lost and cortisol levels may be in the normal range despite severe stress. Adrenal unresponsiveness to ACTH has been demonstrated in hypothermic dogs; also, cortisol levels are relatively low during hypothermic surgery. One point we have made from these findings is that a diagnosis of chronic adrenal insufficiency should not be based on results of ACTH testing during hypothermia. A second possible conclusion is that hypothermia leads to a functional adrenal insufficiency for which glucocorticoid treatment is appropriate; such treatment has been used in Great Britain for some time. A controlled study of the efficacy of glucocorticoid treatment in hypothermic patients has not been done but deserves consideration.

154a.

FERNANDEZ, J.P., R.A. O'Rourke, and G.A. Ewy.

Rapid active external rewarming in accidental hypothermia.
J. Amer. Med. Assoc. 212:153-156; 1970.

Three patients with marked hypothermia resulting from exposure to cold after heavy alcohol consumption were rewarmed in less than eight hours by means of a hyperthermic mattress. Electrocardiography and physical abnormalities reverted to normal during the rewarming period. There were no sequelae. We conclude from the literature and from our experience with these three patients that immediate, active, rapid external rewarming is a simple and effective method of therapy in accidentally cooled patients.

155.

FLYNN, E.T., J.M. Alexander, B. Hoke and D.L. Jackson.

Effect of cold gas inhalation on cardiac rate in man at depth. A preliminary study.
U.S. Navy Exp. Diving Unit, Rep. 13-76, 22p. Dec. 8, 1976.

Two Navy divers breathed first warm and then cold helium-oxygen mixtures while performing graded exercise on a bicycle ergometer at simulated depths of 0, 200, 400, 600, 800, 850, and 1000 feet of seawater. In all cases, heart rate increased in proportion to the increase in oxygen consumption with exercise. When compared with warm gas control values, no consistent changes in heart rate were apparent in either subject during cold gas inhalation through a depth of 800 feet. At 850 and 1000 feet, however, both subjects demonstrated a significant reduction in exercising heart rate on cold gas. The potential mechanisms underlying these changes in cardiac rate and their impact in terms of cardiovascular performance and exercise tolerance are discussed. (Authors' abstract)

156.

FLYNN, E.T., J. Vorosmarti, and H.I. Modell.

Temperature requirements for the maintenance of thermal balance in the high pressure helium-oxygen environments.
Navy Experimental Diving Unit, Rpt. Nr NEDU-21-73; June 1, 1974.

Using a mathematical model of human thermal exchange, the range of environmental temperatures consistent with the maintenance of thermal balance was computed for helium-oxygen dives up to depths of 5000 FSW. In agreement with the trend of empirical data obtained during shallower dives, the required environmental temperature increases progressively with increasing depth while the range of acceptable temperatures decreases. The greatest changes occur in the first 1000 feet of descent. According to the model, sweating will become an ineffective means of extending the upper limit of environmental temperature at depths beyond 2000 feet. Conversely, if chamber temperature falls below the lower limit, body temperature will fall at a rate which becomes more rapid with increasing depth. The normal increase in metabolic rate which serves to limit the fall in central temperature during cold exposure will be attenuated at depth due to a higher mean skin temperature.

157.

FOLDES, F.F., S. Kuze, E.S. Vizi and A. Deery.

The influence of temperature on neuromuscular performance.
J. Neural Transm. 43(1):27-45; 1978.

The influence of lowering the temperature, by 10°C increments, from 37°C to 17°C on the twitch (P_t) and tetanic P_o) tension during direct and indirect stimulation, on presynaptic acetylcholine (ACh) release and on muscle acetylcholinesterase (AChE) and butyrylcholinesterase (BuChE) activity were investigated *in vitro* on the rat's phrenic-nerve-hemidiaphragm preparation. Decreasing the temperature from 37°C to 17°C caused a progressive increase of the isometric P_t to 195.8 ± 9.6 (S.E. of mean) and 169.6 ± 2.9% of control with direct and indirect stimulation respectively. This change in temperature also increased twitch duration and time to peak P_t by factors of about 4 and 6 respectively with both direct and indirect stimulation. The P_o/P_t ratio did not change significantly between 37°C and 27°C, but dropped sharply between 27°C and 17°C. With direct stimulation tetanus was only maintained in 50% of the experiments at 37°C and in none at 27°C or 17°C. With indirect stimulation tetanus was maintained in all experiments at 37°C and 27°C and in none at 17°C. Post-tetanic facilitation was greater with indirect than direct stimulation and at higher than at lower temperatures. Post-tetanic exhaustion, with both direct and indirect stimulation, was only observed at 37°C. Presynaptic ACh release ($pmol \cdot g^{-1} \cdot min^{-1}$) at rest and with stimulation rates of 0.1 to 50 Hz decreased by more than 60% as temperature was lowered from 37°C to 17°C. Cooling from 37°C to 17°C caused a similar decrease in the volley output ($pmol \cdot g^{-1} \cdot volley^{-1}$) of ACh. Muscle-AChE and BuChE activities decreased by 34 and 52% respectively when the temperature was lowered from 37°C to 17°C. The findings presented indicate that the site of the facilitating effect of cooling on P_t is the muscle fiber. The facilitation is

caused by the delay of the relaxation of the contracted muscle, causing prolongation of the active state and increased tension development. The decreased speed of nerve conduction and ACh release caused by cooling adversely affects neuromuscular transmission. This, however, is partially counteracted by decreased muscle-ChE activity and increased sensitivity of the postjunctional membrane to ACh caused by cooling.

158.
FORAY, J., F. Kalt-Binder and P. Lanoye.
The sequelae of frost-bite.
Chirurgie 105(1):37-46; 1979.

From a total of 200 cases of frost-bite treated at Chamonix Hospital, sequelae were noted in 50 cases. These can be divided into 4 groups: 1) subjective sequelae: residual pain and sensitivity problems especially hypersensitivity to cold which is almost constant; 2) objective sequelae: changes in the skin and exoskeleton, hyperhidrosis, tendon retraction, possible scar degeneration and relapsing ulcers; 3) radiological sequelae: osteoporosis which is usually resolvent, bone modifications; 4) thermographic sequelae: residual hypothermia, hyperthermia of amputation stumps. Therapeutic possibilities are limited to reeducational physiotherapy and surgical measures such as late sympathectomy and plastic operations. The sequelae of frost-bite are, happily, not always seen, but their frequency and severity increase according to the initial degree of frost-bite present, and the importance of prevention has to be underlined.

159.
FOSTER, D.O. and M.L. Frydman.
Tissue distribution of cold-induced thermogenesis in conscious warm- or cold-acclimated rats reevaluated from changes in tissue blood flow: The dominant role of brown adipose tissue in the replacement of shivering by nonshivering thermogenesis.
Can. J. Physiol. Pharmacol. 57(3):257-270; 1979.

Radioactive microspheres (12-16 μm) were used to measure cardiac output (CO), its fractional distribution and tissue blood flow in conscious, warm-acclimated (WA) or cold-acclimated (CA) white rats exposed to temperatures of 25, 21, 6, -6 and -19°C, the objective being to assess the tissue distribution of cold-induced thermogenesis. Total O_2 consumption was also measured. CA rats at 25°C (CA_{25}) had elevated arteriovenous shunting and other signs of heat stress. CA_{21} proved more suitable controls for the CA group. The cold-induced changes in blood flow to total skeletal muscle not involved in respiratory movements (M) and to the major masses of brown adipose tissue (BAT) were quantitatively very different in the 2 acclimation groups: in WA_{25} and CA_{21} flows to M were 31 (0.24 CO) and 27 (0.17 CO) ml/min, respectively, while flows to BAT were 2.1 and 9.7 ml/min; in WA_{-19} and CA_{-19} flows to M were 62 (0.32 CO) and 35 (0.16 CO) ml/min, respectively, while flows to BAT were 25 and 56 ml/min. In contrast, the effects of cold exposure on flows to other tissues and organs were remarkably alike in the 2 acclimation groups: e.g., flows to heart, ribcage and diaphragm increased about 3 times between 25 and -19°C, flow to the skin fell about 50% and flows to the hepatosplanchnic region and kidneys were little or not at all affected by cold exposure. Estimates of the contributions of different tissues and organs to cold-induced thermogenesis were made on the basis of the relative changes in blood flow. Apparently BAT is by far the dominant anatomical site of the increased heat production of cold-exposed CA rats and nonshivering thermogenesis in BAT supplements considerably the shivering thermogenesis of cold-exposed WA rats.

159a.
FRANK, D.H. and M.C. Robson.
Accidental hypothermia treated without mortality.
Surg. Gynecol. Obstet. 151(3):379-381; Sept. 1980.

Accidental hypothermia, a core temperature below 34°C, is frequently fatal, particularly in the ill and elderly. Traditional treatment methods result in reported mortalities of between 45 and 100 percent.

Despite these terrible statistics, advocates of slow rewarming persist. They cite the shock and vascular collapse which can occur with peripheral dilation as reasons to avoid rapid external rewarming. Isolated successes using internal core rewarming, such as hemodialysis or cardiopulmonary bypass, are spectacular but not practical in the usual clinical situation. By combining methods used for the resuscitation of burn injury with the treatment principles for frost-bite, a highly effective treatment protocol results. Aggressive fluid resuscitation, rapid immersion rewarming and careful systematic monitoring have been used to treat ten consecutive patients without a single death. Concomitant problems of alcoholism, stroke, myxedema, tuberculosis and paraplegia were also treated. Rapid external rewarming by immersion can result in a low mortality in patients with severe hypothermia. (Authors' summary)

160.

FRANZ, D.R., et al.

Evaluation of fasciotomy and vasodilator for treatment of frostbite in the dog.
Cryobiology 15(6):659-669; Dec. 1978.

Severe freezing injury was produced in the hind foot of 26 mongrel dogs. All dogs were given daily whirlpool treatment and protective bandaging for 14 days following injury. In addition, certain dogs received a vasodilator, fasciotomy, or both vasodilator and fasciotomy following injury. Deep foot temperatures, foot volumes, tissue pressures, and 14 day tissue loss-salvage scores were compared. Significant differences between fasciotomy and nonfasciotomy dogs were seen in foot temperature, volume, and tissue pressure immediately following fasciotomy. Though there was no significant difference in 14 day tissue loss, there was clinically apparent prolongation of integrity of the local vascular system for 2 to 5 days following fasciotomy, and total foot salvage in several dogs receiving fasciotomy.

161.

FRASER, I.C. and J.A. Loftus.

"Trench foot" caused by the cold. (letter).
Br. Med. J. 1(6160):414; 10 Feb. 1979.

A case is presented of an 18 year old who rode a bicycle for several hours in below freezing weather and who developed what they called trench foot because of tightly laced shoes, a pants clip and long continued exposure to cold. The case demonstrates the necessity of, even in a temperate climate, protecting the extremities. (CWS/UMS)

162.

FRASER, R.A., H.M.A. Towler and A.L. Stalker.

The endothelial cell in hypothermia.
Ferbil. Steril. 30(Suppl. 6):539-540; 1978.

The basic mechanisms underlying the disease process of hypothermia has never been demonstrated, but it is thought that increased capillary permeability causing microcirculatory inadequacy has been considered an important factor. To demonstrate this, an ultrastructural evaluation was made of a hypothermic microvascular bed, using the hamster cheek pouch as the experimental model. Hamsters were rendered hypothermic; their cheek pouches were then removed and placed in fixative at the same temperature. The normality of the vessel ultrastructure was the most striking feature observed. There was no evidence of endothelial cell injury or of increased vascular permeability. This might be explained by the possibility that there is a difference in membrane stability between hibernators (hamsters, in this case) and non-hibernators. Another possible explanation lies in the fact that the cheek pouch is in virtually constant contact with the cold and may therefore have a physiological adaptation that protects it from cold-induced micro-vascular injury. (MFW/UMS)

163.

FREITAS, C.R.

Human climates of northern China.
Atmos. Environ. 13(1):71-77; 1979.

A method for the description of human climates using standard mean climatic data is presented. Atmospheric and physiological variables that affect man's thermal state outdoors are included in a simple scheme that produces a unitary measure of body-atmosphere energy exchanges in familiar terms of clothing, defined as insulation required for equilibrium. The climate of the northern area of the People's Republic of China during the cooler half of the year is presented as a case study. Mean minimum and maximum clo values were calculated for 52 meteorological stations across northern China. Maps presented show that there are three climatic zones within which man can expect to experience similar ranges of cold stress during the winter months. It is suggested that clo maps simplify interpretation of the thermal demands of the environment and could be useful in regional assessments.

164.

FREY, M.A.B., R.M. Siervogel and E.A. Selm.

Effects of limb, posture, and duration of immersion on responses to the cold pressor test. Fed. Proc. 37:354; Mar. 1978.

Abstract only. Entire item quoted: Twelve subjects were each tested on 4 days in different posture-limb combinations to determine if limb, posture, or duration of immersion affect responses to the cold-pressor test (4°C). Variables compared were heart rate (HR), ejection time (ET), time from Q wave of the ECG to steepest rise in the upstroke of the carotid pulse contour (dD/dt), ear pulse amplitude by photoelectric sensor (EPA), heart-ear transmission time (TT), respiration, systolic (SBP) and diastolic (DBP) pressures. Responses were determined from differences between control values and those during the period 15-30 sec. after immersion and the period 45-60 sec. after immersion. Preliminary analyses indicate duration of immersion is more critical than limb or posture. This is reflected as differences between responses at the 15-30 sec. immersion period and the 45-60 sec. period in the following variables: HR, SBP, DBP, dD/dt, EPA, and TT. Response differences between supine and seated postures are significant for HR and ET. Hand and foot immersion elicit similar responses for all variables except EPA. These data suggest that comparisons among independent studies may lead to faulty conclusions unless duration of immersion is taken into account.

164a.

FRUEHAN, A.E.

Accidental hypothermia.
Arch Int. Med. 106:218-229; 1960.

Eight cases of accidental hypothermia due to exposure are reviewed with respect to admission clinical data, laboratory findings, clinical course, and autopsy findings. A brief summary of the physiological changes occurring in the temperature range of 75 - 90°F is presented and correlated with the clinical findings. The complications occurring during the rewarming period are discussed, including frostbite and gangrene, pneumonia, arrythmias, hyper-reactivity to heparin, gastrointestinal bleeding and/or perforation, oliguria, edema, and hypotension. Comments on therapy and management are presented which, it is hoped, may help to reduce the mortality rate of 87.5% shown in this series. Two illustrative case reports are included.

165.

FULLER, R.H.

Drowning and the postimmersion syndrome, a clinicopathologic study.
Mil. Med. 128:22-36; Jan. 1963.

This study, based on data from 3,000 cases, results in the following conclusions: 1) In fatal drowning there is an interchange of water and electrolytes between the alveoli and the blood, and an escape of plasma into the lung. 2) There is frequent aspiration of mineral debris, aquatic flora and fauna, and vomitus. 3) Pulmonary edema and accompanying pneumonitis in the resuscitated victim may result in living abscess and emphysema. 4) Anoxic cerebral necrosis is rare. 5) Blood volume changes and electrolyte imbalances are not a great problem; transient cardiac irregularities and asystole do occur. 6) Hemoglobinuria may be associated with near-drowning in fluid both hypertonic and hypotonic to the blood.

7) Renal dysfunction, sometimes fatal, may occur; it results from an acute tubular necrosis similar to that in other types of renal hypoxia. 8) Hyperventilation before submersion may result in syncope and drowning. (MFW/BSCP)

165a.

GAUGHRAN, D.R.

The working diver: Performance in cold water.

Commercial Diving Center, Bell Saturation III; November 26, 1974.

The effects of cold on the various components of diving performance are examined. Recall of memorized information at 45 minutes of cold water exposure was adversely affected. In testing the thermal effects of cold exposure, it was determined that core temperature fell as a function of the thickness of the subcutaneous fat layer. Strength during cold water exposure also was examined and it was determined in 43°F water for periods of up to one hour in duration that isometric strength was unaffected. A list of tests that have been conducted with divers in the program is included.

165b.

GILBERT, T.M., and C.M. Blatteis.

Hypothalamic thermoregulatory pathways in the rat.

J. Appl. Physiol. Respirat. Environ, Exercise Physiol. 43(5):770-777; 1977.

The cutaneous blood flow ($\dot{m}_{bl}$), rate of oxygen consumption ($\dot{V}o_2$), rectal (T_{re}) and cutaneous (T_{sk}) temperatures, and shivering activity were measured in unanesthetized male rats during a 2-h exposure to 26, 33, or 5°C 2 wk after selective bilateral hypothalamic microknife cuts. Animals with preoptic-anterior hypothalamic (PO/AH) junction cuts 1.5 or 3.0 mm lateral to the midline, as well as para-sagittal cuts which separated connections between the PO/AH and medial forebrain bundle exhibited a higher $\dot{m}_{bl}$ at 26°C than did sham-operated rats. At 5°C the extended (3.0 mm) PO/AH cuts as well as the parasagittal cuts prevented cutaneous vasoconstriction but had no effect on shivering activity; hence T_{re} was not maintained. None of the cuts demonstrably impaired thermoregulation in the 33°C environment. These results suggest that different sites in the hypothalamus may separately control cold-induced skin vasoconstriction and shivering activity, as well as heat-induced skin vasodilation. It would seem therefore that the integrity of the PO/AH is indispensable in rats for cold-induced cutaneous vasoconstriction but not for cold thermogenesis, and also not for heat-induced cutaneous vasodilation.

165c.

GILLMORE, J.D., and M. Eicher.

Parabosis and experimental infections, body temperatures of small animals: Methods of observation and control.

Aerospace Medicine, 45(3):249-253; 1974.

The effect of He atmospheres and of other parabaric environments on body temperatures of mice and guinea pigs was determined by measurements with electronic sensors. Air at 15°C and a normoxi-He atmosphere at 25°C both depressed body temperatures of mice. Heating the He atmosphere to 35°C enabled mice to retain a nearly normal body temperature even at 6.7 kg/sq cm (7.5 ATA). Unrestrained mice maintained a normal temperature more readily than those partially restrained: a 37°C ambient temperature sufficed to keep unrestrained, but not restrained, mice at normal body temperature in a normoxic-He atmosphere at 35.1 kg/sq cm (35 ATA). Simulated altitude with hypoxia produced a moderate decrease in body temperature, but normoxic hypobaric environments did not. Normal body temperatures were maintained in guinea pigs in air at either 15°C or 37°C, but were depressed at 30°C in normoxic-He atmospheres at either 7.5 or 35 ATA. Elevation of those gas phase temperatures to 32° -33°C, respectively, resulted in normal body temperatures.

165d.

GIRLING, F.

Seasonal changes in the physiological response of man to an acute cold stress.
Canadian J. Physiol. and Pharmacology 45:13-27; 1967.

Eight male human subjects, resting supine, and wearing swim trunks only, were exposed to an ambient temperature of 8.5°C for 1 hour in the first week of each month from February 1964 to January 1965 inclusive. Skin, rectal, and air temperatures were measured with thermistor probes. Percentage oxygen in expired air and minute ventilation were measured, and heat production was calculated by Weir's method. Electrical activity from the muscles of all four limbs was measured to determine shivering response. Control values of resting respiration and heat production were obtained under comfortably warm conditions and showed marked seasonal variation, with minimum values in spring and maximum values in later summer. In the response to acute cold exposure, marked seasonal changes were found also which were superimposed on the seasonal changes in control values. The response to cold exposure indicated maximum acclimatization to cold in the spring and minimum in later summer. These results are discussed in terms of three modes of response to the cold stress: (i) insulative cooling, (ii) shivering thermogenesis, and (iii) nonshivering thermogenesis. The degree of acclimatization and temperature of exposure may determine the individual mode of response.

166.

GIRARDI, G. and G. Perani.

Il comportamento dell'apparato cocleo-vestibolare nei sommozzatori degli alti fondali. [The behavior of the cochleo-vestibular organ during deep dives].
Ann. Med. Nav. 80:16-28; Jan./Mar. 1975.

The behavior of the cochleovestibular organ during deep dives has been studied; it was found that a sudden reduction of hearing occurs, as well as a less evident hypoacusis detectable only through audiometric tests; vestibular disturbances, consisting of vertigo, were also rather frequently observed. The cause of these functional disturbances is most likely due to the low temperature. (English summary)

167.

GLASS, J.D. and L.C.H. Wang.

Thermoregulatory effects of central injection of noradrenaline in the Richardson's ground squirrel (*Spermophilus richardsonii*).
Comp. Biochem. Physiol. C Comp. Pharmacol. 61(2):347-352; 1978.

The simultaneous changes of heat production (HP), heat loss (HL) and rectal temperature (Tb) in the Richardson's ground squirrel (*S. richardsonii*) to intracerebroventricular injections of noradrenaline [norepinephrine] (NA) (5.0-12.5 μg) were studied during different phases of the annual hibernation cycle and at warm (23°C) and cold (5°C) ambient temperatures. All injections resulted in activation of HP and hyperthermia, except at the lowest dose (5.0 μg) in the cold. There was little difference in NA-induced increases of HP, HL or Tb between warm and cold ambient temperatures in ground squirrels in their hibernating phase. During the hibernating phase, the highest dose of NA (12.5 μg) elicited greater increases of HP and Tb than during the nonhibernating phase. Apparently, modifications in central noradrenergic pathways controlling HP vary with annual hibernation cycles.

168.

GOFFART, M., B. Canguilhem, G. Hildwein and J. Juchmes.

The sympathico-adrenomedullary system and non-shivering thermogenesis in *Perodicticus potto*.
Comp. Biochem. Physiol. C Comp. Pharmacol. 61(1):189-202; 1978.

The daily urinary output of catecholamines in the potto [*P. p. potto* and *P. p. edwarsi*] is similar to that

in other species, 0.56-2.0 μg/kg per 24 h at rest and 3.0 μg/kg per 24 h when the animal is active. It is thus unlikely that the potto's low resting metabolic rate is due to a depressed secretion of calorigenic catecholamines. The proportions of NA [norepinephrine] and A [epinephrine] in the urine vary according to the potto's state of well-being and activity. The adrenals, weighing 100 mg each, contain 1.14 μg/mg NA + A, of which A = 95%. These values are the same as in *Macaca irus*. Exposure to the lowest physiological temperature for the potto, i.e., 15°C, for 1 mo. produces an increase in catecholamines and 17-OH corticosteroid urinary excretion and an enhanced diuresis, which differ only in details from those in other mammals or primates. Exposure to the unphysiological ambient temperature (T_a) of 5°C for 1 wk results in an increase in catecholamine excretion but the output of 17-OH corticosteroids remains unchanged. The diuretic effect of the cold environment is usually not observed. Short exposures (24 h) to a cold environment (5°C), double the O_2 consumption but usually neither the catecholamine output nor the 17-OH corticosteroid excretion are greater than in the thermoneutral zone. The urinary volume is also as a rule the same as that at 25°C, in these circumstances, as the potto does not shiver. Since evidence of the classical means of heat production has not been shown in operation, an unknown process has to be postulated. The metabolic effect of injected NA is smaller at 5°C than at thermoneutrality. At 5 or 10°C T_a pottos do occasionally release their thermoregulatory control and the colonic temperature drops transiently from 35.5-37°C to about 33°C. The variability of the physiological responses of the pottos to a cold environment is stressed.

169.
GOLDEN, F.St.C.
Accidental hypothermia.
In: Cold/wet survival symposium. J. Roy. Nav. Med. Serv. 58:196-206; Winter 1972.

Immersion in cold water produces rapid falls in deep body temperature accompanied by minor alterations in blood pH and electrolytes. The treatment consists of rapid reversal of the body temperature by immersion in a hot bath at 41°C. Generally speaking it is unnecessary and unwise to try and correct the biochemical disturbances. If necessary, then it should not be undertaken until the rewarming is well established. Accidental hypothermia produced in situations which involve high muscle energy expenditure over a period of time is usually accompanied by moderate to severe biochemical changes which may require correction, but again only when rewarming is well established. In this instance rewarming should be slow. Attempts at resuscitation must be made even in those apparently dead. (Author's conclusions)

170.
GOLDEN, F.St.C.
Death after rescue from immersion in cold water.
J. Roy. Nav. Med. Serv. 59:5-7; Spring 1973.

It has been suggested that in many cases, death after rescue from immersion in cold is due to cardiac failure. An account is given of such a case in which the patient was being electrocardiographically monitored at the time of death. Two survivors of a sailing accident died shortly after arriving at hospital, and their deaths were ascribed to drowning. The author believes that treatment for hypothermia might have reversed ventricular fibrillation, which was the terminal event, and which was very possibly brought on by cold. The author cautions that, since ventricular fibrillation is likely to occur during the post-immersion period, it is important to handle the patient very carefully so as to avoid irritating the cold-sensitized myocardium. (MFW/UMS)

171.
GOLDEN, F.St.C.
Immersion hypothermia.
In: Advis. Group Aerosp. Res. Dev., Rep. AGARD 620, p.77-88. 1973.

In this paper human thermo-regulation in water, and the factors affecting survival times of the immersed victim are discussed in broad detail. The physiological changes encountered in hypothermia are outlined

and associated signs and symptoms discussed. Some general advice on treatment is proposed, both from the first-aid and curative standpoint. (Author's summary)

172.
GOLDEN, F.St.C.
The immersion victim.
In: Advisory Group, Aerosp. Res. Devel., Rep. AGARD 642, p.93-97. 1975.

An aircraft accident may result in the occupants being forced to survive the rigors of an aquatic environment. In spite of the provision of sophisticated protective clothing and safety equipment, many such victims will suffer the effects of drowning and/or hypothermia. Those responsible for the training of rescue crews and for the clinical management of such survivors, should be familiar with the treatment of these conditions. This paper briefly discusses the mechanisms involved in the production of both, and outlines a course of management for the immersion victim. (Author's summary)

172a.
GOLDEN, F.St.C.
Recognition and treatment of immersion hypothermia.
Proc. Royal Soc. Med. 66:1058-1061; Oct. 1973.

Hypothermia should always be included in the differential diagnosis of the immersion victim. Rectal temperatures should be taken on all such patients on admission to hospital. Efforts must always be made to resuscitate those who have apparently died from hypothermia. This applies particularly to bodies wearing lifejackets or in life rafts. The resuscitative efforts should not include external cardiac massage until such time as the deep body temperature exceeds 30°C.

172b.
GOLDMAN, R.F.
Clothing: Its physiological effects, adequacy in extreme thermal environments and possibility of future improvements.
Arch. Sci. Physiol. 27(2):A-137-A-147; 1973.

In summary, the approach used in the author's laboratory in estimating the necessary clothing, or evaluating proposed clothing systems for use in extreme thermal environments is to use prediction models for whole body heat transfers in air or water (as well as extremity cooling prediction models discussed elsewhere [14]). These models predict either the necessary clo, i_m, and the pumping coefficients modifying these two heat transfer characteristics of the clothing for a given environment, or the appropriate environment for the given clothing, so that body temperatures (and/or heart rate) is not so seriously altered during any proposed duration of rest-work-recovery exposure that either intolerable shivering or risk of cold injury ensues in the cold, or heat exhaustion collapse or risk of heat stroke is likely to be present in the heat. As a concluding comment, it should be noted that the physiological effects of such vapor barrier clothing as rainwear, body armor or chemical protective clothing – in combination with high levels of working heat production – may convert an otherwise comfortably cool or even cold environment to an extreme thermal heat problem situation; on the other hand, auxiliary heating for the extremities in combination with reflective materials used in the best available cold weather protective clothing can convert – 56°C with 4.4 m/sec winds to a relatively tolerable condition (9).

172c.
GOLDMAN, Ralph F.
Immersion Survival
US Army Research Institute of Environmental Medicine Natick, MA; 01760 USA

Hypothermia and death from immersion is not a random event; body core temperature must be kept above

28-30°C. It falls, predictably, as a function of imbalance between the heat produced by the body and the heat lost to the environment. Heat production (M in W/kg) is predictable at rest, or while shivering, as a function of body size (kg) and skin (T_S) and deep body (T_{re}) temperatures by a number of formulae; e.g.: $M = 0.314 (T_S - 42.2) (T_{re} - 41.4)$. There are limits to man's ability to sustain elevated heat production and physical exhaustion may establish the extent to which "metabolic regulation" of body temperature can be effective. Heat loss is predictable in water, or air, as a function of the water/air temperature, skin temperature and the effects of four types of insulation: (1) vasomotor, altering heat flow between the skin and the body core from 32 to $8 W/m^2 \cdot °C$ including the effect of modest subcutaneous fat; (2) subcutaneous fat, providing ~0.4 clo per cm of fat thickness (transferring heat at 16.75 $W/m^2 \cdot °C$ per cm); (3) clothing, with conventional "wet suits" providing 2 to 3.5 clo in air (transferring heat at 3 to $1.8 W/m^2 \cdot °C$), but as little as ~0.3 clo ($21 W/m^2 \cdot °C$) when immersed, ± 10 to 20% depending on fit and subject/water motion; these clothing values include (4) a still-water film which contributes ~0.05 clo (~$111 W/m^2 \cdot °C$), dropping to ~0.02 clo (~$278 W/m^2 \cdot °C$) with water/body motion. Without adequate insulation, increasing heat production by body motion can increase heat loss to such an extent that there is actually a net loss of body heat; generally, unclothed individuals with less than 40 kg of body weight per square meter of surface should remain as still as possible during immersion. Such individuals also appear to be most susceptible to loss of their ability to maintain vasoconstriction; this probably sets the limit for "vasoconstrictive regulation" of body temperature. Even with the best available protective clothing, tolerace is limited without auxiliary heating of the extremities during immersion in < 12°C water. An approach involving predictive modelling has been developed to deal with these complex interactions.

172d.

GOLDMAN, R.F.

Low temperature hazards.

In: ASHRAE Handbook of Fundamentals. American Society of Heating, Refrigeration, and Air-Conditioning Engineers. New York, NY 1972.

Man's responses to thermal environmental extremes clearly indicate that he is better adapted to existing and surviving in the tropics than in the arctic regions. There is little physiological adaptation to cold, so the major methods of coping with the cold are behavioral or technological. Behavioral is staying inside a shelter when the outside conditions are the most extreme. Technological techniques of coping are clothing and life support equipment. Methods of evaluating such equipment in the field is stressed. (CWS/UMS)

172e.

GOLDMAN, R.F.

Protection against cold injury.

Contemporary Orthopaedics 2(3):263-266; June 1980.

In summary, there are only two choices for prevention of cold injuries; (1) maintain a high level of heat production by staying active while avoiding sweating, which will reduce the insulation of clothing; or (2) provide as much protection as possible by using multiple layers of clothing (so as to be able to adjust them during activity to stay slightly cool and thus avoid sweating), paying special attention to the extremities by providing them with substantially thick and light-weight insulation and attempting to maintain their circulatory heat input by warm drinks, auxiliary heat, and/or thinking warm.

172f.

GOLDMAN, R.F.

The role of clothing in modifying the human thermal comfort range.

INSERM, 75:163-176; December 1977.

The four environmental factors involved in human comfort (air temperature, vapor pressure, mean radiant temperature and air motion) have been extensively explored during the more than 50 years of psychologically oriented, "thermal sensation" or "comfort vote" studies of thermal comfort. The two

factors of human behavioral regulation of comfort, activity and clothing, have had comparatively little exploration in these studies; despite their key roles in determining comfort in a given thermal environment, activity level has been primarily limited to "sedentary rest" (with some, more recent, investigation of "sedentary office work") while clothing level has been limited to the "normal, indoor clothing" worn at the time (currently, an intrinsic clo insulation of 0.4 to 0.6; total clo including the surface air layer is 1.2 to 1.4). The classic, physiologically oriented studies assessing thermal comfort in terms of skin temperature and skin wettedness levels have generally been similarly limited, as have the bioengineering oriented studies assessing thermal comfort in terms of the heat balance equation ($M \pm H_{R+C}-E$). The biophysical approach, which extends quantification of clothing insulation (clo) by including a characterization of the sweat evaporative transfer limits of the clothing (permeability indices such as i_m or F_{pcl}), allows estimation of skin temperature and % sweat wetted area for any combination of clothing and activity level. Development of the "pumping coefficient" concept to describe how clothing insulation and permeability are modified by air and/or subject motion, allows for more accurate prediction of skin temperature and wettedness which, in turn, allows better definition of the interaction of all six key factors. These interactions may move the body out of the "ideal" comfort zone, where physiological regulation of body temperature can be achieved simply by vasomotor control, from full vasodilation into the zone of sweating regulation, up to, and beyond, the "acceptably comfortable" level of 20% skin wettedness, or from moderate vasoconstriction to the level of extremity cooling which delineates the lower boundary of thermal comfort, well before the zone of shivering regulation of body temperature is reached. Finally, such improved understanding of these three primary thermal characteristics of a given clothing ensemble (clo, i_m and pumping coefficient) allows us to come full circle, to begin to understand such psychologically based, second order thermal discomfort effects of clothing as "sticky, clingy, damp or clammy."

172g.

GOLDMAN, R.F., D.R. Brebbia, and E.R. Buskirk.

Heat loss during the night under subarctic conditions.

U.S. Army Quartermaster Res. & Engineering Center, Natick, MA; Tech. Rpt. EP-134; May 1960.

Mean weighted skin (T_s), rectal (T_r) and body (T_b) temperatures of men sleeping 8 hours in the standard arctic sleeping bag were determined at an average ambient temperature (T_a) of -23°C (-10°F), and at a -5°C (+23°F) average ambient temperature. Significant alterations in T_s, T_r, and T_b were observed. Apparently the low point for T_r during the night was not at any time significantly different at -5°C than at -23°C within approximately 30 minutes after retiring; a significant difference was evident for the remainder of the night. The men tended to be more restless (i.e., moved more) in the -23°C environment, particularly during the period when T_s and T_b were at a low level.

172h.

GOLDMAN, R.F., J.R. Breckenridge, E. Reeves, and E.L. Beckman.

Wet versus dry suit approaches to water immersion protective clothing.

Aerospace Med. 37(5); May 1966.

Immersion protection flight clothing can be of either a skin diver, "wet" suit type or waterproof, "dry" suit. A waterproofed copper manikin was used to study the insulative properties of both types of suits, in air and also during water immersion. The bulkier characteristics of the dry suit studied, the Mark 5A, provided greater insulation in air than either a 1/4" or 3/16" unicellar sponge, neoprene wet suit. However, during water immersion, compression of the "dry" suit by the water reduced the insulation by 75 percent. The insulation of the "wet" suits was also reduced but these suits are less compressible and thus during water immersion provide significantly more insulation than the "dry" suit.

172i.

GOLDMAN, R.F., R.W. Newman, and O. Wilson.

Effects of alcohol, hot drinks, or smoking on hand and foot heat loss.

Acta. Physiol. Scand. 87:498-506; 1973.

Using precision calorimetric techniques for measuring extremity heat loss, possible contra-indications or advantages of alcoholic or hot drinks or smoking just prior to cold exposure were assessed. Ten subjects were given 60 min exposures with one hand and one foot immersed in 15°C water, following the drinking of 1) 200 ml of 23°C water, control, 2) 200 ml of 23°C water containing 22 ml of absolute alcohol, 3) 200 ml of 55°C bouillon, 4) 200 ml of 23°C water and smoking 2 cigarettes. No significant effects were noted in the foot, but significant differences were observed in hand heat loss to the calorimeter; smoking depressed hand heat loss, alcohol elevated it. Smoking had a persistent influence, but the effect of alcohol had disappeared after 30 min. Bouillon had an effect similar to alcohol, but of shorter duration, and also resulted in a significantly reduced heat loss after 30 min. Alcohol produced a significantly higher amount of cold induced vasodilation CIVD with greater total temperature elevation in 3 fingers than did smoking, although smoking did not prevent CIVD. With intake of bouillon, CIVD appeared earlier than with alcohol and during the first 15 min, total temperature elevation in the 3 fingers was markedly higher than in the control run, but not as large as with alcohol. All differences were relatively small and would seem to be of little practical importance.

172j.

GOLLAN, F., G.G. Rudolph, and N.S. Olsen.
Electrolyte Transfer During Hypothermia and Anoxia in Dogs.
Am. J. Physiol. 189:277-280; 1957.

Electrolyte changes were studied during artificial respiration and hypothermia in dogs which had been equilibrated with K^{42}, Na^{24} or B^{82}. In the hypothermic animals potassium in plasma, potassium and sodium in skeletal muscle and potassium in auricle decreased, whereas bromide in the auricle increased. In normothermic animals anoxia produced an increase of bromide in the skeletal muscle and of sodium in the auricle; potassium increased in the plasma and decreased in the myocardium. Anoxia during hypothermia resulted in a loss of potassium from the contracting heart as the only significant change. Potassium to sodium ratios decreased more in the auricle than in the skeletal muscle in both hypothermia and anoxia. Thus, increased myocardial irritability during hypothermia and anoxia is caused or accompanied by a loss of potassium and an inability to extrude sodium.

173.

GOODE, R.C.
Acute responses to cold water.
In: Proceedings of the cold water symposium, Toronto, May 8, 1976, p.19-22. Toronto, Royal Life Saving Society Canada, 1976.

Some of the acute responses to cold water discussed here are: increase in systolic pressure (to well over 200 mm Hg), substantial change in ventilation (94.5, 71.3 and 94.6 liters per minute on first three breaths, as compared to 10-12 liters per minute normal ventilation), decrease in alveolar CO_2 (from 36.4 torr to 23.9 torr on the gasp breath), increased heart rate (96 to 134), elevated adrenalin levels (not in all subjects), and increase in circulating noradrenalin. These responses have certain obvious practical applications. The increased ventilation would interfere with drown-proofing (a survival technique in which the head is completely immersed and the body maintained in a relaxed position). It is also difficult to maintain a normal swimming posture when such a drive to breathe exists. Other possible results of the drive to breathe are the vagal arrest of heart action following inhalation of cold water into the naso-pharynx and glottis, and drowning due to inhalation into the lungs. It is possible to consciously override the natural drive to inspire by deliberately slowing ventilation. (MFW/UMS)

174.

GORDON, C.J. and J.H. Ferguson.
The relationship between body composition and survival time during acute cold exposure in white mice (*Mus musculus*).
Cryobiology 15(4):441-445; 1978.

Several body constituents useful in predicting survival time during acute cold exposure in mice were

compared. Survival time of adult, male Swiss-Webster mice exposed to intense cold (-18°C) was determined. Survival time was analyzed as a function of total body weight, dry weight, basic weight, lipid index, total body fat, total body water and percentage body water. Percentage body water and survival time were inversely related. Dry weight was the most significant factor in predicting cold resistance probably because it represents both metabolic capacity (basic weight) and insulative quality (total body fat).

175.

GOTO, M., Y. Tsuda, A. Yatani and M. Saito.

Effects of low temperature on the membrane currents and tension components of bullfrog atrial muscle.

Jpn. J. Physiol. 28(2):211-224; 1978.

To clarify the nature of inotropic action of low temperature, the effects of cooling on the membrane currents and tension components were studied on the bullfrog atrial muscle under voltage clamped and unclamped conditions with double gap method. Cooling (between 7-35°C) produced an increase of overshoot and a prolongation of the action potential accompanied by a slight depolarization of the membrane, a decrease of basal tension and an increase of twitch contraction. Under voltage clamp, a marked augmentation of contraction also occurred despite a decrease of basal tension, suggesting that the inotropic effect of cooling is not merely dependent on the prolongation of action potential. When the components of membrane current and tension were isolated in modified Ringer solutions, it became clear that I_{Ca} and I_{Ca}-dependent tension markedly increased at low temperature, while all other currents (I_{Naf}, I_{Nas}, I_{K1}, I_x) also diminished. Temperature coefficient (Q_{10}) of the I_{Ca}-independent tension component was 1.2-1.5 between 7-17°C, while that of I_{Ca}-dependent tension varied depending on depolarization voltages. These data were discussed in relation to possible alteration of Ca concentration at outer and inner layers of the membrane which may depend on temperature.

176.

GRABOWSKI, J.

Experimental investigations on the effects of low temperature on corneal changes after corneal dehydration.

Klin. Oczna 48(12):677-678; Dec. 1978.

Rabbit cornea investigations were carried out using 10%, 20% and 70% glycerol solutions as protection against low temperature. It was found that 20% glycerol solution exerts a sufficiently protective effect on the cornea. This glycerol solution prevented development of acellular areas in the cornea exposed to cold. No disturbances developed also in the content and distribution of acid mucopolysaccharides.

177.

GRAYSON, J. and L.A. Kuehn.

Heat transfer and loss.

In: Lomox and Schonbaum, eds. Drugs and body temperature, p.71-87. New York, N.Y., Marcel Dekker, 1979.

The contents of this chapter are as follows: I Introduction. II Thermal balance. III Radiation. IV Convection. V Conduction and other minor heat transfer avenues. VI Respiration. VII Evaporation. VIII Neutral control of heat loss. IX Regulation and distribution of sympathetic vasomotor tone. X Cholinergic mechanisms in the regulation of heat loss. (MFW/UMS)

178.

GREEN, J.F. and A.P. Jackman.

Mechanism of the increased vascular capacity produced by mild perfusion hypothermia in the dog.

Circ. Res. 44(3):411-419; Mar. 1979.

The mechanism of the increased vascular capacity produced by perfusion hypothermia was investigated in 20 anesthetized dogs. A right heart bypass preparation separated cardiac output (CO) into splanchnic ($\dot{Q}_s$) and nonsplanchnic (termed peripheral, $\dot{Q}_p$) flows. Each channel drained by gravity into an external reservoir. Blood was then returned to the pulmonary artery at a constant flow of 80 ml/kg per min. Venous resistance and compliance of splanchnic (R_{vs} and C_s) and peripheral (R_{vp} and C_p) channels were calculated from transient and steady state volume shifts which occurred following rapid drops in venous pressure. Arterial pressure (P_a), hematocrit (H), plasma protein concentration, and changes in reservoir volume (ΔV_{res}) were also measured. Filtered plasma (V_F) volume was determined from changes in hematocrit; ascites (V_{as}) volume was determined by an indicator dilution technique. Hypothermia to 33°C decreased both C_s and C_p from 0.022 ± 0.002 (mean ± SE) to 0.014 ± 0.001 liter/mm Hg and 0.023 ± 0.002 to 0.017 ± 0.001 liter/mm Hg, respectively. R_{vs} increased from 7.1 ± 1.0 to 9.0 ± 0.9 mm Hg/liter per min. Portal pressure increased from 7.5 ± 0.4 to 12.9 ± 1.3 mm Hg as H increased from 45.1 ± 1.1 to 49.4 ± 1.5%, and plasma protein concentration increased from 5.1 ± 0.2 to 5.7 ± 0.2 g/100 ml. R_{vp}, P_a, and the steady state distribution of CO did not change. V_{res} decreased 0.785 ± 0.063 liter during hypothermia, whereas V_F increased 0.321 ± 0.031 liter. V_{as} increased 0.082 liter during this period. We conclude that a large fraction of the decrease in plasma volume that occurs during mild perfusion hypothermia in the dog can be accounted for by the exudation at the liver of effectively pure plasma. The remaining percentage of filtered volume appears to be lost elsewhere in the circulatory system as an ultrafiltrate. Much of the hypothermia-induced increase in vascular capacity appears to be the result of an increase in the unstressed vascular volume and/or an increase in the volume sequestered in the splanchnic bed by a constriction of the hepatic outflow vessels.

178a.

GRIBANOV, G.A.

'Hypoxic' hypothermia in the metabolism of phospholipids of the endocrinal organs of rats during acute hypoxia.

Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, 9(2):9-12; March-April, 1975. Translated from the Russian.

The effect of 'hypoxic' hypothermia on the metabolism of phospholipids in the endocrinal organs (thyroid, adrenal, testicular glands) of albino rats has been studied. 'Hypoxic' hypothermia which occurs during acute hypoxia produces no inhibitory effect on phospholipid metabolism in the thyroid, adrenal and testicular glands of the test animals. As a result of disturbed heat release, the content of phospholipids in the thyroid and adrenal glands increases. The rate of label (p32) incorporation into the phospholipids of every gland (especially the thyroid and testicular glands) increases noticeably. This indicates an important compensatory role played by 'hypoxic' hypothermia in phospholipid metabolism. The mechanisms of these phenomena are discussed.

179.

GRIFFIN, W.S.T., D.J. Woodward and R. Chanda.

DNA synthetic ability in cerebella from temperature and handling stressed neonatal rats. Brain Res. Bull. 3(4):365-368; 1978.

DNA synthetic ability of neonatal rat cerebellum was studied in 2 stressful conditions (cooling and excessive handling) which may be inadvertently imposed during the course of certain experiments. A rate study of the ability of animals handled excessively for 10 min to incorporate ^{14}C-thymidine into the DNA tissue fraction (DNAF) from the acid soluble tissue fraction (ASF) of the cerebellum revealed a decreased DNA synthetic ability which lasted for 1 h. Animals with very low core temperatures incorporated little ^{14}C into the DNAF from the ASF 2 h after an i.p. injection of ^{14}C-thymidine. There was a proportional decrease in the ability to synthesize DNA as core temperature decreased.

180.

GRIFFITHS, J.B. and I. Beldon.

Assessment of cellular damage during cooling to -196°C using radiochemical markers.
Cryobiology 15(4):391-402; 1978.

The release of 10 radiochemical markers from MRC-5 (human fetal lung cell) and CHO (Chinese hamster ovary) cells after cooling at various rates and thawing from 0 to -196°C was measured. Many of these radiochemicals had specific sites of attachment on or within the cell. The aim was to determine the effect of freeze-thaw stresses on various parts of the cell. Cell death during cooling and thawing was, in most instances, accompanied by osmotic damage and loss of cytoplasmic constituents. Significant damage to the cell membrane occurred only after the cell was already dead and was related to the disruption of cells killed at higher temperatures and to osmotic stress during rewarming. The release of cations and other cytoplasmic markers was correlated to cell shrinkage and dehydration. The data were used to assess the relative effects of some of the proposed damaging factors in freeze-thaw injury (thermal shock, ice damage, dilution shock, etc.). CHO cells showed a much higher survival rate and release of cations after fast cooling than MRC-5 cells. CHO cells survived freeze-thaw cycles better than MRC-5 cells because they are able to dehydrate more readily, even at fast cooling rates.

180a.

GROTE, W., and F. Schweikhardt.

Elektrolytbestimmungen im serum und milchsaure- und brenztraubensaurebestimmungen im vollblut von kaninchen in normothermie und in kunstlicher hypothermie.
[Electrolytes in serum, and lactic and pyruvic acid in blood under normothermic and hypothermic conditions in rabbits.]
Pfluegers Arch. Ges. Physiol. 305:351-360; 1969.

Non-pedigree rabbits were cooled under ether-oxygen-anesthesia to a body temperature of 25°C. In hypothermia the sodium, potassium, and calcium concentration in the serum, and the lactic acid and pyruvic acid in the blood were measured twice with an interval of one hour. The potassium and calcium concentrations were decreased significantly during hypothermia. On the other hand, the sodium concentration remained unchanged in comparison to controls with normal temperature. The concentration of lactic acid in the blood was significantly increased. The concentration of pyruvic acid in the blood was significantly decreased. The experimental results are discussed in relation to the problem of malformations in hares after low temperature treatment on the ninth day of the embryonic development.

181.

GUILD, W.J.

Central body rewarming for hypothermia—possibilities, problems and progress.
J. Roy. Nav. Med. Serv. 3:173-175; Winker 1976.

The author discusses progress in the development of the central body rewarming equipment first described by E.L. Lloyd in 1972. The equipment consisted of a Waters canister containing about 500 gm of Durasorb soda lime, into which were rapidly passed several liters of CO_2. This produced warm moist air at 50-60°C which was then inspired through an anesthetic tube and mask. It has been found that 50-60°C is dangerously high, and that 47°C or even lower is a safer temperature. Some burning and scalding has occurred. Also, it is necessary to learn more about heat flow pathways, and the extent to which cardiac, pulmonary, and hypothalamic regions may be safely heated. For field use, a lightweight portable model similar to this would be most desirable, since the generally accepted rewarming method of immersion in hot water is obviously not practicable under field conditions. A number of such units are now being constructed and their effectiveness will be reported upon within the next year. (MFW/UMS)

182.
GUILD, W.J.

Rewarming via the Airway (CBRW) for Hypothermia in the Field?
J. R. Nav. Med. Serv. 64(3):186-193; Winter 1978.

In an earlier paper it was suggested that further work was needed to determine whether central body rewarming via the airway (CBRW) could be beneficial to hypothermic casualties under field conditions, and whether it had any advantages, medical or operational, over other recognized treatments. Careful evaluation from medical and operational considerations, and a detailed design study has led to the opinion that it is questionable, therefore, whether a hypothermic casualty would derive any significant benefit from CBRW during the relatively short transit time aboard a rescue craft, compared with careful attention and protection to promote spontaneous rewarming. The small rises in body temperature likely to be obtained with CBRW do not appear to justify its inclusion aboard rescue craft for purely rewarming purposes.

183.
GUILLERM, E.

L'homme, l'eau, le froid.
[Man, water and cold].
Cinesiologie 60:145-161; June 1976.

A review of the subject of heat loss by man during immersion is presented. The following areas are discussed: I. Man and cold: a) Resistance to hypothermia: means of defense, aspects of degree and duration, mechanisms of heat loss, limits of thermal balance; b) Excessive hypothermia: hemodynamic manifestations, metabolic modifications; c) Modifications as a function of certain parameters: subcutaneous fat, body surface/body mass ratio, sweating, age, influence of face immersion, influence of beta-adrenergic blockade and carbon dioxide elevation. II. Cold and immersion: a) Simple immersion without exercise: problem of survival, physiological mechanisms; b) Immersion for swimming or diving: immersion of short duration, prolonged immersion, immersion during breath-hold diving; c) Immersion while diving: air diving, helium diving. III. Treatment of hypothermia: Methods of rewarming, criteria for death in hypothermia, prevention of accidents. (MFW/UMS)

184.
HÄGERDOL, M., M. Keykhah, E. Perez and J.R. Harp.

Additive effects of hypothermia and phenobarbitol upon cerebral oxygen consumption in the rat.
Acta. Anaesthesiol. Scand. 23(1):89-92; Feb. 1979.

The quantitative effects of a combination of hypothermia and phenobarbital on cerebral oxygen uptake (CMR_{O_2}) was studied in rats, curarized and artificially ventilated with 70% nitrous oxide in oxygen. Cerebral blood flow (CBF) was measured with a modification of the Kety & Schmidt (1948) technique, using ^{133}xenon as a tracer. Arteriovenous difference in oxygen content over the brain was measured and CMR_{O_2} was calculated. Four groups were studied. Group 1 was a control group. The three experimental groups were injected with phenobarbital intraperitoneally: Group 2 with 50 mg/kg body weight; Group 3 with 150 mg/kg; and Group 4 with 50 mg/kg of phenobarbital, and, in addition, body temperature was lowered to 32°C in this group. CMR_{O_2} in groups 2, 3 and 4 was reduced by 22, 37 and 43%, respectively, compared to Group 1. The changes in CBF were of the same magnitude. In a previous study we have found that CMR_{O_2} decreases by 5% per 1°C decrease in body temperature. The value for CMR_{O_2} in Group 4 is close to the value obtained if the effect of 50 mg/kg body weight of phenobarbital on CMR_{O_2} is added to the effect of a temperature reduction of 5°C. It is concluded that the effects of barbiturates and hypothermia on CMR_{O_2} are additive.

185.

HALES, J.R.S., A.A. Fawcett, J.W. Bennett and A.D. Needham.

Thermal control of blood flow through capillaries and arteriovenous anastomoses in skin of sheep.

Pfluegers Arch. Eur. J. Physiol. 378(1):55-64; 1978.

Using radioactive microsphere and electromagnetic techniques, hindleg vascular responses were studied in 38 conscious, chronically prepared sheep subjected to exposure to a warm environment, and/or local warming of the hypothalamus, spinal cord, forelegs or hindlegs. The total proportion of cardiac output passing through AVA [arteriovenous anastomoses] increased by all treatments. AVA flow in hindleg skin increased but capillary flow was unchanged by warming the hypothalamus, spinal cord or forelegs. AVA flow was unchanged but capillary flow increased by warming the ambient air or hindlegs alone. Equivalent cooling treatments resulted in AVA and capillary flow changes converse to warming. In sheep, blood flow through cutaneous AVA is controlled by specific thermoregulatory reflexes and capillary flow is the target of local temperature effects. The direction of the thermal gradient across the skin is significant.

186.

HAM, J., R.D. Miller, L.Z. Benet, R.S. Matteo and L.L. Roderick.

Pharmacokinetics and pharmacodynamics of *d*-tubocurarine during hypothermia in the cat.

Anesthesiology 49(5):324-329; Nov. 1978.

To determine the effects of hypothermia on the pharmacokinetics and pharmacodynamics of *d*-tubocurarine (*d*Tc), serum, biliary, and urinary concentrations were determined and twitch tension monitored following intravenous administration of *d*Tc, 0.7 mg/kg, at 39 (n = 5), 34 (n = 5), and 28 C (n = 6) in cats anesthetized with chloralose and urethane. Time from injection of *d*Tc to maximum neuromuscular blockade was prolonged by hypothermia (28 C). Similarly, moderate (28 C) but not mild (34 C) hypothermia delayed recovery from paralysis. The serum half-life was prolonged 76 percent and the serum clearance rate decreased 60 percent by hypothermia (28 C). The combined biliary and urinary elimination of *d*Tc was decreased 47 percent at 28 C compared with 34 and 39 C. The serum concentration of *d*Tc necessary for neuromuscular blockade was less at 39 C (ED_{50} 0.87 μg/ml) than at 34 or 28 C (ED_{50} 1.13 μg/ml). It is concluded that, *in vivo*, hypothermia antagonizes a *d*Tc-induced neuromuscular blockade but decreases the elimination of *d*Tc. At 28 C the net effect is a prolongation of neuromuscular blockade.

186a.

HAMILTON, J.B.

Hypothermia and nervous system activity.

Yale J. Biol. and Med.. 9:327-332; 1937.

In environmentally-produced hypothermia of the unanesthetized rat, mouse, or kitten there occurs a progressive descending paralysis of the central nervous system. Higher nervous functions, locomotion, voluntary movements, attitudes, equilibration, hearing, and sight are lost; then swallowing, biting, and corneal and flexor reflexes are abolished; finally, medullary centers are affected with resultant respiratory failure and death. The responses which are the last to disappear are the first to recover. The manner of central nervous system involvement and recovery indicates the narcotizing nature of hypothermia. Operations may be performed in this condition. At no degree of hypothermia is a state of artificial hibernation produced. Even at body temperatures below 70°F the homeothermic animal attempts to resume a normal level of body heat. In body temperatures so low that nervous reactions and other evidences of life may be indiscernible, the animal can remain alive and subsequently recover.

186b.

HAMILTON, J.B., M. Dresbach, and R.S. Hamilton (1937)
Cardiac Changes During Progressive Hypothermia.
Am. J. Physiol. 118:71-76; 1937.

1. In hypothermia produced in rats and kittens without anesthesia there is a linear relationship between the decrease in heart rate and the lowering of the body level of heat. 2. Body temperatures as 75°F. are not critical, although there is slowing of the heart to one-third the normal rate, and increase in the conduction time and in the width and amplitude of R and T waves. 3. Temperatures of 65°F. or less are critical; the rhythm becomes irregular, the P-R interval lengthens, and A-V block appears. In kittens there develops a peculiar long diphasic ventricular wave. 4. The cardiac changes are reversible, disappearing as recovery proceeds. 5. Cold has a direct effect upon the heart, but the vascular debilities incident to hypothermia are suggested to be secondary to anoxemia induced by cold narcosis of the medullary respiratory centers.

187.

HAMILTON, G. and P. Rosen. (letter)
Ann. Intern. Med. 90(4):721; Apr. 1979.

The experience at Denver General Hospital suggests that there are two classes of hypothermia: those in whom environment was the cause and who responded extremely well to passive rewarming and minimal manipulation; and those who were hypothermic secondary to combined environment and metabolic failure from underlying disease. This group has significant mortality, usually reflecting underlying disease rather than hypothermia.

187a.

HANSON, H.E., and R.F. Goldman.
Cold injury in man: a review of its etiology and discussion of its prediction.
Mil. Med. 134:1307-1316; 1969.

The incidence of cold injury among soldiers during military operations is reviewed. The incidence during cold weather military operations is epidemic, as compared to the more sporadic occurrence in a civilian population, and is associated with long term, largely inactive exposure to relatively "moderate" climatic variables. Cold injury is a significant military problem, because it occurs most often in the front line combat infantryman, because of the long period needed for treatment, hospitalization and rehabilitation, and because of the frequent loss of appendages. Prediction of the potential danger of cold injury, based on meterological, clothing and physiological considerations, is possible but the many contributing circumstances enhancing this potential makes the accurate prediction of actual cold injury incidence almost impossible. However, casualities from environmentally induced causes can be greatly reduced by the individual's awareness of the potential hazards, coupled with the proper issuance and utilization of clothing.

188.

HANSON, R.de G.
Working in cold environments--lessons to be learned from diving.
Ann. Occup. Hyg. 21:193-198; Aug. 1978.

The lessons which have been learned from deep diving in cold water are: the importance of heat loss through the respiratory tract; the importance of being able to maintain the living quarters within the narrow limits of temperature; the unsuitability of wet suits as insulation for all but the shallowest dives; and the importance of heating the diving bell. (Author's abstract)

189.

HARA, A., M. Matsunaga, J. Yamamoto, K. Morimoto, H. Nagai, K. Kanatsu, C.H. Pak, K. Ogino and C. Kawai.

Cryoactivation of plasma renin.

Clin. Sci. Mol. Med. 55(Suppl. 4):139s-141s; Dec. 1978.

1) The mechanism of increased renin activity after human plasma had been kept at -5°C for 4 days (cryoactivation) was investigated. 2) The increase in renin activity of human plasma by cryoactivation was closely correlated to the increase obtained by incubation with trypsin ($r = 0.88$, $P < 0.001$, $n = 10$). 3) An inhibitor of thiol enzyme, *N*-ethylmaleimide did not inhibit cryoactivation. 4) Soyabean trypsin inhibitor and di-isopropyl-fluorophosphate (DFP) inhibited cryoactivation, suggesting that the cryoactivation may be due to the action of a trypsin-like serine enzyme. 5) In an experiment in the rat haemorrhagic shock caused parallel increments of renin activity in non-cryoactivated and cryoactivated plasma, the renin activity being about two times higher in the latter. No significant differences were found in the concentrations of renin and renin substrate between the non-cryoactivated and cryoactivated plasma samples. 6) The results may indicate that a destruction of an inhibitor of the renin-renin substrate reaction is responsible for the increase of renin activity after exposure of rat plasma to low temperature. A trypsin-like enzyme in plasma might have destroyed the inhibitor during this procedure.

189 a.

HARNETT, R.M., and M.G. Bijlani.

The involvement of cold water in recreational boating accidents.

U.S. Dept. of Transportation, United States Coast Guard Report No. CG-D-31-79; February 1979.

This report presents an assessment of the historical significance of cold water immersion as a threat to the lives of recreational boaters. The analysis is based on a detailed review of the fatal accident history of a selected typical year (1974). A demographic analysis of cold-related fatalities is presented to establish the nature of high-risk populations. This information is intended to be useful in directing programs aimed at reducing cold-related fatalities among recreational boaters.

189 b.

HARNETT, R.M., E.M. O'Brien, F.R. Sias, and J.R. Pruitt.

An experimental evaluation of selected rewarming therapies for the treatment of profound accidental hypothermia.

U.S. Dept. of Transportation, United States Coast Guard Report No. CG-D-65-79; June 1979.

This report summarizes the results of rewarming experiments performed with midly cooled volunteers. Rewarming therapies are studies which can be used for treatment of hypothermia at the rescue site. Other therapies are included in the study to serve as standards of comparison for the "portable" ones. The results are analyzed in the context of expected human responses to arrive at comparative evaluations of the therapies for use in the treatment of "profound" hypothermia.

189 c.

HARNETT, R.M., E.M. O'Brien, F.R. Sias, and J.R. Pruitt.

Experimental evaluations of selected immersion hypothermia protection equipment.

U.S. Dept. of Transportation, United States Coast Guard Report No. CG-D-79-79; October 1979.

This report summarizes an experimental test program conducted with state-of-the-art hypothermia protection equipment. Tests included the following attributes: cold-protection effectiveness, mobility reduction, fatigue induction, ease of donning, buoyancy, aesthetic appeal/wearer confidence, flame

resistance and reliability. Cold-protection effectiveness is expressed in terms of survival-time estimates for individuals, with selected body structures, wearing the test articles in 1.7°C (35°F) water. The data from these investigations is intended to collectively support the selection of equipment best suited for use by recreational boaters, Coast Guard crewmen and merchant mariners.

190.

HARRIS, B.W., et al.

In vitro performance of mouse hearts from different age groups at hypothermic temperatures.

Exp. Gerontol. 14(1):1-10; 1979.

The purpose of this investigation has been to establish an understanding of the effects of hypothermia on *in vitro* metabolism in hearts from young (3 month), mature (16 month) and old mice (25 month) of the C57BL/6J strain. Some of the parameters measured were glucose uptake, lactate production and glucogen flux. We have also made *in vivo* recordings of heart rate of mice under stressed and unstressed conditions and compared these to normothermic *in vitro* rates. Hearts perfused at normothermic temperatures demonstrated significantly higher heart rates, utilized more glucose and produced more lactate than those hearts under hypothermic conditions. From all three age categories, mouse hearts perfused under hypothermic conditions beat significantly fewer times during the removal of each μmol of glucose than did normothermic hearts. Although total lactate production was much greater for normothermic hearts, the rate of production as related to number of heart beats per unit produced was similar for all hearts. Glycogen stores in normothermic hearts was neither utilized nor increased following perfusion. Under hypothermic conditions the youngest and oldest hearts did show significant increases in glycogen stores following perfusion, whereas the 16 month old hearts did not show any changes. We also noted significant increases in glycogen stores among nonperfused control hearts which were directly related to increasing age.

190a.

HARRISON, J.T.

Test and evaluation of DUI ECONO II Hot Water Heater.

U.S. Navy Exp. Diving Unit, Rep. 16-78, 10 p. plus append. April 1979.

The Diving Unlimited International (DUI) ECONO II hot water heater was evaluated by the Navy Experimental Diving Unit to determine its suitability for Navy use. Results of both the manned and unmanned testing showed that the ECONO II hot water heater would adequately support two divers in depths less than 100 fsw. Operationally, the unit proved to be reliable and portable. The Diving Unlimited International (DUI) ECONO II hot water heater is therefore recommended for placement on the list of equipment approved for Navy use (ANU), Enclosure (2) to NAVSEA Instruction 9597.1. (Author's abstract).

191.

HAYWARD, J.S., M. Collis and J.D. Eckerson.

Thermographic evaluation of relative heat loss areas of man during cold water immersion.

Aerosp. Med. 44:708-711; July 1973.

Infrared thermography was used to provide illustrations of the regional difference of temperature of the surface of the human body before and after immersion in water of 7.5°C for 15 min. Thermal gradients over the surface are increased by cold water immersion, with areas such as the lateral thorax, upper-chest, and groin having the highest temperatures. It is predicted that heat loss in the water would be

greatest from such areas and that these findings would be useful in the design of thermally-protective lifejackets and for advice on body posture in the water to minimize heat loss. Swimming activity increased the amount of the body surface having higher relative temperatures, thereby increasing overall heat loss. (Authors' abstract)

192.

HAYWARD, J.S., J.D. Eckerson and M.L. Collis.

Effect of behavioral variables on cooling rate of man in cold water.
J. Appl. Physiol. 38:1073-1077; June 1975.

Five different behaviors of man while in cold ocean water (9-10°C) were assessed for their effect on rate of progress into hypothermia. With subjects wearing lifejackets, two thermally protective behaviors were studied which reduce exposure to the water of areas of body surface with high relative heat loss potential. One was huddling of three persons and the other a self-huddle behavior (HELP or Heat Escape Lessening Posture). These two behaviors resulted in significant reductions of rectal temperature cooling rate to 66% and 69%, respectively, of that of a control behavior. With no flotation available, two survival swimming behaviors (treading water and drownproofing) were shown to result in significant increases in cooling rate to 134% and 182%, respectively, of the control behavior. Potential swimming distance of subjects wearing a lifejacket was 0.85 miles in water near 12°C before predicted incapacitation by hypothermia. It was concluded that behavioral variables can be of major importance in determining survival time in cold water through modulation of cooling rate associated with other variables such as fatness, body size, and clothing. (Authors' abstract)

193.

HAYWARD, J.S. and A.M. Steinman.

Accidental hypothermia: an experimental study of inhalation rewarming.
Aviat. Space Environ. Med. 46:1236-1240; Oct. 1975.

Inhalation rewarming of hypothermic humans with heated, humidified oxygen was compared to rewarming by immersion in a hot bath. In 10 subjects cooled to approximately 35°C core temperature, there was no significant difference in the amount of temperature "afterdrop" with the two rewarming procedures. Inhalation rewarming provided rapid commencement of increase in tympanic and esophageal temperatures, indicating effective rewarming of critical core regions, especially heart and brain. This method of core rewarming avoids the physiological hazards associated with the peripheral vasodilation which accompanies external rewarming. Moreover the simplicity of application of this method suggests its greater use in both first-aid and hospital treatment of accidental hypothermia. (Authors' abstract)

194.

HAYWARD, J.S., J.D. Eckerson and M.L. Collis.

Thermal balance and survival time prediction of man in cold water.
Can. J. Physiol. Pharmacol. 53:21-32; 1974.

Metabolic rates and rectal temperatures were continuously monitored for humans immersed in cold ocean water (4.6-18.2°C) under simulated accident conditions. The subjects wore only light clothing and a kapok lifejacket while either holding still or swimming. While holding still, metabolic heat production (H_m • kcal • min^{-1}) was inversely related to water temperature (T_w, °C) according to the equation $H_m = 4.19 - 0.11\ T_w$. This thermogenic response pattern is shown to be similar to that for exposure to air of the same temperature when air velocity is just over 5 m.p.h. (2.24 m/s). The thermogenic response was one-third efficient in balancing the calculated heat loss in cold water, resulting in hypothermia at a rectal temperature cooling rate (C, °C • min^{-1}) dependent on water temperature (T_w, °C) according to the relation $C = 0.0785 - 0.0034\ T_w$. Although swimming increased heat production to 2.5 times that of holding still at 10.5°C water temperature, cooling rate was 35% greater while swimming. A prediction equation for survival time (t_s, min) of persons accidentally immersed in cold

water (T_w, °C) has the form $t_s = 15 + 7.2/ (0.0785 - 0.0034T_w)$, based on the findings of this study, and it is compared to pre-existing models. (Authors' abstract)

195.

HAYWARD, J.S. and A.M. Steinman.

Treatment of accidental hypothermia.

Victoria, Canada, Univ. Victoria, Rep. on Contract 09-7025-75, U.S. Coast Guard, 16p. June 30, 1975.

Inhalation rewarming of hypothermic humans with heated, humidified oxygen was compared to rewarming by immersion in a hot bath. In ten subjects cooled to approximately 35°C core temperature, there was no significant difference in the amount of temperature "afterdrop" with the two rewarming procedures. Inhalation rewarming provided rapid commencement of increase in tympanic and esophageal temperatures, indicating effective rewarming of critical core regions, especially heart and brain. This method of core rewarming avoids the physiological hazards associated with the peripheral vasodilation which accompanies external rewarming. Moreover, the simplicity of application of this method suggests its greater use in both first-aid and hospital treatment of accidental hypothermia. (Authors' abstract)

196.

HAYWARD, J.S., J.D. Eckerson and M.L. Collis.

Man in cold water: Cooling rate in heavy winter clothing.

Victoria, Canada, Univ. Victoria, Rep. on Contract 09-7025-75, U.S. Coast Guard.

Ten men were immersed in the sea at a temperature of 7° to determine the effect of heavy winter clothing on body cooling rate and predicted survival time. Mean body cooling rate in heavy clothing was 1.85°C/hr. This cooling rate corresponds to predicted survival times at different water temperatures which are one-third greater than for lightly-clothed subjects. When subjects wearing heavy clothing adopted a thermally-protective behaviour in the water (H.E.L.P.), a 68% increase in predicted survival time over lightly clothed subjects was observed. When the subjects also wore a thermally-protective flotation device (UVic Thermofloat Jacket) their predicted survival time was doubled, to a duration 3.5 times that of lightly-clothed persons. The relevance of these findings to the situation of seamen on the Great Lakes is discussed. (Authors' abstract)

197.

HAYWARD, J.S., J.D. Eckerson and M.L. Collis.

Thermoregulatory heat production in man: prediction equation based on skin and core temperatures.

J. Appl. Physiol. 42:377-384; Mar. 1977.

The relationship of metabolic rate to skin and core temperatures was measured in eight subjects cooled in 10°C water. Reference core temperatures based on the tympanic and rectal sites, were 41.0 and 41.4°C, respectively. Reference mean skin temperatures were 41.8 and 42.2°C when determined in relation to tympanic and rectal temperatures, respectively. These results enabled construction of equations for predicting the steady-state metabolic rate (MR, $W.kg^{-1}$) of nonexercising man according to thermal inputs from the skin (T_{sk}) and core (T_{ty} or T_{re})

$$MR = 0.0356 (T_{sk} - 41.8) T_{ty} - 41.0)$$

or,

$$MR = 0.0314 (T_{sk} - 42.2) T_{re} - 41.4)$$

Each equation was limited by the low level of basal metabolic rate (1.1 $W.kg^{-1}$) and by the high level of peak metabolic rate (6.4 $W.kg^{-1}$). Evaluation of these equations showed satisfactory agreement with previous observations and concepts on the regulation of heat production in man. (Authors' abstract)

198.
HAYWARD, M.G., et al.
Progressive symptomless hypothermia in water: possible cause of diving accidents. Br. Med. J. 1(6172):1182; 5 May 1979.

Unexplained loss of consciousness, often followed by death, has been common during diving in British waters. Forty-two such deaths were noted by Childs and Norman and no likely cause for them has been established. We describe here progressive symptomless hypothermia which developed during one of a series of fully monitored laboratory experiments designed to assess individual responses to mild surface cooling in water.

198a.
HAYWARD, M.G. and W.R. Keatinge.
Progressive symptomless hypothermia in water: possible cause of diving accidents. Br. Med. J. 1(6172):1182; May 5, 1979.

The authors describe a laboratory experiment in which a young male dressed only in swimming trunks was immersed in 29°C water. After 112 minutes, his rectal temperature had dropped from 37.20°C to 34.70°C, and the ECG showed ventricular and supraventricular ectopics. The subject did not feel cold at any time during immersion. One feature contributing to the hypothermia was the subject's lack of subcutaneous fat. The second was acclimatization to cold due to frequent exposure (as cox of a rowing team) for one month previous to this experiment. A common effect of this is to reduce reflex responses to cold (metabolic response, adequate vasoconstriction, and sensation of cold). "Silent" hypothermia of this type might well be responsible for many unexplained diving accidents and fatalities. (MFW/UMS)

198b.
HEBERLING, E.H., and T. Adams.
Relation of changing levels of physical fitness to human cold acclimatization. J. of Appl. Physiol. 16, 226-230; 1961.

Five nude Caucasian men were exposed for 1 hour to a temperature of 10° ± 1 °C in a cold chamber after normal activity, after physical training, and after bivouac in the interior of Alaska for 6 weeks during January and February. Body temperatures (hand, foot, trunk, skin, and rectal, recorded during exposure to acute cold, were the criteria by which the effects of the changing levels of physical training and the cold-acclimatizing encampment were compared and judged. After the program of physical training, but before the bivouac, skin and extremity temperatures were statistically higher than those recorded before training; no differences were noted after the bivouac, when the level of physical training remained unchanged and the only variable was exposure to cold. These data confirm an earlier suggestion that commonly accepted indices of acclimatization, (elevated skin temperatures) may also result from chronically elevated levels of physical activity. Additional evidence indicates the limitations of the bivouac or field exercises for 'cold exposure,' and suggests the questionable value of accepting physiological and thermal readjustments that occur during such programs as being indicative of the effects of cold.

198c.
HEGNAUER, A.H., H. D'Amato, and J. Flynn.
Influence of Intraventricular Catheters on Course of Immersion Hypothermia in Dogs. Am. J. Physiol. 167:63-68; 1951.

Intraventricular catheterization is inimical to hypothermic dogs in that idioventricular ectopic beats are thereby initiated which in turn precipitate ventricular fibrillation at temperatures above the mean lethal temperature for uncatheterized dogs. Hypothermia, particularly temperatures below 25°, appears to sensitize the heart to the presence of catheters. The sensitization cannot readily be explained in terms of hypoxia for the following reasons: *a*) breathing 100 per cent oxygen, either spontaneously or artificially, does not influence the temperature of onset of the arrhythmia, *b*) the uncatheterized animal survives to a lower temperature and

tolerates for considerable periods a lower blood pressure and pulse rate than those obtained just prior to ventricular fibrillation in catheterized dogs, c) the frequency of success attending the rewarming of uncatheterized dogs is greater than for the catheterized in spite of a lower starting temperature, blood pressure and pulse rate. The data presented make untenable the hypothesis previously presented, i.e. that the ventricular abnormalities observed in catheterized dogs were induced by hypoxia. The mean lethal temperature for uncatheterized dogs under the conditions of these experiments is approximately 16.5°. No evidence was obtained from very small series of experiments that the idioventricular betas of catheter origin could be controlled by intravenous procaine, or by a specific adrenergic blocking agent.

199.

HEIM, T.H.S., F. Varga and E. Goetze.

Tracer kinetic studies on in vivo fatty acid metabolism in white adipose tissue of well-fed and starving newborn rabbits during acute or prolonged exposure to cold.

Acta Physiol. Acad. Sci. Hung. 49(1):1-16; 1977.

Pool size (M) and specific radioactivities (SA) of lipids of white adipose tissue (WAT), and the flow rates (m_s) of free fatty acids (FFA) from plasma into WAT were studied by injecting ^{14}C-1-palmitate ($20 \cdot 10^6$ cpm/100 g body wt) in 7 day old rabbits reared in a thermoneutral (group I) or a cold environment (group II) or subjected to starvation at an ambient temperature (T_a of 35°C (group III) or at T_a 20°C (group IV). Experiments were carried out at T_a 20°C in all 4 groups of rabbits. The pool size of esterified and non-esterified fatty acids of WAT was reduced in both the well-fed animals raised in the cold and in the starving ones. The SA of tissue FFA and phospholipid fatty acid (PL-FA) was highest in group III and group IV, indicating an increased FFA metabolism of WAT in animals subjected to starvation prior to acute cold exposure. The flow rate (m_s) of FFA between plasma and WAT increased 2-fold in group IV but remained about 1/5 that of the m_s between plasma and brown adipose tissue (BAT). This indicates that the contribution of WAT to cold-induced calorigenesis of the whole animal should be considered of secondary importance.

200.

HEIMER, W. and P. Morrison.

Effects of chronic and intermittent cold exposure on metabolic capacity of *Peromyscus and Microtus.*

Int. J. Biometeorol. 22(2):129-134; 1978.

The effect of 30 days of acclimation at 5°C and of a semiweekly series of short severe cold exposures (T_b [body temperature] → 20-30°C) on metabolic capacity (M_{max}) was measured in Alaskan meadow voles (*M. pennsylvanicus tananaensis*) and Wisconsin deer mice (*P. maniculatus bairdii*). Meadow voles, with an M_{max} of 12-14 ml/(gh) or 8-9 met (M_{max}/M_{st} [standard metabolism]), showed little response to either treatment. In deer mice, however, acclimation at 5°C increased M_{max} by about half (from 11.0 to 15.4 ml/(gh) or from 6.0 to 9.1 met). In 25°C acclimated deer mice 7 severe cold exposures produced a similar increase of which about half was seen with the 1st 2 exposures. In 5°C acclimated deer mice, M_{max} averaged a 0.3 ml/(gh) increase for each cold exposure to reach a level of 19 ml/(gh) or 11 met after 6 wk.

200a.

HERDMAN, S.J.

Recovery of shivering in spinal cats.

Experimental Neurology 59, 177-189; 1978.

Normal adult cats and acute and chronic spinal preparations were studied for shivering responses in the hind limbs to spinal cord cooling. A U-shape polyethylene tube was positioned peridurally so that it would lie from L7 to T5-8. Spinal cord transections were made just rostral to the tubing. The tubing was injected with progressively cooler water to cool the cord and induce shivering. There is a significant increase ($P < 0.01$) in the threshold for the initiation of shivering to spinal cord cooling in the acute spinal animal (11.0 ± 5.5°C) compared to that in the intact animal (30.6 ± 3.9°C). Recovery of the

threshold for initiation of shivering to a value of 31.0 ± 4.2°C occurs by postoperative Day 2. The recovered threshold is not significantly different from that of the intact animal. The pattern of shivering in the intact cat has both phasic (burst-like) and tonic (fine tremor) components. In the acute spinal cat, the shivering pattern to spinal cord cooling is twitch-like and lacks the pattern of the intact cat. Unlike the threshold for shivering, the pattern of shivering changes gradually with time until post-operative Day 15 when it is almost normal. The elevated threshold for initiation of shivering and the diminished pattern of shivering which are observed initially after spinal cord transection are comparable to the depression of many cutaneous reflexes during the period of spinal shock. In addition, the threshold and pattern of shivering recover from spinal shock. Unlike cutaneous reflexes, however, neither the threshold nor the pattern of shivering becomes hyperactive with recovery.

200b.

HERVEY, G.R.

The physiology of Cold/Wet Survival.

In: Cold/wet survival symposium.

J. Roy. Nav. Med. Serv. 58:161-170; Winter 1972.

The physiology and effectiveness of the body's thermoregulatory mechanisms are studied. The working of the control system is discussed and its effects demonstrated. The general effect of this thermoregulation on the likelihood of survival is considered, together with the principles of treatment for those suffering from immersion or exposure.

200c.

HIGGINS, R., A. Buguet and L. Kuehn.

Measurement of skin temperatures of active subjects by wireless telemetry.

Avia. Space and Environ. Med. 49(11):1352-1354; Nov. 1978.

A new sensor has been developed for measurement of skin temperatures of active human subjects that consists of a radio transmitter circuit incorporating a skin thermistor in a small epoxy slab or "tab." These tabs are reuseable, being large enough to permit battery replacement if required. They are glued to a subject's skin (thermistor side facing the skin) with a quicksetting adhesive and are easily removed after a 10-h period with an appropriate solvent. Thermal information is easily obtained from the sensor by a hand-held calibrated radio receiver accurate to ±0.1°C. This technique permits easy and rapid documentation of the thermal stress of active human subjects without interfering with their activity or clothing.

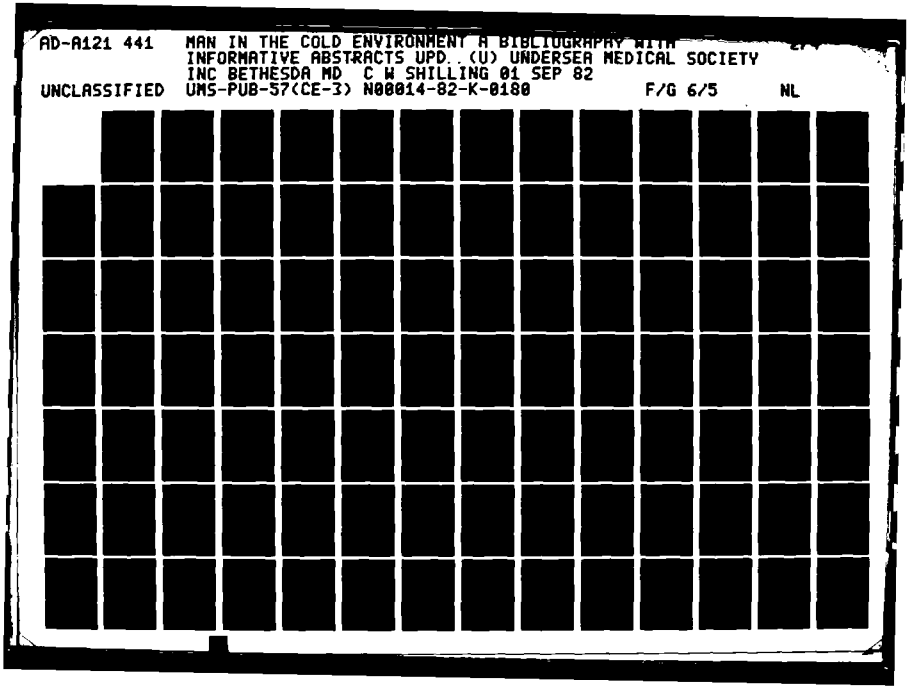
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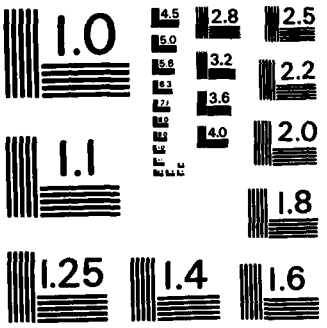
HIRAI, M.

Cold sensitivity of the hand in arterial occlusive disease.

Surgery 85(2):140-146; Feb. 1979.

Digital blood pressure was measured using photoplethysmography in patients with cold sensitivity of the hand. In 19 patients with Buerger's disease, or arteriosclerosis obliterans (arterial occlusion group), 90 of 91 fingers with cold sensitivity showed significantly low pressures. In 17 patients with typical Raynaud's phenomena due either to primary Raynaud's disease or secondary to collagen disease (Raynaud's group), decreased digital pressure was noted in only five of 123 fingers with cold sensitivity. Blood pressure measurements in the fingers after local cooling of the hand showed a more severe response to cold in the Raynaud group than in the arterial occlusion group. These results indicate that the pathophysiologic mechanism for cold sensitivity in arterial occlusive disease is different from that in Raynaud's disease. In the arterial occlusion group impaired circulation due to occlusions in the digital arteries or more proximal arteries is a necessary precondition for cold sensitivity, and an increased sympathetic response to cold is of less importance as an etiologic factor. Thus a patient with cold sensitivity of the hand and normal digital blood pressure should not be considered to have arterial occlusive disease as the underlying cause of cold sensitivity.


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202.

HIRVONEN, J., P. Huttunen and H. Vapaatalo.

Effects of reserpine and propranolol on urinary excretion of histamine and 5-hydroxytryptamine in severe cold exposure in normal and cold-acclimated guinea pigs.

Z. Rechtsmed. 82(1):27-36; 1978.

The effects of cold-acclimation, reserpine and propranolol were investigated on the survival time, rectal temperature and urinary excretion of histamine and 5-HT [5-hydroxytryptamine] in guinea pigs at -20°C. Both reserpine and propranolol shortened survival time by 3 h and 1.5 h, respectively. The shortest time was with cold-acclimated reserpine-treated animals. There was a trend in severe cold exposure to increased excretion of histamine in non-acclimated and cold-acclimated animals. Reserpine did not change the excretion but increased the histamine concentration from 0.08 to 0.25 μg/ml. Propranolol acted as a histamine liberator by increasing the excretion in non-acclimated from 0.10 to 1.40 μg/h and concentration from 0.10 to 4.52 μg/ml. In cold-acclimated animals it increased excretion from 0.20 to 2.85 μg/h and the concentration from 0.08 to 3.23 μg/ml. Severe cold increased the excretion of 5-HT in the non-acclimated animals from 0.08 to 0.21 μg/h in cold-acclimation to 0.17 μg/h. Reserpine diminished excretion from 0.08 to 0.03 μg/h in the non-acclimated animals, but propranolol had no effect. The excretion of histamine and 5-HT into urine change with cold and can be modified with drugs. The application of the data in proving cold stress warrants further study.

203.

HOAR, P.F., L.W. Raymond, H.C. Langworthy, R.E. Johnsonbaugh and J. Sode.

Cardiovascular and metabolic responses of exercising men immersed in 25.5°C water breathing compressed air or helium tri-mix.

Physiologist 18:250; 1975.

Abstract only. Entire item quoted: Efforts have been directed at identifying mechanisms by which exposure of normal men to hyperbaric helium atmospheres, under conditions of thermal stress and underwater exercise, alters cardiovascular and metabolic functions. Fourteen unprotected scuba divers performed ergometric work at 3 meters in 25.5°C water. They were stressed by work and cold. Exercise produced increases in heart rate, minute ventilation (VE), oxygen consumption (VO_2) and catecholamine excretion (CE). Cold lowered core temperature (T_r) despite exercise, and accentuated the increase in VO_2 and CE. Immersion, cold-induced vasoconstriction and scuba breathing contributed to a brisk diuresis; since such factors all tend to centralize blood volume, thereby stimulating central vascular stretch receptors (Gauer-Henry reflex, GHR). Similar exercise in 25.5°C water, breathing helium tri-mix (gas density less than air), produced higher VE but lower VO_2 when compared to air breathing. Thus, tri-mix scuba breathing may stimulate the GHR to a less degree than air scuba breathing, since its lower density should cause less stretch receptor distension during exercise hyperpnea, resulting in decreased diuresis. The fall in T_r during work in 25.5°C water was identical whether air or helium tri-mix was respired, as helium does not accentuate respiratory convective heat loss.

204.

HOAR, P.F., L.W. Raymond, H.C. Langworthy, R.E. Johnsonbaugh and J. Sode.

Physiological responses of men working in 25.5°C water, breathing air or helium tri-mix.

J. Appl. Physiol. 40:605-610; Apr. 1976.

Fourteen scuba divers in swim trunks did ergometer work while breathing air at 3 m in 25.5°C water. They were stressed by work and cold. Exercise produced increases in heart rate, minute ventilation (VE), oxygen consumption (VO_2), and catecholamine excretion. Cold lowered rectal temperature (T_{re}) de-

spite exercise and contributed to the increase in VO_2 and catecholamine excretion. Immersion, cutaneous vasoconstriction, work, and scuba breathing contributed to a brisk diuresis, probably by centralizing blood volume and thus stimulating central vascular volume receptors. Similar exercise in 25.5°C water, breathing helium tri-mix (gas density less than air), produced higher VE but lower VO_2 when compared to air breathing. Tri-mix scuba breathing resulted in a smaller diuresis, perhaps because its lower density leads to lesser atrial distension during work. The fall in T_{re} during work in 25.5°C water was identical whether air or helium tri-mix was respired, since helium does not accentuate respiratory convective heat transfer. (Authors' abstract)

205.
HOEFLIN, F.G.
Cold injuries.
Ther Umsch. 36(1):16-20; Jan. 1979.

Cold injuries are seldom seen in normal times. In war and catastrophe times they are of prime importance. In central Europe the time honored treatment of frostbite with snow and cold water has been gradually replaced by rapid thawing in water of 40-42°C. In accidental hypothermia the aim of the actual treatment is rewarming the body core first.

205a.
HOLMER, I., and U. Bergh.
Metabolic and thermal responses to swimming in water at varying temperatures.
J. Appl. Physiol. 37(5):702-705; 1974.

Five male subjects performed the 20-minute submaximal and 5- to 8-minute maximal swimming. Esophageal and muscle temperature, oxygen uptake, heart rate, and blood lactate were determined when water was 18°C, 26°C, and 34°C, respectively. Lean subjects suffered a 0.2-1.6°C decrease in esophageal temperature during submaximal swimming in 18°C water. A relationship between individual skin-fold thicknesses and change in esophageal temperature during submaximal swimming in 18°C and 26°C was noted. In 18°C water, oxygen uptake at a given swimming velocity was elevated by approximately 0.5 l/min compared with swimming in the warmer water. During maximal swimming in water at 18°C, three lean subjects with esophageal temperature lower than 37°C produced lower temperatures compared with highest value measured in swimming. Heart rate during maximal swimming was linearly related to esophageal temperature. During maximal running on a treadmill, all subjects attained higher values compared with maximal swimming.

205b.
HONG, S.K.
Pattern of cold adaptation in women divers of Korea (ama) [1,2].
Federation proceedings 32(5):1614-1622; May 1973.

Pattern of cold adaptation in ama who daily dive in water of 27-28 C in summer and of 10 C in winter has been systematically studied from 1959 to 1969. The total extra heat loss for diving work is estimated to be 1,000 kcal/day throughout the year. The following adaptive phenomena to cold are found in Korean ama as compared with nondiving Korean women: 1) a consistent, reversible increase in basal metabolic rate of ama in winter (i.e., metabolic adaptation), which seems to be associated with increased utilization of thyroid hormone; 2) a very small (but significant) increase in $\dot{V}o_2$ in response to exogenous norepinephrine in winter; 3) a lower critical water temperature at a comparable subcutaneous fat thickness throughout the year (i.e., insulative-hypothermic adaptation); 4) a significantly greater maximal thermal insulation at a comparable subcutaneous fat thickness throughout the year; 5) a lower heat flux from the limb coupled with a higher blood flow throughout the year during whole-

body immersion in water of critical temperature, suggesting a more efficient countercurrent heat exchange system in the limb; and 6) a lower finger skin temperature and blood flow in winter during hand immersion in 6 C water (i.e., vascular adaptation). These results indicate that the basic pattern of cold adaptation in man is qualitatively similar to that observed in other homeothermic animals.

205c.

HONG, S.K.

Comparison of diving and nondiving women of Korea.

Reprinted from Federation Proceedings 22(3):831-833; May-June 1963.

Studies of the temperature regulation of the Korean women divers have been carried out during various seasons of the year and the results may be summarized as follows: (1) The oral temperature was lowered by 2-4 C during the course of a dive. The magnitude of reduction was greatest in the winter and was least in the summer. (2) The BMR underwent a characteristic seasonal variation in which it was elevated greatly during the winter but was at the normal level in the summer. In general, the BMR were inversely related to the sea water temperature. (3) Shivering threshold was considerably elevated in the divers as compared to nondiving females in both the summer and the winter. (4) The maximal tissue insulation, I, was elevated in the winter in the ama, indicating the development of vascular adaptation. However, it was the same as the nondiving females in the summer. (5) The shivering threshold of the nondiving females was elevated as compared to the males. Moreover, the maximal tissue insulation of the nondiving females was on the average greater than that of the males. This may account for the lack of male divers.

206.

HORTON, G.M.J.

Lamb production, feed utilization, and hematologic and blood chemical changes in sheep exposed to cold.

Am. J. Vet. Res. 39(11):1845-1849; Nov. 1978.

The effects of environmental temperature on the utilization of low- (straw) and high- (barley) energy rations by sheep were studied in 2 experiments. The digestible energy contents of the straw and barley rations were 8.54 and 12.68 MJ/kg of feed, respectively. In experiment 1, 56 pregnant ewes were fed the straw or the barley rations ad libitum at mean ambient temperatures of -14 and 13C in a 2 x 2 factorial experiment. The trial commenced on approximately day 35 of gestation and was terminated when the ewes' lambs were 84 days old. Low temperature exposure had no adverse effect on ewe or lamb performance. Twelve wethers were fed straw and barley rations in experiment 2 to study the effects of -17.8, 0.8, and 18.3C temperatures on feed utilization and hematologic changes. Wethers consumed similar amounts of digestible energy on both straw- and barley-based rations at each of the 3 temperatures. The apparent digestibilities of dry matter, crude protein, crude fiber, and [illegible] energy increased as temperatures decreased. Hematologic values were within the limits for norm[illegible] d both rations at the 3 ambient temperatures. Triglyceride values at -17.8C were decreased b[illegible] 39% on the straw and barley rations, respectively, and although serum urea nitrogen value[illegible] were [illegible] ($P < 0.01$) in wethers fed the straw ration, responses to changes in temperature were inconsistent. Neither thyroxine nor protein-bound iodine was increased at lower temperatures, but they were higher ($P < 0.01$) in wethers fed the barley ration. Changes in total serum protein ($P > 0.05$) and protein fractions ($P < 0.01$) were of doubtful biological importance.

207.
HOULSBY, W.T.
Accidental hypothermia and low-reading thermometers [letter].
Br. Med. J. 1(6173):1284; 12 May 1979.

While agreeing with Professor Gordon L Mills (21 April, p 1082) that a low-reading thermometer is useful in detecting and indeed essential for diagnosis of hypothermia I would suggest that those most sensitive of diagnostic tools the hands are just as useful in detecting variations from normal body temperature. While a patient with a normal core temperature may have cool extremities owing to poor peripheral perfusion, palpation of the trunk will in nearly all cases alert the clinician to the presence of abnormal body temperature. If the hand is inserted between the patient and the bed on which he lies the impression is more accurate than that gained by feeling exposed parts. The suspicion of either fever or hypothermia should then be checked with a suitable thermometer.

208.
HOVE, K. and J.B. Steen.
Blood flow, calcium deposition and heat loss in reindeer antlers.
Acta Physiol. Scand. 104(1):122-128; 1978.

Antler blood flow was studied in a 2 yr old male reindeer during the last half of the antler growth period using an electromagnetic flow probe chronically implanted around the superficial temporal artery. Arteriovenous (a-v) differences of Ca were measured on antler blood. The blood flow increased from 60-90 ml/min when the antler was half-grown to 100-120 ml/min when fully developed. Subsequently a reduction was observed towards shedding. Positive a-v plasma Ca differences (on average 0.2 m*M*) were recorded during the period of active growth. Bulls (2) maintained positive a-v Ca differences after a 48 h starvation period despite of reduced arterial Ca concentrations. Exercise to near exhaustion caused a 2°C rise in the rectal temperature. Antler blood flow was decreased immediately after exercise and returned to pre-exercise values usually within 5-10 min. No overshoot in antler blood flow was recorded during hyperthermia; variations in blood perfusion of the antlers are unimportant in the defense against hyperthermia during and after exercise.

209.
HRUSKA, A.
Hypothermal damage.
Rozhl. Chir. 57(7):452-461; July 1978.

The authors report on the causes, pathophysiology, first aid and treatment of damage caused by hypothermia. They emphasize the great importance of competent first aid and early onset of treatment for favorable final results. The report is supplemented by an instructive case report from the literature and the author's own clinical material. Advantages of new therapeutic procedures in severe frostbite are described.

210.
HSUEH, W.A., J.A. Luetscher, E. Carlson, G. Grislis, D. Elbaum and M. Chavarri.
A comparison of cold and acid activation of big renin and of inactive renin in normal plasma.
J. Clin. Endocrinol. Metab. 47(4):792-799; 1978.

Normal human plasma contains inactive renin, whose ability to generate angiotensin I increases after exposure to pH 3.3. Big renin is a partially inactive enzyme of larger MW, which is also activated at pH 3.3, and is found in plasma of patients with nephropathy, in plasma of pregnant women and in amniotic fluid, but not in normal plasma. The effects of acid exposure and storage at 4 and -4°C on normal plasma and plasma containing big renin were compared. The concentration of inactive renin in normal

plasma was approximately equal to that of normal active renin, and its activity increased slowly on prolonged standing at -4° but not 4°C. The activity of big renin increased by 50% as early as 1-3 days at 4°C and increased even more quickly at -4°C. Acid treatment of plasma containing big renin caused 4-10 times greater increase in active renin than similar treatment of normal plasma. During gel filtration, both cold-activated and previously acidified big renin coeluted with unactivated big renin. Big renin is highly susceptible to cold or acid activation and such activation of big renin does not result in a detectable decrease in its MW of 60,000 daltons. Acid and cold seem to activate the same pool of inactive renin in normal plasma. Although both normal and big renin are stable for long periods below -20°C, a serious overestimate of plasma renin activity can occur if plasma is stored just above its freezing point before assay.

211.

HUNDHAUSEN, E. and B. Theves.

Die Berechnung von thermisch bedingten Durchblutungsanderungen im Finger unter Benutzung thermographischer Hauttemperaturmessungen.

[Calculation of thermally caused blood flow changes in a finger using thermographic skin temperature measurements].

Eur. J. Appl. Physiol. 40(4):235-244; 1 Mar. 1979.

The skin temperature changes of the third finger were registered with the help of an infrared camera during a cooling process of the hand and forearm of a male, 38-year-old subject. Using the system of formulae, explained in previous publications [4-7], it was possible to describe the blood flow changes in the finger. The results are: 1) A formula for the "pseudo thermal conductivity" (material constant of the thermal conductivity plus the convective contribution), which is similar to the formula used for heat release of the whole body [4], describes well the experimental results. The "pseudo thermal conductivity" is a measure for the specific blood flow and can be converted into it. 2) The "pseudo thermal conductivity" has a local maximum. 3) The position of the maximum is independent of the tissue temperature. The anatomical properties of the finger seem to determine the position of the maximum. 4) The maximum of the "pseudo thermal conductivity"--and therefore the maximal blood flow--increases stronger than linearly with the tissue temperature.

212.

HUNT, P.K.

Effect and treatment of the "diving reflex."

Can. Med. Assn. J. 111:1330-1331; Dec. 21, 1974.

A case is described of a five year old boy who fell through ice into a river and remained immersed as he was carried downstream. He was pulled out ½ hour later. The water was between 0 and 1°C. He was stiff and deeply unconscious, his skin was bright pink and his heart rate was between five and ten beats per minute. Mouth to mouth resuscitation was given immediately, and he was warmed with blankets and hot water bottles until a 45°C bath could be prepared, in which he was repeatedly immersed for 10 minutes at a time. The unfavorable after effects included nystagmus and reduced motor power in his limbs and extremities. He returned to normal eventually, after some months. The fact that he had inhaled so little water is commented upon. The diving reflex is particularly well-developed in small children. Elevated serum values of LDH and alkaline phosphatase indicated cold damage to liver tissue. (MFW/UMS)

213.

HUTTUNEN, P. and V. Kinnula.

Effects of catecholamine treatment as well as cold exposure on mitochondrial enzyme activities of the adipose tissue in a guinea pig (*Cavia porcellus*).

Comp. Biochem. Physiol. [C] 63C(1):13-16; 1979.

1) Catecholamine treatment at room temperature elevated the mitochondrial protein content and total activity of succinate dehydrogenase and cytochrome oxidase in adipose tissue of guinea pigs, *Cavia porcellus* as did cold exposure, but changes were not so marked as in cold. 2) As with cold exposure the specific activity of cytochrome oxidase was increased but not that of succinate dehydrogenase by catecholamine treatment. 3) The specific activity of succinate dehydrogenase was, however, higher in the catecholamine-treated than in the cold-exposed animals. 4) The results show that exogenous catecholamine treatment had quite similar effects on the adipose tissue to those of cold, i.e. increased oxidative capacity of the tissue.

213a.

IAIZZO, P.A., R.W. Petry and R.S. Pozos.

An electromyographic study of shiver in immersed human subjects.

In: 7th symposium on underwater physiology, Undersea Medical Society annual scientific meeting, European Undersea Biomedical Society annual meeting, July 5-10, 1980, Athens, Greece. Programs, abstracts and mini-papers, p.19. Bethesda, Md. Undersea Medical Society, 1980.

Abstract only. Entire item quoted: Although shivering is an intense muscular activity, relatively little attention has been paid to an analysis of the frequency and amplitude of electromyograms (EMG's) from the involved musculature. Therefore, this study was undertaken to quantitate such parameters and also to determine the muscle or group of muscles which first demonstrate electrical activity in response to immersion into cold water (15-19°C). Bipolar surface electrodes were placed on the following muscles: masseter, trapezius, pectoralis major, rectus abdominus, external oblique, latissimus dorsi, quadraceps, soleus, biceps, triceps, deltoids, and gluteus maximus. The EMG's were recorded on a Hewlett Packard FM tape recorder for later frequency and amplitude analysis on a PDP-12 digital computer linked to a CDC Cyber 171. The records were taken before, during, and after immersion. The core temperature was monitored using both rectal and tympanic measurements. In addition, peripheral temperatures were recorded from selected locations using Bailey surface thermocouples. Initial results indicate that the predominant frequencies of oscillation appear in several bands between 5-12 Hz. Cross correlation analysis indicates that the muscles were not firing in phase. Further, in this study the observed shiver was due to a drop in peripheral temperature without a significant drop in the core temperature. In several subjects inspiration increased the amplitude of shiver. These findings may provide additional information concerning spinal and supra-spinal control of shiver.

213b.

IAMPIETRO, P.F., R.F. Goldman, E.R. Buskirk, and D.E. Bass.

Response of negro and white males to cold.

J. Appl. Physiol. 14(5):798-800; 1959.

Heat production and body temperatures were measured in matched groups of U.S. Negro and white soldiers during whole body cooling and finger temperatures were measured when only the digits were cooled. Whole body cooling was accomplished by having the subjects, clad only in shorts, sit for 2 hours in a chamber at 50°F with a 5 mph wind. Digital cooling was accomplished by having the subjects immerse the fingers in a water bath at 32°F for 45 minutes. During whole body cooling there were no group differences with respect to the following: heat production, skin and rectal temperatures. During digital cooling white subjects had higher finger temperatures and the 'hunting' reaction was more pronounced than for Negroes. In addition, the white subjects required a shorter period for the onset of the first 'rewarming' of the fingers. The implications of these findings with reference to the reported higher incidence of cold injury among Negro soldiers are discussed.

213c.

IAMPIETRO, P.F., R.F. Goldman, M. Mager, and D.E. Bass.

Composition and caloric density of weight loss during caloric restriction in cold.

J. Appl. Physiol. 16(4):624-626; 1961.

Two groups of six men each lived for 14 days in a cold chamber at 60°F (15.6°C); activity was sedentary and only athletic shorts were worn. During this period one group, A, was semi-starved (600 kcal/day) and the other, B, was completely starved (o kcal/day). Changes in body composition were measured and caloric density of weight loss was calculated. Mean weight loss was 5.66 kg for A, and 8.56 kg for B. Composition and caloric density of weight loss was almost identical for both groups. Composition of weight loss with regard to fat, protein and water was 39, 10, and 51% for A; 39, 11, and 49% for B. Caloric density was 3.91 kcal/g for A and 4.06 kcal/g for B.

213d.

IAMPIETRO, P.F., J.A. Vaughan, R.F. Goldman, M.B. Kreider, F. Masucci, and D.E. Bass.
Heat production from shivering.
J. Appl. Physiol. 15(4):632-634; July 1960.

Healthy young men were exposed, nearly nude, for 2 hours or less to various environmental conditions (dry-bulb temperature, 90°-20°F; windspeed, < 1, 5, 10 mph). Oxygen consumption was recorded at intervals during exposure. The results show that even under conditions where no visible shivering was observed, there was an increase in heat production. Exposure to very low temperatures (20°F) with low winds did not evoke the largest increases in heat production. The greatest mean heat production (370 Cal/hr) was associated with the highest windspeed (10 mph), and this value approached the maximum heat production which can be attained by shivering (mean value about 425 Cal/hr). Thus, increasing the windspeed had a relatively greater impact on heat production than decreasing the dry-bulb temperature. The relationships between heat production and windspeed and heat production and dry-bulb temperature were nonlinear.

214.

INAMDAR, A.R., M. Rau and T. Ramasarma.
Effect of dietary protein status on the activities of hepatic tryptophan pyrrolase and tyrosine aminotransferase and their induction.
Indian J. Exp. Biol. 16(5):577-581; 1978.

There is a differential response of changes in activities of tryptophan pyrrolase (TPY, EC 1.13.1.12) and tyrosine aminotransferase (TAT, EC 2.6.1.5) when feeding low-protein diets to rats. TPY activity decreased considerably with progressive feeding of a low-protein diet while that of TAT remained unaffected. Induction of these 2 enzymes could still be elicited in rats fed a low protein diet on exposure to hypobaria or cold stress or on hydrocortisone treatment. Gelatin, known to be deficient in tryptophan, fed to rats at a level of 20% in the diet, resulted in low TPY levels and high TAT levels. Induction of both enzymes in gelatin-fed animals could be elicited by hydrocortisone treatment but not by exposure to either stress condition, suggesting that corticosteroid production obtained on exposure to stress may be adversely affected in these animals. Exposure to chronic cold stress of rats simultaneously fed low-protein diet for 8 days failed to stimulate activities of both enzymes; continued cold exposure and feeding for 28 days induced TPY but not TAT.

215.

JACOB, A.I., E. Lichstein, S.D. Ulano, K.D. Chadda, P.K. Gupta and B.M. Werner.
A-V block in accidental hypothermia.
J. Electrocardiol. 11(4):399-402; Oct. 1978.

His bundle ECG was performed on a patient with accidental hypothermia on whom the standard ECG showed absent P waves, prominent J waves and a slightly irregular rhythm. Sino-ventricular conduction and a prolonged AH [atrial-His] interval not responsive to atropine were found. These abnormalities reversed with rewarming.

216.

JACQUEMIN, C., P. Varene and J. L'Huillier.

Aspects respiratoires de l'environnement thermique hyperbare.
[Respiratory aspects of the hyperbaric thermal environment].
J. Physiol. (Paris) 63:293-295; May 1971.

The authors attempt to develop a predictive equation of the specific heat of a ventilated gas as a function of the environment and of the activity of the subject. The experimental side of this study comprised an attempt to measure T_{ex} - T_{in} (where T_{ex} = temperature of exhaled gas and T_{in} = temperature of inhaled gas) by means of thermocouples temporarily lodged in the esophagus. Experiments were carried out at 1 and 5 Ata, at rest, in normal and hyperpnea induced by the inhalation of dry gaseous mixtures. No correlation was found between T_{ex} and ventilation, but T_{ex} appeared to be a function of the first degree of T_{in}, as shown in Figure 1 (p. 294). The study of esophageal temperatures also enabled the authors to describe exactly the mechanisms of this thermal exchange: they conclude that, in man at least, the pulmonary thermal exchanger is controlled by the gas-exchange regulatory system, not by the thermo-regulatory system. A constant alveolar temperature is maintained by means of heat exchanges between the inhaled gases and the surrounding tissues of the respiratory tract. (MEH/BSCP)

217.

JAKOBSON, M.E.

Winter acclimatization and survival of wild house mice.
J. Zool. 185(1):93-104; 1978.

If an animal is physiologically adapted to its environment, it is more likely to survive than if it is not. The relation between physiology and survival in the wild has been studied in an island population of the house mouse (*Mus musculus* L.) during 2 winters. Multiple regression analyses showed that significant information on survival was obtained from several measures of cold acclimatization (e.g., metabolism within the thermoneutrality, metabolism under cold stress, and hematocrit), though little came from a measure of non-shivering thermogenesis (noradrenaline (norepinephrine) sensitivity). The predictive value of the multiple regression calculated in any 1 yr was low when applied to another, though similarities in the physiology of survival were present. The survival of a mouse will result from the interaction of many facts of its biology with its environment: in nature it is rare for either of these to remain constant from year to year.

217a.

JANSKY, L., E. Funke, and J.S. Hart.

Analysis of electromyograms in shivering.
Physiologia Bohemoslovaca 19, 397-402; 1970.

Power spectral density analysis of electromyograms from five muscle groups (neck, side, back, front and hind leg muscles) of shaved rabbits exposed to different temperatures (+28, +12, -3, -12, -18°C) shows a frequency range of 10 to 350 Hz, the maximal power being at frequencies 50–100 Hz. No substantial differences have been found in frequency components of electromyograms from different muscle groups and at different temperatures. Subcutaneous temperatures do not reflect changes in electrical activity of muscles, however an indirect relationship exists between average subcutaneous temperatures and average intensity of shivering in one-hour experiments. The anterior parts of the body produce more electrical activity than the back and the hind leg.

218.

JANSSENS, W.J. and P.M. Vanhoutte.

Instantaneous changes of alpha-adrenoceptor affinity caused by moderate cooling in canine cutaneous veins.
Am. J. Physiol. 234(4):H330-H337; 1978.

Experiments were performed to investigate why cooling augments the contractile responses of superficial

veins but depresses that of deep limb veins. Rings of dog's saphenous veins were mounted in an organ chamber for isometric tension recording. Cooling (from 37 to 24°C) depressed the tissular uptake of [^{3}H] norepinephrine and potentiated the contraction caused by norepinephrine and sympathetic nerve stimulation. Potentiation persisted after inhibition of the disposition mechanisms for catecholamine and ouabain or iproveratril. The affinity of the α-adrenoceptors, to judge from the K_A values for norepinephrine and from the pA_2 (negative log of molar concentration of the antagonist which increased the ED_{50} by 2) values for the competitive antagonist phentolamine, was significantly greater at 24°C than 37°C. An instantaneous change in the affinity of α-adrenoceptors explains the augmented response of the cutaneous veins to adrenergic stimulation. By contrast, cooling depressed the response of femoral veins to norepinephrine and did not significantly affect the affinity of α-adrenoceptors in this preparation. This indicated that the temperature sensitivity of α-adrenoceptors in cutaneous veins was related to chronic exposure to variations in local temperature.

219.

JANSSENS, W.J. and P.M. Vanhoutte.

Effect of cooling on efflux of [^{3}H]-noradrenaline in canine cutaneous veins.

Br. J. Pharmacol. 66(1):148P; May 1979.

In the dog saphenous vein, moderate cooling augments the constrictor response to exogenous noradrenaline (Venhoutte & Shepherd, 1970). This augmented response is due to the increased affinity of the alpha-adrenoceptors of the venous smooth muscle cells for the catecholamine (Janssens & Vanhoutte, 1978). In the same preparation, the contractile response to sympathetic nerve stimulation is also augmented by moderate cooling (Vanhoutte & Shepherd, 1970), although in veins previously incubated with [^{3}H]-noradrenaline the overflow of labelled transmitter is depressed (Vanhoutte & Verbeuren, 1976). The present experiments were performed to try to explain this discrepancy. Isolated strips of dogs' saphenous veins were incubated with [^{3}H]-noradrenaline, mounted for isometric tension recording, and superfused with Krebs-Ringer solution (Venhoutte, Lorenz & Tyce, 1973). The amounts of intact labelled transmitter and its metabolites present in the superfusing fluid were determined by column chromatography (Verbeuren, Coen & Vanhoutte, 1977). Since the neuronal uptake of noradrenaline is depressed by moderate cooling (Janssens & Vanhoutte, 1978), all experiments were performed in the presence of cocaine (3×10^{-5} M). In basal conditions, cooling from 37 to 24°C caused a decrease

219a.

JEGOU, A.

Deep diving and cold water – some practical results.

In: The working diver, 1972, Symposium proceedings, February 1972, Columbus, Ohio, p.127-143; Washington, D.C., Marine Technology Society, 1972.

Foundation COMEX, a new Canadian Company, was chosen by Tenneco Oil and Minerals, Ltd., to furnish diving assistance during Tenneco's 1971 summer operations off the coast of Labrador (Canada) with the drilling vessel Typhoon belonging to the Storm Drilling Co. Despite very adverse conditions, including a water depth of 570 ft. a bottom water temperature of 30°F., bottom currents up to one knot, and danger of icebergs, all required underwater operations were successfully carried out. The deep diving equipment had to permit saturation diving (at least very long decompression) and back-to-back bounce dives, and it had to be usable without guidelines in case of necessity. Last, but not least, it had to suit available space. The personnel were carefully selected and trained for the job. Before the beginning of operations, all divers were tested in wet and dry pressure chambers in Marseilles, France, simulating 660 ft. of depth in water of 28°F. The decompression procedures specially computed are quick and safe for optimum utilization. The key factor in making this a successful performance was the utilization of a new type of individual diving rig by the divers. The equipment was developed basically for a saturation dive at 840 ft. and it has been improved during a series of tests under the conditions mentioned above (660 ft. and 28°F.). The divers have worked in water for 70 minutes, though this is not a limit. The special individual equipment consists of (a) a constant-volume dry suit; (b) an electrically heated undergarment with a low voltage supply controlled by the diver; (c) an electric gas heater maintaining a constant gas-inhalation temperature. (Author's abstract)

in tension and in the efflux of [^{3}H]-noradrenaline and its metabolites; this was seen both in the control solution and in the presence of phentolamine (3×10^{-6}M) and yohimbine (3×10^{-7}M). Electrical stimulation (2 Hz) caused an increase in tension and in efflux of tritiated compounds; cooling (from 37 to 24°C) augmented the contractile response, but depressed the efflux of tritiated transmitter and its metabolites. In the presence of phentolamine or yohimbine, cooling still decreased the efflux of tritiated compounds. Increasing the K^+ concentration from 5.9 to 50 and 120 mEq/l caused release of [^{3}H]-noradrenaline; in these conditions cooling from 37 to 24°C decreased the efflux of [^{3}H]-noradrenaline and its metabolites significantly more than during electrical stimulation. The present experiments indicate that: 1) unlike the augmented response to exogenous noradrenaline, the decrease in neurotransmitter overflow caused by cooling cannot be explained by an increased affinity of the prejunctional alpha-adrenoceptor, since it persisted in the presence of both a specific (yohimbine) and a non-specific (phentolamine) presynaptic alpha-adrenergic antagonist; and 2) since the contractile response to nerve stimulation is augmented to the same extent by cooling as that to exogenous noradrenaline, the decrease in tritiated overflow noted in the present experiments with cooling may not reflect the effect of the latter on the synaptic cleft concentration of the adrenergic transmitter.

220.

JENKINS, W.T.

A summary of diving techniques used in polar regions.

U.S. Nav. Coastal Syst. Lab., Preliminary Rep. under ONR Res. Proj. RF 51-523-101, 100p. July 1973.

The contents of this manual are as follows: Chapter 1 – Introduction: Purpose and scope, Background, The environment, Thermal protection; Chapter 2 – Logistics: General, Ground transportation, Air transportation, Surface Effect Vehicles (SEV's); Chapter 3 – Equipment: Exposure suits, Regulators, Diver support; Chapter 4 – Operational: Dive plan, Water entry/exit, Navigation, Emergency procedures; Chapter 5 – Biomedical: Physiological stress, Types of cold injury, Prevention of cold injury, Selection of personnel, Psychological stress. The report concludes with an extensive bibliography and a glossary. (MFW/BSCP)

221.

JENKINS, W.T.

A guide to polar diving.

U.S. Navy Dept. Off. Nav. Res., 135p. Sept. 1974.

The contents of this report are as follows: I. Introduction: Purpose and scope, Background, The environment, Thermal protection; II. Logistics: General, Ground transportation, Air transportation; III. Equipment: Exposure suits, Regulators, Diver support; IV. Operation 1: Dive plan, Navigation, Emergency procedures; V. Biomedical: Physiological stress, Type of cold injury, Prevention of cold injury, Selection of personnel, Psychological stress; Bibliography; Glossary. (MFW/UMS)

222.

JENKINS, W.T.

Diving in the harsh Arctic environments.

Ocean Ind. 10:363, 366, 371, 374; Apr. 1975.

One answer to the problems of diving in Arctic waters is the variable volume dry suit. This type of suit has attached boots and hood, waterproof zipper and waterproof seals at wrists and neck. A source of air is supplied which enables the diver to inflate his suit. By operating inlet and exhaust valve, the diver can maintain complete buoyancy control. This suit affords protection both in the water and in the air. Another problem is the tendency of the breathing regulator to malfunction due to cold. Two-hose regulators cause less trouble than single-hose regulators. Rubber "arctic cups" filled with antifreeze, which fit over the first stage adjusting spring housing has proved effective. More advanced support equipment in lighting, navigation, communications and operational techniques are needed. Such problems are means

of transportation to dive site, types of shelters required at the work site, ice-cutting equipment, type of vehicles to be used for logistic support (air-sea-land combined, usually) confront the Arctic dive operator. Constant research and testing of equipment in Arctic waters is essential. (MFW/UMS)

223.

JENKINS, W.T.

A guide to polar diving.

U.S. Nav. Coastal Syst. Lab., Rep. for Off. Nav. Res., 89p. June 1976.

This report brings together data from various Arctic diving experiments. Various techniques and equipment are discussed, along with aspects of medical and logistic support. The contents are as follows: I. Introduction: 1) Purpose and scope, 2) Background, 3) The environment, 4) Thermal protection; II. Logistics: 1) General, 2) Ground transportation, 3) Air transportation; III. Equipment: 1) Exposure suits, 2) Regulators, 3) Diver support; IV. Operational: 1) Dive plan, 2) Navigation, 3) Emergency procedures; V. Biomedical: 1) Physiological stress, 2) Types of cold injury, 3) Prevention of cold injury, 4) Selection of personnel, 5) Psychological stress. The report concludes with a bibliography and a glossary. (MFW/UMS)

224.

JESCH, F., U. Pohl, L. Sunder-Plassmann, R. Dieterle, U. Loehrs and K. Messmer.

Hypothermic circulatory arrest after total blood exchange in dogs.

Res. Exp. Med. 173(1):67-88; 1978.

Total body washout (hct [hematocrit] $< 1\%$) in hypothermia was performed in 31 dogs using either a crystalloidal or a collodial perfusate. Blood exchange and cooling was achieved by partial bypass and heat exchanger. Short lasting blood exchange for crystalloids without cardiac arrest resulted in 66% survival of the animals. When circulatory arrest was also established for 30 min at 14°C esophageal temperature, blood exchange for crystalloids was not tolerated. All 4 animals of this group died within 19 h presenting massive interstitial edema. Replacement of the crystalloidal perfusate by a colloidal solution (2.5 g% Dextran 60 in Ringer's Lactate) and establishing circulation for 30 or 60 min resulted in survival rates of 71 and 50%, respectively. The use of the collodial perfusate effectively prevented edema formation. Death could not be correlated with the parameters controlled.

225.

JESSEN, K., and J.O. Hagelsten.

Peritoneal Dialysis in the Treatment of Profound Accidental Hypothermia.

Av. Space and Env. Med. 49:426-429; 1978.

Profound accidental hypothermia is an unintended lowering of the body temperature below 30°C caused by exposure to cold and/or wet surroundings. In the treatment of this dangerous condition, an "after-drop" of the body-core temperature should be avoided, as should the development of hypopotassaemia, which can be very pronounced during the rewarming period. Successful treatment of profound hypothermia requires: 1) rapid rewarming with fluid, 2) central rewarming to avoid after-drop, 3) rapid correction of electrolyte balance, particularly potassium, during rewarming, 4) elimination of toxic agents during rewarming since many patients are hypothermic because of drug-overdosage, 5) related symptomatic treatment, such as artificial ventilation, external cardiac massage, defibrillation, etc., and 6) no part of the treatment should, per se, expose the patient to severe risk. Peritoneal dialysis is a very effective method to rewarm the body-core in advance of the shell. It is possible to correct "automatically" the hypopotassaemia by use of a dialysate with a normal content of potassium and, at the same time, remove toxic agents from poisoned patients. In most modern hospitals, this treatment can be instituted quickly and easily, it does not interfere with other symptomatic treatment, and it is almost without risk while it offers many therapeutic advantages for these high-risk patients. Some examples of cases treated successfully by this method are described. Peritoneal dialysis is recommended for the treatment of profound accidental hypothermia when the body-core temperature is below 30°C.

225a.

JESSEN, K., and J.O. Hagelsten.
Search and Resue Service in Denmark with special reference to accidental hypothermia. Aerospace Med. 43:787-791; 1972.

The S-61 helicopter in use has a maximal capacity of 15 stretchers with access to every head. During a 5-year period since 1966 the Helicopter Squadron of the Royal Danish Air Force has accomplished 1,148 missions, 90% of which has a civilian character, now with about 300 yearly missions, equally spread on the three air bases. A physician joined the crew in about 25% of the missions. Because of the very cold sea surrounding Denmark special attention has been paid to accidental hypothermia, i.e., an unintentionally lowering of the body temperature in a previously conscious person due to exposure. Slow rewarming was previously recommended in general to avoid "rewarming collapes" due to asystole or ventricular fibrillation. However, if the body core temperature is lower than 30°C, (86°F.) it seems more rational to rewarm the central parts and especially the neck region actively, for exampe in a bath tub, while the extremities should not be heated. Special probelms are considered concerning death criteria in hypothermia persons.

226.

JOHNSON, C.E., M.L. Nuckols and P.A. Clow.
Hyperbaric diving systems and thermal protection. OED Vol. 6.
New York, N.Y., American Society of Mechanical Engineers, 1978. 149p.

This volume is made of papers presented at two sessions of the 1978 Winter Annual Meeting of the American Society of Mechanical Engineers. This was an interdisciplinary symposium in which ideas and concepts were exchanged among research engineers, engineering scientists, applications engineers, and medical and physiological scientists and practitioners, in the interest of improving diving safety and performance. Individual papers will be found under the following author entries: Audet, N.L., G.M. Orner and Z. Kupferman; Chetta, G.E. and J.R. Colston; Doerschuk, D.C.; Kuehn, L.A. and K.N. Ackles; Nishi, R.Y.; Nuckols, M.L.; Riegel, P.S. and G.H. Alexander; Wattenberger, J.F. and J.R. Breckenridge; Wissler, E.H.; Zumrick, J.L. (MFW/UMS)

227.

JOHNSON, D.G., J.S. Hayward, T.P. Jacobs, M.L. Collis, J.D. Eckerson and R.H. Williams.
Plasma norepinephrine responses of man in cold water.
J. Appl. Physiol. 43:216-220; Aug. 1977.

The hypothermic stress of immersion in cold water stimulates release of norepinephrine from the sympathetic nervous system. The speed and pattern of this response was studied in six healthy men by serial measurements of plasma norepinephrine concentrations before, during, and after 60 min of immersion in 10°C water. After immersion for 2 min, the mean norepinephrine concentration was increased from 359 ± 32 (basal) to 642 ± 138 pg/ml and rose gradually to a maximum of 1,171 ± 226 pg/ml after 45 min of immersion. Metabolic rate increased approximately threefold during the immersion period. After rewarming in warm water (40°C), the subjects showed a transient peak in plasma norepinephrine followed by a rapid decrease to basal levels after 30 min. The fall in plasma norepinephrine after approximately 8 min of rewarming occurred despite persistent depression of the core temperature and coincided with a sudden decrease in metabolic rate and cessation of body shivering. These results suggest that the sympathetic nervous response to cold can be activated or suppressed very quickly and is dependent on the skin temperature. (Authors' abstract)

228.

JOHNSON, D.J. and F.E. Leider.
Influence of cold bath on maximum handgrip strength.
Percept. Motor Skills 44:323-326; 1977.

12 female college students participated in a repeated-measures experiment, receiving an experimental treatment and a control treatment. The former was a 30-min. cold bath to the forearm while the control was a similar 30-min. period without the cold bath. Subjects' maximum handgrip strength was measured 11 times, immediately prior to treatment, immediately following treatment, and then every 20 min. for 3 hr. The subjects were tested at the same time of the day, on the same day of the week, for two consecutive weeks. Grip strength was significantly decreased immediately following the experimental treatment below pre-treatment measures and post-treatment measures for the control session. Grip strength during the experimental session significantly increased at 80 min. post-treatment when compared to the strength measures for the control at the same time interval or when compared to pre-treatment measures for either treatment. The strength measures for the two treatments remained significantly different over the rest of the testing occasions. (Authors' summary)

229.

JOHNSON, M.A., J. Owers and S.P. Horwood.

Air transport of infants in Newfoundland and Labrador.

Can. Med. Assoc. J. 119(2):127-134; 1978.

Air transportation of 33 infants in small, depressurized aircraft over long distances was described. Of the infants, 26 were transported more than 320 km in environmental temperatures varying from -35-+21°C. A commercially available incubator was used. Although more than half the infants had a rectal temperature within the normal range at the time of arrival at hospital, 12 infants had rectal temperatures above 37.5°C, a result of efforts to diminish heat loss. Adequate oxygenation of infants at 3000 m in depressurized aircraft was difficult. Cold and vibration can affect equipment, and at high altitudes readings from O_2 analyzers may not be correct. The use of an expanded transport team, which included experienced nonmedical personnel, was particularly important in these cases.

230.

KAKOS, G.S., P.E. Karayannacos, J.F. Cornhill, J.W. Kilman and J.S. Vasko.

Global cardiac ischemia in the hypertrophied heart: effects of hypothermia and beta-adrenergic blockade on ventricular function.

Surg. Forum 28:237-239; 1977.

The data suggest that hypothermia alone produces less functional myocardial depression than hypothermia plus moderate β-adrenergic blockade in the immediate postarrest state following cardiopulmonary bypass in this model of LV hypertrophy. LV function and EVR were negatively affected in the β-blockaded animals to a greater degree than in the hypothermia-alone group (with each animal acting as its own control). While this might suggest alterations in degree of myocardial preservation, a dose-time relationship to circulating propranolol could be directly affecting these data. (Authors' conclusion)

230a.

KANTER, G.S.

Hypothermic Hemoconcentration.

Am. J. Physiol. 214(4): 856-859; 1968.

The purpose of this investigation was to examine the basis of hemoconcentration during hypothermia in dogs. Some 35 acute experiments on anesthetized dogs were conducted. All dogs were made progressively hypothermic by packing in ice and rectal temperature was reduced from normothermia control of 38 C to 27 C. In *series 1*, 10 dogs thus handled showed an increase in hematocrit of 28.6 ± 3.7%. Total protein determined by refractometry and by the biuret method showed respective increases of 9.4 ± 1.6% and 14.1 ± 1.4%. In *series 2*, two dogs were tested for 4 hr under normothermic conditions. Little change in hematocrit and total protein was found. In *series 3*, seven dogs were acutely splenectomized and treated as in *series 1*. The increase in hematocrit was 7.8 ± 1.5% while total protein increased 5.5 ± 2.1% and 4.7 ± 1.0% by the methods described above. Lastly, in *series 4*, four dogs chronically splenectomized and then tested as in *series 1* showed results similar to *series 3*. It may therefore be concluded that a major cause of hemoconcentration in hypothermic dogs is due to splenic contraction.

230b.

KANTER, G.S.

Regulation of Extracellular Potassium in Hypothermia.
Am. J. Physiol. 205: 1285-1289; 1963.

Reduction of rectal temperature by ice packing in anesthetized dogs resulted in a fall in plasma K potassium concentration in spite of the fall in arterial pH. Such a decrease in extracellular pH in normothermia would cause an increase in plasma K concension of renal acidification mechanisms in hypothermia, there occurred a K^+ for Na^+ exchange in the renal tubule with K^+ being excreted instead of H^+. It was expected that removal of renal function during hypothermia would allow the alteration in pH to cause an increase in extracellular K. Renal function was therefore removed by bilateral nephrectomy in five dogs and by ligation of both ureters in four dogs. Contrary to expectations, it was found that in the absence of renal function during hypothermia plasma K still fell markedly. No difference was found in the nephrectomized or ureter-tied dogs. It was proposed that in hypothermia, in the absence of renal function, some function of intracellular metabolism controlled extracellular K. Possibly intracellular pH decreased relatively more than did extracellular pH with a resultant movement of H^+ out of the cell and K^+ in. With renal function present in hypothermia, the influx of K into the cell seen in nephrectomized and ureter-tied dogs is reversed by the renal gradient which causes both a decrease in cellular and extracellular K.

230c.

KANTER, G.S.

Renal clearance of sodium and potassium in hypothermia.
Canada J. Biochem. and Physiol. 40:113-122; 1962.

The handling of sodium and potassium by the renal tubules at various levels of hypothermia was studied. Fourteen dogs were anesthetized with 30 mg/kg sodium pentobarbital. After suitable control clearance measurements, the rectal temperature was lowered progressively by ice-packing to about 25°C while renal clearances were continuously measured. Artificial respiration was not used. No change in plasma sodium was detected but plasma potassium fell significantly from a control value of 4.1 ± 0.09 meq/l. at 38°C to 3.4 ± 0.12 meq/l. at 25°C. Urine sodium concentration fell during exposure to cold while potassium concentration increased slightly. In spite of the marked fall in glomerular filtration rate (69.0 ± 3.1 ml/minute control to 17.0 ± 3.6 ml/minute at 25°C) the final urine flow at 25°C was slightly greater than that of control. The clearance ratios (in percentage) increased significantly, reflecting the marked decrease in tubular reabsorption: water, 0.49 ± 0.05 at 38°C to 2.02 ± 0.25 at 25°C; sodium, 0.47 ± 0.12 to 1.13 ± 0.27; potassium, 18.0 ± 2.6 to 54.0 ± 12.0. The difference in clearance ratio alterations is a reflection of the dissimilar effect of hypothermia on particular renal regulations.

230d.

KEATINGE, W.R.

The effect of repeated daily exposure to cold and of improved physical fitness on the metabolic and vascular response to cold air.
J. of Physiol. 157:209-220; 1961.

A group of men wearing only shorts and footwear sat or stood in air at 5.7°C for 7½ hr a day on 19 out of 21 days. Another group was given physical training in warm conditions during this time, except on the first and last days, when they kept still in the cold room. The basal metabolic rate did not change in either group, and no evidence was found that the men acquired any important means of increasing their heat production in the cold other than by increased muscle tone and shivering. Repeated exposure to cold generally increased the men's immediate metabolic response in the cold room, but it always decreased their metabolic rate at the end of a day in the cold and it increased the rate at which their rectal temperatures fell. These changes are attributed to central nervous adjustments. Physical training in the warm reduced the men's immediate metabolic response to the cold room and caused them to maintain rather higher forearm skin temperatures.

231.

KEATINGE, W.R., C. Prys-Roberts, K.E. Cooper, A.J. Honour and J. Haight.

Sudden failure of swimming in cold water.

Brit. Med. J. 1:480-483; Feb. 22, 1969.

To investigate the effect of cold water on swimming four men who declared themselves good swimmers were immersed fully clothed on separate days in water at 23.7° and 4.7°C. The time that they were able to swim in the cold water was much shorter than in the warm. The two shortest swims ended after 1.5 and 7.6 minutes, before rectal temperature fell, when the men suddenly floundered after developing respiratory distress with breathing rates of 56-60/min. The other cold swims, by the two fattest men, ended less abruptly with signs of general and peripheral hypothermia. It is concluded that swimming in cold water was stopped partly by respiratory reflexes in the thin men and hypothermia in the fat, and partly by the cold water's high viscosity. The longer swimming times of the fat men are attributed largely to their greater buoyancy enabling them to keep their heads above water during the early hyperventilation. The findings explain some reports of sudden death in cold water. It is clearly highly dangerous to attempt to swim short distances to shore without a life-jacket in water near 0°C. (Authors' summary)

232.

KEATINGE, W.R.

Survival in cold water.

Great Britain, Blackwell Scientific Publications, 1969. 131p.

The extreme hazards of cold water are emphasized. It is stated that even in the comparatively temperate waters of the British Isles, an hour or two is the limit of survival without special protection. The mechanism of body temperature control is explained, and the value of fat as an insulator is noted. A thin man might do best to remain still to conserve heat, while a fat man could continue swimming. Before immersion, care should be taken to put on as much clothing as possible, if survival suits are not available. Extreme cold causes dilation of peripheral blood vessels, which increases heat loss. Other factors of importance are age, drugs, alcohol, and acclimatization. Most effective therapy for hypothermia is immediate rewarming in a 40°C bath, under close surveillance. Death by drowning, and treatment following near-drowning are discussed, as is the rather rare phenomenon of sudden death following immersion in cold water, the cause of which has never been conclusively determined. (MFW/BSCP from review by S. Miles in Underwater Sci. Technol. J. 2(2):119; June 1970)

233.

KEATINGE, W.R.

The concept of hypothermia.

In: Proceedings of the cold water symposium, Toronto, May 8, 1976, p.15-17. Toronto, Royal Life Saving Society Canada, 1976.

Exercise during cold water immersion always increases heat loss because of increased muscle blood flow which carries heat from the heart to the limbs. Normally during cold water immersion (15°C or 59°F) blood flow to the skin and the fat beneath it stops due to vasoconstriction, leaving the surface area as an almost inert area of insulation. At colder temperatures (less than 12°C or 53°F) vasoconstriction fails. This is due to cold paralysis of peripheral blood vessels. External insulation can prevent this. Even ordinary clothing is a help—the thicker the better. Healthy people die during prolonged cold immersion because of tissue anoxia caused by excessive decrease in cardiac output. The other major hazard is ventricular fibrillation. Children lose heat very rapidly, boys faster than girls. Children afloat in cold water should always be rescued as soon as possible, boys first. Hypothermia is the main cause of death in shipwrecks in the open sea. In inland waters, sudden overloading of the heart by intense cold can cause almost immediate ventricular fibrillation. Also, in inland boat accidents where victims are trying to swim for shore, they frequently drown because they become exhausted very quickly and because of

respiration difficulties due to the cold, and the viscosity of cold water. It is dangerous to drink even a small amount of alcohol after exercise in field conditions without eating food as well. (MFW/UMS)

234.
KEATINGE, W.R.

Treatment of the hypothermic victim.

In: Proceedings of the cold water symposium, Toronto, May 8, 1976, p.29. Toronto, Royal Life Saving Society Canada, 1976.

The best immediate treatment for a victim of hypothermia is to put him in a hot bath, preferably with his arms and legs out of the water. It should not be continued for more than 20 minutes because rapid vasodilation will cause lowering of the blood pressure. If a hot bath is not available immediately, a warm room and blankets would help. If this is not possible, a device for warming inspired air might help. Unnecessary manipulation of the throat must be avoided, because this can bring on ventricular fibrillation by vagal slowing of the heart. Cardiac massage and artificial ventilation should be avoided unless the heart has stopped or is in ventricular fibrillation. For prolonged monitoring of temperature in conscious humans, a probe in the external auditory meatus is the best method. Even after the patient is in a hospital and an ECG has been taken, it is best not to treat any abnormalities except full ventricular fibrillation. Blood chemistry monitoring is difficult, because blood taken from a cold, constricted arm can give misleading indications. (MFW/UMS)

235.
KEATINGE, W.R.

Accidental immersion hypothermia and drowning.

Practitioner 219(1310):183-187; Aug. 1977.

The author deals first with immersion hypothermia. The cardinal rules are first to wear several layers of clothing and to stay as still as possible while in the water. When rescuing a group of survivors, small boys should be given priority, since they are at the greatest risk. Death in immersion hypothermia usually results from low temperature at the heart. Afterdrop can cause the heart to reach a lethally low temperature. Rewarming in a hot bath can prevent this. Another major hazard is ventricular fibrillation. It usually stops on rewarming. The victim should be placed in a hot bath even if he appears to be dead. Cardiac massage should be given (at about half the normal rate), if the heart has stopped. Airways should be cleared if obstructed. Immediate rewarming is always more important than taking the victim to hospital. Salt-water drowning is much more likely to be dealt with successfully than fresh-water drowning, in which the inhaled water is rapidly absorbed, causing hemodilution and hemolysis. The release of potassium from the red cells causes ventricular fibrillation. In salt water drowning, emptying of the airways and artificial respiration and cardiac massage can redistribute the calcium and magnesium which have been absorbed by the blood, reducing their concentration so that the heart can start beating. There have been cases of near drownings in very cold water in which the victims, usually children, have been revived by cardiac massage, artificial respiration, and exchange transfusion. (MFW/UMS)

236.
KEATINGE, W.R.

Body fat and cooling rates in relation to age.

In: Folinsbee, L.J., et al., ed. Environmental stress. New York, Academic Press, 1978. pp.299-302. QT 140 E61 1977.

In a warm or neutral environment, many factors affect body temperautre, including differences in vasoconstrictor tone and sweat rates. However, experiments during cold stress, particularly cold immersion, show a close linear correlation between body cooling rates and reciprocal subcutaneous fat thickness. It appears that in these conditions normal people undergo almost complete vasoconstriction in the skin, and that insulation provided by subcutaneous fat then largely determines heat loss. Men in general are thinner and cool faster than women in the cold; children are thinner and cool faster than adults, though

children's higher surface area/mass ratio also contributes to their rapid cooling. The only major exceptions seem to be conditions such as alcohol-induced hypoglycaemia and occasional degenerative conditions in old age, when breakdown of the vasoconstrictor mechanism leads to rapid body cooling even with a thick layer of subcutaneous fat.

236a.

KEATING, W.R.

Cold immersion and swimming.

In: cold/wet survival symposium.

J. Roy. Nav. Med. Serv. 58:171-176; Winter 1972.

Experiments to indicate the effects on survival after immersion in water of such factors as subcutaneous fat, exercise and clothing are described. The causes of sudden death in water are discussed and advise is given on action to be taken to preserve life after immersion.

236b

KEATINGE, W.R., M.G. Hayward and N.K.I. McIver.

Hypothermia during saturation diving in the North Sea.

Br. Med. J. 280(6210):291; Feb. 2, 1980.

The authors report the body temperatures of divers during saturation dives at 130-145 m in the North Sea, using the conventional heating system, which consists of flooding the diving suit continuously with warm water pumped from and monitored at, the surface. Urine temperatures were measured within eight minutes of their return to the bell. It was found that in some cases divers suffered hypothermia without feeling any definite sensation of cold. Since the subjective perception of cold is the only criterion by which the water temperature is regulated, the divers in these cirumstances are running a definite risk of hypothermia, which could lead to mental confusion, loss of consciousness, and even death. The authors suggest a control system on the outside of the diving suit which supplies warm water under the suit, with sensors to monitor the temperature inside the suit. If the system keeps skin temperature reasonably uniform, and mean skin temperature and inspired gas temperature at about 35°C, hypothermia cannot occur. (MFW/UMS)

237.

KEEFE, F.J. and E.T. Gardner.

Learned control of skin temperature: Effects of short- and long-term biofeedback training.

Behav. Ther. 10(2):202-210; 1979.

The extent to which learned control over finger temperature could be developed was assessed. Human subjects received a short-term (5 session) biofeedback training regimen to decrease or increase temperature. Analyses of temperature data for the training periods revealed highly significant between-group differences. Subjects in the increase condition displayed increases of up to 2.5°F, while subjects in the decrease condition displayed decreases of up to 2.9°F. Ability to produce the required changes in temperature improved as a function of training. The effect of longer term training to increase temperature (20 sessions) was evaluated. Significant within-session increases in finger temperature were obtained after 3 days of training. There was no significant improvement in temperature control with further training. Apparently voluntary control over digital temperature can be established, but the magnitude of temperature changes is small even with extended feedback training.

238.

KENNEDY, J.H., N.H.C. Hwang, S.G. von Miller and A. Hartman.

Biological and physical factors influencing distribution of cerebral gas embolism.

Cryobiology 10(6):513; 1974.

Abstract only. Excerpt quoted: Using computer analogy, and experiments in baboons, this study was

undertaken in order to consider the physical and biological factors influencing distribution of gas emboli. Blood vessels with diameter 4.5 mm are not likely to be blocked by a pure oxygen embolus, however, once a gas embolus is lodged in a small artery, it will block the blood flow in that vessel; e.g., an O_2 embolus, radius 1 mm in blood will take 500" to be dissolved in blood, and 8250" in plasma or in blood with saturated hemoglobin. In 6 baboons placed on hypothermic (brain 18°C) perfusion there was a 50% decrease in cerebral blood flow (C_{14} Antipyrine) and redistribution of flow to cortex.

239.

KENNEDY, W.L.

Hypothermia (letter).

Ann. Intern. Med. 90(4):721-722; Apr. 1979.

The "J" wave of the electrocardiograph was pointed out in a recent article to be "pathognomic of hypothermia." This is not true as the "J" wave may or may not be associated with hypothermia, the diagnosis however is not made by the EKG but by the low temperature of the subject. (CWS/UMS)

240.

KETTLE, M.

Maintaining the operational efficiency of divers in cold conditions.

In: The working diver—1974. Symposium proceedings, March 1974, Columbus, Ohio, p.157-169. Washington, D.C., Marine Technology Society, 1974.

Various practical means employed to enable divers to carry out a full range of operations in the sea in winter conditions are described. Water temperatures involved were in the order of 1.5°C. However, heat loss problems were quite severe, as a significant proportion of the diver's time in the water was spent inactive in a water stream. Dives up to 3 hours have been achieved with minimal supplementary heating. Simple equipment was devised to combat severe chilling of the hands which occurred on earlier dives. Dry suit systems alone were considered for body protection; no attempt was made to evaluate wet suits for such conditions. It was established that suitable dry suits are available for low temperature, shallow diving although tailoring and buoyancy are problem areas. Opportunity was also taken to investigate the endurance of carbon dioxide absorbent in cold water. Gas samples were taken from the semi-closed circuit breathing apparatus during dives. Very little temperature dependence was detected. (Author's abstract)

240a.

KHALIL, H.H.

Hypothermia by Internal Cooling.

Lancet 1:185-188; 1957.

A new method of inducing hypothermia in dogs by circulating cold water through an intragastric rubber balloon is described. This method was used on 14 animals and proved quite simple and practicable. The rectal temperature was brought down to 25—23°C, and the heart-rate from about 200 to about 40 per minute. All the animals recovered quickly and apparently completely. E.C.G. tracings showed a striking absence of injury potential when the rectal temperature was above 29°C. Injury potential appeared below this temperature in 4 out of 16 experiments, but it did not develop or lead to ventricular fibrillation.

240b.

KHALIL, H.H.

Hypothermia by Internal Cooling in Man.

Lancet 1:1092-1094; 1958.

An apparatus for giving a continuous flow of cold or warm water through an intragastric balloon is described.

Two cases in which intracranial tumours were removed surgically under hypothermia by internal cooling are reported. The first patient was cooled to a rectal temperature of 29°C and the second to 32°C. The method proved simple, easy to manage, and very effective—so much so that it was necessary to keep the intragastric balloon only half-filled to avoid too rapid cooling. Both patients had an uneventful postoperative course. This method could be used in major neurosurgical and cardiac operations and in other indications for hypothermia.

240c.

KHALIL, H.H., and R.C. MacKeith.

A simple method of raising and lowering body temperature.
Brit. Med. J. 2:734-736; 1954.

A method of raising and lowering the body temperature in animals and man by the introduction of changes of water into an intragastric bag is described. It has possible applications in the treatment of excessively high and low body temperatures and also in the management of hypothermia in operative surgery.

241.

KLARSKOV, P. and F. Amter.

Hypotermi efter drukning korrektion med peritonealdialyse.
[Hypothermia following submersion corrected by peritoneal dialysis].
Ugeskr. Laeger 138:1937-1940; Aug. 2, 1976.

Two children of 4¾ and 6 years, respectively, were resuscitated following submersion with severe hypothermia of 24 and 21°C, respectively. Both children had clinical cardiac arrest for approximately half an hour and were treated symptomatically for this. The hypothermia was ameliorated by peritoneal dialysis with fluid at 40°C. In this manner the temperature increased to 30°C in the course of 3½ hours in one child and to 29°C in the course of one hour in the other. The body temperatures were maintained actively at approximately 32°C during the first 24 hours by means of continued peritoneal dialysis while mechanical hyperventilation (pCO_2 at approximately 30 mm Hg) was continued for 72 hours. The second patient recovered completely after this treatment while complete recovery did not occur until after one month in the first patient. (English summary)

241a.

KLISSUROV, L.N. and N.G. Doukov.

Sravnitelna etektivnost na razlichni vidove lekovodolazni kostyumi v usloviyata na eksperimenta s podvodnata laboratoriya "Chernomor."
[Comparative efficiency of different types of scuba divers' suits under the conditions of experiments from the "Chernomor" underwater laboratory in 1974].
Okeanologiya 3:64-75; 1979.

Investigations were carried out during the 15-day experiment with the underwater laboratory "Chernomor" in 1974, with a view to establishing the comparative efficiency of individual types and combinations of diving suits used in Bulgaria and in the Soviet Union. The investigations were concerned with the following: Time necessary to put on the suit; Determination of the physical loading of the scuba-diver while putting on the suit; Measuring the surface temperature at various points of the diver's body after a certain stay underwater; Time for performing a certain amount of work underwater; Subjective assessment of the suit as regards maximum period of staying underwater until a strong sensation of freezing, as regards comfort during work, etc. As a result of the data obtained, recommendations are given about the utilization of the diving suits depending on the concrete conditions, namely: water temperature, duration of the stay, and the character of the work done underwater. (English summary)

242.

KOBAYASI, S. and T. Ogawa.

Effect of water temperature on bradycardia during nonapneic facial immersion in man. Jap. J. Physiol. 23:613-624; Dec. 1973.

Bradycardiac response to nonapneic facial immersion in man was examined at water temperatures of 10, 20, 30, 35, 40, and 47°C. The response was mainly dependent on the water temperature. In general, the colder the water, the greater the response. However, the least response was noted at 40°C; at 47°C the bradycardia was greater than at 40°C. The bradycardiac response was generally more marked in trained swimmers and divers than in subjects unaccustomed to swimming. The magnitude of changes in facial skin temperature appeared to have an additional influence on the cardiac slowing. Heart rate reached the minimum value in 20-30 sec, then tended to return toward the initial rate during immersion. Stimulation of cutaneous cold receptors is assumed to be most responsible for the development of bradycardia on nonapneic facial immersion, and the return of heart rate during immersion may be attributed to adaptation of these receptors. (Authors' summary)

242a.

KONSTANTINOV, V.A.

Some peculiarities of the animals thermoregulation in the helium-oxygen milieu. Fiziologicheskiy Zhurnal S.S.S.R. 60(8):1272-1277; August 1974, Translated from the Russian.

Inhalation of the helium-oxygen mixture at different external temperatures entails in the animals increase in the thermoregulatory muscular activity as compared with inhalation of the normal mixture with nitrogen. The initial link of this thermoregulatory response may be supposed to be the cooling effect of helium on the upper respiratory ways' thermoreceptors. When inhaling the helium-oxygen mixture, occurrence of the cold shiver happened at a higher external temperature which indicated the decrease in the threshold of the thermoregulatory responses.

243.

KOZYREVA, T.V. and M.A. Yakimenko.

Sensitivity to cold in humans. Fiziol. Zh. Sssr. Im. I M. Sechenova 64(2):220-225; 1978.

In humans, the number of the skin cold-sensitive spots was a linear function of the local skin temperature within the range of 25-35°C. Prolonged and repetitive cooling decreased the number of the cold-sensitive spots, i.e., the number of active skin thermoreceptors within the range of skin temperatures under study.

244.

KROG, J. and M. Wika.

Studies of hand blood flow of the Igloolik Eskimo. Med. Biol. (Helsinki) 56(3):148-151; 1978.

The hand blood flow of Igloolik Eskimos was measured by venous occlusion plethysmography to study circulatory adjustments to cold exposure. Such adjustment can be anatomical or functional. Attention was especially directed to maximal resting circulation with the aim of obtaining information about the capacity of the peripheral vascular bed in different age groups of cold-exposed people. Resting blood flow ml/100 ml handvolume/min in vasodilated Eskimo men did not appreciably differ from that of men of the same age in other ethnic groups. Women of age 20-50 yr had significantly higher circulation than men of the same age. This may be due to the smaller hand and the relative quantities of different tissues. Females over 50 yr old had a very low hand circulation compared with the younger females. In contrast, males over 50 yr old did not significantly differ from their younger colleagues. Any explanation other than hormonal is not warranted at this time. Cold stress to the skin does not induce hypertrophy of the

peripheral vascular bed which can be detected during vasodilated conditions or reactive hyperemia after 5 min of arterial stasis.

245.

KUEHN, L.A., T.J. Smith and D.G. Bell.

Thermal requirements for lockout submersibles in cold water.

In: The working diver 1976. Symposium proceedings Mar. 2-3, 1976. Columbus, Ohio. p.215-244. Washington, D.C., Marine Technology Society, 1976.

The heat loss from each crew member of a diver lockout submersible has been modelled in a comprehensive digital program called Cold Diver for submersible operations to depths of 300 m and ambient water temperatures of -2 to 30°C. The operation of the lockout submersible was considered to involve three distinct thermal environments: 1) the control sphere in which two pilots and an observer work in air at a pressure of one atmosphere; 2) the lockout sphere in which as many as two divers and a tender are transported to and from an underwater work site in an oxygen-helium gaseous mixture at a pressure that is depth-equivalent to that at the work site and 3) the immersion phase during which two divers leave the submersible to perform underwater work. For each of these environments, the Cold Diver program computes the heat requirements for thermal comfort for each of the crew members and for various levels of work, clothing, ambient water and vessel temperatures, depth and fluid velocities. In addition, the total heat budget for the entire crew has permitted prediction of the depth-temperature operational profiles for thermal safety for a variety of submersible operations and has aided in the redesign of the submersible power source and thermal insulation. Verification of these results has been possible through comparison with other reports in the literature as well as an extensive experimental program in which diver heat loss was measured in the range 0 to 100 m and at ambient temperatures of -2, 5 and 10°C. (Authors' abstract)

246.

KUEHN, L.A. and J.L. Zumrick.

Human convective heat loss in cold hyperbaric oxyhelium environments.

In: Program and abstracts. Undersea Medical Society annual scientific meeting, May 13-16, 1977, Toronto, Canada, p.A46. Undersea Biomed. Res. 4, Mar. 1977. Appendix A.

Abstract only. Entire item quoted: During a series of three saturation dives to simulated depths of 1000, 1200 and 1400 feet at the Ocean Simulation Facility, measurements were made to establish the rate of heat loss of unclad divers in helium-oxygen gaseous environments as part of a program to determine the dangers of cold stress and the temperature/time relationship tolerated by divers in cold diving bells or in hypberbaric chambers in which the environmental conditions are uncontrolled. Three specific gaseous temperatures of 15, 20 and 25°C were considered. In each experiment, as many as four subjects were monitored for their body core and mean skin temperatures over a two hour testing period. In addition, one or two of the subjects were monitored for mean body convective heat loss to determine physiological (shell) thermal insulation. The results of these experiments are expressed in depth-time-temperature three dimensional graphs in which the temperature variable is one of the following: mean skin temperature change, mean body temperature change and mean rectal (core) temperature change, suitable for defining diver thermal limitations. The heat loss measurements made are used for comparison with predictions made by the DCIEM Cold Diver model and further serve to verify its application to these depths and environmental temperatures.

247.

KUEHN, L.A., K.N. Ackles and J.D. Cole.

Survival test of submersible life support systems.

Aviat. Space Environ. Med. 48:332-338; Apr. 1977.

An experiment to validate predictions concerning submersible survivability was performed in December

1975, by members of the Canadian Forces in the CF Submersible Lockout Vehicle SDL-1 in Halifax Harbour in water of 4°C temperature at a depth of 40 ft. Data was collected relevant to the life support equipment to determine if it would operate for a simulated 6-h mission followed by a 24-h immobility period, at the end of which rescue was presumed to have occurred. Physiological data was collected from the submersible occupants in order to assess the degree of thermal stress experienced in this exercise. The experiment was terminated after a duration of approximately 25 h at 1 atm internal pressure due to exhaustion of two of the three on-board power supplies, causing the CO_2 scrubbers to be inoperative and the CO_2 content in the breathing gas to increase to toxic levels. Only two of the three submersible occupants experienced cold stress, one in the forward sphere and one in the aft sphere. At the end of 24 h, the core temperatures of both individuals had decreased by 0.5°C and, during this time, skin temperatures, particularly at the extremities, had steadily and slowly decreased. Neither individual was hypothermic, but it was considered likely that after a 3-d exposure, at least two of the crew members would have had core temperature of 35°C or lower, assuming that CO_2 poisoning had not occurred earlier. (Authors' abstract)

248.

KUEHN, L.A. and R. Higgens.

Wireless telemetry for assessment of diver thermal stress.

In: Program and Abstracts, Undersea Medical Society, Inc., Annual Scientific Meeting. Undersea Biomed. Res. 5(Suppl.):32-33; Mar. 1978.

Abstract only. Entire item quoted: Two techniques of radio telemetry developed at DCIEM now make possible relatively easy determination of the thermal stress experienced by working divers in operational cold water dives or hot hyperbaric chamber exposures. The first technique is a modification of the classical temperature-radio pill concept in which a small capsule is swallowed which contains a radio transmitter emitting temperature-dependent radio signals. Decoding of these signals permits easy and accurate determination of the temperatures of the diver's core before and after dives, especially if a hand-held calibrated radio receiver is used. The principal modification in this technique has been the cheap manufacture of the 'pills,' thereby permitting disposability, a concept that renders them much more attractive to the diver than would otherwise be the case. The second technique is a novel new development never before used on divers or human subjects in adverse thermal environments, namely encapsulation of the same radio transmitter circuit in a small epoxy plate or 'tab' which are situated on the diver's skin at various sites to measure skin temperatures. These tabs are reusable and are not disposable, being large enough to permit battery replacement if required. They are glued to the subject's skin with a quick-setting adhesive and are easily removed after 10-hour periods with an appropriate solvent. Use of a hand-held calibrated radio receiver permits easy and quick determination of skin temperatures before and after dives by this telemetric process. Both telemetric techniques produce measurements accurate to the order of 0.1°C.

249.

KUEHN, L.

Assessment of convective heat loss from humans in cold water.

J. Biomech. Eng. 100:7-13; Feb. 1978.

Convective heat loss is a primary cause of hypothermia in humans undergoing water immersion, particularly for swimmers and divers at relatively shallow depths. Various biophysical models have been advanced to account for body heat loss in water of different temperatures and cold stress, most of which have made use of physiological data obtained with easily applied classical thermometry techniques. Explicit techniques for the determination of body heat loss must involve direct calorimetry or the use of heat flow transducers, techniques which are difficult to apply in realistic simulations of actual cold water exposure. This paper describes these latter two techniques in some detail, concentrating on the accuracy to be attained and the calibration necessitated with each method. Results obtained with each method specific to heat loss determination at surface and both dry and wet hyperbaric exposures are shown, illustrating the types of data that can be attained. (Author's abstract)

250.

KUEHN, L.

A review of Canadian development of thermal stress instrumentation.

Downsview, Ontario, Canada, Def. Civ. Inst. Environ. Med., DCIEM Tech. Rep. 78X14, 12p. plus illus. June 1978.

During the preceding ten years, the Defence and Civil Institute of Environmental Medicine has been in the forefront instrumentation development for the assessment of thermal stress and physiological strain in military personnel in adverse thermal environments. Several new fast-responding and direct-reading instruments have been invented, commercialized and produced for measurement of the Wet Bulb Globe Temperature (WBGT), a heat stress index combining effects of air temperature, humidity, wind and radiation into a single physiological variable. This technology has evolved into a heat/strain dosimeter for workers operating in hot industrial environments. With respect to cold air environments, a similar series of instruments has been developed for assessment of the Burton Still Shade Temperature, a cold stress index that incorporates effects of air temperature, wind and radiation into a single variable that is adjustable for different clothing ensembles and working rates of operational personnel. To augment this environmental technology, new temperature-radio transducers have been developed to monitor either the core temperature of operational personnel, via an ingested 'throw-away' temperature-radio pill, and/or the skin temperatures of the same personnel, using small reusable temperature-radio 'tabs' glued to the skin. Measurements from both the pill and tabs are easily expedited by use of a handheld calibrated radio receiver which produces the appropriate temperature readings in degrees Celsius. The spectrum of this technology 'family' permits easy and complete understanding of the thermal stress/strain relationship of operational personnel in hostile thermal environments. (Author's abstract)

251.

KUEHN, L.A. and K.N. Ackles.

Thermal exposure limits for divers.

In: Johnson, C.E., M.L. Nuckols and P.A. Clow, eds. Hyperbaric diving systems and thermal protection. OED Vol. 6, p.39-51. New York, N.Y., American Society of Mechanical Engineers, 1978.

Hypothermia is one of the major factors affecting diver safety, performance and comfort in operational diving in cold water. Diver hyperthermia is now worthy of concern due to the increasing use of saturation diving chambers and hot-water heated diving suits. This paper presents a brief overview of the physiology involved in human heat exchange and the consequential physiological events to heating or cooling. Thermal exposure limits which can be easily implemented in laboratory environments are presented as well as rough and ready generalizations which are applicable to field emergency situations. The use of cheap disposable temperature-radio pills in conjunction with portable battery-powered hand-held temperature-radio receiver is recommended for application to the working environment to monitor diver core temperature on the surface (or in a bell) before and after dives. (Authors' abstract)

252.

KUNDU, S., J.K. Ghosh, A.K. Ghosh and A. Devi.

Seasonal cold acclimatization and sympathetic response in man.

Indian J. Physiol. Allied Sci. 31(2):73-80; 1977.

Immersion of the hand in ice cold water increases sympathetic activity and immediately enhances heart rate. The degree of enhancement is neither equal in each month for the same individual nor is it similar for all. The variations may be due to the acclimatization status of the individual. The sympathetic activity of those well-acclimatized to winter cold is decreased but sustained. If the acclimatization is not complete, sympathetic activity increases but is not sustained. The sympathetic activity is probably controlled by the adaptation level of the cold receptors over the skin surface.

253.

KURAHASHI, M. and A. Kuroshima.

Changes in adipocyte beta-adrenergic receptor of cold-acclimated rats.
Jpn. J. Physiol. 29(1):15-23; 1979.

The changes in the number and affinity of binding sites in the β-adrenergic receptors of rat white adipocytes after cold exposure were studied with the aid of (−)-[^{3}H]dihydroalprenolol. One day cold exposure did not change the number and affinity of binding sites in β-adrenergic receptors. Chronic exposure of rats to cold (5 C) for 1 and 4 weeks significantly decreased the affinity of β-adrenergic receptors without any alteration in the number of binding sites. Such changes in the binding affinity observed in cold-acclimated rats (4 weeks, 5 C) remained for 18 hr after these animals were transferred to a warm environment of 25 C. The decreased affinity of binding sites in β-adrenergic receptor induced by cold acclimation could not explain the enhanced metabolic response of cold-acclimated animals to noradrenaline.

254.

KUROSHIMA, A., K. Doi and T. Ohno.

Role of glucagon in metabolic acclimation to cold and heat.
Life Sci. 23(13):1405-1410; 1978.

Plasma glucagon concentration increased in 2 wk cold-acclimated rats but returned to normal value in 4 wk cold-acclimated ones. Plasma free fatty acid (FFA) and β-hydroxybutyrate concentrations also showed the similar pattern of changes. Plasma glucagon and FFA concentrations also showed the similar pattern of changes. Plasma glucagon and FFA concentrations decreased in both 2 wk and 4 wk heat-acclimated animals. Plasma β-hydroxybutyrate concentration was not changed by heat acclimation. Plasma glucose concentration decreased in heat-acclimated animals but was not affected by cold acclimation. There was a significant positive correlation between plasma glucagon and FFA levels as a whole in 2 wk warm-, cold- and heat-acclimated rats; in 4 wk in warm- and heat-acclimated rats. Apparently in both cold and heat acclimation, glucagon is closely involved as one member of a hormonal team for regulating lipid and carbohydrate metabolism.

255.

KURSS, D.I., C.E.G. Lundgren and A.G. Pasche.

Effect of water temperature and vital capacity in head-out immersion.
In: Bachrach, Ed. Underwater Physiology VII. p 297-301. Bethesda, MD. Undersea Medical Society. 1981.

In order to illuminate the hypothesis that vital capacity (VC) was reduced in head-out water immersion because of intrathoracic blood pooling secondary to warming and vasodilation in peripheral tissues nine human subjects were tested in different water temperatures. There was a 5.4% reduction in VC due to the hydrostatic pressure, and in addition there was a reduction in VC due to cold exposure. (CWS/UMS)

256.

LAFFERTY, J.J., M.M. Keykhah, H.M. Shapiro, K. Van Horn and M.G. Behar.

Cerebral hypometabolism obtained with deep pentobarbital anesthesia and hypothermia (30°C).
Anesthesiology 49(3):159-164; 1978.

Cerebral metabolic and vascular effects of hypothermia (30°C) and deep pentobarbital anesthesia, separately and combined, were evaluated in 15 mongrel dogs. External cardiovascular support was not used and mean arterial blood pressures remained greater than 60 torr. Normothermic deep pentobarbital anesthesia, characterized by an EEG frequency of < 1 Hz, was associated with 30% decreases in cerebral metabolic rates for O_2 ($CMRO_2$) and glucose (CMR_G) from lightly anesthetized control values. Hypothermia (30°C) alone caused similar decreases in $CMRO_2$ and CMR_G in the presence of an active EEG.

The use of pentobarbital anesthesia and hypothermia combined achieved significantly greater ($P < 0.05$) decreases in CMR_{O_2} (70%) and CMR_G (72%) from the control state. Cerebral vascular resistance (CVR) increased by 70% ($P < 0.05$) during hypothermia and about 20% when pentobarbital was administered to normothermic dogs. In hypothermic animals the addition of pentobarbital had a minimal effect on CVR. No alteration in the O_2-glucose or lactate-glucose index indicative of cerebral hypoxia occurred in any experimental group. Barbiturates combined with hypothermia decreased cerebral metabolism to a greater extent than hypothermia or barbiturate alone. When cerebral hypometabolism is therapeutically necessary, barbiturates might be indicated as an adjunct to moderate hypothermia.

257.

LANGDON, L., and D.P.E. Kingsley.

Changes in serum and urinary potassium levels during profound hypothermia in man.
J. Clin. Path. 17:257-259; 1964.

Samples of blood were taken at five to ten minute intervals during cooling, circulatory arrest, and rewarming in eight consecutive patients undergoing open cardiac surgery under profound hypothermia at nasopharyngeal and oesophageal temperatures of approximately 10°C and the serum potassium levels were estimated. Urine samples were also collected from six of the eight patients and the total potassium excretion calculated per minute. It was found that there was a tendency for the serum potassium level to rise towards the end of cooling. A further more significant rise occurred during circulatory arrest, and on rewarming there was a pronounced fall of approximately 2.5 mEq./litre, the lowest level being reached at 27.5°C. Above 27.5°C, there was no further significant change in the serum potassium level. It is suggested that the acidosis which occurs during circulatory arrest and a depression in the function of the cell menbrane at very low temperatures are at least partly responsible for the changes in serum potassium. Certainly the excretion of potassium in the urine does not account for them.

258.

LANGERMAN, N.

Mountain divers in winter.

In: National Association of Underwater Instructors. Proceedings of the eleventh international conference on underwater education, p.184-187. Colton, Calif., published by the Association, 1979.

The author describes ice diving technique – the best way to cut the hole, the special safety equipment required, the problems of freezing equipment (particularly breathing apparatus) and ways of dealing with these situations are briefly discussed. One duty of the ice master is to check each diver's equipment thoroughly before he goes in, and to thaw out with warm water anything that is frozen. The wet suit is filled with warm water immediately before and after the dive, and a warming tent is provided. One diver, known as the safety diver, is fully geared and equipped with an extra-long floating safety line. He is on the alert to go in after a diver in trouble at a moment's notice. The ice master is also on the alert to go in and aid the safety diver. Sometimes, but not usually, they are one and the same person. (MFW/UMS)

259.

LARIONOV, N.P., L.N. Medvedev and S.A. Khramenko.

Activation of Na, K-ATPase of the rat brain and kidneys on adaptation to cold.
Biull. Eksp. Biol. Med. 87(3):221-222; Mar. 1979.

The activity of Na, K-ATPase of the rat brain and kidneys is 1.5-2-fold as increased during intermittent and prolonged (16 weeks) adaptation to cold, without changes in the enzyme affinity to ATP. It is suggested that adaptive increase in the power of the Na pump, triidothyronine-dependent in the kidneys and triiodothyronine-independent in the brain, ensures elevation in thermal production on body cooling.

259a.

LASH, R.F., J.A. Burdette, and T. Ozdil.
Accidental Profound Hypothermia and Barbituate Intoxication, A Report of Rapid 'Core' Rewarming by peritoneal Dialysis.
J.A.M.A. 201:269-270; 1967.

Peritoneal dialysis is a technically simple, readily available method of rapidly rewarming the large vascular areas and organs of the abdomen and, to some extent, the adjacent thoracic organs. Initial rewarming of the core appears to be a significant factor in complete recovery from profound hypothermia.

260.

LAURY, M.C. and F. de Marco.
Effects of cold acclimation conditions on rat non-shivering thermogenesis.
C. R. Seances Soc. Biol. Fil. 171(6):1182-1188; 1977.

As indicated by theophylline administration prior to norepinephrine infusion, nonshivering thermogenesis does not seem to be mediated by the cyclic[c]AMP system in continuously cold-acclimated rats, in contrast to rats acclimated to discontinuous cold. In the latter condition, the cAMP mediation is not observed in the brown adipose tissue or the liver.

261.

Le BLANC, J.
Physiological changes in prolonged cold stress.
In: Proceedings of the cold water symposium, Toronto, May 8, 1976, p.9-13. Toronto, Royal Life Saving Society Canada, 1976.

The author discusses various experiments in cold adaptation, both with animals and humans. Subjects were subjected to long periods of moderate and short periods of extreme cold temperatures. Hand immersion tests and face immersion tests were administered. Tests were made in which reactions of cold-adapted subjects, such as Eskimos and Gaspe fishermen were compared with controls. The studies in general showed that adaptation to frequent short exposures is characterized by a decrease of pain, which results in enhanced performance. Improved circulation reduces the incidence of frostbite. Adaptation to cold in humans is an important mechanism of defense against cold. However, this type of adaptation does not protect against accidental hypothermia. (MFW/UMS)

261a.

LeBLANC, J., J.A. Hildes, and O. Heroux.
Tolerance of Gaspe fishermen to cold water.
J. Appl. Physiol 15(6):1031-1034; 1960.

A group of Gaspe fishermen used to cold water immersion and control subjects from the same vicinity were studied to determine if the fishermen's hands were adapted to cold. With one hand immersed in cold water, the pressor response was greater in the control subjects; the fishermen maintained a higher finger temperature and complained less of pain; heat flow from the fishermen's hands was greater than in the control group; finger numbness as measured by a modification of Mackworth's V-test was varible and not significantly different in the two groups. Skin biopsies showed no difference in skin thickness or cell size but there was a significantly greater number of mast cells in the fishermen's skin. The differences between the fishermen and the control subjects may be related to repeated cold exposure.

261b.

LeBLANC, J.S.

Impairment of mannual dexterity in the cold.
Defence Research Northern Laboratory Report No. 4/55, 9:62-64; 1955.

In an attempt to estimate the factors involved in manual dexterity impairment observed in the cold, the following has been found. When the fingers alone were cooled, performance of tests involving little movement of the joint was only slightly enhanced, whereas the impairment was large when the joint movements were increased. This is interpreted as additional evidence to the hypothesis that the increased viscosity of the synovial fluid is a factor since cooling of the arm, even when the hands are kept warm, also caused a large decrement in finger dexterity.

262.

Le BLANC, J., J. Cote, S. Dulac and F. Dulong-Turcot.

Effects of age, sex and physical fitness on responses to local cooling.
J. Appl. Physiol. Respir. Environ. Exercise Physiol. 44(5):813-817; 1978.

The response to local cooling was estimated by the cold hand test [CHT] (5°C for 2 min) and the cold face test [CFT] (0°C with 66 km/h wind for 2 min). Heart rate, blood pressure and skin temperature T_{sk} were measured before, during and after the tests. The increase in blood pressure (CHT) and the fall in T_{sk} (CFT) were reduced in trained subjects. Similarly older subjects (53-60 yr of age) responded less to a CHT than younger subjects aged 20-40. The bradycardia caused by the CFT was more pronounced in the older subjects. The responses to the CHT and CFT were the same for male and female subjects. During the 2 min after the test, blood pressure and heart rate fell below initial values in the female group but not in the male. Besides adaptation to cold, individual factors such as age, sex and physical fitness also have a relative importance in the responses to local cooling.

263.

LEELA, N.S.

Effect of median eminence mediated cortisone and cold stress on pituitary histology.
Proc. Indian Acad. Sci. Sect. B 87(12):361-370; 1978.

Stereotaxic implantation of 200 μg cortisone pellet in agar were placed in the median eminence region of male albino rats of Holtzman strain. A group of cortisone implanted animals were exposed to cold stress (8 ± 1°C) and the other group was kept in the animal house (25 ± 2°C). After 3 and 5 days of implantation, the animals were autopsied and the changes in histology of the pars distalis and pars intermedia were studied. Hypertrophy of basophils was observed in the implanted group and the additional stress of cold resulted in gradual degranulation of ACTH cells by the 3rd day and complete abolition of ACTH cells with infarction by the end of fifth day. A significant increase and degranulation of cells in the parts intermedia could be observed in the cortisone implanted, cold stressed group as compared to those kept in the animal house. These groups are compared with the pituitaries of sham operated groups.

264.

LEITCH, D.R. and R.R. Pearson.

Decompression sickness or cold injury?
Undersea Biomed. Res. 5:363-367; Dec. 1978.

This paper reports two cases involving divers who presented with painful hands and were treated for decompression sickness. Although treatment was successful, their symptoms and diving history suggest non-freezing cold injury, the so-called immersion hand, rather than decompression sickness. For long exposures or cases where the diver may have inadequate insulation, thermal protection of hands is recommended even in water as warm as 16°C. (Authors' abstract)

265.

LEMAIRE, C., J.P. Charpy and X. Fructus.

Capacite de travail et efficience du plongeur jusqu'a la profondeur de 350 metres (36 ATA).

[Work and performance capacity of the diver at the depth of 350 meters (36 ATA)].

Maroc Med. 582:492-495; 1974.

Pressure and helium did not affect the muscular, sensory-motor, or mental function of the diver. Rapid compression rate, on the other hand, was a detrimental factor, as indicated by recordings of tremor and encephalographic waves. The addition of nitrogen brought on the well-known narcotic manifestations and also diminished muscular function. In open water conditions, there were added stresses due to the liquid environment (resistance of the water itself, cold and poor visibility) as well as those due to the task to be performed. From the ergonomic point of view, it is, therefore, essential that the pressure rate be kept moderate, and that no narcosis-producing elements, which only act to mask the effects of compression, be introduced. Protection from cold by an effective suit which also does not limit movement or manual dexterity, is essential. (Authors' conclusions condensed and translated by MFW/UMS)

265a.

L'HUILLIER, J.-R.

Deperdition de chaleur par voie respiratoire en plongee. Verification experimentale jusqu'a 21 ATA.

[Respiratory heat loss in diving. Experimental verification up to 21 ATA].

In: L'Huillier, J.-R., ed. Medecine de plongee. Gaz. Hop. 35:1039-1042; Dec. 20, 1971.

The author discusses respiratory heat loss through evaporation and through convection. Heat loss through evaporation is independent of pressure, and is constant for a given temperature. As to heat loss through convection, it is noted that heat exchange between a fluid and a solid is a function of the flow of the fluid. The turbulence of the gas in the airways grows with increasing pressure. Calculations made during the Physalie dives, to 21 ATA, resulted in the conclusion that the depth at which the diver will lose all his metabolic heat, while breathing heliox at 0°C is 380 m. In these dives, the subjects went to 520 meters. It was calculated that at this depth, and with a breathing mixture at the temperature of 20°C, the divers would have lost 60% of their total heat These calculations make it clear that, even for conditions less exceptional, it is essential to rewarm the breathing mixture. Numerous charts, diagrams and mathematical equations are given to substantiate the conclusions. (MFW/BSCP)

265b.

LIM, Thomas P.K.

Central and peripheral control mechanisms of shivering and its effects on respiration.

J. Appl. Physiol. 15(4):567-574; 1960.

Central and peripheral contributions to the initiation of shivering have been studied in anesthetized dogs employing a thermal dissociation technique. Shivering was elicited invariably during differential cooling of the head or the trunk alone as well as in the course of whole-body cooling. Either 'peripheral' or 'central shivering' could be produced repeatedly and also inhibited by elevation of subcutaneous temperature in central shivering or brain temperature in peripheral shivering. In part 2 of this study, respiratory effects of shivering have been assessed during the steady state of hyperthermia in the anesthetized animal. During shivering, O_2 intake and CO_2 output were doubled or tripled but the respiratory exchange ratio remained essentially unchanged. Total ventilation increased linearly with metabolic rate and yet arterial pH, pCO_2 and buffer base revealed no significant changes with or without shivering. Although alveolar ventilation was increased almost three times, no marked alterations occurred in physiological dead space. Moderate hemoconcentration and a consistent elevation of pulse pressure were seen during shivering.

266.

LIN, M.T., I.H. Pang, S.I. Chern and W.Y. Chia.

Changes in serotonin contents in brain affect metabolic heat production of rabbits in cold.
Am. J. Physiol. 235(1):R41-R47; 1978.

Elevating serotonin (5-HT) contents in brain with 5-hydroxytryptophan (5-HTP) reduced rectal temperature (T_{re}) in rabbits after peripheral decarboxylase inhibition with the aromatic-L-amino-acid decarboxylase inhibitor R04-4602 (N^1-(DL-seryl)-N^2(2,3,4-trihydroxybenzyl)hydrazine hydrochloride) at 2 ambient temperatures (T_a), 2 and 22°C. The hypothermia was brought about by both an increase in respiratory evaporative heat loss (E_{res}) and a decrease in metabolic rate (MR) in the cold. At a T_a of 22°C, the hypothermia was achieved solely due to an increase in heat loss. Depleting brain contents of 5-HT with intraventricular, 5,7-dihydroxytryptamine (5,7-DHT) produced an increased E_{res} and ear blood flow even at T_a of 2°C. MR increased at all but the T_a of 32°C. Depleting the central and peripheral contents of 5-HT with *p*-chlorophenylalanine (*pCPA*) produced lower MR accompanied by lower E_{res} in the cold compared to the untreated control. Both groups of *pCPA*-treated and 5,7-DHT-treated animals maintained their T_{re} within normal limits. Changes in 5-HT content in brain affects the MR of rabbits in the cold. Elevating brain content of 5-HT tends to depress the MR response to cold, while depleting brain content of 5-HT tends to enhance the MR response to cold.

266a.

LINDEROTH, L.S., Jr., E.A. Kuonen, M.L. Nuckols and C.E. Johnson.

Heat and mass transfer in the human respiratory tract at hyperbaric pressures.
Durham, N.C., Duke Univ. Sch. Eng., Final Rep. on Contract N-00014-67-A-0251-00018, 77p. Nov. 1975.

The gas properties and psychrometric charts necessary to extend the experimental results to a pertinent depth situation were developed. A computer program to calculate gas transport properties for any gas mixture at any pressure was developed and used to calculate viscosity, density, specific heat and Reynolds, Lewis and Prandtl numbers for water vapor saturated helium-oxygen mixtures at depths of 0, 61, 305 and 457 metres (1, 100, 200, 1000 and 1500 feet) of sea water. Psychrometric charts were then developed for these four depths using the appropriate heliox mixture for each depth. Methods to measure humidity at depth are discussed. The respiratory heat loss of a diver working at 1000+ feet can be greater than the metabolic heat generated, and it is observed that the insensible heat loss at 1000+ feet with heliox is negligible. All significant loss is essentially sensible heat loss due to raising the temperature of the gas mix. All data recorded was appropriately reduced by means of digital computer techniques. The programs are included as are the diagrams and tables for flow profiles and depth of penetration of the inspired gas before equilibrium with core temperature is reached. Finally data from this study are compared with the data available in the literature and with data from experiments performed under simulated diving conditions. Suggestions are made for continuing and additional studies in the field of respiratory heat loss. (Author's abstract)

266b.

LINK, H.F. and P.S. Riegel.

Divers' heating hose comparison study.
U.S. Navy Exp. Diving Unit, Rep. NEDU 13-77, 30p. Nov. 1977.

Diver's heating hose is used to transport heated sea water from the surface to a diver to provide him with thermal protection. At present no criteria exist for determining the suitability of a given hose for this application. This report describes how requirements of hot water heating systems were used to define hose evaluation criteria. These criteria were then applied to findings of a comprehensive survey of commercially available hoses. As a result, a number of hoses are identified as suitable for diver heating. (Authors' abstract)

266c.

LINTON, A.L., and I. McA. Ledingham.
Severe Hypothermia with Barbituate Intoxication.
Lancet 1:24-26; 1966.

A case of severe barbiturate intoxication, complicated by profound hypothermia (body temperature 23°C) and ventricular fibrillation is reported. Defibrillation was possible only after thoracotomy and direct warming of the mediastinum. Diuresis and barbiturate clearance were good during hypothermia, but, as the body temperature rose, the anitdiuretic effect of barbiturate poisoning appeared, and forced diuresis was needed. The patient recovered completely. There is probably only one other recorded case of successful resuscitation from a temperature as low as 23°C.

266d.

LIPPITT, M.W., Jr.
Development and test of thermal protection systems for the Navy diver.
In: Riegel, P.S., ed. The working diver 1978. Symposium Proceedings, March 7-8, 1978, Columbus, Ohio, p.74-86. Washington, D.C., Marine Technology Society, 1978.

Thermal physiological criteria were worked out to establish a basis for an engineering development program in which the operational requirements define performance and the thermal limits define the permissible thermal stress. Currently available commercial equipment was evaluated, and dry suits were selected for development. Improvement in seals and closures and also in underwear are essential. Provisions for the absorption of perspiration are required. Provisions must be made for the containment of urine. The outer garment will be made of an elastomer-coated fabric with improved seals and closures. Thermal protection is provided by underwear constructed of several layers: a comfort layer next to the skin, a moisture absorbing layer, a vapor barrier, and a compression-resistant insulation covered with a gas-permeable water-impermeable layer. These components are currently under development. A urine collection system with a 2-liter capacity has been designed. For helium diving, a liquid heat distribution system is under development. Three types of heat sources are being developed: a propane catalytic heater for surface-supported diving, magnesium wool in oxygen for the free diver and clandestine operations, and hydraulic power for the personnel transfer capsule in saturation diving. (MFW/UMS)

267.

LIPPITT, M.W., Jr. and G.F. Bond.
Improved thermal protection and rewarm procedures for cold water divers.
U.S. Nav. Coastal Systems Lab., Rep. NCSL 271-76, 79p. Feb. 1976.

A series of tests were made to evaluate the thermal effectiveness of variable volume dry diving suits equipped with a NASA Project Apollo urine collection device compared to SDV wet suits. Six-hour dives at water temperatures from 35°F were successfully completed with no apparent problems except cold feet. Breathing gas consumption, oxygen consumption, and carbon dioxide production were measured during the dives which included rest, and intermittent light and moderate exercise. A rewarm technique involving the circulation of hot water around the torso area in a rewarm garment was evaluated using subjects and in microchronic and acute hypothermia. The method was found to produce a rapid return to thermal equilibrium with a small rectal temperature afterdrop. (DD abstract)

268.

LIVINGSTONE, S.D., J. Grayson, L.D. Reed and D. Gordon.
Effect of a local cold stress on peripheral temperatures of Inuit, Oriental, and Caucasian subjects.
Can. J. Physiol. Pharmacol. 56(5):877-881; 1978.

Male subjects comprised of six Inuit from Igloolik, N.W.T., and five Orientals and six Caucasians from Toronto, Ont., volunteered for tests to determine the effect of localized cold stress on peripheral temperatures. In each subject, skin temperatures of the right index finger, the arm, and the cheek, as well as blood pressure and heart rate, were measured before, during, and after foot immersion in water of 10°C temperature for 10 min. There was an immediate decrease in finger temperature on foot immersion in all three subject groups; however, the Inuit finger temperatures recovered very quickly to control values, the Caucasian finger temperatures began to increase after decreasing for 7.5 min, and the Oriental finger temperatures decreased continuously during the foot immersion and remained cool even 10 min after the removal of the cold stimulus. The cold stimulus did not affect the cheek or arm temperatures of any of the groups. In all subjects, systolic and diastolic blood pressures and heart rates increased on foot immersion, gradually returning towards normal values. No intergroup differences were seen in these parameters. (Authors' abstract)

268a.

LIVINGSTONE, S.D., L.D. Reed and R.E. Limmer.

The application of heat flow discs and infrared thermography to the study of human heat loss in cold water.

In: Aerospace Medical Association, Preprints of 1980 Annual Scientific Meeting, p.72-73. Published by the Association. [1980].

The purpose of this study was to investigate heat transfer rates during immersion by means of heat flow discs and after immersion by means of heat flow discs and a thermographic system. It was found that site-to-site variation was insignificant. Heat flow was reduced when the arms were lowered, thus protecting the sides of the torso. The lateral thorax was not shown to be more vulnerable to heat loss than the rest of the torso. The studies reinforce the concept that heat loss during immersion in cold water can be diminished by contact with adjacent bodies or limbs. (MFW/UMS)

269.

LLOYD, E.L., B. Mitchell and J.T. Williams.

The cardiovascular effects of three methods of rewarming sheep from immersion hypothermia.

Resuscitation 5(4):229-234; 1976.

Hypothermia was induced in 11 anesthetized sheep by immersion in a cold bath. Cardiovascular status was assessed by measurement of cardiac output, heart rate, arterial and central venous pressure and calculation of stroke volume and peripheral resistance. The changes occurring during the 3 methods of rewarming were compared: immersion in hot bath, spontaneous rewarming with surface insulation alone and airway warming in addition to surface insulation. For acute hypothermia, airway warming is at least as safe as the standard methods in use. (© BA)

270.

LLOYD, E.L., B. Mitchell and J.T. Williams.

Rewarming from immersion hypothermia: A comparison of three techniques.

Resuscitation 5(1):5-18; 1976.

Rewarming from immersion hypothermia was assessed in sheep by the use of 3 techniques: hot bath, body insulation and airway warming. Though the hot bath was the fastest of the methods of rewarming studied, consideration of temperature gradients and therefore total body heat diminished its advantage in comparison with central body rewarming via the airway (CBRW), which in turn showed considerable advantage over body insulation alone. CBRW did not have any thermal advantage gained on assisting the ventilation as compared with spontaneous breathing. The results illustrate the importance of adequate insultation of the body to prevent further heat loss and this was found to be true whether or not airway warming was being used. The site of heat uptake with CBRW was determined and observations were made on the physical behavior of temperature gradients. [This is applicable to resuscitation of humans in accidental hypothermia.] (© BA)

270a.

LLOYD, E.L.

Accidental hypothermia treated by central rewarming through the airway.
Brit. J. Anaesth. 45:41-47; 1973.

Eleven hypothermic patients were treated by heat supplied via the airway. Three patients died during rewarming, three died of unrelated causes several days after successful rewarming and five survived. Core temperatures were measured by a low reading mercury rectal thermometer and by a thermistor probe inserted into the rectum or mid-oesophagus. In every patient the core temperature rose without any initial after-drop. The problems of the method are discussed and the suggestion made that it might be applicable in rescue work, in the treatment of elderly hypothermic patients, and in combating accidental hypothermia in the operating theater.

270b.

LLOYD, E.L.

Diving and hypothermia.
Br. Med. J. 2(6191):668; Sept. 5, 1979.

Emergency equipment to combat heat loss should be provided in diving bells in case of loss of power due to an accident of some sort. It is suggested that respiratory heat loss could be reduced by a heat exchanger that is also a condenser humidifier. An insulated canister filled with soda lime could perform this function. It would first act as a passive condenser humidifier and heat exchanger, then as expired carbon dioxide reacted with the soda lime to produce heat and moisture, it would become a positive heating system. Such a canister should provide about six hours of positive heating and CO_2 absorption. Problems to be solved would be fitting it into the breathing system, a slight increase in breathing resistance, and a gradual increase in dead space as the soda lime became exhausted. (MFW/UMS)

271.

LLOYD, E.L.

Treatment of accidental hypothermia (letter).
Br. Med. J. 1(6160):413-414; 10 Feb. 1979.

The point made in this letter to the editor is that treatment of accidental hypothermia is made more difficult by the assumption that it is a single clinical entity. There are at least three common types: firstly, "immersion" hypothermia, where the cold stress is greater than the maximum heat production of the body; secondly, exhaustion hypothermia, where the critical factor is depletion of the body's usuable food (fuel) stores; and thirdly, subclinical chronic hypothermia, which is the usual type found in the elderly, in whom, though the core temperature may be normal, the chronic cold stress has resulted in considerable intercompartmental fluid shifts—which complicate the management of any superimposed acute episode. The types can be distinguished only by the case history; for example, a climber disabled by a broken leg will probably cool as if immersed, whereas a strong swimmer lost overboard in relatively warm water is a candidate for exhaustion hypothermia.

271a.

LLOYD, E.L., N.A. Conliffe, H. Orgel, and P.N. Walker.

Accidental hypothermia: Apparatus for central rewarming as a first aid measure.
Scot. Med. J. 17:83-91; 1972.

Apparatus is described which can provide a certain amount of heat for the central rewarming of a hypothermic patient. This equipment is portable and cheap and can be used by non-medical people. Examples are given of the quantities of heat involved which can amount to 30 percent of the heat production of a hypothermic patient.

272.

LLOYD, E.L. and K. Little (letter).

Accidental hypothermia and low-reading thermometers.

Br. Med. J. 1(6173):1284; 12 May 1979.

(Sir,–)Professor G.L. Mills suggests (21 April, p.1082) one reason for diagnosing hypothermia is failure to use a low-reading thermometer. In the accident and emergency department of Edinburgh Royal Infirmary if temperatures fail to register on a normal clinical thermometer the nurses routinely use an electronic thermometer (range 15-45°C) with a rectal probe. This avoids any errors due to failure to shake down the mercury and the thermometer can accompany the patient to the ward with the probe left in situ for repeated measurements, thus avoiding the hazard of unnecessary movement of the patient. Glass and mercury thermometers have the additional danger that they can break during use. In the treatment of hypothermia "space blankets" have been replaced by polyethylene sheeting, which is equally effective, is cheaper, and is less liable to tear. It also has the advantage that there is none of the continual crackling noise produced by the metallised "space blanket," which is very distressing to the confused patient.

272a.

LONG, R.W.

Phase Change–An active system for heating sport divers.

In: Addendum to the Proceedings of the Eighth International Conference on Underwater Education, November 1976, San Diego, Calif., p.34-38. Colton, Calif., National Association of Underwater Instructors, 1976.

In man's ventures into the sea for sport, military, and professional purposes, he has been protected from the debilitating effects of cold water by being passively insulated with wet or dry suits, or, actively insulated with hot water or electrically produced heat. Passive insulation allows self-contained mobility while active insulation usually saddles the diver with an umbilical. An active insulation system, using the latent heat of crystallization of a solution as a heat source, has been developed recently. It requires no umbilical so the diver is both warm and mobile. This paper describes the system's use in sport diving. (Author's abstract)

273.

LOPUKHIN, Y.M., M.N. Molodenkov, N.G. Evseyev, B.K. Shurkalin, S.L. Ageyev, V.A. Pitenov, R.M. Balabanova, Z.S. Alekberova (letter).

Plasma perfusion in treatment of cold rash and systemic lupus erythematosus.

Lancet 1(8119):777-778; 7 Apr. 1979.

(Sir,–)Encouraged by our success with plasma perfusion through charcoal columns in the treatment of acute hepatic failure we decided to try this method to remove immunoglobulins from patients with cold rash and systemic lupus erythematosus (S.L.E.). A 43-year-old man was admitted to hospital with weakness, fatiguability, a widespread rash, and severe pruritus. His skin was covered with a pink to bright-red rash with marginal hemorrhages. Polyarthritis affected hand, wrist, and elbow joints. Clinical examination revealed severe heart-failure. The liver was enlarged and painful when palpated, and the spleen was also enlarged. No S.L.E. cells were found in the blood. For the previous 20 years the patient had had the cold rash along with continuous multiple rash with severe pruritus which got worse with any cooling. Despite long-term corticosteroid therapy the patient was never free of the rash and pruritus. A hot bath provided some relief. After preliminary therapy 2000 ml of the patient's plasma was perfused through the one 300 ml charcoal column included into plasma line of continuous blood-cell separator (Aminco). During perfusion no complications were observed. On the next day the condition of the patient dramatically improved: the rash on his upper and lower extremities and the pruritus had disappeared. For 2 weeks after the perfusion no new rash appeared, despite cooling challenges. After low-dose corticosteroid therapy stable remission of the cold rash was achieved and the patient was discharged. Patient B, a 25-year-old woman was admitted to hospital with cold rash combined with S.L.E. She had had this for 11 years. Massive corticosteroid therapy brought no stable clinical effect. After cooling tests a massive

diffuse skin edema and pruritus appeared immediately. Laboratory investigations revealed L.E. cells in blood. Antinuclear antibodies (D.N.A.) and cryoglobulins were found. After short-term pre-perfusion therapy 3000 ml of plasma was perfused through two 300 ml charcoal columns included into plasma line of 'Celltrifuge.' Perfusion was tolerated well. On the next day the condition dramatically improved. The rash and pruritus disappeared and a cooling test was negative. No L.E. cells were found in blood, nor were anti-D.N.A. antibodies or cryoglobulins. To prevent the formation of new immunoglobulins and antibodies low-dose corticosteroid therapy was started. 2 weeks later the patient left hospital with her S.L.E. in stable remission, clinically and on laboratory findings; her cold rash was in clinical remission, for the first time in her life. Plasmaperfusion through charcoal may make it possible to avoid the undesirable consequences of long-term corticosteroid therapy in such patients.

274.

LOTT, G.G. and R.J. Gatchel.

A multi-response analysis of learned heart rate control.
Psychophysiology 15(6):576-581; 1978.

College students (30) were classified on the basis of cold-pressor blood pressure responses and then randomly assigned to 1 of 3 treatment groups. One group merely tracked a visual analog display of thier heart rate (tracking group). A 2nd group attempted to increase and decrease heart rate without the visual display (no-feedback group). A 3rd group attempted to increase and decrease heart rate with the aid of the visual heart rate display (feedback group). Heart rate changes produced by the feedback and nofeedback groups were significantly greater than those observed in the tracking group. There was no significant difference between the former 2 groups. High cold-pressor reactors produced significantly larger heart rate changes than the low reactor subjects. A correlational analysis of physiological responses accompanying heart rate change suggested that the response topographies of the high and low cold-pressor reactors also differed. No relationship between coronary-prone personality characteristics, as measured by the Jenkins Activity Scale, and cold-pressor reactivity or heart rate control performance was indicated.

275.

LUPANDIN, Yu.V.

The role of vascular thermoreceptors in the mechanism of cold tremor inhibition by oxotremorine, seduxen and phentolamine.
Byull. Eksp. Biol. Med. 86(9):314-317; 1978.

I.v. infusion of oxotremorine, seduxen, and phentolamine to cats not only decreased the cold-induced tremor, but also reduced the subcutaneous vein receptor impulses. Diminished activity of the vascular thermoreceptors served as an additional component in the mechanisms of the inhibitory effect of oxotremorine and seduxen on cold tremor. Reduction of the thermoreceptors activity after phentolamine administration is primary, and may be considered as the leading factor in the cold tremor inhibition.

276.

LUPANDIN, Yu.V. and N.K. Poleshchuk.

Skeletal muscle motor unit activity in cats during cold tremors.
Fiziol. Zh. Sssr. 65(3):391-397; Mar. 1979.

The electrical activity of single motor units of the cat m. sartorius during the preshivering tone and shivering tremor revealed a steady frequency 5-10/sec. The transition from preshivering tone to shivering tremor involved recruitment of motor units with similar properties: the low-threshold units. The response of motor units to local thermal stimuli applied to vascular thermoreceptors depended on the level of peripheral temperature.

277.

McANDREW, F.T.

Memory disruption in mice following immersion in cold water.
J. Gen. Psychol. 99(1):151-152; July 1978.

The results support the contention that immersion in cold water immediately following a one-trial passive-avoidance task can disrupt memory of that task. The water in the CWE condition (1°C) was unquestionably a tremendous shock to an organism accustomed to room temperature. These results indicate that environmental stimuli delivered to an organism via the peripheral nervous system may in fact have a detrimental effect on learning and memory.

278.

McARDLE, W.D., J.R. Magel, G.R. Lesmes and G.S. Pechar.

Metabolic and cardiovascular adjustment to work in air and water at 18, 25, and 33°C.
J. Appl. Physiol. 40:85-90; Jan. 1976.

By use of successive increments of discontinuous work with an arm-leg cycle ergometer the oxygen consumption ($\dot{V}O_2$), cardiac output ($\dot{Q}$), stroke volume (SV), and heart rate (HR) were studied in six male subjects at rest and during exercise in air and in water at 18, 25, and 33°C. The $\dot{Q}$ values obtained by CO_2 rebreathing were reproducible. $\dot{V}O_2$ was linearly related to work with the plots for air and 33°C water being similar. However, during work in 25 and 18°C water, the $\dot{V}O_2$ averaged 9.0% (150 ml) and 25.3% (400 ml) higher, respectively, than values observed in 33°C water with the largest differences observed in leaner subjects. The plot of HR-$\dot{V}O_2$ was linear and almost identical during work in air and 33°C water, but shifted significantly to the right in cooler water. $\dot{V}O_2$ averaged 250-700 ml higher in cold water compared to air and 33°C water at a given mean heart rate. The $\dot{Q}$ vs. $\dot{V}O_2$ line was similar during work in air and in water with no effect of water or temperature. At similar levels of $\dot{V}O_2$, SV was significantly larger ($P < 0.05$) in 25 and 18°C water than in air or 33°C water. Consequently, the reduction in heart rate during work in cold water was entirely compensated for by a proportionate increase in the SV of the heart. $\dot{Q}$ was therefore maintained at similar levels of energy expenditure in air and in 18, 25, and 33°C water.

279.

McCARROLL, J.E.

Morbidity associated with cold weather training.
Reprinted from Military Medicine 144(10):680-684; October 1979.

A descriptive epidemiologic investigation was performed to determine the incidence of medical complaints in a large scale cold weather training exercise. Data are presented as frequencies of cases by category and by the cumulative incidence of selected disorders. It was found that respiratory, orthopaedic, surgical, dermatologic, and cold-associated complaints were the most frequently reported. Estimates of proportions returned to duty and duty time lost are provided.

279a.

McCARROLL, J.E., R.F. Goldman, and J.C. Denniston.

Food intake and energy expenditure in cold weather military training.
Reprinted from Military Medicine, 144(9):606-610; September 1979.

This paper examines the question of energy demands of military activities in a cold environment and the associated food requirements. The metabolic effects of cold on skin temperature are shivering and non-shivering thermogenesis. These effects are negligible for the well-clothed person since the temperature is not lowered. Acclimatization to cold is a complicated phenomenon which has only slight gains in comfort compared with the time required to achieve it. Energy expenditure (activity) is the primary determinant of food requirements. An energy expenditure prediction equation is presented for practical use when the following factors are known: load carried, velocity of movement, and the type of terrain.

Estimates of energy expenditure for various military activities are presented, in order to allow the reader to make rough estimates of energy demands upon troops in varying terrains and using different means of mobility. Using these estimates, a scenario can be created and food requirements can be predicted.

280.

McCARROLL, J.E., C.A. Traver, P.W. Phair, R.E. Jackson, R.C. Langevin, C.A. Murray and L.J. Farese.

Morbidity associated with cold weather training.
Military Medicine 144(10):680-684; 1979.

A descriptive epidemiologic investigation was performed to determine the incidence of medical complaints in a large scale cold weather training exercise. Data are presented as frequencies of cases by category and by the cumulative incidence of selected disorders. It was found that respiratory, orthopaedic, surgical, dematologic, and cold-associated complaints were the most frequently reported. Estimates of proportions returned to duty and duty time lost are provided.

281.

McMURRAY, R.G. and S.M. Horvath.

Thermoregulation in swimmers and runners.
J. Appl. Physiol. 46:1086-1092; June 1979.

Thermoregulatory responses of six trained swimmers and five runners to cold and heat were evaluated during 30 min of exercise (60% $\dot{V}O_{2max}$) while immersed to the neck in 20, 25, 30, and 35°C water. Mean oxygen uptake was similar for both groups during all four trials. Changes in metabolic rate during the 8th to 28th min were significantly greater for the runners in 20°C water, and swimmers in 30 and 35°C water. Heart rates, $\bar{T}_{sk}$, ΔT_{re}, $\bar{T}_b$, body heat content, and heat storage were dependent on water temperature. Runners were able to attain higher sweat rates than swimmers in 35°C water. Swimmers had significantly greater tissue conductance values in the 35°C exposure. Swimmers thermoregulated better in 20°C water than runners, possibly due to a larger surface area-to-volume ratio, percentage body fat, subcutaneous fat, or improved vasomotor control. Exercise in the heat was better tolerated by runners. Physical training in water does not improve heat acclimatization to the extent of training in air, but does improve cold tolerance. (Authors' abstract)

281a.

MACKAY, D.E.

The problem of cold/wet survival.
In: Cold/wet survival symposium. J. Roy Nav. Med. Serv. 58:156-160; Winter 1972.

A general introduction setting the scene for the Symposium. The practical problems of the preservation of life following exposure are stressed, with particular reference to the lone survival of a trawlerman following a disaster in Arctic waters.

281b.

MACLEAN, D., P.D. Griffiths, D. Emslie-Smith.

Serum Enzymes in Relation to Electrocardiographic Changes in Accidental Hypothermia.
Lancet 2:1266-1270; 1968.

High levels of serum-enzyme activities, particularly of creatine kinase and "α-hydroxybutyrate dehydrogenase," have been found during a study of 25 patients with accidental hypothermia. The results suggest that accidental hypothermia causes profound cellular damage, particularly of skeletal and cardiac muscle. This may help to explain the high mortality and the characteristic changes in the electrocardiogram found in such circumstances. These findings may be important in the use of hypothermia in surgery.

282.

MacINNIS, J.B.

Arctic diving: operational results of five expeditions.

In: The working diver–1974. Symposium proceedings, March, 1974, Columbus, Ohio. p.7-28. Washington, D.C., Marine Technology Society, 1974.

Between 1970 and 1974 the author led or participated in five scientific diving expeditions to the high Arctic. Under-ice locations included the Queen Elizabeth Islands, the Mackenzie River Delta, and the north coast of Alaska. Diving operations were conducted from various platforms including a surface support vessel, a jet helicopter, and structures built on the ice. Climate conditions ranged from summer to winter, and temperatures between 50°F above and below zero. On one diving day a chill factor of -90°F was recorded. Each expedition had doctorate level marine scientists whose disciplines included biology, geology, and diving medicine. Throughout one month-long expedition, human and equipment performance was studied during two hundred and five dives by an engineering psychologist. A small workshop and four refuge stations were constructed beneath one meter of ice and eleven meters of water. The sea temperature was 29°F. After supervision of over three hundred arctic dives, the author believes that the combination of polar surface and underwater stressors represents the earth's most hostile working environment. However, the increasing quest for energy resources implies future working dives to arctic depths of at least five hundred meters. Considerably more field performance data is required before such dives can be conducted with maximum safety and efficiency. (Author's abstract)

283.

MacINNIS, J.B.

The underwater Arctic: earth's most hostile frontier.

In: The working diver 1976. Symposium proceedings, March 2-3, 1976, Columbus, Ohio. p.196-214. Washington, D.C., Marine Technology Society, 1976. (Substantially the same paper was presented at the Fourth world congress of underwater activities, Stockholm, Sweden, September 1975.)

A review of 715 Arctic ocean dives made during nine expeditions have led the author to conclude that the underwater Arctic represents the planet's most inhospitable environment. Manned dives conducted during the four seasons of the year, from such diverse northern regions as Alaska, the Canadian Archipelago and the North Pole, have confirmed that work beneath the polar icecap is far more difficult than the same task carried out in temperate waters. In addition to the problems of ice, magnetic variability, cold and winter darkness, considerable personal energy must be expended to overcome well known surface stressors. Arctic IV was the most recent of a series of expeditions that attempted to define the problems and clarify the operational requirements for future commercial, military and scientific dives in the Arctic. During this two month expedition a saturation dive was conducted and the first polar oxy-helium dives were carried out. In addition, a series of survey dives were made at the North Pole to examine the operational problems of placing small teams of divers at remote locations in the high Arctic. Details of the eighteen underwater projects conducted during Arctic IV are found in this paper. (Author's abstract)

284.

MacKENZIE, J.A. and D.C. Jackson.

The effect of temperature on cutaneous CO_2 loss and conductance in the bullfrog. Respir. Physiol. 32(3):313-324; 1978.

Cutaneous and pulmonary CO_2 loss were measured simultaneously in bullfrogs, *Rana catesbeiana*, at 10, 20 and 30°C. Arterial blood samples were taken in each experiment and analyzed for $[H^+]$ and total plasma $[CO_2]$. These values were used to calculate arterial partial pressure of CO_2 (Pa_{CO_2}) by means of the Henderson-Hasselbach equation. Both $[H^+]$ and Pa_{CO_2} increased with temperature as previously observed. Skin CO_2 loss was measured using a titration method. (At 30°C it was necessary to add cal-

cium hypochlorite (5-9 ppm) to block bacterial growth and respiration). Skin CO_2 loss rose with temperature but the mean fraction of the total CO_2 lost by this route decreased from about 50% at 10°C to less than 1/3 at 30°C. At each temperature, over 90% of an incremental increase in total CO_2 loss was excreted via the lungs while skin loss was releatively constant over a wide range of total loss values. The increase in skin CO_2 loss with temperature corresponded to a proportional increase in the estimated transcutaneous P_{CO_2} difference. (This difference was assumed to equal Pa_{CO_2} minus ambient P_{CO_2}.) Consequently, the skin CO_2 conductance (skin CO_2 loss/transcutaneous P_{CO_2}) was not significantly influenced by temperature. This apparent temperature independence of skin CO_2 conductance may be important for acid-base regulation of skin breathers in response to temperature change.

285.

MACTUTUS, C.F., et al.

Retrograde amnesia for old (reactivated) memory: some anomalous characteristics. Science 204(1399):1319-1320; 22 June 1979.

Old memory, when reactivated by cue exposure, was disrupted by mild or deep hypothermia treatments. New memory was impaired only by deep cooling. Moreover, old but not new learning showed spontaneous recovery. Old reactivated memory may be qualitatively different from newly acquired memory.

286.

MALHOTRA, M.S. and L. Mathew.

Effect of rewarming at various water bath temperatures in experimental frostbite. Aviat. Space Environ. Med. 49(7):874-876; 1978.

Studies were conducted on 72 rats to determine the most suitable temperature at which rapid rewarming should be done as an immediate treatment for frostbite. Animals were put in a harness containing arrangements for warming the body. Their hind limbs were left out of the harness. They were then exposed to -15° ± 1°C in a deep freeze for 60 min, during which paw temperature was recorded every 5 min. After this, the animals were taken out, the left hind limb was rapidly rewarmed in a water bath maintained at 35°, 37°, 39°, 41°, 43° or 45°C for different batches and the right hind limb was left free for slow rewarming at room temperature (27°-29°C). The severity of cold injury in the 2 limbs was compared. The paw temperature showed a drop on cold exposure, followed by a rapid rise and then a 2nd fall. The degree of injury was related to the duration of exposure after the rise in the paw temperature. The rapid rewarming was effective only at water bath temperature of 37°-39°C and was harmful at 45°C. Rewarming at about body temperature is most effective as immediate treatment for frostbite.

286a.

MARCUS, P.

Laboratory comparison of techniques for rewarming hypothermic casualties. Aviat. Space Environ. Med. 49: 692-697; May 1978.

The efficacy of inhalation, hot bath, piped suit and spontaneous rewarming have been directly compared under controlled conditions. Hot bath rewarming was significantly more effective at raising deep body temperature than the piped suit technique and both were more effective than the other two methods. The effect of inhalation rewarming was not significantly different from that of spontaneous rewarming. All techniques gave rise to afterdrops of core temperature of widely varying degrees and durations. It is concluded that inhalation rewarming should not be employed if it entails a delay in transporting a patient to a facility for rapid external rewarming. Piped suit rewarming is a convenient field alternative to the use of a hot bath and a simple apparatus for carrying this out is described. The sluggish response of rectal temperature to cooling and rewarming in this study suggests that it should not be relied upon as the sole indicator of a patient's thermal state during treatment. Auditory canal temperature is a more valid substitute. (Author's abstract)

287.

MARCUS, P. and S. Richards.

Effect of clothing insulation beneath an immersion coverall on the rate of body cooling in cold water.

Aviat. Space Environ. Med. 49:480-483; Mar. 1978.

Deep body and skin temperatures were measured on nine subjects during a 1 h immersion in water at 2.5°C whilst wearing an RAF Mark 10 immersion coverall. With no additional insulation, mean skin temperature fell 13.1°C and deep body temperature 0.74°C. When a full Acrilan pile suit was worn beneath the coverall mean skin temperature fell 8.3°C and deep body temperature 0.33°C. With insulation covering the trunk and upper limbs alone, mean skin temperature fell 9.9°C and deep body temperature 0.45°C. Conclusions are drawn concerning the effects on body cooling of changes in insulation of aircrew clothing assemblies designed to protect against immersion in cold water. (Authors' abstract)

288.

MARCUS, P. and R. Edwards.

Serum enzyme levels during experimental hypothermia in man.

Q. J. Exp. Physiol. 63(4):371-381; Oct. 1978.

Deep surgical and accidental hypothermia cause elevations in serum enzyme levels, probably because of ultrastructural cell damage. Many variables hinder work on this problem in the clinical situation and the mechanism is obscure. Accordingly, enzymes and other physiological parameters were monitored in four subjects cooled four times, under controlled conditions in the laboratory, to a mean auditory canal temperature of 35.0°C. Mild hypovolaemia and acidosis occurred. Serum enzyme levels did not change significantly and it is concluded that elevations due to hypothermia cannot be studied in laboratory experiments on healthy volunteers who can only safely be cooled to 35°C.

289.

MARCUS, P. and A. Belyavin.

Thermal sensation during experimental hypothermia.

Physiol. Behav. 21(6):909-914; 1978.

Ten subjects were cooled to a deep body temperature (T_{DB}) ~ 35°C by the passage of cold air and water over the skin. Four subjects repeated the exposure on 3 more occasions. Subjective assessments of thermal comfort were recorded using an automated 10 cm line device. Multiple regression analysis showed that comfort was related to the levels and gradients of T_{DB} and mean skin temperature $T_{\bar{s}}$ and the presence or absence of shivering. First exposures were characterized by extreme discomfort associated with the initial rapid fall of $T_{\bar{s}}$ at the onset of cooling, and an improvement in thermal sensation as $T_{\bar{s}}$ plateaued before T_{DB} began to fall. This response was not seen in subsequent experiments. In these, discomfort occurred initially with falling $T_{\bar{s}}$ and then remained constant, finally increasing further as T_{DB} fell. This suggested habituation to steep gradients of $T_{\bar{s}}$. Other indications of habituation, leading to less discomfort at given levels of $T_{\bar{s}} + T_{DB}$ during later stages of cooling, were not statistically significant. There was no evidence of physiological acclimatization to cold in those subjects undergoing repeated exposures.

290.

MARCUS, P.

"Trench foot" caused by the cold. (letter)

Br. Med. J. 1(6163):622; 3 Mar. 1979.

In this letter to the editor attention is called to a previous letter to the editor entitled "Trench foot caused by the cold." The present author says that the original case uses not trench or immersion foot but one of frost-bite. He outlines the difference between these two conditions. (CWS/UMS)

290a.

MARSHALL, Hazel W., and H.B. Stoner.

Catecholaminergic α-Receptors and Shivering in the Rat.

J. Phyiol. 292:27-34; 1979.

(1) A rise or a fall in systemic blood pressure brought about by the i.v. infusion of peripherally acting drugs (adenosine, noradrenaline or methoxamine) inhibited shivering in the cold-exposed rat. (2) Since the injection of commonly used doses of noradrenaline (0·05–0·10 μmole) into a lateral cerebral ventricle of a rat was usually accompanied by a rise in blood pressure, special precautions were required to determine whether noradrenaline had a specific central effect on shivering. (3) Small doses of noradrenaline (0·02–0·03 μmole) or clonidine (0·01 μmole) which had no effect on blood pressure when injected into a lateral cerebral ventricle still inhibited shivering in the cold-exposed rat and this effect was prevented by phentolamine. (4) It is concluded that noradrenaline can inhibit the cold sensor-shivering pathway in its central course by an action on α-receptors.

290b.

MARSHALL, Hazel W., and H.B. Stoner.

The effect of dopamine on shivering in the rat.

J. Physiol. 288:393-399; 1979.

(1) Dopamine (0·5–0·2 μmole) injected into a lateral cerebral ventricle inhibited shivering and lowered core temperature in rats at an ambient temperature of 0–5°C. (2) These effects were inhibited by the dopamine antagonist, pimozide, and imitated by the dopamine agonists, piribedil and apomorphine. (3) Pimozide itself had no effect on shivering. (4) It is concluded that while there are inhibitory dopamine receptors on the cold sensor-shivering pathway in the rat they are not concerned in the normal function of this pathway.

291.

MARTIN, S., K.E. Cooper and R. Sainsbury.

Psychological effects of cold water immersion.

Proc. Ann. Meeting Can. Fed. Biol. Sci. 19:1; 1976.

Abstract only. Entire item quoted: Although the psychological effects of long term cold water immersion are known, no thorough investigation of the results in humans of short immersion has been done. The implications of possible memory or decision-making deficits are self-evident in terms of water related activities. Three experimental protocols were designed to test recall and recognition as well as the individual's ability to make a decision when a task was presented. Two protocols involved the use of slides presented before or during the immersion and tests were carried out after removal from the tank, to see if any memory impairment had occurred. The third protocol involved the presentation of eight series of 7 digit numbers during immersion and the subjects performed a specific test (recall number, do computation) at a given signal. Male and female subjects participated at temperatures of 13°C, 15°C and 32°C; ventilatory responses were measured during two protocols. The results of Protocol II showed a significant difference in the subjects' performance in the cold vs. warm water, and a correlation between the number of errors and the mean % change in end-tidal pCO_2 was evident.

292.

MARTIN, S., K.E. Cooper and R. Sainsbury.

Cold water immersion: influence on recall.

Neurosci. Abstracts 2(Part.1):447; 1976.

Abstract only. Entire item quoted: Long term cold water immersion can produce irrationality, delirium and unconsciousness. No thorough study has been made in humans of the psychological effects (e.g. memory deficit) which might accrue as a result of short term immersion. Experiments were carried out

to investigate the effects of cold water immersion on memory. In Protocol I, 13 subjects were shown a stimulus set of 25 slides, each exposed for 2 sec, before immersion in cold water (15.0°C) for 4 min. Recall tests were administered following exit from the water. Protocol II involved 11 subjects who were shown slides 1 min after immersion in cold water and subsequently tested as in Protocol I. These experiments were repeated in warm water (33.0°C). There was a significant difference ($p < 0.05$) in the number of errors during the recall tests between the warm and cold water conditions as well as between the control and cold water in Protocol II. A rank correlation test of the number of errors and the mean % change in end-tidal pCO_2 in the cold water showed statistical significance ($p < 0.001$). No significant difference was noted in Protocol I. These results do not appear to be influenced by offering monetary incentives. The data support the possibility of a recall deficit as a result of short term cold water immersion. The area of difficulty may lie with either information acquisition or processing and an inability to recall due to changes in cerebral blood flow.

292a.

MARTIN, S., R.J. Diewold and K.E. Cooper.

The effect of clothing on the initial ventilatory responses during cold-water immersion.
Can. J. Physiol. Pharmacol. 56(5): 886-888; 1978.

The effect of clothing on ventilatory responses during cold-water immersion was studied. Subjects (human) were immersed in water at 13.9°C on 2 occasions wearing either a bathing suit only or clothed with jacket, shirt, pants and sports shoes. The initial gasp and subsequent min of expired ventilation were significantly attenuated but the changes in end-tidal P_{CO_2} (partial pressure of CO_2) were only significantly different for the 2nd and 3rd min of the immersion. The use of clothing may prove beneficial during the first few min of a cold-water immersion by decreasing the powerful drive to increased respiration. (© BA)

293.

MARTIN, S., K.E. Cooper and R.J. Diewold.

Effects of alcohol on body temperature and ventilatory responses during immersion in cold and warm water.
Fed. Proc. 36:419; Mar. 1977.

Abstract only. Entire item quoted: Since alcohol is a central nervous system depressant and a peripheral vasodilator, it may hasten body heat loss during exposure to cold. This work was undertaken to examine the relationship between blood alcohol levels and both skin and body temperature during immersions in water at different temperatures. Following alcohol ingestion, subjects were immersed for 20 min in water at 13.5°C. The control immersion was done at 13.5°C. During each experiment aural, rectal, skin temperatures, ECG, total ventilation and end-tidal PCO_2 were measured. Blood samples (5 ml) were taken before immersion and analyzed by gas-liquid chromatography. The mean blood alcohol level was 90 ± 11.2 mg %. Alcohol did not alter the change in either the ventilatory responses, aural, rectal or skin temperatures observed during the cold water immersion. Therefore, it would appear that for an immersion at 13°C, alcohol does not increase body heat loss. At the present time the same subjects are being studied during immersions at 22°C and 30°C on the grounds that the lesser degree of vasoconstriction in the warmer water may be more easily overcome by the central and peripheral effects of alcohol.

294.

MARTIN, S., R.J. Diewold and K.E. Cooper.

Alcohol, respiration, skin and body temperature during cold water immersion.
J. Appl. Physiol. 43:211-215; Aug. 1977.

Subjects who had not been exercising, were immersed for 20 min in water at 13°C after ingestion of alcohol. During the immersion period, total ventilation, end-tidal PCO_2 rectal temperature, aural temperature, and mean skin temperature were recorded. Control experiments were carried out at the same water temperature. Blood samples (3 ml), taken immediately before the immersion period, were analyzed by gas liquid chromatography. The mean blood alcohol level was 90 ± 11.2 mg · $(100\ ml)^{-1}$. There was no significant difference in ventilatory responses, rectal temperatures, aural temperatures, or mean skin

temperatures achieved during the two cold water immersions. It would appear that for a 20-min immersion at 13°C, relatively high blood alcohol levels do not affect ventilatory responses or increase body heat losses. (Authors' abstract)

295.

MARTIN, S. and K.E. Cooper.

Factors affecting shivering during cold water immersion.

In: Proceedings of the International Union of Physiological Sciences, July 18-23, 1977, Paris. Volume XIII. Abstracts, p.482. Published by the Secretariat of the XXVII International Congress of Physiological Sciences, 1977.

Abstract only. Entire item quoted: Shivering is one of the physiological methods used by man for heat production when exposed to cold. We have investigated surface and deep skin temperatures during the shivering initiated by cold water immersion. Eight subjects who had been preheated in a sauna or exposed to room air were immersed in cold water (14.5°C) for ten minutes. During the immersions, total expired volume, end-tidal PCO_2, deep skin temperature and surface skin temperature were recorded. Subcutaneous fat thickness of the subjects were also measured. The results show that shivering occurred in some subjects when the deep skin temperature was 25°-29°C and in others when it was 20°-22°C. When the subjects had been preheated, the latency to shivering was longer but occurred at about the same or lower deep skin temperature than the shivering recorded during immersion after room air exposure. During both immersions, the surface skin temperature declined rapidly and plateaued at a level 4°-10° lower than the deep skin temperature and 2°-3° higher than the water temperature. It would appear that the afferent impulses from deep skin receptors are more important than those from surface temperature receptors in this heat production mechanism.

296.

MARTIN, S. and K.E. Cooper.

The relationship of deep and surface skin temperatures to the ventilatory responses elicited during cold water immersion.

Can. J. Physiol. Pharmacol. 56(6):999-1004; 1978.

Subjects were immersed for 10 min in water at 14.5°C, after exposure either to ambient temperature or sauna heating. During the immersions, total ventilation, end-tidal P_{CO_2}, the mean of 3 surface skin temperatures and deep skin temperatures were measured. There was a statistically significant correlation between the rate of change of deep skin temperature and the initial ventilatory responses evoked during both cold water immersions. After the sauna heating and cold water exposure, the temperature gradient through the skin appeared to be related to the ventilatory response. There was no significant correlation between the rate of change of mean surface skin temperature and the ventilatory response. Primary drive to increased ventilation during cold water immersion is the rate of change of deep skin temperature. (Authors' abstract)

297.

MARTIN, S., R.J. Diewold and K.E. Cooper.

The effect of clothing on the initial ventilatory responses during cold-water immersion.

Can. J. Physiol. Pharmacol. 56(5):886-888; Oct. 1978.

The effect of clothing on ventilatory responses during cold-water immersion was studied. Subjects were immersed in water at 13.9C on two occasions wearing either a bathing suit only or clothed with jacket, shirt, pants, and sports shoes. It was found that the initial gasp and subsequent minutes of expired ventilation were significantly attenuated, whereas the changes in end-tidal P_{CO_2} were only significantly different for the 2nd and 3rd min of the immersion. It would appear that the use of clothing may prove beneficial during the first few minutes of a cold-water immersion by decreasing the powerful drive to increased respiration.

298.

MASKREY, M. and P.P. Hoppe.

Thermoregulation and oxygen consumption in Kirk's dik-dik (*Madoqua kirkii*) at ambient temperatures of 10-45°C.

Comp. Biochem. Physiol. A. Comp. Physiol. 62(4):827-830; 1979.

Thermoregulatory and metabolic responses of dik-dik (*M. kirkii*) were measured over an ambient temperature (T_a) range of 10-45°C. The lower critical temperature was estimated at T_a 25°C. At T_a 40 and 45°C, dik-dik panted and O_2 consumption fell below that measured at thermoneutrality. The dik-dik appears well adapted to a high T_a, but can cope with a low T_a only at a high metabolic cost.

299.

MATHEW, L., S.S. Purkayastha and M.S. Malhotra.

Cold-induced vasodilatation response at different water bath temperatures in monkeys.

Aviat. Space Environ. Med. 49:976-979; Aug. 1978.

The response of cold-induced vasodilatation (CIVD) at different water bath temperatures was studied in 20 monkeys (3.5 kg) in a conscious state in a thermoneutral room. The animals were controlled by seating in a monkey chair, and the right hind limb up to 7.5 cm from the heel was immersed in a water bath for 60 min. Four series of experiments were conducted at water bath temperatures of 0°, 4°, 8°, and 12°C, respectively, at weekly intervals and the skin temperatures were measured from three sites in the foot. Marked CIVD response was noted from the dorsum and, to a lesser extent, from the sole of the foot, but no response was seen from the tip of the middle toe at 0°, 4°, and 8°C water bath temperatures. The pattern of CIVD response at 4°C was identical to that of 0°C, but the response at 8°C was poor and was absent at 12°C. Three patterns of CIVD—such as hunting, proportional control, and slow, steady, and continuous rewarming—was observed. However, 15% of the animals did not exhibit any CIVD. The observations show that the CIVD response of monkeys is remarkably similar to that of man. (Authors' abstract)

300.

MATHEW, L., S.S. Purkayastha, A. Jayashankar and R.P. Sharma.

Responses of high altitude natives to a standard cold test at sea level.

Aviat. Space Environ. Med. 50(4):372-375; Apr. 1979.

Studies have been conducted to evaluate the thermoregulatory, calorigenic, and peripheral vascular responses to cold of high altitude (HA) natives on their descent to sea level. Two groups of subjects (18 each), one representing high altitude (3500 m) natives and the other lowlanders, were exposed to a standard cold test at 10°C wearing only shorts for 2 h. Their heart rate (HR), blood pressure (BP), oxygen consumption ($\dot{V}_{O_2}$), oral temperature (T_{or}), mean weighted skin temperature ($\bar{T}_s$) and shivering activity were recorded initially in a thermoneutral room, and at 30 min intervals during the cold exposure. Afterwards, their cold-induced vasodilatation (CIVD) response was studied and the peripheral blood flow during local cold stress was calculated. The responses were statistically compared. The highlanders maintained significantly higher T_{or}, $\bar{T}_b$ (mean body temperature), $\bar{T}_s$ and peripheral T_s during cold stress, and they shivered much less and showed higher CIVD response and peripheral blood flow than the other group. The rise in $\dot{V}_{O_2}$ on cold stress was identical. The observations showed better cold tolerance for high altitude natives compared to lowlanders, even at sea level.

300a

MATHEW, L., S.S. Purkayastha, W. Selvamurthy, and M.S. Malhotra.

Cold-induced vasodilation and peripheral blood flow under local cold stress in man at altitude.

Aviat. Space Environ. Med. 48(6):497-500; 1977.

The cold-induced vasodilation (CIVD) response was studied on 17 lowlanders (20-30 years) at Delhi, using a water bath maintained at 4° ± 0.2°C. The temperatures were measured at the tip of the index finger, center of the palm, over a prominent wrist vein, and orally. Then the subjects were air-lifted to an altitude of 3500 m, where the measurements were repeated at weekly intervals for a period of 3 weeks. After this, they were flown back and retested. For comparison, the study at altitude was done on 10 acclimatized lowlanders and on 10 high-altitude natives. The peripheral blood flow under a local cold stress was calculated. Three types of CIVD responses–viz. typical hunting, proportional control, and continuous rewarming–were observed. At altitude, the pattern was more or less the same but there was a significant reduction in the response. The responses of the natives were more or less identical to those of the lowlanders at sea level, and responses of the acclimatized lowlanders were better than the fresh inductees, but much less than the natives. The changes in peripheral blood flow was in accordance with the CIVD response.

301.

MATSUDA, M., H. Nakayama, A. Itoh, N. Kirigaya, F.K. Kurata, R.H. Strauss and S.K. Hong.

Physiology of man during a 10-day dry heliox saturation dive (SEATOPIA) to 7 ATA. 1. Cardiovascular and thermoregulatory functions. Undersea Biomed. Res. 2:101-118; June 1975.

Cardiovascular functions, energy metabolism, and body heat exchange were studied in 7 male subjects during a 10-day stay in a dry heliox hyperbaric environment (7 days at 7 ATA and 3 days of decompression). Temperature was maintained at 28-29°C in order to study the effects of cold. The daily caloric intake remained at about 3000 kcal throughout the dive. The pulse rate was about 20% below the predive level; lowering the temperature did not augment this bradycardia. There were slight increases in systolic and diastolic blood pressures. Both the rectal and skin temperatures decreased at 7 ATA (28-29°C) with a further reduction at 25-26°C. A decrease in mean body temperature was mainly due to the lowered peripheral skin temperatures. The urinary excretion of catecholamines showed no marked changes. During a standard submaximal exercise (500 kilopond meter/min); the O_2-pulse was greater and the ventilatory equivalent was lower compared to their respective predive values. Diurnal changes in the body temperatures and VO_2 became more exaggerated at depth. Toward the end of the 7-day period at 7 ATA, the pulse rate and body temperatures tended to return to the predive level, suggesting a possible adaptation to hyperbarism. (Authors' abstract)

302.

MATSYNIN, V.V.

Heat losses and body temperature of albino rats in hyperoxia.
Dopov. Akad. Nauk. Ukr. Rsr. Ser. B Heol. Khim. Biol. Nauky. (4):365-371; 1978.

Heat losses caused by radiation and evaporation and rectal and skin temperature were studied in albino rats under conditions of normal and hyperbaric hyperoxia. Radiation heat loss did not essentially change while evaporation loss decreased. Under hyperbaric hyperoxia, heat loss due to radiation and evaporation increased. Body temperature, in both cases, did not differ from the initial one. In the model

experiments with heated bodies and those heated in the constant regimes under hyperbaria, the radiation heat losses increased and body temperature decreased. The relative inertia of the living system along with the cooling effect of hyperbaric hyperoxia, is caused by an increase in thermogenesis.

303.

MEERSON, F.Z., M.G. Pshennikova, L.P. Golubeva, E. Yanishevsky, E.G. Krause and A. Vollenberger.

Effect of adaptation in high altitude hypoxia and to cold on adenylate cyclase activity of the rat myocardium.

Vopr. Med. Khim. 24(4):486-490; 1978.

Activity of adenylate cyclase from heart muscle was increased in rats adapted to cooling as compared to control animals; the enzymatic activity did not alter in rats adapted to high altitude hypoxia. Activation of adenylate cyclase by noradrenaline [norepinephrine], sodium fluoride and by 5'-guanilyl imidodiphosphate was significantly decreased in rats adapted to both environmental changes.

304.

MENSE, S.

Effects of temperature on the discharges of muscle spindles and tendon organs.

Pfluegers Arch. Eur. J. Physiol. 374(2):159-166; 1978.

In anesthetized cats the effects of temperature on the nervous outflow from skeletal muscle via thick myelinated afferent fibers were studied. Single unit recordings were made from afferents of muscle spindles and tendon organs during slow and fast temperature changes of the medial gastrocnemius muscle which was deeferented by ventral root section and prestretched to a tension of 100 p [pond]. Group I afferent units from muscle spindles were activated by warming and depressed by cooling, the effect of warming being much more pronounced than that of cooling. Afferents from secondary spindle endings with a high background discharge behaved similar to Ia fibers whereas those with a low initial discharge rate showed an activation by cooling and a depression (mostly to cessation of firing) by warming. The discharges of group I afferents from tendon organs varied; an activation by warming was the most frequently observed reaction. Some of the afferents from muscle spindles and tendon organs showed signs of a dynamic sensitivity to thermal stimulation but in general the dynamic component in the responses to temperature changes was only small. The afferent outflow via thick myelinated fibers from a resting, moderately prestretched muscle apparently strongly depends on temperature. At raised intramuscular temperatures (about 42°C) the nervous outflow is characterized by an increased activity in all of the Ia and many of the Ib afferents, while the majority of group II spindle afferents will be depressed. In a cold muscle (about 29°C) the nervous outflow via afferents from primary spindle endings will be reduced, while the net activity from secondary spindle endings will be increased and no marked changes are expected to occur in the discharges of Ib fibers.

305.

MERER, P. and A. Guirriec.

A propos de deux observations de survie en eaux temperees froides.

[Two cases of survival in moderately cold water].

Cinesiologie 60:163-175; June 1976.

The author cites two instances of cold exposure. The first was a shipwreck involving 39 people, of whom only one, who happened to be wearing a foam neoprene diving suit, survived. He spent 8 hours, partly in the water and partly on a raft. All other survivors who did not drown died of cold. The second concerned three divers who were swept away from their boat by a sudden change in wind and tide, but who managed to survive 8¼ hours of exposure due to the fact that they were in good physical condition, were well equipped, and dressed in foam neoprene suits. Their folly consisted of embarking on a night dive without a thorough understanding of the environmental conditions or dangers. The thinner of the

three suffered severely from cold. Two of them, who had eaten rather copiously and had also partaken of alcohol before diving, became severely seasick. In the case of these three young men, the will to survive, particularly strong in one of them, played an inestimably important part. (MFW/UMS)

306.

MILLER, E.A., M.J. Fregly, M.J. Katovich and C.C. Barney.

Time for loss of increased cardiac responsiveness to isoproterenol in cold-acclimated rats after removal from cold.

Aviat. Space Environ. Med. 50(2):159-162; 1979.

Female rats exposed to air at 5 ± 1°C for 12 wk had a greater increase in heart rate [HR] in response to s.c. administration of *d,l*-isoproterenol (8 μg/kg body wt) than warm-acclimated controls when both were tested in air at 25 ± 1°C. After removal from cold for 24, 48 or 72 h, cold-acclimated rats still showed a greater responsiveness of HR to s.c. administration of isoproterenol (8 μg/kg body wt) when compared with warm-acclimated controls. However, by 96 h after removal from cold the responsiveness of HR to isoproterenol in the cold-treated group no longer differed from that of the warm-acclimated group. The increased β-adrenergic responsiveness of HR in cold-acclimated rats was lost at some time from 72-96 h after removal from cold.

307.

MILLER, R.D., S. Agoston, F. van der Pol, L.H.D.J. Booij, J.F. Crul and J. Ham.

Hypothermia and the pharmacokinetics and pharmacodynamics of pancuronium in the cat.

J. Pharmacol. Exp. Ther. 207(2):532-538; Nov. 1978.

We tested the effect of hypothermia on the pharmacokinetics and pharmacodynamics of pancuronium in the cat. In 14 cats given pancuronium, 120 μg/kg i.v., we found that neuromuscular block lasted between 2.5 and 3.0 times longer at 29°C ($N = 5$) than at 34°C ($N = 5$) or 39°C ($N = 4$). The apparent plasma elimination half-life was 46 ± 7 min (S.E.) at 29°C as compared to 21 ± 2 and 25 ± 6 min at 34 and 39°C, respectively. The volume of distribution of the central compartment and total volume of distribution at steady state were less at 29 and 34°C than at 39°C. Total plasma clearance was 4.3 ± 0.4 ml/kg/min at 29°C and 10.7 ± 0.9 and 10.9 ± 1.5 ml/kg/min at 34 and 39°C, respectively. The reduced plasma clearance resulted at least in part from a markedly reduced biliary and urinary excretion of pancuronium at 29°C as compared to 34 and 39°C. In four other cats, the plasma concentration of pancuronium was correlated with depression of twitch tension under steady-state conditions. The ED50 of pancuronium (plasma concentration required for a 50% depression of twitch tension) was 0.035 and 0.073 μg/ml at 29 and 38°C, respectively. We conclude that a pancuronium neuromuscular block is prolonged at 29°C because of an increased sensitivity of the neuromuscular junction to pancuronium and delayed biliary and urinary excretion.

308.

MILLER, V.M. and F.E. South.

Spinal cord, hypothalamic, and air temperature: Interaction with arousal states in the marmot.

Am. J. Physiol. 236(1):R107-R116; 1979.

Yellow-bellied marmots, *Marmota flaviventris*, prepared with U-shaped thermodes in the epidural space of the thoracic vertebral canal, a thermode in the preoptic hypothalamus and cortical surface and hippocampal electrodes, were used to investigate the interaction of arousal states with temperature regulation. Arousal state of the animal influences the thermoregulatory responses initiated in the spinal cord or hypothalamus. Changes in ambient temperature affected the gain and the threshold of these responses. The interaction of the hypothalamus and spinal cord was not an additive function; however, the threshold for shivering of each could be altered by temperature manipulation of the other. Future studies in

modeling of temperature regulation should consider the contributions of temperature receptors of the spinal cord and the arousal state of the animal during the stimulation period.

309.
MILLS, G.L.
Accidental hypothermia and low reading thermometers (letter).
Br. Med. J. 1(6170):1082-1083; 21 Apr. 1979.

This letter to the editor points out the need for a low-reading thermometer since the usual hospital thermometer does not give the appropriate reading for a patient suffering from accidental hypothermia. (CWS/UMS)

310.
MIMS, L.C. and J.A. Pascale.
Cold stress influence on lung lecithin in the newborn rabbit.
Biol. Neonate 35(1-2):90-94; 1979.

Term, food-water deprived newborn rabbits exposed to a cold environment for 48 h demonstrated a significant decrease in total lung lipid ($p < 0.01$), total triglyceride ($p < 0.001$), total phospholipid ($p < 0.05$), and total phosphatidylcholine ($p < 0.025$). Disaturated phosphatidylcholine remained unchanged. Fatty acid methyl esters of total and disaturated phosphatidylcholine were not influenced by cold stress. Likewise, there was no alteration in pulmonary function as determined by deflation pressure-volume relationships.

311.
MITCHELL, J., R.O. Weller and H. Evans.
Capillary regeneration following thermal lesions in the mouse cerebral cortex. An ultrastructural study.
Acta Neuropathol. (Berl) 44(3):167-171; 15 Dec. 1978.

Cold lesions were induced in the parietal cortex of 20 mice and capillary revascularisation of the necrotic zone in the subsequent four weeks was observed by light and electron microscopy. During the second week after injury, capillaries grew into the lesion from the thickened pia. Each vessel was covered by several thin lamellae of pial cell and was accompanied by bands of collagen. Capillaries which grew into the necrotic zone from the surrounding brain during the 2nd-3rd weeks after injury were all surrounded by astrocyte processes; there was also a pericapillary space which contained pericyte processes and a few collagen fibres. Lacunae lined by basement membrane and surrounded by processes of one or more astrocytes were observed during the early stages of revascularisation. Each lacuna contained a few collagen fibrils together with cell processes which were similar to the pericyte processes around regenerated capillaries. Cells resembling immature endothelial cells were occasionally seen within the lacunae. The hypotheses proposed here are, that the regenerating capillaries grow through or along the astrocyte lacunae and that the course of capillary regeneration is in this way influenced and guided by the astrocytes.

312.
MITCHELL, J., R.O. Weller and H. Evans.
Reestablishment of the blood brain barrier to peroxidase following cold injury to mouse cortex.
Acta Neuropathol. 46(1/2):45-50; 1979.

After induction of cold lesions in the parietal cortex of mice, i.v. injected horseradish peroxidase (HRP) was used to study the blood-brain barrier [BBB] of the intracerebral vessels to this protein. During the 1st wk the majority of the arterioles and capillaries within the necrotic zone of the lesion had leaked had HRP into the brain parenchyma. The capillaries in the peripheral zone were surrounded by swollen

astrocyte end feet but HRP was confined to vesicles within the endothelial cell cytoplasm. Small arterioles (10-20 μm diameter) in the peripheral zone were leaking HRP and the reaction product was observed in the perivascular basement membranes and in vesicles within the endothelial cell cytoplasm. During the 2nd and 3rd wk the regenerating capillaries which grew into the previously necrotic zone from the periphery showed no evidence of leakage of HRP. Several non-patent regenerating capillaries were seen at this time but by the 4th wk all capillaries contained HRP within their lumen. The small arterioles in the peripheral zone continued to leak peroxidase throughout the period of the study. In the 2nd wk approximately 10% of the arterioles examined were leaking HRP but by the 4th wk only 2 of 53 arterioles were involved. The impaired BBB function of the small arterioles is possibly due to an absence of a sympathetic innervation or to raised levels of serotonin.

313.

MITTELMEIER, H. and O. Schmitt.

Carcinoma in scar tissue after frost inquiry to the foot.

Arch. Orthop. Trauma Surg. 92(1):47-52; 11 Aug. 1978.

Carcinomas of the extremities are relatively rare neoplasms when compared to Sarcomas. After a review of the literature about carcinomas in chronic fistulae and other bone lesions, two cases are reported in which a carcinoma originated in scar-tissue, 31 years after a frost-bite lesion of the foot. The problems of etiology, pathogenesis and therapy are pointed out.

314.

MOGIL'NITSKAYA, L.V. and L.Z. Pevzner.

Acid protein content in the nuclei of neurons and glial cells of rat hypothalamus during adaptation to cold.

Byull. Eksp. Biol. Med. 86(8):187-190; 1978.

The acid protein content/cell was determined in the nuclei of the neurons, the glial satellite cells of the medial peroptic area and the supraoptic nucleus of the rat hypothalamus by 2-wavelength cytospectrophotometry. Rat hypothalamus were kept at 2-4°C for 1, 3, 7 or 15 days (adaptation to cold). This cooling resulted in an initial decrease in the nuclear acid protein content in the whole neuron-neuroglia system of the medical preoptic area with a gradual return to normal by the 15th day of constant cooling. In the glial cells, the acid protein content increased temporarily above the control level before returning to normal. A gradual accumulation of acid proteins and its subsequent return to the control level was revealed in the neuron-neuroglia system of the supraoptic nucleus. By the 15th day of cold adaptation the content of neuronal and glial acid proteins of this nucleus became somewhat lower than the control.

315.

MOGIL'NITSKAYA, L.V. and V.S. Shugalei.

Proteolytic processes in the rat brain and liver during cold adaptation.

Fiziol. Zh. Sssr. Im. I M Sechenova. 64(7):1035-1038; 1978.

Autolysis and the neutral proteinase activity with respect to protamine in rat brain and liver were studied during cold adaptation on the 1st, 3rd, 7th, 15th and 45th days in a cold chamber at 2-4°C. A short cold effect (1-3 days) decreases brain autolysis by 33% and the liver by 18%. The activity of protamine-lytic peptide-hydrolase is diminished by almost ½ in the brain and liver. In cold-adapted rats (45 days) autolysis increased by 50% in the brain and 24% in the liver. The activity of neutral peptide-hydrolase remained lowered by 43% in the brain and by 36% in the liver. Only autolytic processes are intensified in cold-adapted animals. The neutral peptide-hydrolase does not participate in the increasing protein catabolism in the brain and liver.

316.

MOGILNITSKAYA, L.V. and L.Z. Pevzner.

Acid protein content in the nuclei of the neurons and glial cells of the rat hypothalamus during cold adaptation.

Biull. Eksp. Biol. Med. 86(8):187-190; Aug. 1978.

By means of two-wave length cytospectropnotometry the acid protein content per cell was determined in the nuclei of the neurons and their glial satellite cells of the medial preoptic area and the supraoptic nucleus of the hypothalamus of rats kept at 2-4°C for 1, 3, 7, or 15 days (adaptation to cold). This cooling resulted in an initial decrease in the nuclear acid protein content in the whole neuron-neuroglia system of the medial preoptic area with a gradual restoration to the normal by the 15th day of constant cooling. In the glial cells of this area the acid protein content increased temporarily above the control level before the restoration to the normal. A gradual accumulation of acid proteins and its following restoration to the control level was revealed in the neuron-neuroglia system of the supraoptic nucleus. By the 15th day of the adaptation to cold the content of neuronal and glial acid proteins of this nucleus became somewhat lower than in the control.

317.

MOHRI, H., et al.

Use of athrombogenic tubing for perfusion rewarming following surface-induced deep hypothermia.

J. Thorac. Cardiovasc. Surg. 77(2):277-282; Feb. 1979.

A method of heparinless, oxygenatorless, left heart bypass perfusion rewarming following surface hypothermia, with the use of a closed circuit with 130 ml. prime volume including heat exchanger, has been devised. The use of polyurethane-polyvinyl-graphite (PPG)-coated tubing has previously been reported. In this text, the use of an athrombogenic coating with cetyl-pyridinium chloride (CPC) as a regional heparin carrier was studied in dogs, comparing groups with PPG tubing and total systemic heparinization or plain polyvinyl tubing without systemic heparinization. Heparin compounded in the CPC coating eluted into the blood and caused mild transient whole-body heparinization during rewarming from 20° to 25°C., as evidenced by prolongation of the thrombin time. Alterations of hematologic parameters in all three groups were similar to those during surface rewarming except for those affected by heparinization. The left heart bypass method was found useful for hypothermic open-heart surgery when utilized with an athrombogenic surface coating or total body heparinization. It was concluded that the CPC coating is superior to the PPG coating since no cracking develops, it is translucent, and it provides a more effective athrombogenic surface.

317a.

MOLNAR, G.W., A.L. Hughes, O. Wilson, and R.F. Goldman.

Effect of skin wetting on finger cooling and freezing.

J. Appl. Physiol. 35(2):205-207; 1973.

The middle phalanx of a finger of seven subjects was exposed in duplicate tests, once dry and once wet, to a windstream of 6.8 m/s at −15.0°C. Both pre-Newtonian and Newtonian cooling rates were somewhat faster for the wet than for the dry skin. The difference can be ascribed to an increment of heat transfer by evaporation from the wet skin. The mean time to reach the supercool temperature at which the wet skin started to freeze, however, was only 1.0 min longer for the dry skin. Freezing occurred in six of the seven cases of wet skin (cold induced vasodilation supervened in the seventh case), but only in three cases with dry skin. It is concluded that water in the corneum precipitates crystallization at a higher supercooled temperature than that at which crystallization will tend to occur in dry skin.

317b.

MOLNAR, G.W., O. Wilson, and R.F. Goldman.

Analysis of events leading to frostbite.

Int. J. Biometeor 16(3):247-258; 1972.

In a previous paper (Wilson and Goldman, 1970) data were reported concerning the incidence of digital frostnip in different combinations of wind and air temperature. In order to ascertain the cooling constants for correlation with the incidence of freezing, the temperature measurements were subjected to semilogarithmic analysis as previously described (Molnar, 1969b). Under the conditions of the experiments with only the second phalanx exposed to cold air, the cooling trend appeared to be non-Newtonian and the constants were not immediately ascertainable. A preliminary analysis of the problem was reported earlier (Molnar, 1971). A more complete study is presented here.

318.

MONTGOMERY, L.D.

Analytic model for assessing the thermal performance of scuba divers.

J. Hydronautics 8:108-118; July 1974.

An analytic model is developed to simulate the thermoregulatory system in man under immersed conditions. The biothermal model is divided into two distinct subsystems: the physical-controlled system and the dynamic-controlling system. Two types of experimental data are used to substantiate the analytic model: neck immersed, seminude subjects in cool to temperate water, and neck-immersed "wet-suited" subjects in cold water. These types of data encompass a wide range of water temperatures, protective clothing, breathing gas mixtures, and durations of immersion. From the Law of Propagation of Errors, influence coefficients are developed for 16 major parameters and initial conditions that may be used to enhance man's performance in cold water. A standard set of parameter values and initial conditions is used in the sensitivity analysis so that each case investigated has a common basis for comparison. Influence equations are derived that may be used to predict body temperatures for various dive conditions represented by small variations in the standard set of parameters and to assess proposed life-support system designs. (Author's abstract)

318a.

MOORE, T.O., E.M. Bernauer, G. Seto, Y.S. Park, S.K. Hong, and E.M. Hayashi.

Effect of immersion at different water temperatures on graded exercise performance in man.

Reprinted from Aerospace Medicine 41(12)1404-1408; December 1970.

Eight subjects performed graded leg exercise at loads from light to forced maximal in air and totally submerged in water at 30°, 22°, and 16°C. There was no significant decrement in performance between the air and immersed environments. Heart rate, minute volume ($\dot{V}e$), oxygen consumption ($\dot{V}o_2$), and carbon dioxide production had high linear correlation coefficients with imposed work load. $\dot{V}e$ and $\dot{V}o_2$ were higher in water under all work loads and at the two lower water temperatures. Heart rate was the same at rest under all conditions, but significantly less at high work loads in 16°C water when compared to air. It is concluded that monitoring of a diver's heart rate will cause underestimation of work load in surface-equivalent terms at high loads in water of low temperature. The data confirm and extend information on underwater work to lower temperatures and higher work loads.

319.

MOORE, T.O. and J.F. Morlock.

Quantification of heat loss from various routes in man dwelling in a wet/dry hyperbaric environment.

Univ. Hawaii, Sch. Med., Dept. Physiol., Final Rep. on Contract N00014-67-A-0387-0016, 208p. June 1, 1976.

This work was divided into the following six phases: 1) Respiratory and whole body heat losses at 16.1 ATA; 2) Respiratory heat loss breathing air and heliox; 3) Recovery parameters following underwater exercise; 4) Energy cost of bicycle work underwater as indexed by pedaling frequency; 5) & 6) Thermal cost of repetitive cold water exposures, surface/depth equivalent temperatures, and predictive heat loss and heat replacement equations. Each section has a bibliography. The three appendixes are (A) Derivation of relative convective and evaporative heat transfer coefficients; (B) Computer program for dry hyperbaric environment study; (C) Computer program for water immersion study. (MFW/UMS)

320.

MORITA, R.Y.

Survival of bacteria in cold and moderate hydrostatic pressure environments with special reference to psychrophilic and barophilic bacteria.

In: Gray, T.R.G. and J.R. Postgate, eds. Symposium of the Society for General Microbiology, No. 26. The survival of vegetative microbes, Cambridge, England, April 1976, p.279-298. Cambridge University Press, 1976.

The author states that in dealing with the effects of environmental changes on the survival of barophilic and psychrophilic bacteria, some of his statements must be speculative due to the lack of data. He deals with the following subject areas: The natural environment for psychrophiles and barophiles; Survival of psychrophiles and barophiles in the natural environment; Temperature elevation in water masses, salinity changes, organic matter, pressure-temperature relationships, occurrence and activities of deep sea organisms; Some speculations concerning the microbiology of the deep sea. (MFW/UMS)

321.

MORIYA, K. and T. Hiroshige.

Sex ratio of offsprings of rats bred at 5°C.

Int. J. Biometeorol. 22(4):312-315; Dec. 1978.

The sex ratio at birth was examined in offsprings of rats reared in 5°C for successive generations. The sex ratio of their offsprings significantly skewed toward females and the litter size markedly reduced, as compared with those of controls reared in 22°C. Continuous administration of norepinephrine for 12 weeks which purports to simulate a cold stress resulted in a reduction of litter size with a tendency of skewness in sex ratio toward females.

322.

MORRISON, J.B., M.L. Conn and J.S. Hayward.

An evaluation of inhalation rewarming in treatment of cold water hypothermia.

In: Program and Abstracts, Undersea Medical Society, Inc., Annual Scientific Meeting. Undersea Biomed. Res. 5(Suppl.) 32; Mar. 1978.

Abstract only. Entire item quoted: A respiratory rewarming apparatus was designed to supply hot, moist gas at a constant temperature. A feedback loop was incorporated such that ventilatory response could be controlled by rebreathing expired carbon dioxide. Experiments were carried out on the Pacific Coast of Canada. Subjects were immersed in sea water until a 2°C drop in rectal temperature occurred and were then rewarmed by breathing hot, moist air at 44 ± 1°C. Minute ventilation, inspired and alveolar O_2 and

CO_2 gas fractions, inspired gas, rectal, tympanic, chest and calf temperatures were recorded for 30 minutes. Each subject was rewarmed once breathing air and once rebreathing a controlled amount of CO_2 adjusted to maintain a ventilation of 45-50 L/min. The data from 14 subjects were normalized and a mean rewarming curve was obtained from each temperature site. In comparing the results of the two rewarming methods, when breathing air, ventilation decreased rapidly as shivering thermogenesis subsided, having an average value of 21 L/min. over the test period. With CO_2 induced hyperventilation, ventilation was relatively constant having a mean value of 47 L/min. Following the "afterdrop" rectal temperature increased 0.34°C when breathing air compared with 0.8°C when hyperventilating. The corresponding rise in tympanic temperatures were 1.23°C and 1.49°C respectively. There was no significant difference in temperature afterdrop but the rate of increase and absolute rise in rectal and tympanic temperatures were significantly greater ($P < .05$) when using the CO_2 induced hyperventilation. Calculations suggest that rectal temperature rise may be entirely due to respiratory heat input. These experiments indicate that hyperventilation significantly improves the rate of rewarming and would be particularly effective in the nonshivering subject having a low ventilation.

322a.

MORRISON, J.B., J.S. Hayward and M.L. Conn.

Effect of body temperature and composition on recovery from hypothermia.

In: 7th symposium on underwater physiology, Undersea Medical Society annual scientific meeting, European Undersea Biomedical Society annual meeting, July 5-10, 1980, Athens, Greece. Programs, abstracts and mini-papers, p.19. Bethesda, Md. Undersea Medical Society, 1980.

Abstract only. Entire item quoted: Inhalation warming has been promoted as a process which can be easily administered in remote environments. Its effectiveness has been challenged, however, and experimental studies appear to be contradictory. Comparison of various studies may be confounded by differences of physiological conditions and body composition. After cooling in 11.8°C seawater, 14 subjects having varied core temperatures were rewarmed by inhalation of saturated air at 44°C. Multiple linear regression anslyses were computed for best possible subsets relating rectal and tympanic rewarming rates (ϕR, ϕT) to physiological and anthropometric measures. It was found that although there was a good correlation ($0.61 < r < 0.74$) between $\phi i (i = R,T)$ and the corresponding mean metabolic or ventilatory rates, rewarming rates ϕi could be more closely predicted by a combination of initial core and skin temperatures ($r = 0.75, 0.78$; $i = R,T$). The best predictive equations of rewarming rate (°C/hr) were

$$\phi R = 79.08 - 1.644\ TOR - 12.56\ (h/w)\ \tfrac{1}{2}r = 0.79$$

$$\phi T = 100.8 - 1.023\ TOR - 0.947\ TOT - 18.06\ (h/w)\ \tfrac{1}{2}r = 0.88$$

where TOT, TOR are initial rectal and tympanic temperatures, (h/w) is the height/weight ratio (cms/kg), and r is the adjusted multiple correlation. Results indicate that the rate of rewarming from hypothermia is strongly influenced by initial core and skin temperatures and by body composition. Comparisons of rewarming data obtained in different investigations and with other treatment methods are likely to be misleading unless experimental protocols and subject groups are carefully matched.

322b.

MOSS, G.

Systemic hypothermia via gastric cooling.

Arch. Surg. 92:80-82; 1966.

Eight dogs underwent gastric cooling for systemic hypothermia. Each dog was cooled with the balloon filled with a "safe" volume based on weight (20 ml/kg) and subjected to cooling with the balloon filled maximally, but safely, to a pressure of 10 mm Hg. Consistently, the latter procedure was far more efficient, averaging 2.6 times as rapid for all degrees of hypothermia. A decrease in core temperature by 7°C required an average of only 28.4 minutes. On comparison with clinical reports of hypothermia induced by the usual gastric cooling, an improved efficiency of twofold to threefold is still noted.

322c.

MOTT, Joan.

The effects of baroreceptor and chemoreceptor stimulation on shivering.
J. Physiol. 166:563-586; 1963.

(1) It is confirmed that shivering can be intensified by baroreceptor stimulation. The development of shivering appeared to be largely dependent on the integrity of the baroreceptor nerves. (2) Weak electrical stimulation of the central end of the depressor nerve of the rabbit augmented shivering; but stronger stimulation stopped it and stimulated breathing but did not cause a rise of arterial pressure. (3) Stimulation of the chemoreceptors by perfusion of the isolated carotid body and sinus with Krebs-Henseleit solution equilibrated with 95% N_2, or by intravenous injection of sodium cyanide, nicotine or lobeline, reduced or stopped shivering. Sodium cyanide failed to stop shivering in nine of ten rabbits after cutting the vagi and carotid sinus nerves. (4) When electrical stimulation of the central end of a carotid sinus nerve stimulated breathing shivering also stopped. (5) Administration of hexamethonium 15 mg/kg did not stop shivering in rabbits or cats. When the stimulation of breathing caused by nicotine in vagotomized rabbits was abolished by hexamethonium, the inhibition of shivering previously caused by nicotine was also abolished. The increased breathing and inhibition of shivering elicited by sodium cyanide persisted after the administration of hexamethonium. (6) Small doses of adrenaline or noradrenaline had variable effects on shivering. After cutting the nerves from chemoreceptors, however, shivering increased simultaneously with the rise of arterial pressure. This increase of shivering was abolished or greatly reduced after cutting the depressor nerves of the rabbit or the aortic nerves of the cat. (7) The hypothesis that chemoreceptor stimulation inhibits shivering in anesthetized animals was confirmed, but it is pointed out that changes of arterial pressure during such stimulation may simultaneously influence the intensity of shivering. (8) It is suggested that the phenomena described are more likely to be due to changes in α- rather than in γ-mononeurone activity.

322d.

MOURITZEN, C.V., and M.N. Andersen.

Myocardial temperature gradients and ventricular fibrillation during hypothermia.
J. Thor. and Cardiovasc. Surg. 49(6):937-944; June 1965.

Experimental studies were performed in dogs to evaluate the possible causal relationship of intramyocardial temperature gradients to the development of ventricular fibrillation during induced hypothermia. The following observations were made: (1) Ventricular fibrillation appeared to be related to intramyocardial temperature gradients during induced hypothermia. The larger the temperature gradient between left and right ventricular myocardium the higher the temperature at which fibrillation occurred. (2) Fibrillation was readily produced by induction of temperature gradients during non-uniform rewarming in hearts which had been uniformly cooled to substantially lower temperatures without fibrillation. (3) At increasingly lower temperatures, fibrillation occurred with progressively smaller gradients, and, below 20°C fibrillation sometimes occurred with no measurable gradient. (4) Electrical defibrillation by a standardized technique was readily accomplished, even at very low temperatures, if the intramyocardial temperature gradients were below 1°C, but defibrillation was difficult or impossible with gradients over 2°C. (5) Intramyocardial thermal gradients appear to be a significant factor in ventricular fibrillation during hypothermia at temperatures above 20°C. Below this level the relationship is less certain.

322e.

MOYER, J.H., G. Morris, and M.E. DeBakey.

Hypothermia: Effect on renal hemodynamics and on excretion of water and electrolytes in dog and man.
Ann. Surg. 145(1):26-40; Jan. 1957.

The effect of hypothermia on renal hemodynamics and on excretion of water and electrolytes has been studied on 39 dogs and 11 human subjects in whom the hypothermia was used to facilitate vascular

operations. There was essentially no difference between the laboratory observations and those made on the human subjects. As the body temperature was progressively reduced to 27°C (laboratory observations), the mean blood pressure decreased progressively to approximately 75% of the control values. This was associated with a progressive reduction in glomerular filtration rate and renal blood flow without significant alterations in urine or sodium excretion. The reduction in rate of glomerular filtration and in renal blood flow was not improved when the blood pressure was raised to control values with an infusion of norepinephrine. However, when the body temperature was again increased to the control levels, the mean blood pressure returned completely to the control levels although the glomerular filtration rate and renal blood flow usually returned to only about 75% of the control levels. However, within 24 hours, these had returned to the control levels in those animals studied. There was essentially no difference in these responses between dogs and man.

323.

MURAZIAN, R.I., S.V. Smirnov and N.R. Panchenkov.

Diagnosis and treatment of frostbite of the extremities.

Vestn. Khir. 121(9):74-78; Sept. 1978.

The method of thermography is believed to be a valuable means of an early diagnosis of the depth of the injury in frostbites of the extremities. The use of immune preparations aimed at the lessening of the percentage of infectious complications, both with conservative and surgical treatment of the frostbites of the extremities, should be applied for prophylaxis of the above-mentioned complications.

324.

MUSACCHIA, X.J. and M. Jacobs.

Helium-cold induced hypothermia in the white rat.

Proc. Soc. Exp. Biol. Med. 142(3):734-739; 1973.

Exposure to a helox mixture of 80% He and 20% O_2 and low ambient temperature induces hypothermia in Sprague-Dawley white rats. Hypothermia to body temperatures of about T_{re} (rectal temperature) 14-15°C in the white rat is tolerated for various periods, for example, after four hr 88% survived and after 6 hr 25% survived. Rewarming to normotheric body temperature is achieved by exposure to room temperature, about 21-22°C. Additional sources of external heat moderately enhanced survival after rewarming. There is a direct relationship between body weight and percent survival. Despite the fact that they require a longer period in order to become hypothermic, the heavier animals are better able to survive. Spontaneous rewarming from low body temperatures of T_{re} 13.5-17°C to normothermic body temperatures, T_{re} 37°C, occurred routinely in those animals placed at 16°C ambient temperatures. Survival rates were substantial; 65% of the 60 animals used in the latter experiment survived indefinitely. Spontaneous rewarming is a consequence of the ambient cold room temperature rather than the body temperature (within limits) reached during induction. Comparisons with previously published data concerned with other methods of induction of hypothermia in the white rat indicate that the He cold method described is slightly more efficacious. The white rat is in no manner comparable to the hamster, in terms of depth of body temperature; T_{re} 7°C and lengths of 1-3 days of hypothermia induced by this same method in the hamster. (PGH) (© BA)

325.

MUSACCHIA, X.J., A. Volkert and D.R. Deavers.

A model for hibernation using halothane-helox-induced hypothermia.

Cryobiology 13(6):659; 1976.

Abstract only. Excerpt quoted: Hamsters are readily made hypothermic by exposure to helox (helium: oxygen, 80%: 20%) at low amt ient temperatures. Previously, our laboratory demonstrated that liver

glycogen and plasma glucose are markedly reduced during the lengthy cold exposure necessary for induction into hypothermia and continue to decrease during hypothermia (T_{re}, 7°C). Faster induction results in higher levels of liver and blood carbohydrates at the onset of hypothermia and also appears to be a major factor in increasing survival time. The present experiment has shown there are two possible advantages to using halothane-helox-induced hypothermia. First, induction time is markedly reduced, preventing excessive depletion of liver glycogen. Second, halothane produces hyperglycemia, resulting in a larger pool of blood glucose to be used during hypothermia. Hamsters have been maintained hypothermic for 3-4 days, rewarmed to normothermia (T_{re}, 37°C for 10 hr), reinduced into hypothermia for 1 or more days, and rewarmed to normothermia for a second time. These two complete cycles were made possible by halothane-helox induction and by supplying glucose during intermittent periods of normothermia.

326.

MYERS, R.D. and W.D. Ruwe.

Thermoregulation in the rat: Deficits following 6-OHDA injections in the hypothalamus. Pharmacol. Biochem. Behav. 8(4):377-386; 1978.

Bilateral microinjections of 6-hydroxydopamine (6-OHDA) were made in a volume of 0.5-0.7 μl through chronically implanted cannulae into anterior hypothalamic, preoptic loci. Sites were selected at which 1.0-12.5 μg of norepinephrine (NE) had previously elicited a fall in the rat's body temperature. After 2.0-6.0 μg of 6-OHDA were injected in the same volume at the same loci, a comparable hypothermia ensued. When the rats were exposed repeatedly for 1 h intervals to an environmental temperature of either 35.0°C or 8.0°C, they were unable to thermoregulate against the heat and their colonic temperature rose. In some experiments, the rats also failed to adequately defend against the cold ambient temperature, but mainly following the microinjection of the higher 6-OHDA doses. Food and water intakes were generally suppressed, accompanied by a transient decline in body wt. The severity, duration and direction of the thermoregulatory impairment depended upon the anatomical site of injection and the dose regimen of the neurotoxin employed. An intact catecholaminergic pathway within the anterior hypothalamus is required for the rat's physiological control of heat loss in a warm environmental temperature.

327.

NADEL, E.R., I. Holmer, U. Bergh, P.O. Ashtrand and J.A.J. Stolwijk.

Energy exchanges of swimming man.

J. Appl. Physiol. 36:465-471; Apr. 1974.

Three male swimmers underwent 10-min resting and 20-min swimming (breaststroke) exposures in a swimming flume. Water temperatures in separate exposures were 18, 26, and 33°C. At each water temperature the subjects rested and swam at water velocities of 0.50, 0.75, and 0.95 m.s.$^{-1}$, which were designed to produce around 40, 70, and 100% of maximal aerobic power. Measurements were made of esophageal temperature (T_{es}), four skin temperatures, water temperature, heat flow from five local skin surfaces (Hatfield-Turner discs), and oxygen uptake ($\dot{V}O_2$). Calculations were made of mean area-weighted skin temperature ($\bar{T}_s$) and heat flow, metabolic rate, and heat storage. Internal body temperature changes after 20 min of swimming were related to water temperature, swimming intensity and body composition. $\dot{V}O_2$ was proportional to swimming speed during submaximal effort in any water temperature, but the increase in $\dot{V}O_2$ per increment in swimming speed became greater as the swimmer approached his maximal effort. $\dot{V}O_2$ was also greater in 18°C than in 26°C water at any submaximal swimming speed and likewise greater in 26°C than in 33°C water. Increased cost of swimming in cold water was largely attributed to shivering. The convective heat transfer coefficient was calculated from heat flow and skin and water temperature data and was found to be 230 W • m^{-2} • °C^{-1} at rest in still water, 460 W • m^{-2} • °C^{-1} at rest in moving water, and 580 W • m^{-2} • °C^{-1} while swimming, regardless of swimming speed. Core-to-skin conductances were primarily related to internal temperature, although there appeared to be a minor effect of $\bar{T}_s$ modifying this relation. (Authors' abstract)

327a.

NADEL, E.R., I. Holmer, U. Bergh, P.-O Astrand, and J.A.J. Stolwijk.
Thermoregulatory shivering during exercise.
Life Sciences 13:983-989; 1973.

Three subjects with lowered internal body temperatures performed brief bouts of bicycle ergometer exercise at 150 and 200 W. Oxygen uptake during exercise was consistently greater than that required by the working muscles, the increase being the result of the additional cost of shivering. Increases in metabolism during exercise above control levels were inversely proportional to internal temperature (with skin temperature constant) below a given internal temperature threshold. Observations of intense shivering during exercise which is proportional to lowered internal temperature in the same manner as during rest provides further evidence against the concept of a decrease in the thermoregulatory set point during exercise in man.

327b.

NAIR, C.S., I. Singh, M.S. Malhotra, L. Mathew, A. Dasgupta, S.S. Purakayastha, and J. Shanker.
Studies on heat output from the hands of frostbite subjects.
Aviat. Space Environ. Med. 48(3):192-194; 1977.

We studied 12 subjects, who had suffered first- to third-degree frostbite at high altitude during winter, at Delhi, India. At normal sea level pressure there (P_B 740 mm Hg) and in a decompression chamber at a simulated altitude of 4085 m, the studies were at both 26°C and 6.8°C. A group of control (non-frostbite) subjects of comparable age were also studied for their heat output at 26°C, P_B 740 mm Hg. Heat output from the hands of a group of mountaineers from the sea level was also studied at 2121 m at 25°C and 4485 m at 7°C. The results indicated that the frostbite subjects had a significantly higher heat output at P_B 740 mm Hg and 26°C than the non-frostbite subjects. When the former were tested at sea level (P_B 740 mm Hg) at 6.8°C, the hand heat output showed a marked and significant decrease. On testing them at a simulated altitude of 4085 m at 26°C and at 6.8°C, a very highly significant reduction in hand heat output was observed compared to their initial value at sea level (740 mm Hg) and 26°C. Their hand heat output also showed a very highly significant decrease compared to mountaineers at 4485 m and 7°C.

327c.

NAKAYAMA, H.
Body thermal drain under hyperbaric dry heliox environment with undersea excursion dives.
J. Hum. Ergol. (Tokyo) 7(2):177-183; Dec. 1978.

A series of undersea experiments were undertaken at the Japan Marine Science and Technology Center since 1972 in order to investigate thermal drain due to higher heat conductivity of helium which is essential as a breathing medium in deep-sea diving substituting for nitrogen in the air. While the less narcotic effect and the low density of the gas is adequate for maintaining better respiratory functions of divers, distortion of the diver's voice due to low density and thermal drain should be overcome. Measuring body heat loss in a hyperbaric dry environment, wet pot thermistors and heat flux transducers were applied at four to seven points on the body surface before, during, and after hyperbaric exposure to 11 ATA. As a result it was acknowledged that heat loss from the body surface, in hyperbaric heliox environment, was greater than that at the 1 ATA condition. Further, additional heat loss during immersion proved significant. The other modifying factors revealed were ambient water temperature, kinds of diving suits or underwear, and others. (Author's abstract)

328.
NAMUR, M., J. Juchmes and J. Lecomte.
Sur la bradycardie provoquee par l'immersion.
[On the bradycardia brought on by immersion].
J. Belge Rhumatol. Med. Phys. 30(2):85-92; Mar./Apr. 1975.

Immersion in thermo-indifferent water bath (35°C) induces in normal man a bradycardia (5 to 20%) due to increased vagal tone. When the temperature of the water is gradually decreased, bradycardia increases. Cardiac rhythm is abruptly accelerated when chilling is important (32-33%). Cold bath, from 27 to 20°C, causes bradycardia even when chilling is present. From 35 to 20%, the relationship between the temperature of the bath and cardiac frequency does not belong to the linear type. (English abstract)

328a.

NAVAL HEALTH SCIENCES EDUCATION & TRAINING COMMAND.
Hypothermia.
In: Cold weather medicine. Instructional program for U.S. Navy medical department personnel, p. 48-57. Bethesda, MD., National Naval Medical Center, 1978.

This chapter of a U.S. Navy manual provides a general discussion of hypothermia, its symptoms, preventive measures, treatment measures (divided into "field first aid" and "medical"), and prognosis. Presented in outline form, as a guide to classroom instruction, it includes a rather complete bibliography and visual aids which might be used to illustrate the subject. The rest of the manual is devoted to other cold-related illnesses and trauma of less interest to the diving community. (LET/UMS)

329.
NAZIAN, S.J. and B.E. Piacsek.
Sexual maturation of the cold-exposed male rat: Alterations in secondary sexual organ sensitivity to testosterone.
Biol. Reprod. 19(2):256-260; 1978.

From an age of 35 days, male rats were raised at either 23°C or 4°C under identical lighting schedules (LD[light:dark] 14:10). On day 49, animals were castrated and a testosterone-filled capsule implanted s.c. Capsule number and size were adjusted to provide 25, 50, 100, 200 or 300 mm^2 implant surface area/100 g body wt. Control animals received empty capsules. Animals were decapitated on day 52. One group of rats was left intact and killed on day 50. Prostates and seminal vesicles were weighted and serum LH [lutropin], FSH [follitropin] and prolactin (PRL) determined by radioimmunoassay. Cold-exposed intact animals had significantly ($P < 0.05$) smaller prostates and seminal vesicles than controls. There were no differences in LH, FSH or PRL in intact rats. Secondary organs were less sensitive to testosterone in cold-exposed castrated animals. Control animals showed maximum growth of both accessory structures with capsules of 50 mm^2 or larger. Cold-exposed animals required 100 mm^2 capsules for maximum prostate growth and 300 mm^2 implants were required for maximum seminal vesicle growth. All sizes of capsules suppressed LH and FSH. No differences were found in serum PRL. Delay in sexual maturation experienced by cold-exposed male rats may be the result of a reduced secondary organ sensitivity to androgen. Changes in gonadotropin and/or PRL secretion do not seem to be involved in this response.

330.
NAZIAN, S.J. and B.E. Piacsek.
Effect of chronic exposure to cold on serum concentrations of thyroxine and prolactin during sexual maturation in the male rat.
J. Endocrinol. 77(2):269-270; 1978.

The concentrations of prolactin and T_4 [thyroxine] in the serum of rats were studied after chronic exposure to cold to determine if the effects of low temperature on the sexual maturation of the male rat could be mediated by these hormones. The relative weights of the thyroid glands of rats raised in a cold environment were significantly higher. The concentration of T_4 in the serum of the control animals rose between days 28 and 49 and declined thereafter; a more gradual rise took place in rats exposed to cold, with a peak on day 54.

330a.

NELMS, J.D.
Adaptation to cold and cold injury.
In: Cold/wet survival symposium.
J. Roy Nav. Med. Serv. 58:189-194; Winter 1972.

The possibility of acclimatization to cold is discussed. The normal adaptation and reaction to cold is described both peripherally and generally, together with the pathology and treatment of frostbite.

331.
NEMIROFF, M.J.
Accidental cold-water immersion and survival characteristics.
In: Program and abstracts. Undersea Medical Society annual scientific meeting, May 13-16, 1977, Toronto, Canada, p.A56. Undersea Biomed. Res. 4, Mar. 1977. Appendix A.

Abstract only. Entire item quoted: The diving reflex has been considered a protective mechanism in cold water human immersion accidents. Twelve patients were selected from a series of 47 near-drowning survivors to demonstrate this reflex and its influence on survival. Eight patients are alive and normal despite the following initial clinical findings; 8 comatose, 6 with fixed dilated pupils, and 10 apneic. All were cyanotic and 11 of the 12 were hypothermic (rectal temperatures 90-96.8°F). The underwater times ranged from 1-38 minutes, with 2 patients submerged 4 minutes, 3 patients submerged 5 minutes, 4 patients submerged 10 minutes, and one of 15 minutes and another 38 minutes. The two fatalities in this series occurred after short immersions. The role of the diving reflex was noted because of the apnea, bradycardia, and cyanosis present in these patients. Preventive measures for hypothermia in people working near water colder than 70°F (20°C) are presented including thermal flotation gear.

332.
NEMIROFF, M.J.
Resuscitation following cold-water near-drowning.
In: Proceedings of the Ninth International Conference on Underwater Education, p.168. Colton, Calif., National Association of Underwater Instructors, 1977.

Abstract only. Entire item quoted: Following submersion and cessation of breathing, permanent brain damage has been thought to occur in 4 minutes. An apparent exception to this concept is the victim of cold-water near-drowning. In water temperatures below 70°F (20°C) the protective effects of hypothermia and the mammalian diving reflex may make survival possible. Such victims appear blue, pulseless, and without respirations. Sixteen patients are presented where submersion times ranged 1-40 minutes (mean 13.1 minutes) and survival was possible. Resuscitation should include rewarming and electrocardiographic monitoring. Survivability depends on aggressive, prolonged resuscitation, correct techniques, and careful medical examination.

333.

NEMIROFF, M.J., G.R. Saltz and J.C. Weg.

Survival after cold-water near-drowning: the protective effect of the diving reflex.
Amer. Rev. Resp. Dis. 115(4, Pt.2):145; 1977.

Abstract only. Entire item quoted: The fate of 11 near drowned individuals retrieved from cold water (20°C or <) after prolonged immersion (> 4 min) seen between 1967-1976 was studied. Eight survived without any neurologic deficit: 2 had residual chronic anoxic brain damage; one died. The age range was 1-42 years with 10 being 18 years or less. Documented submersion time was 4-38 minutes. At the time of recovery from the water 10 were apneic; 4 were pulseless; 10 were cyanotic; 6 had fixed dilated pupils; 4 were comatose, 2 decerebrate and 2 decorticate. At admission to the hospital recorded body temperature was 94.3° ± 2.5; all but one were hypoxemic or had a widened A-aO_2 gradient; $PaCO_2$ 51.7 ± 23.4 mm Hg; and all had a metabolic acidosis pH 7.09 ± .13. Significant electrolyte disturbances or hemolysis did not occur. Five required intubation and mechanical ventilation for 7-16 days. Three were treated with Positive End Expiratory Pressure ranging from 10-20 cm. H_2O. Survival is attributed to the diving reflex which redistributes blood flow from skin muscle and gut to heart and brain and the protective effect of hypothermia. Patients with this reflex, usually children, have cyanosis, apnea, diminished or absent pulses, fixed dilated pupils and coma. If these protective mechanisms in cold water near drowning are recognized, resuscitation beginning at the water's edge, continued with oxygen supplementation in route to the hospital, and followed with necessary ventilatory support and correction of metabolic acidosis will often lead to complete recovery. The survivors include a 42 y.o. physician returned to a busy practice (10 min immersion) and an 18 y.o. college student doing "A" work (38 min immersion). The prognosis in near drowning in cold water is distinctly better than that reported in warm water.

333a.

NEMIROFF, M.J.

Accidental cold-water immersion and survival characteristics.
In: Program and abstracts. Undersea Medical Society annual scientific meeting, May 13-16, 1977, Toronto, Canada, p.A56. Undersea Biomed. Res. 4, Mar. 1977. Appendix A.

Abstract only. Entire item quoted: The diving reflex has been considered a protective mechanism in cold water human immersion accidents. Twelve patients were selected from a series of 47 near-drowning survivors to demonstrate this reflex and its influence on survival. Eight patients are alive and normal despite the following initial clinical findings; 8 comatose, 6 with fixed dilated pupils, and 10 apneic. All were cyanotic and 11 of the 12 were hypothermic(rectal temperatures 90-96.8°F). The underwater times ranged from 1-38 minutes, with 2 patients submerged 4 minutes, 3 patients submerged 5 minutes, 4 patients submerged 10 minutes, and one of 15 minutes and another 38 minutes. The two fatalities in this series occurred after short immersions. The role of the diving reflex was noted because of the apnea, bradycardia, and cyanosis present in these patients. Preventive measures for hypothermia in people working near water colder than 70°F (20°C) are presented including thermal fictation gear.

333b.

NIAZI, S.A., and F.J. Lewis.

Profound hypothermia in man.
Ann. Surg. 147:264-266; 1958.

In a 51-year-old woman widespread, metastatic ovarian carcinoma was treated by body cooling to a rectal temperature of 9°C (48°F). This low temperature was reached, as planned, during cardiac standstill which lasted for one hour, yet the immediate recovery was complete. Unfortunately, her cancer did not regress, and she succumbed to the disease 38 days after the cooling.

334.

NILSEN, K.H.

Assessment of cold sensitivity in Raynaud's phenomenon associated with scleroderma.
Microvasc. Res. 15(2):251-256; 1978.

Raynaud's phenomenon may be due to exaggerated sympathetic reflexes or to an abnormal response by skin blood vessels or blood constituents to localized cooling. These mechanisms may have differing relative importance in the pathogenesis of Raynaud's phenomenon associated with various disorders. It has been difficult to differentiate local mechanisms from systemic sympathetic reflexes. A method is described [based on epicutaneous application of ^{133}Xe gas] for estimating cutaneous blood flow response to a standardized local cooling stimulus which is too weak to evoke systemic reflex vasoconstriction. Local cold sensitivity was assessed. Preliminary results indicate that the abnormal local response is diminished or abolished when the symptoms are controlled by medical treatment. The test can safely be repeated, as local skin radiation dosage was estimated to be less than 3 rads and total body dosage was negligible due to rapid loss of Xe through the lungs. This test seems useful for studying the pathogenic mechanisms of Raynaud's phenomenon and the evaluation of its treatment.

335.

NOCK, J.E. and J.B. Senturia.

Helium hypothermia in maromota monax.
Cryobiology 13(6):660; 1976.

Abstract only. Excerpt quoted: A system was designed and constructed which is composed of two main components: 1) an environmental compartment containing, 2) an experimental chamber. The environmental compartment is maintained at a temperature of -20 ± 2°C. The experimental chamber contained in this environment is therefore subject to its temperatures. Helox gas (80% helium, 20% oxygen) flows directly into and rapidly assumes the temperature of the experimental chamber. However, rapid body temperature reductions could be accomplished only by attaching heat sinks to the base of the experimental chamber and coupling these to an auxiliary cooling device. These heat sinks produced, within an empty experimental chamber, temperatures ranging from -28 to -32°C. Body temperature monitoring was accomplished by radiotelemetry. A mini-Mitter Model J W transmitter was implanted under muscles in the thoracic region. Constant temperature readings were accurate to 0.1°C and reproducible to 0.05°C. Pilot experiments have shown that a body temperature of 15°C could be established from a normal body temperature of 35°C in 4 hr. An initial loss of 8°C/hr for the first hour tapers off to a relatively constant temperature reduction rate of 6°C/hr. Complete recovery from the hypothermic condition occurs in 10 hr with the subject maintained in an environment of 15°C. The technique appears to be useful for rapid controlled induction of specific reduced body temperatures.

336.

NOLAN, R.S.

High dive in Hawaii.
Skin Diver 25:32-33, 90-91; Nov. 1976.

A dive was made in Lake Waiau, Hawaii, at an altitude of 13,020 feet. Diving at such altitudes increases the danger of decompression sickness, because while the diver absorbs nitrogen during descent at a normal sea level pressure rate, when he surfaces he is subjected to a lower atmospheric pressure, which leads to bubble formation. A 20 minute maximum water time was agreed upon, although the deepest section of the lake was only about 20 feet deep. Hypoxia was dealt with by consciously maintaining breathing rates, by breathing 100% oxygen at intervals, and conserving energy. It remained a problem, nevertheless. The dive itself was the most comfortable part of the expedition. The divers were kept warm by O'Neill Super Suits. The purpose of the dive was to set an altitude record and to collect specimens of water, plankton, and sediment. (MFW/UMS)

337.

NORWOOD, W.I., C.R. Norwood and A.R. Castaneda.

Cerebral anoxia: effect of deep hypothermia and pH.

Surgery 86(2):203-209; Aug. 1979.

Deep hypothermic circulatory arrest facilitates repair of congenital cardiac anomalies in infants. It is known empirically that hypothermia protects against central nervous system (CNS) ischemic damage. The $Q_{10}O_2$ is only 2.2 for brain and thus a decrease in metabolic rate does not fully account for protective effects of hypothermia. Since enthalpy of dissociation of H_2O is high (~ 7 kcal/mole), its pH is temperature dependent (7.0 at 25°C, 7.4 at 20°C) and hypothermia may in part protect by its influence on hydrogen ion concentration. A manifestation of CNS susceptibility to ischemia is an obstruction of the microcirculation [no-reflow lesion (NRL)] demonstrated by infusion of carbon black into the cerebral circulation after a period of circulatory arrest. White lesions (NRL) against a gray background on cut section of brain increase in size with increasing time of arrest. The effect of anoxia versus circulatory arrest, brain temperature, and extracellular brain pH on NRL was studied in 45 mongrel dogs, subjected to varying periods of N_2-induced anoxia on cardiopulmonary bypass (CPB) at 37°C or 20°C. In some studies jugular venous pH was adjusted by infusion of $NaHCO_2$ or HCl. Control groups included normothermic CPB without anoxic and normothermic CPB, anoxia, and equimolar NaCl infusion. NRL was quantified by planimetry of photographs of cut sections of brain. These results confirm that NRL is abated by hypothermia and suggest that 1) NRL is a function of anoxia and not arrested circulation since perfusion with N_2 at 37°C does not protect the brain (i.e., NRL is not solely related to "critical reopening pressure") and 2) NRL is in part a function of extracellular pH.

337a.

NUCKOLS, M.L.

Heat flow transducer responses to hyperbaric environments.

New York, American Society of Mechanical Engineers, ASME Publ. 79-WA/OCE-5, 6p., 1979.

The responses of heat flow transducers, used in the evaluation of convective body heat losses, have been investigated in hyperbaric environments. Environmental temperatures, pressures, and gas composition were varied while transducer responses to constant heat fluxes were observed. Ambient temperatures were varied between 3° and 40°C. Ambient pressures were varied between simulated depths of 0 and 1000 feet of seawater (445 psi). Transducer responses to heat fluxes varying between 0 and 250 watts/m² are reported in the above temperature and pressure ranges within atmospheres of helium, nitrogen, and air. Ambient pressure variations were found to have little effect on the response of the heat flow transducers to a constant heat source once appropriate temperature corrections were made. However, transducer response variations of up to 14 percent were observed when environmental gas compositions were varied at hyperbaric conditions. (Author's abstract)

337b.

NOWELL, N.W., and D.C. White.

Season Variation of Magnesium and Calcium in Serum of the Hypothermic Rat.

J. Appl. Physiol. 18:967-969; 1963.

Records of changes in blood Mg and Ca during body cooling are conflicting. Although a rise in serum magnesium is established in hibernators and with less certainty in artifically cooled animals, some workers have associated these changes with CO_2 accumulation. In the present experiments rats were cooled to a rectal temperature of 15 C with artificial respiration to prevent CO_2 accumulation. Cardiac arrest did not occur. A mean 24% rise in serum magnesium was found in the winter months. A fall occurred in the summer but the mean figure for these months was not significant. No change in the calcium levels was observed. The possible significance of the findings is discussed.

337c.

NUGENT, S.K. and M.C. Rogers.

Resuscitation and intensive care monitoring following immersion hypothermia.
J. Trauma 20(9):814-815; Sept. 1980.

A case history is recounted in which neurologic recovery occurred in a 3-year-old patient following immersion hypothermia and prolonged cardiopulmonary resuscitation. Recognition of hypothermia in cases of near-drowning is imperative for appropriate resuscitative efforts; these are sometimes inadequate or ended prematurely if hypothermia is not diagnosed. The authors discuss the possibility of hypothermia-induced cerebral protection from hypoxia, circulatory arrest and elevated intracranial pressure (ICP). The role of intensive care monitoring (intracranial pressure, pulmonary artery catheterization) in facilitating patient management and optimum neurologic recovery is emphasized. (Authors' abstract modified by LET/UMS)

338.

NUNNELEY, S.A.

Physiological responses of women to thermal stress: a review.
Med. Sci. Sports 10(4):250-255; Winter 1978.

The recent increase in women's participation in physically challenging activities prompted this review of female responses to heat and cold (68 references). Relevant sex differences include hormone levels, anthropometric factors, and body composition. Many studies show that women are less heat tolerant than men, particularly when physical work is required. Much of the difference is related to women's relatively low level of physical fitness and lack of heat acclimatization, which are in turn a result of their traditionally sedentary lifestyle. When work load is adjusted relative to individual capacity, females respond to heat stress much as males do. Acclimatization mechanisms are the same. Women generally have lower sweat rates, an appropriate adjustment to lesser cooling needs. The menstrual cycle has no meaningful effect on heat tolerance. Cold response reflects individual subcutaneous fat thickness, and women have an advantage there, but in extreme cold exposure they may be handicapped by their small muscle mass. Sex *per se* is but a small factor in determining human thermal responses; individual body size, physical fitness, and state of acclimatization play far more important roles.

339.

NUYTTEN, P.

Deep helium diving in the high Arctic.
In: 1973 Offshore Technology Conference, April-May, 1973, Houston, Texas. Preprints, Vol. I, p.497-504. Published by the conference.

One of the most significant problems currently facing the tri-faceted (commercial, scientific and military) diving communities is the necessity to carry out deep, manned operations in water temperatures equal to those found in the Arctic circle. The problems of respiratory heat loss, and diver protective garments are well known, but most prevalent solutions are largely based on laboratory acquired data and interpolation of traditional intemperate water techniques. This paper outlines parameters of the problem, methodology of approach and evaluation of some solutions. The research and testing took place in facilities in California and western Canada, under actual operating conditions in the sub Arctic, through the ice in the high Arctic, and finally culminated in hyperbaric tests to 1,000′ in 32° water. (Author's abstract)

340.

O'BRYAN, R.K., R.L. Clinton and R.A. Vendetto.

Evaluation of the Mark II Mod O UBA.
U.S. Navy Exp. Diving Unit, Rep. 10-78, 14p. May 1978.

The MK II Mod O UBA was evaluated for its ability to efficiently absorb carbon dioxide during prolonged moderate work in cold water. In addition, thermal protection of the absorbent bed and the degree of inspired gas warming were analyzed. The results show that near the surface the apparatus can efficiently absorb CO_2 for prolonged periods in cold water, and that the absorbent bed is thermally protected. However, there was a virtual absence of inspired gas warming which may be a limiting factor for a diver at depth. (Authors' abstract)

341.

O'HARA, V.S.

Hypothermia (a four-letter word).

In: National Association of Underwater Instructors. Proceedings of the sixth international conference on underwater education, October 1974, San Diego, Calif. p.302-311. Published by the Association, 1975.

Some of the major systemic changes seen with hypothermia: Respiration – The sudden immersion of an unprotected person in ice cold water can produce immediate severe uncontrollable hyperventilation, completely out of voluntary control that can continue on to severe metabolic imbalance, exhaustion and death. Gradual hypothermia leads to a drop in volume and rate which is directly proportional to temperature. There is marked bronchiolar dilatation with a significant increase in dead space. CO_2 production is reduced and serum CO_2 levels can fall so low that the normal respiratory drive is absent. Vascular – There is initial vasoconstriction down to 24-25°C then vasodilatation. There is a shift of plasma from the vascular spaces with a subsequent rise in the viscosity. Coagulability may actually decrease. The blood pressure initially rises due to the vasoconstriction but as the cardiac output drops the pressure falls. The combination of increased viscosity, vasoconstriction, decreased blood pressure may lead to local small vessel thrombosis and tissue damage. Heart – The heart rate drops–as a direct result of cooling of the heart muscles and pacemaker. It's not changed with drugs. The volume of each stroke doesn't change and the result is less blood is pumped because of the decreased rate. Metabolic – The major metabolic change is the decrease in O_2 uptake from hemaglobin. There is a marked increase in the ability of the serum to carry O_2 in solution. At 10°C all the body metabolic needs can be met by serum O_2 in solution. At 10°C all the body metabolic needs can be met by serum O_2 alone. CO_2 production falls way off and serum CO_2 falls very low. There is a tendency for the body chemistry to become more acid. This acidosis is throughout but most marked in the areas most affected by vasoconstriction, i.e., muscle. Acidosis has a very basic evil effect on the physiology of reducing cellular activity. It decreases the ability of the cells to take up O_2. The liver is unable to handle lactic acid, thus perpetuating the acidosis. It makes the heart more susceptible to irregularities and arrest. (Author)

341a.

O'HARA, W.J., C. Allen, and R.J. Shephard.

Loss of body weight and fat during exercise in a cold chamber.

Europ. J. Appl. Physiol. 37:205-218; 1977.

Ten men spent one week in a cold climatic facility performing a simulated arctic military exercise demanding an energy expenditure of 13–16 MJ · day^{-1}. Although the ration pack was adequate, extensive plate wastage led to a negative energy balance of 2.2 MJ · day^{-1}. Fluid intake was also insufficient, with a 3.25% decrease of body weight, and a 9.7% decrease in skin thickness over the cold exposure. Extensive fat mobilization was indicated by a decrease of skinfold thicknesses, an increase of body density, and associated ketonuria and glycosuria. The fat breakdown far exceeded the calculated energy deficit, and it is postulated that much of the "surplus" energy was required for synthesis of additional muscle protein. In the arctic environment, both energy and fluid balances are better maintained because there are few distractions from the simple pleasure of preparing and eating meals.

341b.

O'HARA, W.J., C. Allen, and R.J. Shephard.
Loss of body fat during an arctic winter expedition.
Can. J. Physiol. Pharmacol. 55:1235-1241; 1977.

Fifty-five soldiers have been observed over a vigorous 10-day sledging patrol in the Canadian arctic and subarctic. Initial observations showed a low level of physical fitness (26% body fat, aerobic power 41.9 $\pm$ 7.8 ml kg^{-1} min^{-1}, handgrip force 43.7 $\pm$ 7.2 kg). Over the 2-week northern sojourn, energy expenditures as measured by a Kofranyi-Michaelis respirometer and diary observation averaged 3248 kcal (13.6 MJ) day^{-1}, with a small (152 kcal [633 kJ]) positive daily energy balance. A weight loss of 1 kg, presumably water, was made good within 1 week of return to the south. A fat loss of some 3.9 kg was probably attributable largely to the demands of lean tissue synthesis. The lean mass was increased by 3.9 kg over the trial, with parallel gains of muscle force and aerobic power. The rapid mobilization of depot fat led to marked ketonuria.

341c.

O'HARA, W.J., C. Allen, R.J. Shephard, and G. Allen.
Fat loss in the cold--a controlled study.
J. Appl. Physiol.: Respirat. Environ. Exercise Physiol. 46(5):872-877; 1979.

A simple crossover design tested the specificity of fat loss induced by exercise in the cold. Fifteen middle-age, moderately obese males exercised 2.5 h/day for 2 wk, separated by an intervening (recovery) week. For 1 wk, the climatic chamber was maintained at -40°C (still air, full arctic clothing), with ambient temperatures for the alternate week. A total daily energy expenditure of about 13 MJ was estimated from diary recrods of activity, the tables of Durnin and Passmore, and Kofranyi-Michaelis measurements of oxygen consumption for subjects in the chamber. Comparison with diary records of food consumption showed a small energy deficit ($\sim$2.9 $MJ \cdot day^{1}$) over both warm and cold exposures. Cold exposure led to a reduction of skinfold thicknesses and an increase of body density (underwater weighing), with a loss of body fat (2.3 kg from skinfolds, 0.8 kg from underwater weighing) and a 1.5 kg increase of lean body mass. However, no significant changes of body composition occurred with comparable exercise under temperate conditions. Core temperatures were well maintained in the cold environment, but skin temperatures were 10°C lower than under ambient conditions. Mean skin temperature in the cold was positively correlated with fat loss. The observed fat loss in the cold can be explained by 1) new protein synthesis, 2) ketosis, and 3) a small energy deficit.

342.

OHMURA, A., K.C. Wong, D.R. Westenskow and C.L. Shaw.
Effects of hypocarbia and normocarbia on cardiovascular dynamics and regional circulation in the hypothermic dog.
Anesthesiology 50(4):293-298; Apr. 1979.

The effects of carbon dioxide on the cardiovascular system, cerebral, mesenteric, and renal blood flows, and total-body oxygen consumption under surface-induced hypothermia to 24C were evaluated in 12

dogs. In Group I (six dogs), Pa_{CO_2} was allowed to decrease from 35 to 18 torr during cooling without the addition of CO_2 to the inspired gas mixture. In Group II (six dogs), CO_2 was added to the inspired gases to maintain Pa_{CO_2} 34-38 torr during cooling. Arterial blood *p*H increased in Group I (7.39 to 7.50), while it decreased in Group II (7.35 to 7.27). Cardiac index decreased markedly with cooling in Group II, from 3.37 to 1.18 l/min/m^2, while it showed an initial increase in Group I at 34C, followed by a decrease to 1.62 l/min/m^2 at 24C. Stroke index did not change significantly, but heart rate decreased significantly in either group, with Group II showing a greater decrease. Mean arterial pressure was significantly decreased in either group from about 120 to 80 torr, but there was no significant differences in mean arterial pressures between groups at the same hypothermic temperatures. Mean pulmonary arterial and pulmonary capillary wedge pressures were essentially unchanged in both groups. Pulmonary vascular resistance showed significantly greater increases in Group II than in Group I. Internal carotid arterial blood flow was significantly greater in Group II than in Group I, but there was no difference in renal or superior mesenteric arterial blood flows between the two groups. Total-body oxygen consumption in either group decreased from about 127 ml/min/m^2 at 37C to 41 at 24C, and there was no significant difference between groups. These results suggest that adding CO_2 to the inspired gases to maintain normal Pa_{CO_2} during hypothermia may be desirable for cerebral perfusion but harmful to the cardiovascular system.

343.

OLEINICK, N.L.

The initiation and elongation steps in protein synthesis: relative rates in Chinese hamster ovary cells during and after hyperthermic and hypothermic shocks.

J. Cell Physiol. 98(1):185-192; Jan. 1979.

The relative rates of the initiation and elongation phases of protein synthesis have been determined in heat- and cold-shocked CHO cells from measurements of the incorporation of ^{35}S-methionine into N-terminal and internal positions of growing peptides by a modified Edman degradation. When the cells are shifted from 37°C to temperatures between 10°C and 34°C, the rate of initiation is at first reduced more extensively than that of elongation. After 20 to 30 minutes at the lower temperature, however, the cells undergo a metabolic adjustment which includes increasing the rate of initiation until it corresponds to the rate of elongation at that temperature. Calculated apparent energies of activation for initiation and elongation are in reasonable agreement with those determined in other mammalian cells. When the cooled cells are returned to 37°C, the rates of initiation and elongation recover immediately but do not exceed the control values. Exposure to elevated temperature (43°C) causes an immediate cessation of initiation and thus a delayed inhibition of elongation; upon return to 37°C, the rate of initiation is transiently elevated above the control rate, and the rate of elongation returns to the control rate after a 2- to 3-minute delay. Hence, a factor which leads to supranormal rates of initiation may accumulate at high but not at low temperatures.

344.

ORITSLAND, N.A., D.M. Lavigne and K. Ronald.

Radiative surface temperatures of harp seals.

Comp. Biochem. Physiol. A Comp. Physiol. 61(1):9-12; 1978.

Ambient air temperature rather than wind speed or heat flow exerted the greatest effect on radiative heat loss from harp seal (*Pagophilus groenlandicus*) pup fur. Fur conductance was higher when calculated using radiative temperature rather than air temperature as representative of ambient temperatures. An equation was derived from data on thermal properties of fur samples and adjusted to fit the expected in vivo heat loss to predict the radiative temperatures of harp seal pups on the ice.

345.
OSTERLUND, D.

The development of unisuit dry diving suit.

In: Adolfson, J., ed. Underwater 75. Proceedings of the fourth world congress of underwater activities. Vol. II, p.485-492. Stockholm, Sweden, Almqvist & Wiksell International, 1976.

Unisuit was developed by Poseidon Industry at the request of the Swedish government. The effort was initiated in 1965, and the suit was put on the market in 1968. It is a gas-inflated dry diving suit, shaped to the body, made of resilient foam insulating material, with a neck seal which separates the suit and the gas within the suit from the hood. It can be used in combination with almost any existing auxiliary equipment. Buoyancy is controlled by the diver. Heat insulation is achieved by the Arctic underwear and by the layer of air or gas around the body. Unisuit has been used with complete success in Arctic experiments by the U.S. Navy, the Canadian Navy, and by the MacInnis expeditions. The Unisuit Combi is a combination of a dry suit with wet suit covering for the legs. This gives greater mobility. Unisuit Save has an oral inflating tube instead of the two valves. This is used by land-based personnel, or by helicopter life saving personnel, who may be in danger of falling into the water. They can be kept warm and afloat indefinitely. (MFW/UMS)

346.
PALM, J.

Educating the public in the risks of cold water immersion.

In: Proceedings of the cold water symposium, Toronto, May 8, 1976, p.37-38. Toronto Royal Life Saving Society, Canada, 1976.

The author reviews some of the survival techniques that have been discussed in this symposium: the use of life jackets and personal flotation devices, the question of when to hang on and when to swim for shore, the use of drownproofing and HELP, and the huddle. All of these procedures have advantages and disadvantages, and difficulties from the point of view of educating the public in their use. One problematical fact is that in Canada more than half the people who drown annually never intended to go into the water, whereas the experimental research described at this symposium was carried out by people who knew they were going into cold water. (MFW/UMS)

347.
PASTUKHOV, Yu.F., R.P. Valov and V.S. Sazonov.

Changes of muscle thermogenesis in cold adapted rats after beta-adrenoreceptor blocking. Fiziol. Zh. Sssr. 65(1):61-66; Jan. 1979.

The administration of beta-adrenergic blocking agent propranolol to cold adapted rats entailed some decrease of the total metabolic reaction and body temperature as well as an additive (compensatory) increase of electrical muscle activity. The compensatory effect was more obvious in postural-tonic groups of muscles (m. trapezius, m. masseter) and in deeper portions of muscles (m. tibialis ant., m. trapezius), mainly presented by the red fibers. An adaptive increase of non-shivering thermogenesis and temperature effect of muscular contraction seem to be mainly controlled by beta-adrenergic mechanisms.

348.
PELLEGRINI, L.

Immersioni nel gelo: motivi e problemi.

[Diving in the cold: motives and problems].

In: Proceedings of the first national symposium of the Italian Committee on Underwater Research, Rome, 11-12 Oct. 1974. p.58-60. Published by Il Subacqueo.

Difficulties and rewards of sport diving in very cold water and under ice are discussed. The rewards of unusual underwater sights, including seals and penguins, giant algae, and the kaleidoscopic colors of sunlight shining through the ice, are great. The problems include transportation of equipment (especially to Alpine lakes), protection from cold in the water and while dressing and undressing, and the necessity for changing breathing mixtures and decompression schedules for high altitudes. Industrial applications of cold-water diving are foreseen, especially in petroleum exploration. (MEMH/UMS)

349.

PERKINS, John, Jr.

The role of the proprioceptors in shivering.
Am. J. Physiol. 145:264-271; 1946.

(1) Shivering movements in cats were recorded by means of two phonograph pickups connected to a two-channel ink-wiring oscillograph. (2) Simultaneous records of the tremor were made in normal and in deafferented hind limbs. The movements of the limbs during shivering were rhythmic on the normal side, always irregular on the deafferented side. (3) A hemidecerebellate animal and two animals with severance of one dorsal column shivered normally on both sides. (4) The rate of shivering in a normal muscle could be changed by 100 percent or more by varying the mechanical resonance of the moving muscle. This was accomplished by adjusting the position of a pair of weights mounted on a lever attached to the tendon, or by varying the tension of a rubber band against which the tendon pulled. Deafferented muscles did not shiver rhythmically even with this arrangement. (5) It is concluded that the rhythmicity and rate of shivering are determined peripherally by a mechanism which involves the proprioceptors and resembles that of reflex clonus. The rate of shivering in the normal animal is probably close to the resonant frequency of the moving part. A pacemaker action of the shivering center appears unlikely.

349a.

PETAJAN, H.H., and D.D. Williams.

Behavior of single motor units during pre-shivering tone and shivering tremor.
Am. J. Physical Med. 51(1):16-22; 1972.

Frequency characteristics of motor units that initiate muscle contraction were investigated in biceps and triceps. Frequency alterations and the behavior of these units during the development of pre-shivering tone and shivering were investigated in 6 male subjects during 12 cooling sessions. Pre-shivering tone develops in the same units that initiate contraction and onset frequencies are the same. During cooling, triceps is first to develop tone and to shiver. The recruitment pattern is altered by cooling. Higher threshold units fire when the primary unit that initiates contraction is firing at a lower frequency than occurs during voluntary recruitment. Tonic bursts of higher threshold units may serve to pace the shivering tremor by activating the myotatic loop.

350.

PETERSDORF, R.G.

Hypothermia (letter).
Arch. Intern. Med. 139(4):399; Apr. 1979.

Hypothermia is a medical emergency largely because the hypothermic patient is subject to lethal cardiac arrhythmias, including ventricular fibrillation, severe metabolic acidosis, myocardial or cerebral infarction, shock, and infection. Resuscitative efforts should be instituted at once and should be prolonged.

351.
PETROVIC, V.M., V. Janic-Sibalic, A. Aminot and J. Roffi.
Adrenal tyrosine hydroxylase activity in the ground squirrel: effect of cold and arousal from hibernation.
Comp. Biochem. Physiol. C Comp. Pharmacol. 61(1):99-102; 1978.

Tyrosine hydroxylase (TH) activity in the adrenals was studied in autumn in 3 groups of the normothermic ground squirrels (*Citellus citellus*). One group was kept at 20°-25°C; the 2nd group was kept over the same period in the cold room at 6°-8°C and the 3rd group was examined immediately after artificial arousal from hibernation. TH activity was higher in the euthermic ground squirrel kept at 6°-8°C (in the period prior to hibernation) than in those kept during the same period at 20°-25°C ($P < 0.01$). TH activity in the adrenals of animals examined immediately after artificial arousal from hibernation was lower than in active ones kept at the same environmental temperature ($P < 0.01$).

352.
PETROVIC, V.M., M. Vrnaski, O. Rajcic and B. Milic.
Biosynthesis of mitochondrial protein components in the liver of cold exposed or adapted rats.
Pfluegers Arch. Eur. J. Physiol. 377(2):181-184; 1978.

Liver mitochondria of rats exposed or adapted to cold were fractionated after labeling in vivo with radioactive amino acid mixture. Specific activity (cpm/mg proteins) of unfractionated proteins from the whole mitochondria, water soluble proteins and cytochrome c after the animals were exposed to 4°C for 3, 6, 12 and 24 h was higher than controls adapted to 24°C. Specific activity of contractile and structural proteins was unchanged. In rats exposed to cold for 7, 14 and 21 days, the labeling of all fractions studied was the same as the control. The liver weight was increased in cold adapted rats (21 days). If expressed per total liver mass, radioactivity of all fractions was higher in cold adapted rats than in controls.

353.
PEYRONNARD, J.M., M. Pedneault and A.J. Aguayo.
Neuropathies due to cold: quantitative studies of structural changes in human and animal nerves.
In: den Hartog Jager, W.A., et al., ed. Neurology. Amsterdam, Excerpta Medica. p.308-329. 1978.

Peripheral nerves may be injured by severe cold. In man, cold-induced neuropathies are more often encountered in war or shipwreck. In peace time they may affect mountain climbers, hikers, individuals accidentally exposed to cold, the elderly, or those who, under the effects of alcohol or drugs, may fall asleep outdoors and become hypothermic. Nerves, together with other body tissues, are damaged by freezing as seen in frost-bite injury; however, low temperatures above freezing may also cause a neuropathy by the combined effects of cold and wetness ('trench foot') or as a result of immersion in cold water ('immersion foot'). After exposure to cold, limbs may become discolored, swollen and pulseless. Upon rewarming, the peripheral pulses return and the swelling gradually decreases but patients may complain of numbness, severe tingling often associated with pain, muscle weakness and dryness of the skin. Pain is, as a rule, a short-lasting symptom but sensory autonomic and motor function may be slow to recover. Superimposed pressure injuries, infection and gangrene are known complications of cold injury.

354.
PIANTADOSI, C.A. and W.H. Spaur.
Life support characteristics of the Mark 11 semi-closed mixed gas underwater breathing apparatus at intermediate depths.
U.S. Navy Exp. Diving Unit, Rep. 18-78, 26p. Nov. 30, 1978.

A series of three saturation dives designed to evaluate the ability of the Mark 11 UBA to support a working diver in its normal semi-closed mode of operation were performed at the Navy Experimental Diving Unit. Experiments were undertaken to determine the life expectancy of Mark 11 CO_2 removal canisters in several configurations, and to investigate the ability of the system to support sustained, heavy work in cold water to depths of 450 FSW. Canister duration studies were performed with three types of CO_2 absorbent beds and with or without prototype baffles. Analysis of the data revealed a maximum mean Mark 11 canister life expectancy of 270 ± 50 minutes at 310 FSW and 35°F (1.7°C), which decreased substantially with depth and cold temperature, and was highly variable from diver to diver. No changes to the basic canister configuration offered any significant increases in mean canister duration, however, canisters using Baralyme at 390 FSW had shorter durations than the other tested absorbents. Other life support characteristics such as breathing resistance, thermal protection, and P_{O_2}, were adequate to depths of 450 FSW. The large scatter in canister breakthrough data coupled with limited sample size made it difficult to establish high-confidence operational limits for the Mark 11 UBA in its present configuration. (Authors' abstract)

354a.

PIANTADOSI, C.A., D.J. Ball, M.L. Nuckols and E.D. Thalmann.

Manned evaluation of the NCSC diver thermal protection (DTP) passive system prototype.

U.S. Navy Exp. Diving Unit, Rep. 13-79, 26p. Aug. 1979.

(Also published as U.S. Navy Exp. Diving Unit, Rep. 4-80, Mar. 1980).

Twenty-eight, long duration, manned, air dives were performed at the Navy Experimental Diving Unit in 35 - 42°F (1.7 - 5.6°C) water and depths of 10 FSW and 70 FSW to evaluate the effectiveness of the NCSC Diver Thermal Protection (DTP) Passive System Prototype. Measurements used to establish rates of heat loss in divers wearing the DTP prototype included body core temperature, mean skin temperature, and mean body convective heat loss. These measurements were compared with currently accepted physiological criteria for thermal exposures in divers to obtain guidelines for use of the system. Results indicated that the DTP Passive System Prototype can safely support a working diver for up to six hours, and a resting diver for up to three hours, in 35 - 42°F (1.7 - 5.6°C) water. Depth dependent degradation of suit performance was not observed, as suit insulation averaged 1.0 clo at both test depths. Attempts by cold resting divers to rewarm themselves with intermittent leg exercise were sometimes associated with a small body core temperature afterdrop which could be overcome by continued exercise. Problems requiring additional design and test effort were encountered with inadequate thermal protection of the extremities, particularly the hands, and inadequate sealing of the dry suit outergarment. (Authors' abstract)

354b.

PIPKIN, G.

Caloric labyrinthitis: a cause of drowning.

Am. J. Sports Med. 7(4):260-261; 1979.

The case history of an experienced swimmer otolaryngologist who dove off the end of his dock into very cold water and nature reproduced the caloric Barany test leaving him completely disoriented--vertigo, lost balance sense, lost position sense, and a feeling of weightlessness. Was able to feel his way up the side of the lake to the surface. (CWS/UMS)

355.

POCZOPKO, P., R. Jusiak and L. Tomaszewska.

The effects of acclimation to moderate and acute cold in rats.

Acta Theriol. 23(7-18):247-258; 1978.

In adult (300-400 g) male Wistar rats, acclimated for 3 wk either to moderate (13 ± 1°C) or acute (5 ± 1°C) cold the changes of the metabolic rate in intact animals, respiration of muscle and liver slices

in vitro, urinary catecholamine excretion and total serum thyroxine concentration were measured. After 21 days of acclimation to both temperatures the basal metabolic rate (BMR) was elevated. Acclimation to 5°C accelerated also the metabolic rate in vitro of both tissue tested, but acclimation to 13°C produced a slight elevation of the metabolism of muscle slices and a decrease of that of liver slices. Urinary adrenaline (norepinephrine) excretion during exposure of rats to 5°C was 5-13 times higher than prior to exposure, but the rise in noradrenaline excretion was much less pronounced. In rats acclimated to 13°C after a rise of urinary excretion of both amines taking place during first few days, a drop to approximately initial level occurred. Practically no changes in total serum thyroxine concentration took place at exposure to both temperatures. Observed rise in adrenergic system activity may fully explain acceleration of the metabolism of isolated tissues and BMR.

356.

POKROVSKII, A.A. and I.N. Loshkomoeva.

Effect of varying ascorbic acid provision on some metabolic indices in the body of guinea pigs exposed to cold.

Vopr. Pitan. (1):44-48; 1978.

Changes in the content of ascorbic acid in the blood, urine and adrenals and also of glucose and 11-oxycorticosteroids in guinea pigs with different vitamin C allowances under cold stress conditions were studied. The degree of the vitamin C allowances was essential for adequate response of the organism to cold, but more reserved utilization of high ascorbic acid doses are needed in metabolic transformations.

357.

PORTET, R., M. Beauvallet and M. Solier.

Variations of rat brown adipose tissue composition during cold acclimatization.

Arch. Int. Physiol. Biochim. 84(1):89-98; 1976.

The modifications in weight and composition (lipids, proteins, water) of rat interscapular brown adipose tissue (BAT) were studied during the first 6 wk of cold exposure and acclimatization. The variations of norepinephrine content was also investigated. During the 1st day of cold exposure, the major part of tissue lipids was released. During the following 2 days there was a fall in lipid and norepinephrine contents and uptake of water. Until the end of the 1st wk a rapid repletion occurred. At that moment the relative pass of the tissue and the amounts of its principal components reached values which were not changed during the following wk. The adaptative changes in the levels of BAT essential components were carried out at the end of the 1st wk of cold exposure, long before the non-shivering thermogenesis is entirely effective.

358.

PORTET, R., M. Beauvallet, G. Blancher and M. Solier.

Effect of ambient temperature on the development and the composition of brown adipose tissue of newborn rat.

C R Seances Soc. Biol. Fil. 172(2):263-268; 1978.

The weight and the lipid, water and norepinephrine contents of the interscapular brown adipose tissue from 1, 3, 7, 11, 14 and 21 day aged rats were measured. The animals were maintained at an ambient temperature of 16°, 23° or 28°C from birth. Nonshivering thermogenesis is apparently not necessary after 3 days of age in animals kept at 28°C and after 11 days of age in the ones kept at 23°C. Thermogenesis probably persists for the entire suckling period in those kept at 16°C.

359.

PRAKASH, O., B. Jonson, E. Bos, S. Meij, P.G. Hugenholtz and W. Hekman.

Cardiorespiratory and metabolic effects of profound hypothermia.

Crit. Care Med. 6(5):340-346; Sept.-Oct. 1978.

At operation the body temperature of mechanically ventilated infants was initially decreased to 25-22°C with surface cooling and further lowered to 16°C by total body perfusion. During circulatory arrest, averaging 40 min, repair of complex intracardiac deformities was carried out. Rewarming to 36°C was achieved by 35-65 min of total body perfusion. Of 29 infants, 23 under 10 kg survived their correction; normothermic ventilation without added CO_2 was given throughout the cooling period. The following measurements were made: gas exchange, lung mechanics, heart rate, arterial pressure, right atrial pressure, cardiac output ($\dot{Q}t$), ECG, core and nasopharyngeal temperature, as well as biochemical determinations. During surface cooling O_2 consumption ($\dot{V}O_2$), CO_2 production ($\dot{V}CO_2$), endtidal CO_2 ($P_{ET}CO_2$) and $PaCO_2$ decreased proportionally and linearly with body temperature. Inspiratory resistance, total compliance, physiological dead space (V_D/V_T), and the single breath CO_2 curve did not reveal disturbed lung function. Mean arterial pressure was 98, 90, and 70 mm Hg and heart rate was 141, 107, and 76 beat/min, at temperature 35, 30, and 25°C, respectively. Cardiac index was 2.2 ± 0.2 liter/min/m^2 (mean ± SEM, n = 25) 2 hours after surgery. Arterial lactate reached peak values of 4.1 ± 0.3 mM/liter (n = 17), during rewarming but returned to normal. Respiratory alkalosis caused by hyperventilation during cooling caused no apparent harm. No neurological damage was observed. It is concluded that surface cooling performed with normothermic ventilation under guidance of core temperature, $\dot{V}O_2$, $P_{ET}CO_2$, and $\dot{V}CO_2$, is a safe method.

359a.

PRESCOTT, L.F., M.C. Peard, and I.R. Wallace.
Accidental hypothermia.
Brit Med. J. 2:1367-1370; 1962.

Nine cases of accidental hypothermia seen in a small hospital within a period of four months are reported. Three patients survived. Electrocardiographic and biochemical abnormalities are briefly reviewed. It is suggested that the condition is by no means uncommon and should be considered in the differential diagnosis of all patients with impaired consciousness during the winter months. It can occur rapidly and is by no means confined to the elderly and neglected. Although there is often a history of exposure during cold weather, hypothermia can develop when the patient is in bed in relatively warm surroundings. The phenothiazine group of drugs should be given to the elderly and hypothyroid patient with caution and the rectal temperature checked if confusion or drowsiness occurs. This should be taken with a low-reading thermometer or, if unavailable, an ordinary lotion thermometer. The prognosis is poor, but is more favorable in the younger patients.

360.

PRESTON, F.S.
Water hazards, or how to avoid a watery grave.
Practitioner 211:209-219; Aug. 1973.

This is an article directed to the diving population and to the medical practitioner with scant knowledge of diving dangers and problems. The following subjects are dealt with: hypothermia – its diagnosis, its prevention, its treatment, and complications during treatment (hypotension, "afterdrop," and cardiac arrest); drowning – causes, pathology, clinical picture, treatment, and prevention; accidents and hazards – blackout from anoxia, barotrauma, both of the ear and of the lung (resulting in air embolism), pneumothorax; decompression sickness and its treatment; and nitrogen narcosis. Of necessity, each subject is rather briefly dealt with, but the article represents an effective and clearly written review for the reader who is unfamiliar with the subject area. (MFW/UMS)

360a.

PROVINS, K.A., and R.S.J. Clarke.
The effect of cold on manual performance.
J. Occupational Med. 2:169-176; April 1960.

This is a general review covering various aspects of the problem, such as reaction time, tracking pro-

ficiency, general dexterity, and racial discrimination. Two particularly interesting points are made: In one study it was shown that native Eskimo and Indian men were definitely superior to white men newly arrived in the territory – "the decline of each of these functions was, for the natives, about half as much as that reported for the white personnel." The second point is the call for the proper design of equipment for use in cold weather. (CWS/UMS)

361.

RAIFMAN, M.A., M. Berant and C. Lenarsky.

Cold weather and rhabdomyolysis.

Journal of Pediatrics 93(6):970-971; Dec. 1978.

Rhabdomyolysis is an uncommon condition which may have serious consequences, such as severe electrolyte imbalance, cardiac arrhythmias, renal failure, and respiratory failure. The clinical presentation is frequently nonspecific. Reports on rhabdomyolysis do not list exposure to cold as one of the causes of this condition. This report describes three instances of rhabdomyolysis associated with exposure to cold weather.

362.

RAJCIC, O. and V.M. Petrovic.

Changes in protein and nucleic acids content in adrenal cortex and medulla of the rat exposed to cold.

Arh. Biol. Nauka. 27(3/4):117-122; 1975.

Protein and nucleic acid content was studied in adrenal cortex and medulla of the rat exposed to cold for 6 and 96 h. Cold exposure resulted in a significant increase of protein and RNA content in the arenal cortex of the rat as compared with controls ($P < 0.01$). After 6 h of cold exposure no change in protein and RNA content in the medulla was found. However, after 96 h of cold-exposure, protein and RNA content were increased ($P < 0.01$ and $P < 0.05$, respectively). DNA content was not changed in the cortex or in the medulla of the cold-exposed rats.

363.

RAKHIMOV, K.R., A.I. Demidova and Sh.K. Kurbanov.

The effect of heat, cold, and muscle stress on amylolytic and invertase activity of different segments of rat small intestine.

Fiziol. Zh. Sssr. Im. I M Sechenova. 64(9):1339-1347; 1978.

In rats, after 1, 2, 4 and 10 h heat (40°C), cold (6-7°C) or swimming, invertase and γ-amylase activity sharply increased in distal parts of small intestine while in proximal and medial segments the enzymatic activity either decreased, remained the same or slightly increased. These shifts seem to have adaptive significance and maintain carbohydrate balance in stress situations.

364.

RAPP, G.M.

Convection coefficients of man in a forensic area of thermal physiology: heat transfer in underwater exercise.

J. Physiol. (Paris) 63:392-396; May 1971.

Development of a rational method of analysis for predicting the convective and conductive heat losses of underwater swimmers and divers exercising in cold water. The method is based upon the assumption that a heat balance with exercise in 22°C water can be maintained for reasonable durations of time by the swimmer. Subject to prescribed conditions, it is concluded that because the peripheral internal body tis-

sues have conductive resistance 15 to 32 times larger than the convective resistance of the external body surface, internal conduction instead of external convection governs. (FRL) (Aerosp. Med. Biol.)

365.

RAWLINS, J.

Man in the deep. Part III.

In: Oceans 2000. Third world congress of underwater activities. p.58-59. London, British Sub-Aqua Club, 1973.

The author outlines the well-known hazards of narcosis, airway resistance due to density of the breathing mixture, poor visibility and cold. It is the last-named hazard that he deals with more fully, emphasizing the need to heat suits, and to heat the breathing mixture. The mechanisms of heat loss are discussed. As the heating equipment becomes more complicated, it becomes more cumbersome and burdensome to the diver. It is the author's belief that the ultimate solution to the problems of working at depth will have to take the form of "sophisticated submersibles, with great maneuverability, navigational efficiency, manipulative skill and strength." (MFW/UMS)

365a.

RAWLINGS, J.S.P.

Thermal Balance in Divers.

In: Cold/wet survival symposium.

J. Roy. Nav. Med. Serv. 58:182-188; Winter 1972.

Studies affecting the thermal balance of divers are discussed with particular attention to the effects of 'wet' and 'dry' suits, methods of heat replacement, and fators contributing to heat loss.

366.

RAYMOND, L.W.

The mechanisms and management of hyperthermia and hypothermia.

In: Egstrom, G.H., ed. Thermal problems in diving. Proceedings of a seminar held at Commercial Diving Center, Wilmington, Calif., Mar. 19-20, 1976, p.35-63. Wilmington, Calif., Commercial Diving Center, June 1977.

Hyperbaric helium is equally as effective in conducting heat to the occupant of a chamber or habitat as it is in conducting it away from him. Injury and death can occur if hyperbaric helium atmospheres are kept at high temperatures for more than a few minutes. Another factor in the hyperthermia problem is the fact that the insulating garments that protect against cold can cause the divers to become dangerously overheated under certain conditions. Electrically heated suits offer another risk of hyperthermia. If there is a delay in starting compression, the divers' body temperature can rise to 104°F, even without the electricity turned on. Then with compression, further overheating occurs, possibly to the point of danger to the brain. For optimal function, the body should be between 35°C and 39°C. It is dangerous to let a diver's temperature fall to 35°, because then when he is returned to the chamber or habitat, afterdrop is likely to bring his temperature down to the danger level. This occurs when the chilled peripheral blood returns to the central circulation as rewarming begins. Physiological aspects of metabolism and thermal balance are discussed at some length. Various aspects of heat illness are discussed: heat cramps, heat exhaustion (prostration), heat stroke, and exertional rhabdomyolis (in which heavy exercise in unaccustomed heat causes breakdown of muscle fibers, which release their myoglobin into the circulation, causing kidney failure). The danger of confusing hyperthermia with fever and incapacity due to infection is noted. Aspects of hypothermia are discussed: radiation as a form of heat transfer; the extremely narrow comfort zone that exists for some divers; accidental immersion; hypothermic coma, which protects against fatal drowning; rewarming; aspects of insulation. The paper is accompanied by numerous photographs, drawings, diagrams, and tables. There are several long discussion periods interspersed. (MFW/UMS)

367.

RAYMOND, L.W.

The thermal environment for undersea habitats.

In: Egstrom, G.H., ed. Thermal problems in diving. Proceedings of a seminar held at Commercial Diving Center, Wilmington, Calif. Mar. 19-20, 1976, p.85-87. Wilmington, Calif., Commercial Diving Center, June 1977.

The tables presented give the thermal conductivity of gases (helium, nitrogen, air and carbon dioxide), heat transfer coefficient in helium, and thermal confort in hyperbaric helium atmospheres. It is demonstrated that the distance between thermal discomfort, thermal stress, and thermal hazard is much shorter in hyperbaric helium than in normal air. The heat transfer coefficient of helium at 31 ATA when atmospheric movement is 120 fpm is 30.0, as compared to 8.1 at 15 fpm, and 0.3 for air at surface pressure at 15 fpm, and 1.1 for air at surface pressure at 120 fpm. In a hyperbaric helium environment (depth not specified) with atmospheric movement at 120 fpm, thermal comfort is rated as warm at 95°F, very cold at 85°F and 75°F, intolerable at 65°F, and fatal at 55°F. These estimates do not place adequate emphasis on respiratory heat loss in hyperbaric helium, and the effects of velocity upon convective and evaporative heat loss. Radiant heat loss may also increase if the surface temperature of the habitat is lowered by compression of the internal insulation. (MFW/UMS)

367a.

RAYMOND, L.W., G. Lindgren, E. Thalmann, J. Crothers, W. Spaur, W. Braithwaite, H.D. Langworthy, and T. Berghage.

Thermal homeostasis of men in helium-oxygen at 50 atmospheres absolute.

Navy Experimental Diving Unit, Rpt. NR 23-74; April 1974.

Spaur et al showed last year that man can work effectively and live comfortably for periods of at least 7 days in helium-oxygen at 49.5 atm. abs. (ATA). This pressure is equivalent to 1600 ft (499 m) sea water. Two of six men were studied during compression, habitation and decompression from 49.5 ATA in hyperbaric chambers with a Po_2 of 0.30-0.35 ATA, over 32 days. To avoid thermal discomfort, ambient temperature was maintained at 30-32°C (86-89°F), relative humidity was 68-74% and there was no measurable atmospheric velocity (V 10 m/min, or 33 ft/min). Comfort and thermal balance were adequate during mild activity when the men wore swim trunks and cotton jersey shirts. When they were seated without shirts, rectal temperature fell during 2-hr observation periods at depths below 800 ft, while skin temperature and oxygen consumption remained normal, and scrotal temperature was increased.

367b.

REES, J.R.

Accidental Hypothermia.

Lancet 1:556-559; 1958.

Four cases of accidental hypothermia are reported. The primary conditions were senility, myocardial infarction, acute paraplegia, and diabetic coma. The diagnosis may be overlooked if a low-reading rectal thermometer is not used whenever the ordinary clinincal thermometer fails to register. In treatment moderate warming should not be used, owing to the risk of increasing hypothermia and death from cardiac arrest. In acute hypothermia rapid warming is indicated; but in chronic hypothermia this may cause hypotension, and spontaneous, slow warming by the patient's metabolic processes is best. In circumstances where metabolism is depressed or heat conservation defective this may be insufficient, and some external warming is required. In one case accidental hypothermia may have protected against shock. Deterioration during slow warming may be an indication to continue hypothermia. My thanks are due to Dr. W.E. Lloyd, Dr. C.J. Gavey, and Mr. H.E. Harding for permission to publish these cases, and to Miss Jeanette Pirkis for the illustrations.

368.

REINHARDT, D. and E. Ritter.

Hypothermia-induced potentiation of histamine H_2-receptor-mediated relaxation and cyclic AMP increase in the isolated mesenteric artery of the rabbit.

Agents actions 9(1):9-14; Apr. 1979.

On helically cut strips of the rabbit's mesenteric artery, a temperature decrease from 42°C to 25°C reduced the contractile responses to histamine. Metiamide shifted the dose-response curve of the histamine-induced contraction towards higher values at 25°C, but not at 42°C. Furthermore, on arterial strips contracted by phenylephrine histamine evoked a dose-dependent relaxation at 25°C whereas at 42°C only slight relaxing responses to histamine occurred. Metiamide was capable of preventing the relaxation induced by histamine in a competitive manner. At 25°C the relaxation as produced by histamine was accompanied by increases in cyclic AMP which occurred prior to the relaxing effects. Metiamide abolished the cyclic AMP increase in response to histamine. At 42°C histamine was unable to elevate the cyclic AMP content. Thus, it is concluded that a cyclic AMP mediated relaxation due to stimulation of H_2-receptors counteracts the histamine-induced contraction and reduces the contractile responses to histamine at low temperatures. In addition, clear-cut evidence exists from the present study that also on artery smooth muscle the H_2-receptor-mediated responses are closely associated to cyclic AMP.

369.

RENNIE, D.W.

Thermal insulation of Korean diving women and non-divers in water.

In: Rahn, H. and T. Yokoyama, eds. Physiology of breath-hold diving and the Ama of Japan, p.315-324. Washington, D.C., National Academy of Sciences, National Research Council, 1965.

Cold tolerance is generally related to the thickness of the subcutaneous layer of fat. However, the diving women, who are lean, have much greater tolerance than non-divers, with the same fat thickness. Women have a greater body insulation than man because of the greater thickness of their subcutaneous layer of fat. (MFW/BSCP from author's summary)

370.

RENTZ, F.P.

A review of available heated wet-suit protection for divers and swimmers.

U.S. Nav. Submar. Med. Res. Lab., Rep. NSMRL 739, 15p. Feb. 28, 1973.

It is evident that heated wet suits are required for long underwater missions in temperate water and for short excursions in cold water. Several diver heating systems have already been developed and are in use, such as the free-flooding umbilical supplied suit and the battery powered, electrically heated suit. These are adequate for most underwater tasks today. A diver working from a personnel transfer capsule or a deep habitat is usually tethered for safety. An umbilical carrying heated water or electrical power would not be much added encumbrance. A combat swimmer could use the battery-powered suit for his free-swimming mission of two to three hours, drawing power from the larger, swimmer delivery vehicle battery during the longer trip to and from the area. Thus, he would not really be limited by the relatively short free excursion time permitted by today's batteries. Improvements in these systems are to be expected, as well as eventual development of a successful, practicable, isotope-fueled heating unit. With their low cost and high energy-to-weight ratio, the combustion heating devices may soon achieve prominence A system which will keep a free-swimming diver comfortable in cold water for periods of six to eight hours has yet to be perfected, and represents a challenge for future development. (Author's conclusion)

371.

RESCH, G.E. and X.J. Musacchia.

A role for glucose in hypothermic hamsters.

Am. J. Physiol. 231(6):1729-1734; Dec. 1976.

Hamsters undergo hypothermia when exposed to a mixture of 80% helium and 20% oxygen at low ambient temperatures. The hypothermic hamster, rectal temperature (T_{re}) 7°C, becomes hypoglycemic, and reversal of hypoglycemia is effected with glucose infusion. Hypothermic hamsters at T_{re} 7°C showed a fivefold increase in survival times from 20 to 100.5 h when infused with glucose which maintained a blood level at about 45 mg/100 ml. A potential role for osmotic effects of the infusion was tested and eliminated. There was no improvement in survival of 3-*O*-methylglucose or [illegible]n 40-infused animals. The fact that death eventually occurs even in the glucose-infused animal after about 4 days and that $\dot{V}_{O_2}$ undergoes a slow decrement in that period suggests that hypothermic survival is not wholly substrate limited. Radioactive tracer, [U-^{14}C]glucose, showed that localization of the ^{14}C, was greatest in brain tissue and diaphragm, intermediate in heart and kidney, and lowest in skeletal muscle and liver. The significance of the label at sites important to respiration and circulation was presented.

372.

REULER, J.B. and R.A. Parker.

Peritoneal dialysis in the management of hypothermia.

J. Am. Med. Assoc. 240(21):2289-2290; 1978.

Peritoneal dialysis is suggested as the method of choice for rewarming patients with profound depression of body temperature using K^+ free, dextrose and lactated Ringer's solution. Reversal of cold stress effects is accomplished by rapid installation and immediate removal of a 43.5°C dialysate for 6-8 times. Advantages over core rewarming techniques are cited, including no need for vascular access in frostbite cases and total body drug clearance in drug associated hypothermia.

373.

REULER, J.B.

Hypothermia: pathophysiology, clinical settings, and management.

Ann. Intern. Med. 89(4):519-527; Oct. 1978.

Hypothermia, defined as a core temperature less than 35°C, is frequently not recognized, in part because of the inadequacy of standard thermometers. This entity has multiple causes and unique pathophysiologic consequences that complicate diagnosis and treatment. Understanding of the physiology of thermoregulation is important in light of recent advances in therapy using core rewarming. Pathophysiology, etiology and management of the hypothermia syndrome are reviewed.

373a.

REULER, J.B.

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374.

REYNOLDS, J.L.

Further thoughts on the diving reflex (letter).

Am. Heart J. 98(2):273-274; Aug. 1979.

(To the Editor) The paper by Drs. Hamilton, Moodie, and Levy in the March issue of the *Journal* indicates the diving reflex can be used successfully to terminate supraventricular tachycardia in a neonate. The authors state they manually occluded the infant's nostrils to prevent aspiration when her face was placed in ice water. I write to confirm that my experience with the method in the case of several neonates also indicates it is frequently dramatically successful. To avoid the problem of aspiration, instead of immersing the infant's face in ice water, I soak a face cloth in ice water, quickly wring it dry, and then apply and hold it over the entire face for about 20 seconds. This modification seems to work well, even in infants younger than two weeks of age, is simple to effect, and avoids possible aspiration.

375.

RICO, A., V. Burgat-Sacaze, J.C. Godfrain, J.P. Braun and P. Bernard.

Long-term toxicity of cadmium administered in very low doses to rats: response to cold stress.

Toxicol. Appl. Pharmacol. 46(3):793-801; Dec. 1978.

The toxic action of Cd and its interaction with a cold stress was studied on 4 groups of COBS-CD rats (10 ♂, 10 ♀), absorbing O (TT and TF) or 2.5 (CdT, CdF) ppm of Cd (drinking water). After 12 mo. under observation, the TF and CdF groups were housed at +1°C for 48 h. In the course of, or just after, this stress, various urinary parameters (volume, Na^+, K^+, urea, creatinine) and blood parameters Hb, Na+, K+, Ca^{2+}, Cl^-, P_i, urea, creatinine, blood sugar) were measured. In the CdT groups, Cd was responsible for lower urea concentrations in urine (16%) and lower phosphate and creatinine in serum (16 and 10%). Under cold stress, treated animals (CdF) reacted differently than the control animals (TF): they had less polyuria and no trace of hypokalemia, hypophosphatemia and hyperglycemia as opposed to the TF groups which showed the presence of hypercreatinemia (15%) and hypocalcemia (6%). These results hint at the existence of latent noxious effects related to the well-known toxicity of high doses of Cd.

376.

RIDGEWELL, B.A.

DCIEM diving program general.

In: The Third Canadian Diving Symposium, held at Defence and Civil Institute of Environmental Medicine, October 30-31, 1978. p.33-37. Downsview, Ontario, Canada, Def. Civ. Inst. Environ. Med., 1978.

The mission of the Defence and Civil Institute of Environmental Medicine (DCIEM) is to improve the human effectiveness of man-machine systems in hostile environments for the Canadian forces. The research and development program concerned with man-in-the-sea is called Man Underwater, and is divided into three sub-programs: 1) Diver systems and techniques; 2) Submersible systems and techniques; 3) Diving biomedical research. The emphasis of the first is on test and evaluation. They are working on compressed air, breathing apparatus, surface supported breathing apparatus, closed circuit breathing apparatus, an underwater tools project, and an operational decompression computer project. The second sub-program is engaged in evaluating one atmosphere diving systems, doing research on manipulators, and looking into the usefulness of remote control vehicles for the Canadian Forces. The third subprogram is concerned with thermal protection and methods of temperature monitoring. Neurological disorders such as HPNS and the effects of rapid decompression on the inner ears of laboratory animals

are being investigated. Also, a psychological screening profile for selecting potential divers is under development. Psychomotor tests are also being developed to determine the effects of pressure on performance. (MFW/UMS)

377.

RIEGEL, P.S. and G.H. Alexander.

A simple experiment in diver heating.

In: Johnson, C.E., M.L. Nuckols and P.A. Clow, eds. Hyperbaric diving systems and thermal protection. OED Vol. 6, p.75-81. New York, N.Y., American Society of Mechanical Engineers, 1978.

An experiment was conducted with a human subject to determine the approximate amount of heat required to maintain comfort in an inactive diver in cold water. The subject was outfitted in a closed-circuit hot-water suit worn beneath a ¼-inch (6 mm) conventional wet suit. Temperatures and flows were measured, as well as diver comfort. Heat required to maintain comfort in 38°F (3°C) water was found to be on the order to 1400 watts, for the configuration tested. Comfort levels versus heat input are discussed, and original data are presented. (Authors' abstract)

378.

ROCHELLE, R.D. and S.M. Horvath.

Thermoregulation in surfers and nonsurfers immersed in cold water.

Undersea Biomed. Res. 5:377-390; Dec. 1978.

During immersion to the neck in 19 ± 0.6°C water, surfers maintained higher toe temperatures than nonsurfers. The Lewis hunting response was seen only in the toes of the surfers. The shivering response of the surfers occurred later and was of lesser intensity. Threefold increases in metabolic heat production (140 kcal/m^2-h) above rest level were found in both groups. Rectal temperature changes were similar in both groups, with a mean decline of 1.2°C over the 1-h exposure period. Individual changes in rectal temperature were negatively correlated to percent of body fat. An initial hyperventilation upon immersion was followed first by a decline and then by a rise to three times that of rest. A transient rise in heart rate (35 beats/min) occurred in the initial stage of immersion in both groups and subsequently fell to basal levels, rising slightly thereafter. Sinus arrhythmias were observed during the first few minutes of immersion. In nonsurfers, plasma cortisol approximated the decrease anticipated because of the circadian cycle but was elevated in the surfers. Plasma volume decreased 12.2% (surfers) and 17.6% (nonsurfers). Diuresis was observed in both groups, and was 3.2 and 5.0 ml/min for surfers and nonsurfers, respectively. (Authors' abstract)

379.

ROCHELLE, R.H., R.R.J. Chafee, J.E. Greenleaf and C.D. Walker.

The effects of magnesium on state 3 respiration of liver mitochondria from control and cold-acclimated rats and hamsters.

Comp. Biochem. Physiol. B Comp. Biochem. 60(3):267-270; 1978.

Increasing the Mg^{2+} concentration resulted in a depression of succinoxidase-linked state 3 respiration of liver mitochondria from control and cold-acclimated rats and hamsters. In the cold-acclimated hamster, liver mitochondrial respiration was more sensitive to changes in Mg^{2+} levels than that of the rat.

380.

ROUHET, J.C., L. Crocq, Y. Lemasson and G. Petretto.

System for divers in cold water: A molten salt heat storage system associated with a dry type suit with hot water circulation.

In: Association of Diving Contractors. International diving symposium '79. New Orleans, Louisiana, February 5-7, 1979, p.171-177. Published by the Association, [1979].

The equipment uses latent heat mode of thermal storage in a salt as power source for heating the seawater circulating within the double walled diver suit. The diver is linked to the hot water source (for instance disposed in a lock-out submersible) by an umbilical which also conveys the breathing mixture, thus reheated, and the telephone wires. The complete system allows the diver to work during about 6 hours in a 2°C (35°F) water in optimum comfort conditions. It requires no other power source thus being considerably weight saving during underwater intervention. In this paper, the system (heat storage unit, pumping unit, diving hose . . . and special dry suit with hot water circulation) is described and an experimentation is presented with 16 mm movies pictures and slides. (Authors' abstract)

381.

THE ROYAL LIFESAVING SOCIETY CANADA.

Proceedings of the Cold Water Symposium held in Toronto, Ontario, May 8, 1976. Toronto, Royal Life Saving Society Canada, 1976, 45p.

The Department of Physiology, University of Toronto, and the Sports Medicine Section of the Ontario Medical Association collaborated with the Royal Life Saving Society Canada in the planning and carrying of this symposium. It is directed toward commercial and scientific divers as well as sport divers, and is intended to clarify the risks of immersion hypothermia and to discuss methods of preventing and/or treating it. Specific papers will be found under the following author entries: Collis, M.L. (two); Conn, A.W.; Cooper, K.E.; Elsey, D.; Goode, R.C.; Keatinge, W.R. (two); LeBlanc, J.; Palm, J. (MFW/UMS)

382.

RUSCH, N.J., et al.

Effect of profound cooling on adrenergic neuroeffector interaction in the blood vessel wall (proceedings).

Br. J. Pharmacol. 66(1):149P-150P; May 1979.

The present study was performed to investigate the effect of profound cooling (from 37° to 5°C) on the adrenergic neuroeffector interaction in the blood vessel wall. Rings of canine lateral saphenous veins and anterior tibial arteries were mounted for . . . These experiments suggest that: 1) progressive cooling causes a progressive depression of the contractile process, as evidenced by the inhibition of the K^+ induced responses; 2) the increased affinity of the alpha-adrenoceptors of the vascular smooth muscle cells, evidenced by moderate cooling (Janssens & Vanhoutte, 1978), persists at very low temperatures; 3) at very low temperatures the release of noradrenaline by nerve activation is inhibited since the vessels still respond to exogenous noradrenaline but not to electrical stimulation; and 4) the intracellular depressant effect and the inhibition of noradrenaline release may combine, in the intact organism, to explain 'cold vasodilation' occurring at very low temperatures.

383.

RUSSIN, V.Ya. and V.A. Barashkov.

Cold adaptation in albino rats under conditions of experimental hyper- and hypothyrosis. Fiziol. Zh. Sssr. 64(10):1463-1467; Oct. 1978.

Thyrotoxicosis or methylthiouracil hypothyrosis delays but does not completely eliminate the ability for cold adaptation in white rats. The adaptation in these conditions is accompanied by an obvious increase of the organism unspecific resistance and its resistance at the cellular level. A significant correlation exists between these two kinds of the resistance.

384.

RUSSELL, C.J., A. McNeill and E. Evonuk.

Some cardiorespiratory and metabolic responses of scuba divers to increased pressure and cold.

Aerosp. Med. 43:998-1001; Sept. 1972.

Some cardiorespiratory and metabolic responses of 10 scuba divers during a short period of rest and moderate exercise were studied under field conditions at 1.2 and 3 atmospheres absolute. The data were collected in a fresh water lake which has a constant temperature of 5.5°C below a depth of 1 m and is located at an altitude of 915 m. The results indicated that at greater depths, both during rest and exercise, the VO_2, VCO_2, V_r, O_2 pulse, and heart rate increased significantly ($P < 0.05$), while the respiratory frequency progressively decreased. The V_E decreased significantly ($P < 0.05$) only during the resting test periods. At greater depths the progressive increase in VO_2 and VCO_2 can be attributed primarily to the increased work of breathing air of greater density and to the responses induced by exposure to cold water. The elevation in heart rate may have been caused by a release of catecholamines into the general circulation due to the cold stress, while the greater O_2 pulse may reflect the individual or combined contributions of a larger stroke volume or an increased oxygen extraction from the blood. (Authors' abstract)

385.

RUWE, W.D. and R.D. Myers.

Dopamine in the hypothalamus of the cat: pharmacological characterization and push-pull perfusion analysis of sites mediating hypothermia.

Pharmacol. Biochem. Behav. 9(1):65-80; 1978.

Within the rostral diencephalon of the cat, 113 sites were examined for their reactivity of 2.33-14.0 μg dopamine (DA) or 2.33-14.0 μg norepinephrine (NE) microinjected in a volume of 0.75 μl. During each experiment, colonic temperature was monitored and additional physiological measures were recorded continuously. In contrast to CSF controls, an intrahypothalamic injection of either catecholamine at circumscribed sites evoked a dose-dependent fall in the cat's body temperature, with NE ordinarily evoking a more profound hypothermic response. The morphological sites of maximum sensitivity were localized in the anterior hypothalamic, preoptic region. At some but not all sites, a prior microinjection of 3.5-7.0 μg phentolamine attenuated the magnitude of the DA-induced hypothermia and delayed its onset. Conversely, at all loci, the pretreatment by the injection of this α-adrenergic antagonist markedly reduced the absolute magnitude of the NE-induced fall in the cat's temperature. Similar pretreatment of a reactive hypothalamic locus with a β-adrenergic receptor blocking agent, practolol (3.5 μg), failed to alter the hypothermia following a microinjection of DA. Either of 2 DA receptor antagonists, haloperidol (0.04-7.0 μg) or *d*-butaclamol (0.48-1.47 μg), when given in a sufficient dose, effectively delayed the onset of the DA-hypothermia and reduced its absolute magnitude; the NE-induced decline in the cat's temperature was unaffected by DA receptor blockade. Endogenous stores of DA and/or NE in the cat's hypothalamus were radiolabeled with either ^3H- or ^{14}C-catecholamines or both, microinjected through the implanted guide tube into an identified amine-sensitive site. By using push-pull cannulae, the site was subsequently perfused for 5 min with artificial CSF at a rate of 25 μl/min with samples collected at 15 min intervals. During either the 3rd or 4th perfusion, the ambient temperature of the cat's chamber of 22-24°C was elevated to 35-45°C and maintained at this level for 15 or 30 min. This environmental warming evoked a release of either DA or NE or both amines from certain circumscribed sites within the cat's rostral hypothalamus. These results provide pharmacological, physiological and anatomical evidence for a differential role of DA in the hypothalamic mechanism which mediates the heat loss processes.

386.

RYAN, R.W., M.P. Gourlie and R.C. Tilton.

Release of rhodanese from *Pseudomonas aeruginosa* by cold shock and its localization within the cell.

Can. J. Microbiol. 25(3):340-351; Mar. 1979.

Whole cells of *Pseudomonas aeruginosa* possess rhodanese activity. The enzyme can be released by rapidly resuspending the cells in cold Tris-HCl buffer. Approximately 95% of the rhodanese activity is released by cold shock. Release of the enzyme can be inhibited either by preincubating the cells with Mg^{2+} or by incorporating Mg^{2+} into the shocking buffer. The effect of Mg^{2+} can be reversed by washing

the cells twice with buffer prior to cold shock. While rhodanese can be released from *P. aeruginosa* by cold shock, lactic dehydrogenase, a cytoplasmic enzyme, remains within the cell. Diazo-7-amino-1,3-naphthalenedisulfonic acid, a compound which does not penetrate the cytoplasmic membrane, completely inactivated rhodanese and alkaline phosphatase, a periplasmic enzyme, whereas lactic dehydrogenase retained its full activity. These data suggest that rhodanese in *P. aeruginosa*, like alkaline phosphatase, is located distal to the cytoplasmic membrane in the periplasmic space. Electron micrographs also show that portions of the lipopolysaccharide outer membrane are shed from the cell during cold shock, while cells preincubated with Mg^{2+} did not release segments of their outer membrane.

387.

SABLE-AMPLIS, R., R. Sicart and R. Agid.

Abnormal liver cholesteryl ester storage in a strain of golden hamsters: possible model for studies on cholesterol metabolism.

Biochim. Bophys. Acta. 531(2):215-221; 1978.

Very high values of hepatic cholesteryl esters were found in a strain of golden hamsters isolated in our laboratory: 2 g/100 g in animals kept at 22°C and more than 10 g/100 g in starved cold-adapted animals. The rate of incorporation of labeled mevalonate was not increased, but the esterification of the newly-synthesized cholesterol was markedly stimulated.

388.

SAMPSON, J.B.

Effects of anxiety on finger temperature response to cold water immersion.

Psychophysiology 15(3):292; 1978.

Abstract only. Excerpts quoted: In the present study 26 men were given a 15-min cold water hand immersion test on 3 consecutive days. On the second day each man was presented a stress movie in conjunction with hand immersion. . . . The results show subjective anxiety and contralateral finger temperature but not heart rate changed significantly during the stress trial. Stress effects were also observed in the parameters of time to lowest temperature and the proportion of subjects warmed. Thus, contrary to expectation, anxiety arousal increased the incidence of vasodilation. These results are discussed in terms of the state dependent hypothesis which states that vasomotor reaction to stress is contingent on the initial level of vasomotor anxiety. Given the initial state of vasoconstriction in cold, anxiety would produce vasodilation. The question remains, however, whether higher levels of anxiety would lead to vasodilation or more intense vasoconstriction. There are some indications that the relationship between anxiety and vasomotor response to cold is a non-linear inverted-U function.

389.

SATO, M.

Studies on hypertension: Changes of blood pressure and catecholamine under various environments.

Nichidai Igaku Zasshi 37(11):1199-1210; 1978.

To investigate the effects of environmental stimuli on the development and maintenance of spontaneous hypertension, spontaneously hypertensive rats (SHR) were raised under cold exposure, noisy environment and combined visual and auditory stimuli. Patients [human] with essential hypertension were observed in summer and winter. SHR fed under cold exposure showed significantly increased blood pressure and adrenal weight, but no difference in body weight compared with controls. Catecholamine levels of adrenal glands, brain and plasma increased significantly and that in the heart muscle decreased. SHR under noisy environment showed decreased body weight and increased adrenal weight and blood pressure. Catecholamine levels were augmented in brain, plasma and adrenal glands but were reduced in heart muscle. SHR under combined visual and auditory stimuli showed elevated blood pressure but no difference in body weight. Catecholamine levels of brain and adrenal glands increased and that of plasma

increased, but that of heart muscle decreased. Untreated essential hypertensive [human] patients showed significantly higher blood pressure in the cold of the winter than in the heat of the summer, and a similar tendency was observed in plasma catecholamine levels.

389a.

SCHAFER, Sonja S.

The behavior of the proprioceptors of the muscle and the innervation of the fusimotor system during cold shivering.

Exp. Brain Res. 17:364-380; 1973.

(1) Primary and secondary muscle spindle endings and Golgi tendon organs from the gastrocnemius muscle of the cat were investigated before, during and after a cold shivering of the animals. The discharge patterns of the proprioceptors were recorded during a ramp stretch of the muscle. The stretch length was varied from 4 to 14 mm, the stretch rate from 30 to 350 mm/sec. (2) The static, dynamic, and acceleration responses were determined before and during cold shivering tremor and plotted against the corresponding stretch parameters (length, velocity, or acceleration). These curves are called "characteristic curves" and their slopes characterize the "sensitivities" of a receptor. During shivering sensitivity changes, i.e. changes of the curves' slope, were observed. (3) During cold shivering the velocity and acceleration sensitivities of the primary endings decrease. Their length sensitivity exhibits a non-uniform behavior. The secondary endings slightly minimize their length sensitivity during shivering but the velocity and acceleration sensitivities remain unchanged. The three sensitivities of the Golgi tendon organs, too, remain unchanged. (4) The changes that occur in the discharge patterns during cold shivering are compared with the changes that are caused by artificial fusimotor stimulations. This comparison reveals that during cold shivering the activity of the dynamic fusimotor system increases and the activity of the static fusimotor system decreases. (5) The fusimotor innervations that are observed by other authors during the different tremor states are compared with the present data.

389b.

SCHAFER, Sonja S.

The role of the primary afference in the generation of a cold shivering tremor.

Exp. Brain Res. 17:381-393; 1973.

(1) In a previous paper we have shown (Schafer and Schafer, 1973), that a pronounced change in the sensitivities of the primary spindle afference is observed during cold shivering and during an artificial fusimotor stimulation. Now we will give a theoretical interpretation of these experimental results. We are of the opinion that the tremor of the musculus gastrocnemius is due to an instability of the stretch reflex feedback system. We show that the instability is caused by property changes of the spinal cord and sensitivity changes of the primary spindle afference. The sensitivity of the primary spindle afference is determined by the intensity of the γ-innervation. (2) The transfer functions of the servo elements muscle, muscle spindle, and spinal cord are established. We deduce from these transfer functions an expression which describes the discharge pattern of a primary afference during a ramp stretch of the muscle and, moreover, we can apply Hurwitz's instability criterion. From this criterion, it is to be seen that the observed sensitivity changes of the primary afference influence the servo loop in the direction of an instability. (3) The importance of the secondary endings and the Golgi tendon organs to the generation of a tremor are discussed. (4) We comment upon the idea that the spinal cord should have a pacemaker function during cold shivering.

390.

SCHARA, M., et al.

Magnetic resonance study of freezing damage development in rat liver tissue.

Cryobiology 15(3):333-339; June 1978.

Cryolesions were produced by contact cryoprobes on male Wistar rat livers. The development of freezing damage was followed *in vivo* for 24 hr by morphological examinations, proton spin lattice relaxation

times T_1, and paramagnetic center concentration measurements. Significant proton T_1 increase, related to an increased tissue water content, as well as a concentration decrease of the paramagnetic centers, was observed for the cryolesion, as compared to the undamaged liver tissue of the same animal. The concentration decrease was observed for the $g = 2.00$ free radicals and $g = 1.94$ reduced state iron protein centers, specified by the parameter g indicating the position of their absorption lines in the electron paramagnetic resonance spectrum. It was also found that the rate of damage development following a single freeze-thaw cycle depends significantly on the cooling capacity of the cryoprobe. The final changes produced by 6- and 4-mm-diameter liquid nitrogen-cooled cryotips are comparable, but the development of damage was different.

390a.

SCHNEIDER, M.F., and J.D. Brooke.

Bimodal relationship of human tremor and shivering on introduction to cold exposure.
Aviat. Space Environ. Med. 50(10):1016-1019; 1979.

Four subjects were exposed to an environmental challenge of $-12^{\circ}C$ for 15 min in four conditions of exposure: 1) clothed body and clothed arm, 0.5 clo units; 2) clothed body and exposed arm, 0.4 clo; 3) exposed body and exposed arm 0.1 clo; 4) exposed body and clothed arm, 0.2 clo. Core temperature, surface temperature of the right arm, perceived thermal comfort, EMG indicated onset of shivering, and the frequency of tremor using accelerometry were monitored and data collected every 30 s. The results indicate that tremor frequency significantly increases with cold exposure, but that a significant drop in tremor frequency precedes the onset of shivering. It is suggested that pre-shivering tetany occurs prior to the onset of shivering, acts as a load upon the lever of the hand and reduces the oscillation of the limb.

391.

SCIARLI, R.-J.

La medecine de la plongee.
[Diving medicine].
Oceans (Marseille) Suppl. 39B:1-72; 1976.

This special issue of Oceans consists of 26 articles by R.-J. Sciarli that had been published previously. The titles are as follows: Physiological aspects of free diving; Pathology of free diving; Blackout at seven meters; Free diving and loss of consciousness; Mechanisms and dangers of hyperventilation; Decompression sickness: progress in its treatment; Military diving; Pressure chambers and diving accidents; With respect to decompression, there are tissues and tissues; Breathlessness; Water and aspirin; Oxygen diving; Underwater diving; Emergency resuscitation of the drowning victim; Disorders of the ear; Cold; Diving and the digestive apparatus; Asthma and diving; Accidents caused by fish and other marine life; Advice on diving in Senegal; Diving and children; The general practitioner and the aptitude examination for sport diving; Underwater professions and legislation; Medical therapy and deep diving; Human intervention into the 1000 meter zone; Oxygen in synthetic environments. (MFW/UMS)

391a.

SEKAR, T.S., K.F. MacDonnell, P. Namsirikul and R.S. Herman.

Survival after prolonged submersion in cold water without neurologic sequelae.
Arch. Intern. Med. 140(6):775-779; June 1980.

Two cases are reported of patients who suffered prolonged submersion in cold water (25 min 32 s, and 6 min, respectively) with complete neurologic recovery. They demonstrate that patients suffering prolonged submersion and showing profound neurologic abnormalities initially, may be resuscitated successfully without permanent neurologic deficit. Hypothermia is suggested as the major factor in protecting the brain from hypoxic injury. It acts presumably by decreasing rates of biochemical reactions. Procedures for treating near-drownings, both immediate and follow-up are discussed. (LET/UMS)

392.

SELIGSOHN, U., B. Osterud, J.H. Griffin and S.I. Rapaport.

Evidence for the participation of both activated factor XII and activated factor IX in cold-promoted activation of factor VII.

Thromb. Res. 13(6):1049-1056; 1978.

The activation of ^{125}I-factor XII and of ^{125}I-factor IX in plasma during the cold-promoted activation of factor VII was studied. Limited proteolysis of factors XII and IX, a measure of activation, was determined from radioactivity profiles of reduced polyacrylamide gels following electrophoresis with sodium dodecyl sulfate. Significantly greater formation of factor IX_a and factor XII_a was found in citrated plasma incubated at 4°C from 4 subjects whose factor VII activity increased compared to plasma from 5 subjects who factor VII activity did not increase. Adding anti-factor IX antiserum to citrated plasma inhibited 50% of the observed cold-promoted activation of factor VII. Factor XII_a and factor IX_a may be direct activators of factor VII during cold-promoted activation of factor VII in citrated plasma.

393.

SHAFRANOV, V.V., T.A. Belous, O.A. Alentyeva and V.V. Shishov.

Mechanism of hemostatic effect of low temperature.

Klin. Khir. (1):28-30; Jan. 1979.

A series of experiments was carried on 25 guinea pigs and 5 rabbits. Liver resection and renal resection was performed at the border of the ice field. The effectiveness of cryohemostasis was evaluated during resection without preliminary freezing. It was established that low temperature is a rather safe hemostatic factor. But as thawing occurred vessels with a diameter of 1 mm and more bled. Parenchymatous bleeding did not develop repeatedly. An analysis of histological changes showed that the basis of cryohemostasis is the phenomenon of cold-induced coagulation of tissues which explains the hemostatic effect of low temperature.

393a.

SHAMPINE, J.C. and D.A. Reins.

Physiological evaluation of a commercially available abandon-ship survival suit.

Navy Clothing and Textile Research Unit, Natick, MA. Tech. Rpt. No. 97, Nov. 1971.

Navy Clothing and Textile Research Unit (NCTRU) personnel have tested a commercially available abandon-ship survival suit in water at 35°F temperature, which is comparable to that found in various oceans throughout the world. Test results indicate that this suit will give protection from exposure to cold water for periods of 13 hours and more when worn over any of the ensembles studied during this test providing no other stresses are present which could influence the user's tolerance time. This suit can be donned quickly but cannot be worn over bulky cold-weather clothing. NCTRU personnel recommend that weight be added to the feet of the suit, a modification to permit the wearer to move from a horizontal (floating) to a vertical (bobbing) position without exerting much energy. They also advise that the use of a waterproof zipper would decrease the amount of water leaking into the suit. These improvements would enhance the usefulness of the garment to various Navy services that need a suit with these characteristics.

393b.

SHANKS, C.A., and H.M. Marsh.

Simple core rewarming in accidental hypothermia.

Brit. J. Anaesth. 45:522-525; May 1973.

Active rewarming of the hypothermic patient can be assisted by the inspiration of warmed, fully saturated gases and the administration of heated intravenous fluids. Utilization of a heated humidifier can be instigated quickly and permits flexibility in the amount of heat delivered to the thorax, though requiring continuous monitoring of airway temperature. A case is reported in which use of these

techniques was associated with "rapid" rewarming, and some of the problems involving hypothermia and acidosis are discussed.

394.
SHIOMI, K.
Relations of pain threshold and pain tolerance in cold water with scores on Maudsley Personality Inventory and Manifest Anxiety Scale.
Percept. Mot. Skills 47(3 Part 2):1155-1158; 1978.

Testing 56 Japanese undergraduates, the relationships between pain threshold and pain tolerance in cold water and personality factors were investigated. Significant negative correlations of moderate magnitude between the pain threshold and scores on Maudsley Neuroticism and the Manifest Anxiety Scale were found. Significant positive, moderate correlations between pain tolerance and the Maudsley Extraversion were obtained.

395.
SHMIDT, N.A.
Effect of moderate cooling of the body on the retention of slightly fibrogenic dust in the lungs of rats.
Gig. Tr. Prof. Zabol. (5):36-39; May 1979.

Long-term experiments on rats have shown that periodic moderate cooling, alone or in combination with exposure to carbon monoxide or oxides of nitrogen at a level of the respective MAC, stimulates a reaction of alveolar phagocytosis. Thus, when a slightly fibrogenic dust which had caused only moderate mobilization of coniophages in the airway was inhaled chronically, exposure to the factors mentioned above was found to reduce the amount of dust retained in the lungs.

396.
SHUGALEI, V.S. and L.S. Kozina.
The urea content and the arginase activity in organs of the rat during cold acclimation.
Fiziol. Zh. Sssr. Im. I M Sechenova. 63(8):1199-1202; 1977.

Arginase activity in the brain and liver and urea concentration in the brain, liver and blood of rats on the 1st, 3rd, 30th and 45th days of cold acclimation (+2 to +4°C), were studied. Arginase activity was also studied in the brain, liver and kidneys of adrenalectomized rats. During acclimation, the arginase activity decrease 1.5-2 times in the brain and increased 2-2.5-fold in the liver. The urea concentration in the tissues increased due to arginase activation in the liver. The brain activity of adrenalectomized animals did not differ from the control, but activity decreased in the liver and kidneys by 33 and 60%, respectively. The difference between response of the brain and liver arginases to cold was based on their different regulation by the adrenal hormones.

396a.
SHVARTZ, E., Z. Glick, and A Magazanik.
Responses to temperate, cold, and hot environments and the effect of physical training.
Aviat. Space Environ. Med. 48(3):254-260; 1977.

Ten young men underwent several tests before and after a training program: a bicycle ergometer test and 60 min of moderate exercise performed at a temperate 24°C; the same work load performed in heat (40.0°C DB, 30.4°C WB) for 3 h; and cold (10°C) exposure for 60 min. Training consisted of 13 1-h sessions of hard, strenuous, and exhaustive work performed in temperate conditions four times a week. Training resulted in substantial decreases in heart rate, and rectal temperature responses to exercise in temperate, minor increases in hot, and no significant changes in cold conditions. Subjects who showed

good responses to heat, also showed good responses at 24°C, and poor compensatory responses to cold, which were indicated by relatively low heat production and rectal temperature values, and relatively high body heat loss and extremities temperature values. Subjects who showed poor heat tolerance also showed poor responses in temperate and good compensatory responses in cold conditions. Positive correlation coefficients were found between rectal temperatures in the three environments, and between heart rate and sweat rate responses in temperate and hot conditions. The results indicated that moderately severe training causes minor tolerance improvements in heat and no changes in cold, and that responses in temperate, cold, and hot environments are interdependent.

397.

SHVETSOVA, E.I.

Trace effects of short-term cooling and their importance in adaptation to cold.
Fiziol. Zh. Sssr. I M Sechenova 63(12):1715-1720; 1977.

Thermoregulation indices (O_2 consumption, electrical activity of the cervical muscles, deep rectal temperature and skin temperature) were observed for 30 min periods at ambient temperatures of +20-24°C and +6-7°C for 1, 5, 10 and 30 days after cooling. The after-effects of cooling depended on the conditions of cooling. Prolonged after-effects were caused by single or double cooling followed by a fall in core temperature to 30°C, intermittent cold exposures (15 two-min exposures at −20°C) without a fall in core temperature and a cold long-term (4-5 wk) exposure at +2-4°C. The short-term cooling increased the thermoregulatory indices for 5-10 days after cooling; these indices were similar to changes in cold acclimated rats.

397a.

SIAS, F.R., Jr., R.M. Harnett and J.R. Pruitt.

Resuscitation from hypothermia: a critical review of six alternative therapies.
In: Aerospace Medical Association, Preprints of 1979 Annual Scientific Meeting, p.165-166. Published by the Association. [1979].

Hypothermia victims may be rewarmed by a number of methods that have been used successfully to resuscitate patients. Trunk immersion rewarming is most rapid and may always be used to rewarm victims of short-time immersion hypothermia. Extracorporeal blood rewarming and peritoneal irrigation are both useful in a hospital where properly trained personnel are available. Neither offers much potential as a first-aid measure away from the hospital. While heat input rates are low, first-aid inhalation of hot moist gas will prevent respiratory heat loss and will directly warm the lungs and heart. Intragastric balloons and diathermy both offer some potential as a first-aid measure and should be investigated further. Animal experiments are probably required since it may not be possible to clearly differentiate between alternative therapies with experiments using slightly cooled human volunteers. (Authors' conclusions)

398.

SIGLER, R.W., A.I. Levinson, R. Evans III, Z. Horakova and A.P. Kaplan.

Evaluation of a patient with cold and cholinergic urticaria.
J. Allergy Clin. Immunol. 63(1):35-38; Jan. 1979.

A 20-year-old male Army paratrooper presented with a history of inducible urticaria associated with exercise as well as cold exposure. Upon evaluation, he not only had a positive ice cube test, but also had a positive mecholyl skin test with numerous satellite lesions and generalized punctate urticaria following exercise challenge. Thus, he appeared to have combined cold and cholinergic urticaria. When mediator release was examined during cold and exercise challenge, histamine release was observed in each instance: a rapid rise and fall of plasma histamine was seen after cold challenge, while a lag phase followed by sustained elevation of plasma histamine was associated with exercise challenge. This represents the fourth reported case of combined cold and cholinergic urticaria and is the first in whom mediator release was assessed. The time-course of histamine release was characteristic of each disorder.

399.

SILLMAN, A.J., D.A. Bolnick, E.W. Clinite and K.S. Rudert.

The effect of temperature on rapid dark adaptation in bullfrog photoreceptors: A difference between rods and cones.

Vision Res. 18(10):1375-1380; 1978.

The late receptor potential of the perfused bullfrog [*Rana catesbeiana*] retina was isolated with Na-aspartate. Rapid dark adaptation of the rods and of the cones was monitored independent of one another. In rods, decreasing the temperature increased the latency of onset of rapid dark adaptation and decreased the rate of adaptation following onset. In cones, only the latency of onset of adaptation was temperature dependent. Both the latency and recovery phases of the adaptation are apparently enzymatically mediated in rods, but in cones the actual recovery phase is dependent mainly on diffusion. The basis of these observations was discussed.

400.

SIMON-OPPERMANN, C. and R. Martin.

Mammalian-like thermosensitivity in the lower brainstem of the Pekin duck.

Pfluegers Arch. 379(3):291-293; 30 April 1979.

In Pekin ducks the brainstem between the preoptic region and the medulla oblongata was probed with chronically implanted bilateral thermodes to evaluate its thermosensory function in temperature regulation. Cooling of the lower mesencephalic and rostral rhombencephalic region in conscious animals elicited cutaneous vasoconstriction and increased metabolic heat production by shivering. This finding contrasts to the observation of a paradoxical inhibition of cold defence activities by cooling the preoptic/anterior hypothalamic region in the same species.

401.

SINGH, P.N. and P.K. Das.

Effects of seasonal variations, acute hypothermia and physostigmine on cardiac acetylcholine, tissue glycogen and blood sugar concentration in frogs.

Indian J. Physiol. Pharmacol. 21(4):302-310; 1977.

The effects of seasonal variations and the effects of acute hypothermia (8.0%) and/or physostigmine (PHY) in different seasons were studied on tissue glycogen, cardiac acetylcholine (ACh) and blood sugar contents in frogs. Seasonal variations had no significant effect on cardiac cholinergic activity. Cardiac ACh concentration was significantly reduced by hypothermia in all seasons. The extents of increase in cardiac ACh in PHY pretreated hypothermic frogs indicate that hypothermia depresses cardiac cholinergic activity much more in summers than in rainy and winter seasons. The tissue glycogen contents and blood sugar concentrations were significantly lower in winter than those in summer and rainy seasons. Hypothermia produced marked tissue glycogenolysis and hyperglycemia during summer and rainy seasons and not during winters. In general PHY had no effect on tissue glycogen contents in any season, but it produced hyperglycemia during winter and rainy seasons. PHY pretreatment increased cardiac, hepatic and muscle glycogen contents and produced hyperglycemia in hypothermic winter frogs, and it increased ventricular and muscle glycogen contents during summer and hepatic glycogen during rainy seasons, there being no significant effect on blood sugar. Even though the frog is a poikilothermic animal, it reacts adversely to acute cooling, particularly in the summer. The cholinergic system functions normally in all seasons. An anticholinesterase agent can prevent tissue glycogenolysis produced by hypothermia in all seasons.

401a.

SKINNER, R. (In consultation with five physicians).

When your patient suffers frostbite.

Patient Care. 132-141; February 1, 1977.

A semi-popular article covering all aspects of frostbite: prevention, signs and symptoms, healing,

pathology and therapy. Also mentions the often complicating condition of general hypothermia. (CWS/UMS)

402.

SKRESLET, S. and F. Aarefjord.

Acclimatization to cold in man induced by frequent SCUBA diving in cold water.
J. Appl. Physiol. 24:177-181; 1968.

Three SCUBA divers, members of an archeological-biological underwater team, working in the Svalbaard area, 79°N were shown to have established a short time adaptation to cold as a result of extensive diving in the cold sea. At intervals during a period of 45 days they were tested physiologically under standardized conditions in a cold bath. The results obtained from the tests seem to indicate the following pattern of successive acclimatization; 1) unacclimatized stage: cold stress met with by an elevated metabolic rate compensating heat loss, 2) intermediate stage: there is a fall in the rectal (core) temperature as heat loss is not fully compensated for by the metabolism, believed to be caused by habituation of the central nervous system. 3) acclimatized stage; a constant rectal temperature is maintained, although minor metabolic heat is produced. Conservation of heat is attributed to lowered heat transfer with the blood to the body surface. (Authors' abstract)

403.

SLEE, J.

The effects of breed, birthcoat and body weight on the cold resistance of newborn lambs.
Anim. Prod. 27(1):43-50; 1978.

Scottish Blackface (22), Welsh Mountain (51) and 22 Tasmanian Merino lambs aged between 6 and 75 h were tested for resistance to body cooling in a climate chamber. Blackface lambs had long birthcoats. Merinos were short-coated. Welsh lambs were from 2 strains with long (L) and short (S) types of birthcoat. Some lambs were clipped before cold exposure. Clipping reduced cold resistance in Welsh (S) and (L) lambs by factors of 3 and 13, respectively. Unclipped lambs showed significant breed differences, Welsh (L) and Blackfaces having the greatest cold resistance and Merinos the least. Long-coated lambs (Blackface and Welsh (L)) were on average 6 times more cold resistant than the average of Welsh (S) and Merino lambs. Welsh (L) lambs were 4 times more resistant than the Welsh (S) type. Birth weight and age did not significantly influence cold resistance. In clipped lambs there was a significant positive linear regression between cold resistance and birth weight. Breed differences in cold resistance were still significant if no adjustment was made for the effect of breed differences in birth weight. Cold resistance was strongly influenced by breed differences in birthcoat morphology and probably by other physiological factors partly attributable to the different genetic backgrounds associated with birthcoat type. The breed differences in cold resistance were generally consistent with field data on mortality and body temperature regulation of lambs in severe weather, suggesting that climate chamber tests might be used to evaluate potential viability in the field.

404.

SMALES, O.R.C. and D. Hull.

Metabolic response to cold in the newborn.
Arch. Dis. Child. 53(5):407-410; 1978.

Blood concentrations of glycerol and free fatty acids were measured in healthy and sick 5 day old infants during and after cold exposure. In apparently similar infants in similar circumstances, the blood concentrations varied widely. Although the concentrations of both glycerol and free fatty acids were higher during cold exposure, it is not possible to use either as an index of cold exposure in individual infants.

405.

SMITH, D.M. and D.Y. Tenney.

The effect of cold shock on mouse oocyte maturation in vitro.

J. Reprod. Fertil. 54(2):401-403; Nov. 1978.

Maintenance of mouse ovaries in ice-cold medium for 1, 2 or 4 h before removing the oocytes did not alter the incidence of spontaneous maturation or increase the number of oocytes degenerating, fragmenting or forming 2 equal blastomeres in culture.

405a.

SMITH, D.S.

Handbook of Cold Water Survival.

Dept. of Transportation, U.S. Coast Guard. I; Oct. 1978.

An extensive and excellent review of all aspects of water safety with emphasis on cold water drowning. One of the important statements is: "Many of our boating fatalities relate to drowning in cold water. We are beginning to realize that: (1) Some of these people do not really drown; (2) Some may not be dead when so pronounced; and (3) Cold water survival times can be extended much further than previously thought." (CWS/UMS)

406.

SMITH, R.M. and J.M. Hanna.

Skinfolds and resting heat loss in air and water: equivalent air-water temperatures.

In: Proceedings of the first annual meeting of the North Pacific Branch of the Undersea Medical Society, 5-7 Sept. 1974. p.12. Avalon, Calif., Univ. So. Calif. Santa Catalina Mar. Sci. Cent. 1974.

Abstract only. Entire item quoted: Fourteen male subjects with unweighted mean (9 sites) skinfolds (MSF) of 10.23 mm underwent several three hour exposures to cold water and cold air of similar velocities in order to compare by indirect calorimetry the overall rate of heat loss in water and air. Measurements of heat loss (excluding the head) at each air temperature (Ta = 25, 20, 10°C) and water temperature (Tw = 29 - 33°C) were used in a linear approximation of overall heat transfer from body core (Tre) to air or water. We found the lower critical air (T_{ca}) and water (T_{cw}) temperatures to fall as a negative linear function of MSF. The slopes of these curves were not significantly different in air and water, with the mean of -.237°Cmm MSF. Overall heat conductance was 3.34 times greater in water. However, this ratio was not fixed but varied as an inverse curvilinear function of MSF. Thus, equivalent water-air temperatures also varied as a function of MSF. Between limits of 100 to 250% of resting metabolism the following relationships between MSF and equivalent water-air temperatures were found:

MSF (mm)	Regression	Useful Ta Range of Regression (°C)
5	Tw = .24 Ta + 28.11	24.85 - 6.62
10.23	Tw = .30 Ta + 25.92	24.01 - 4.53
15	Tw = .36 Ta + 23.73	22.61 - 1.03
20	Tw = .405 Ta + 22.02	21.49 - (-) 1.78

406a.

SMITH, N.E.

Effect of substituting hydrogen for helium on human thermal exchange in hyperbaric environments.

Annapolis, Md., Westinghouse Electric Corporation, Ocean Res. Eng. Cent., Final Rep. on Contract N00014-72-C-0545, 26p. Jan. 1974.

The substitution of hydrogen for helium as an inert gas in hyperbaric environments was examined for its impact on human thermal exchange at depths between 10 and 100 atmospheres. Based on present data the theoretical ambient temperature required for thermal balance does not differ significantly between hydrogen-oxygen and helium-oxygen mixtures in a dry environment. A diver in cold water will experience a respiratory heat loss approximately one-third greater breathing hydrogen-oxygen than when breathing helium-oxygen, and his inspiration temperature must be adjusted accordingly. This investigation revealed a definite lack of experimental data on transport or thermophysical properties of gas mixtures involving helium and/or hydrogen at pressures to 100 atmospheres. (Author's abstract)

406b.

SMITH, R.T.

Electrolyte studies in experimental animals during hypothermia.
Am. J. Surg. 92:228-232; 1956.

Data on physiologic alteration in dogs undergoing general body cooling and rewarming are presented. Heart rate, mean arterial pressures, platelets and white cell counts all showed significant decreases at low temperature levels (22° to 25°C). Serum potassium concentrations were found to be greatly increased just prior to ventricular fibrillation in the cold state. Prolonged acidosis or alkalosis did not alter this elevation. Electrocardiographic patterns were fairly constant with deep cooling and could be used to predict impending difficulty. It is suggested that a relative tissue hypoxia associated with low coronary flow is a factor in the production of ventricular fibrillation during profound hypothermia.

407.

SOBOLEV, V.I.

Quantitative estimation of thyroid secretion during cold adaptation in albino rats.
Fiziol. Zh. Sssr. Im. I M Sechenova 63(11):1589-1597; 1977.

The rate of thyroid secretion was evaluated in rats by determining the dose of triiodothyronine necessary for normalization of a series of thermoregulatory reactions in chemically thyroidectomized animals which were sustained at temperatures of 12° and 24°C for 40 days. The level of thyroid secretion was equivalent to 6.23 ± 0.72 μg/kg of triiodothyronine/day in rats which were acclimated to cold. The secretion index was 1.21 ± 0.36 μg/kg in animals not subjected to cold. Prolonged exposure to moderate cold was accompanied by a 5-fold increase in the amount of hormones secreted by the rat thyroid.

408.

SOBOLEV, V.I.

Mechanisms of heat formation during adaptation to colds.
Fiziol. Zh. (Kiev) 24(4):493-499; 1978.

In experiments with 70 cold-acclimated albino rats and controls, the thermogenic effect of muscle contractions in the course of cooling at different levels of body temperature was studied. The caloric effect of 2,4-dinitrophenol (DNP) also was determined. With reduction of rectal temperature, thermal effectiveness of muscle contraction increased in acclimatized animals and decreased slightly in controls. The thermogenic effect of 2,4-DNP was decreased with reduction of the surrounding temperature. Thermal effectiveness of muscle contractions may be a regulated level, depending on the level of thermoregulatory disassociation of cold intensity.

409.

SOEJIMA, T., Y.L. Yamamoto, E. Meyer, W. Feindel and C.P. Hodge.

Protective effects of steroids on the corticomicrocirculation injured by cold.
J. Neurosurg. 51(2):188-200; Aug. 1979.

Early microcirculatory changes after focal cold injury of the cerebral cortex were examined in dogs with and without steroids by serial fluorescein angiography of the brain (FAB), by measurement of the

diameter of epicerebral vessels, and by measurement of cerebral blood flow with the clearance method using krypton-85 and xenon-133. Changes in the transcerebral vessels were examined by x-ray projection microangiography. Within 30 minutes of the injury, the cortical area injured by a temperature of -65°C showed a reduction in blood flow of 60%. When treated with steroids and while still at the same temperature, blood flow was reduced by only 35%. Serial FAB revealed slowing and arrest of flow in the epicerebral microcirculation which could be noted first in the small veins, then in the medium-sized veins and small arteries. Fluorescein dye leaked from the epicerebral vessels, around the small veins, then around larger veins and small arteries. Some leakage of dye from medium-sized arteries was noted 2 hours after injury. This sequence of slowing and arrest of the microcirculation, with exit of dye from intact arterial vessels, identified here for the first time in relation to a cortical freezing lesion, may help to explain the development of later brain edema which spreads widely in the subcortical white matter. After steroids, improvement of the microcirculation was present as defined by cortical blood flow, fluorescein angiography, and x-ray projection microangiography.

410.

SOHAR, E., Y. Shoenfeld, R. Udassin, A. Magazanik and M. Revach.
Cold-induced profuse sweating on back and chest – A new genetic entity?
Lancet 2(8099):1073-1074; 18 Nov. 1978.

Two sisters whose parents shared a grandfather had cold-induced sweating. Since childhood they had sweated profusely from the back and chest when exposed to environmental temperatures of 18° to 7°C. They had additional abnormalities–e.g., high palate and inability fully to extend the elbows–which neither their parents nor their sibs shared. The cold-induced sweating, which could not be stopped by a beta-adrenergic blocking agent, was abolished by postganglionic blockade with atropine sulphate. This indicates the possibility of a peripheral mechanism.

411.

SOMERS, L.H.
Cold weather and under ice scuba diving.
Grand Terrace (Colton), Calif. National Association of Underwater Instructors, NAUI/NDA Tech. Pub. 4. 38p. 1973.

This paper deals with personnel selection and evaluation, equipment, dive planning and procedures, ice diving techniques and an ice diving training program. It is intended for use in the instruction of beginning ice divers and for use as a reference in those areas where ice diving is not part of normal diving activity. (Author)

411a.

SPAAN, G., and F.W. Klussman.
Frequency of cold shivering in animal species of different body size.
Pflugers Arch. 320:318-333; 1970.

(1) Shivering was induced by peripheral cooling in 47 lightly anesthetized animals (10 mice, 7 rats, 9 guinea pigs, 7 rabbits, 8 cats, and 6 dogs). The mean frequency of grouped voltages in the electromyogram of the different animal groups increased with decreasing body size. The differences in the mean frequencies of the tremor between two adjacent animal groups were significant with the exception of rats and guinea pigs. These two groups differed only slightly in their mean body weight. The results suggest that the shivering frequency is dependent on body weight rather than species. No correlation was found between shivering frequency and body weight within one animal group. (2) On a double-logarithmic scale the relationship between the mean frequency of shivering and the mean body weight can be expressed by the following regression equation:

$$\log y = 1.85 - 0.18 \cdot \log x$$

x = mean body weight (g)
y = mean shivering frequency (grouped voltages/sec)

(3) The mean value for the shivering frequency for man, as determined from this equation, agrees well with those reported in the literature. (4) The mean shivering frequency decreased with decreasing body temperature. (5) Reflex time and contraction time measurements were done for the M. tib. anterior in 5 guinea pigs and 4 cats. The mean reflex time for guinea pigs was 4.3 msec and 7.7 msec for cats. The mean interval between muscle action potential and muscle contraction was 2.2 msec in the guinea pigs and 2.9 msec in the cats, the mean contraction time was 18.7 msec for the former, and 21.8 msec for the latter. The data suggest that the contraction time is relevant for the shivering frequency.

412.
SPAUR, W.H.
Heat loss in divers.
Skin Diver 25:34-38; Oct. 1976.

A diver suffers the same heat loss in 80°F water as he would standing unclothed in 42°F air. A water temperature of 92°F is required to maintain thermal balance. Core temperature must be maintained particularly to ensure normal function of the heart and the brain. Changes in stored body heat are made in three ways. First, heat production from exercise or from shivering is added to the constant basal metabolism. Second, heat is lost to the environment by radiation, conduction, and convection. Third, heat is lost through evaporation from the skin, and evaporation to moisturize the air drawn into the lungs. Insulation is provided by the layer of subcutaneous fat on the body, the layer of air or water between the body and the suit, and third, a layer of clothing. Heat loss through the skin is lessened by vasoconstriction. After some time, however, in water below 50°F, this mechanism reverses itself, and vasodilation occurs and heat loss is rapid. While exercise in air increases heat production, exercise in cold water may have the opposite effect due to increased blood flow into the limbs and away from the trunk. Shivering has a similar effect. Maximum shivering will barely maintain thermal balance in 60°F water. Heat loss impairs mental function. Chief treatment for hypothermia is rewarming. If undertaken promptly, this can revive a person whose heart and respiration have stopped. At first, during rewarming, cold blood is shunted to the core of the body, causing "afterdrop." The simple indication that rewarming is complete is the onset of sweating. This is a requirement if further diving in cold water is planned. (MFW/UMS)

412a.
SPRINGBETT, B.M.
The effects of exposure to cold on motor performance.
Physiology 3, Defence Scientific Information Service, Defence Research Board:231-242; 1951.

The first two years' work was carried out with the following aims: (1) To demonstrate a relationship between exposure to cold and deterioration of motor performance. (2) To find tests of motor performance sufficiently sensitive to measures of deterioration to show results with subjects using Arctic clothing and short period of exposure. (3) To use these tests to assess the relationship between deterioration and such factors as ambient temperatures, wind velocities, duration of exposure, exercise, etc. (4) To investigate the relationship between degree of deterioration and a crude measure of skin temperature. The third year's work was designed to determine to what extent the effects of exposure to cc were local. Thus test performance was measured under four conditions: (a) Warm body–warm hand, (b) Warm body–cold hand, (c) Cold body–cold hand, (d) Cold body–warm hand. Results indicated that day-to-day variation in outdoors temperature was insufficient to permit determination of its effect: differences in wind velocity appeared however, to be associated with performance. Physical activity appeared to reduce decrement with exposure. Approximate measures of skin temperature (taken directly by thermometer, not thermocouple) were related to environmental factors and to impairment.

412b.

SPURR, G.B., G. Barlow, and H. Lambert.

Influence of Prolonged Hypothermia and Hypothermia on Cardiac Response to Inject Potassium.

Am. J. Physiol. 196:696-702; 1959.

Left ventricular Na, K, Cl and H_2O and plasma Na, K and Cl have been measured in normothermic dogs, animals cooled to a rectal temperature of 25°C for 2 hours, and dogs maintained at a rectal temperature of 41.5°C for 1 hour. These three main groups are subdivided into a control group killed with pentobarbital sodium prior to obtaining cardiac tissue, and dogs that received an intravenous injection of 11.2% KCl at a rate of 0.5 ml/kg/min. until ventricular fibrillation or cardiac arrest occurred. The method employed to measure cardiac sensitivity to K is criticized. Despite the criticisms, the data suggest a reduced sensitivity of hypothermic hearts and an increased sensitivity of hyperthermic hearts to injected KCl. The rapid rate of injection of KCl employed in these experiments resulted in a high incidence of ventricular fibrillation except in one group of hypothermic dogs in which cardiac arrest was predominant. It is concluded that this predominance was the result of a slowed rate of supply of the injected KCl to cardiac tissue probably resulting from reduced coronary blood flow.

412c.

SPURR, G.B., B.K. Hutt, and S.M. Horvath.

Shivering, oxygen consumption and body temperatures in acute exposure of men to two different cold environments.

J. Appl. Physiol. 11(1):58-64; 1957.

Skin and rectal temperatures, oxygen consumption, respiratory minute volume, carbon dioxide production, respiratory quotient and shivering were recorded in 11 experiments on 9 nude male adults before, during and after sudden exposure to a 10°C environment. The results are compared statistically with those of experiments in an ambient temperature of −3°C. In the 10°C environment the first tremors of shivering appeared in 6.43 minutes and generalized shivering in 10.25 minutes. These times were significantly longer than those observed in the −3°C environment. However, the average mean skin and mean body temperatures of the two groups of subjects were not significantly different at the time the first tremors of shivering and generalized shivering commenced, suggesting that the temperature receptors may sense absolute temperature as well as responding to rate of change. The respiratory minute volume, oxygen consumption and respiratory quotient showed significant increases as a result of the exposure to 10°C and shivering. From a consideration of the data on the ventilation equivalent and the percentage of carbon dioxide in expired air, it is suggested that the rise in respiratory quotient observed in both ambient temperatures was a true increase and not due entirely to over ventilation on the part of the subjects. It was estimated that in the 10°C environment shivering was approximately 5.9% efficient in protecting the body against total heat loss. This was significantly reduced below the value of 11.6% observed at −3°C. It appeared, therefore, that shivering afforded relatively greater partial protection to the total body heat content in the colder environment.

413.

STANG, P.R.

Arctic III expedition.

Mar. Technol. Soc. J. 8:44-48; Jan. 1974.

The Arctic III Expedition was a multi-disciplinary diving and undersea habitat operation which took place in November and December 1972, 80 miles southeast of the magnetic North Pole in the Northwest Territories of the Canadian Arctic. The objectives and activities of the expedition are described with emphasis on the environmental conditions, topside and diving operations, diving equipment and the Sub-Igloo habitat. The availability of detailed reports on specific projects during the expedition is indicated. (Author's abstract)

414.

STEEGMANN, A.T., Jr.

Human facial temperatures in natural and laboratory cold.
Aviat. Space Environ. Med. 50(3):227-232; Mar. 1979.

Asian, European, and American Indian men were subjected to craniofacial cooling to determine relative ranking and temperature curves for various facial skin sites. Moving and still air 0°C to -35°C in both laboratory and subarctic outdoor settings were used. The objective was to examine resistance to facial frostbite. Facial temperatures stabilize well above freezing even under quite cold conditions and this conclusion is congruent with low incidences of facial frostbite. Racial differences in face temperatures were clearly shown at only the malar eminence, and there was some evidence that exercise can be used to enhance facial circulation. These results and those of other studies reviewed demonstrate that facial sites cooled by convection are usually ranked from forehead (warmest) through malar, cheek, and chin, to nose (coldest). When cooled by still air, the sites tend to retain that same ranking, but there is more variation in ranking.

415.

STEINMAN, A.M., M.L. Collis and R.D. Chanel.

Accidental hypothermia: an experimental study of practical rewarming methods.
Final Rep. on Contract DOT-CG-61914-A, 38p. plus Append. May 1976.

Five rewarming techniques, appropriate for first-aid use in the non-hospital setting, were applied to each of nine subjects whose body temperatures had been lowered to 35°C in a stirred tank of 7.5°C water. The rewarming techniques were as follows: a) Shivering, b) Inhalation of heated, water-saturated oxygen, c) Placement of heating pads over areas of high heat transfer, d) Combination of methods b) and c), e) Hot whirlpool bath. Inhalation of heated, water-saturated oxygen was significantly better than the shivering control in terms of minimizing temperature "afterdrop," and is therefore preferred over the other techniques as it avoids the physiological hazards associated with the peripheral vasodilation which accompanies external rewarming. (Authors' abstract)

415a.

STEVENS, J.B. and A.P. Autor.

Proposed mechanism for neonatal rat tolerance to normobaric hyperoxia.
Fed. Proc. 39(13):3138-3143; Nov. 1980.

Induction of two forms of superoxide dismutase, catalase and glutathione peroxidase, occurs very rapidly in neonatal rat lung tissue upon exposure of these animals to 95 + % normobaric oxygen. No such oxygen-mediated enzyme induction occurs in the lungs of adult rats. The age-dependent pattern of enzyme induction correlates with the well-established age-dependent tolerance of neonatal rats to hyperoxia. Enzyme induction occurs in the lungs of neonates in only those species known to be resistant to oxygen-provoked lung damage. Compromise of oxygen-mediated enzyme induction predisposed the neonatal rats to pulmonary oxygen toxicity. These data have formed the basis of the proposal that oxygen induction of the superoxide dismutase, catalase and glutathione peroxidase provides a vital part of the defense mechanism against oxygen toxicity. A biochemical mechanism of oxygen-provoked pulmonary damage has been elaborated to explain the role of each enzyme in the protection against oxygen and free radical toxicity. (Authors' abstract)

416.

STEVENS, J.C. and L.E. Marks.

Spatial summation of cold.
Physiol. Behav. 22(3):541-547; Mar. 1979.

In three experiments on the forearm, back, and cheek, respectively, the method of magnitude estimation served to reveal first-order descriptions of how the magnitude of cold sensation depends quantitatively

on the strength of stimulation (degree of skin cooling) and on the area size of stimulation. In all three regions, the magnitude of cold sensation turned out to depend almost as much on size as on amount of cooling, implying rich spatial summation in the cold modality. Although both warmth and cold modalities characteristically exhibit lavish spatial summation, they contrast in at least one important way: with warmth the contribution of field size relative to degree of warming progressively diminishes with ever higher levels of warmth (i.e., degree of summation declines), whereas with cold the relative contributions of size and degree of cooling tend to stay fixed.

417.

STRAUSS, M.B. and W.S. Vaughan, Jr.

Effects on core temperatures of suited divers exposed to 6° centigrade water for 4 and 6 hour durations.

In: Program and Abstracts, Undersea Medical Society, Inc., Annual Scientific Meeting. Undersea Biomed. Res. 5(Suppl.):31; Mar. 1978.

Abstract only. Entire item quoted: Four pairs of U.S. Navy combat swimmers were studied during exposures to 6°C water for 4 and 6 hour periods in wet submersible operations at depths of 3 to 5 meters. Compressed air, open-circuit SCUBA was used. Subjects wore neoprene wet suits with 1.59 cm. thickness over the trunk and 0.64 cm. thickness over the limbs. Surprisingly, mean core temperature declines were greater after the 4 hour exposures (0.96°C; R = 0.24 to 1.80°C) than after the 6 hour runs (0.87°C; R = 0.51 to 1.48°C). Rapid declines in core temperatures occurred during the first two exposure hours, with only gradual declines thereafter. Average weight loss was 1.9 kg. or 2.4% of initial body weight. Correlations between declines in subjects' core temperatures and their heights, weights, or body surface areas were not observed. However, strongly positive ($r = 0.79$; $p < 0.01$) rank correlations were observed between the divers' 4 hour and 6 hour exposures. Conclusions include: 1) Suited divers tolerated exposures three times the estimated LD_{100} for 6°C water without critical declines in core temperature. 2) Hypothermia is not a limiting factor in wet submersible operations in shallow 6°C waters for 6 hour periods. 3) Each diver appears to have a particular core temperature decline profile with respect to cold water exposure. 4) Conditioning to prolonged cold water exposure occurs relatively rapidly.

418.

STREMPEL, H.

Adaptive modifications of cold pain: III. Short-term experiments with 1-min-intervals. Eur. J. Appl. Physiol. Occup. Physiol. 39(1):63-72; 1978.

The subjective short-term habituation to pain-inducing cold stimuli was demonstrated [in men] by measuring the tolerated exposition time. A detection threshold of cold pain could not be temporally separated from the distress reaction level. The slope of subjective habituation is clearly dependent on the individual vegetative starting position. The blood pressure reaction may be used as a valid parameter for the experienced intensity of a cold pain sensation only to a limited extent.

418a.

STINE, R.J.

Accidental hypothermia.

J.A.C.E.P. 6:413-416; Sept. 1977.

Accidental hypothermia is an acute medical emergency with a high mortality rate. Physiologic derangements include hypoxemia, hypotension, acidosis, and arrhythmias. Management consists of careful monitoring, rewarming, vigorous supportive care, and treatment of underlying and complicating disorders. Active core rewarming is recommended for hypothermia with associated cardiovascular insufficiency or instability and rapid core rewarming for hypothermia with cardiovascular collapse. Otherwise, passive or active external rewarming may be used. Good supportive care with correction of physiologic disturbances and vigorous treatment of underlying and complicating disorders are important in improving the survival rate.

418b.

STRAUSS, M.B.
The challenge of cold water.
Skin diver 20:66-67; Mar. 1971.

The author discusses the medical effects of reduction of core temperature: (1) shunting of blood; the blood is shunted from the extremities to the trunk; (2) metabolism; shivering increases body heat production five to seven-fold and exercise ten to twenty-fold. However, the demands made overshadow the beneficial effects. Divers conditioned to cold have a shivering threshold of a much lower temperature. (3) Insulation; subcutaneous fat is the most effective insulator. (4) Body shape; when the ratio of surface area to body mass is lower, heat loss is reduced. As to methods of conserving the body's heat under water, the wet suit conserves the body's own metabolic heat, but does not provide any supplemental heat. Electrical, nuclear and chemical sources of heat have been found unsatisfactory and dangerous. The hot water circulatory system seems at this time to be the most satisfactory method of providing heat. The answer to the need for noncompressible material still remains to be found. Cold makes the diver more susceptible to decompression sickness, nitrogen narcosis and oxygen toxicity, and reduces the quality of his performance, both manual and mental. (MFW/BSCP)

418c.

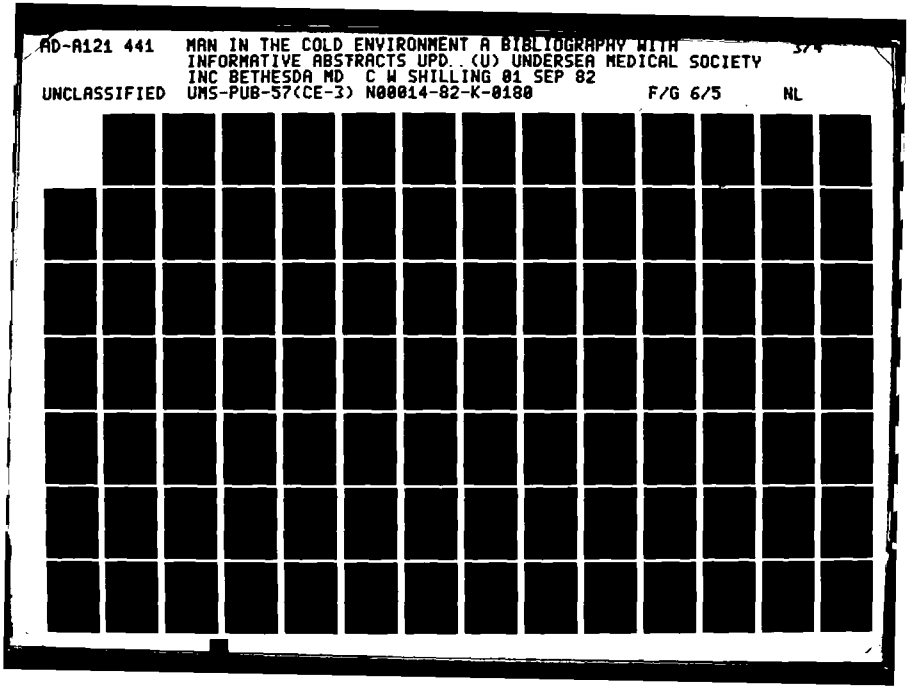
STUART, D.G., W.J. Freeman, and A. Hemingway.
Effects of decerebration and decortication on shivering in the cat.
Neurology (Minneap) 12:99-107; Feb. 1962.

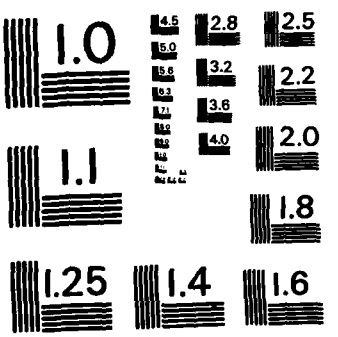
The results of these experiments may be summarized as follows: Decerebrate cats were found capable of movements in response to rapid body cooling. However, similar movements were evoked by rapid body warming. This suggested the movements were a generalized avoidance response to nociceptive stimulation rather than a temperature regulating response. The movements consisted of spasmodic jerks, kicks, and running motions and sometimes included tremulous activity. Such tremors appeared to be alternating, that is, agonists relaxed while antagonists contracted, with limb tremor frequencies of 4 to 7 cps. There was no appreciable rise in oxygen consumption rate during this tremulous activity nor during any of the other observed activities. The tremor of shivering in an intact cat is 9 to 11 cps, and involves synchronous agonist-antagonist muscular contractions with a twofold to fourfold elevation in oxygen consumption rate. It therefore seems that decerebrate cats cannot shiver and that neural control of this form of muscular activity must be more rostral than midbrain. For the first few days after surgical removal of the telencephalon, cats were found to be autonomically hyperactive, urinating, defecating, vomiting, and "raging" excessively. Classically, such hyperactivity is considered a result of removal of the net suppressive influence which the telencephalon is supposed to exert tonically upon the hypothalamus and its subservient functions. However, as measured metabolically, the intensity of shivering was depressed at this stage and did not return to the preoperative level until four weeks after surgery. By the time shivering had returned to its preoperative intensity, the autonomic hyperactivity had abated. Such results imply that the net telencephalic influence on shivering is not solely one of inhibition as implied by previous investigators but rather reflects either a balance of inhibitory and facilitating influences or the absence of any tonic influence. This opinion is in keeping with results of those who have produced and suppressed shivering by electrical stimulation of the forebrain and by hypnotic suggestion. All decorticate cats studied in these experiments could huddle in the cold. This observation has not been discussed in previous literature on the nervous control of body temperature.

418d.

STUART, D.G., R. George, W.J. Freeman, A. Hemingway, and W.M. Price.
Effects of anti- and pseudo-Parkinson drugs on shivering.
Experimental Neurology 4:106-114; 1961.

Effects of atropine, an anti-Parkinson agent, and reserpine, a pseudo-Parkinson agent, on the intensity


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of shivering in cats were determined. This intensity was measured by the ratio of shivering oxygen consumption rate (V^*O_2) to resting V^*O_2. In six cats the mean ratio was 3.0 before administration of 5 mg/kg atropine sulfate, i.p. After administration the ratio was 2.6, an insignificant difference. Thus atropine, at a dose level in excess of that necessary to suppress Parkinson or experimentally-induced alternating tremor, had no effect on the intensity of shivering. Since the reticulospinal tracts appear to be involved in both shivering and Parkinson tremor, it is suggested that the suppression of the latter by atropine is not by inhibition of multisynaptic extrapyramidal pathways in the midbrain or more caudal regions. In ten cats the mean ratio of shivering to resting V^*O_2 was 3.2 before the administration of 0.5 mg/kg reserpine, i.v. After administration shivering was suppressed, the mean ratio being 1.7, a significant difference ($P < 0.001$). In all cats reserpine evoked an alternating tremor with Parkinson characteristics together with excessive parasympathomimetic activity. It is suggested that reserpine suppressed shivering by activation of an anterior hypothalamic region known to suppress shivering when stimulated thermally or electrically.

418e.

STUART, D.G., Y. Kawamura, and A. Hemingway.
Activation and suppression of shivering during septal and hypothalamic stimulation.
Experimental Neurology 4:485-506; 1961.

In acute experiments on thirty-eight lightly anesthetized cats, the septal region of the forebrain and the hypothalamus were explored for loci, activation of which by electrical stimulation produced, suppressed, or failed to affect shivering. Shivering was consistently and repeatedly produced by stimulation of the dorsomedial region of the posterior hypothalamus, and sometimes by stimulation of the ventrolateral region of the septum. A greater intensity of stimulus was needed to produce more latent and less intense shivering during septal than during hypothalamic stimulation. Similarly, more intense stimulation than during anterior, or ventrolateral posterior hypothalamic stimulation. The most effective stimulation frequency for both activation and suppression of shivering was 50 pulses/sec, i.e., five times the evoked or suppressed limb-tremor frequency. It was concluded that septal influences on shivering were secondary to a primary hypothalamic modulation of this tremor. Such modulation appears to be more concerned with initiation and maintenance than with the rhythm of shivering.

418f.

STUART, D.G., Y. Kawamura, A. Hemingway, and W.M. Price.
Effects of septal and hypothalamic lesions on shivering.
Experimental Neurology 5:335-347; 1962.

Shivering and heat loss in the cold were determined in cats several weeks or months after bilateral destruction of various septal and hypothalamic regions. Septal lesions had no effect on either parameter. The tremor was abolished or markedly reduced with lesions in the dorsomedial region of the posterior hypothalamus, but postural, pilomotor, and behavioral responses to cooling persisted. Lesions of the dorsolateral region of the posterior hypothalamus increased heat loss despite the presence of shivering, huddling, and piloerection. These results confirmed our previous electrical stimulation data that the primary region controlling the efferent (motor) aspect of shivering is the dorsomedial region of the posterior hypothalamus and additionally indirectly suggested that the dorsolateral region of the posterior hypothalamus is implicated in cold-induced cutaneous vasoconstriction.

419.

SU, J.Y., D.W. Amory, M.P. Sands and H. Mohri.
Effects of ether anesthesia and surface-induced hypothermia on regional blood flow.
Am. Heart J. 97(1):53-60; Jan. 1979.

Regional blood flow and distribution of cardiac output (CO) were evaluated by the radioactive microsphere technique in seven rhesus monkeys prior to anesthesia, following the induction of deep ether

anesthesia and throughout the cooling course during surface-induced hypothermia to temperatures of 20°C. As given, deep ether anesthesia alone significantly decreased CO 10 percent to 15 percent and output fraction (Qt) was decreased to the carcass, increased to the splanchnic circulation (although not statistically significant), and unchanged to other organs, while total vascular (TVR) and organ resistances were reduced. With the addition of cooling, CO progressively decreased. Individual organ Qt's, however, did not change from anesthetized normothermic values; thus organ flows decreased parallel to the reduction of CO as cooling progressed. TVR and organ vascular resistances increased to levels in excess of 150 percent of anesthetized precooling values, apparently as the result of viscosity rather than vascular changes.

420.

SUNAMORI, M. and C.E. Harrison, Jr.

Myocardial respiration and edema following hypothermic cardioplegia and anoxic arrest.
J. Thorac. Cardiovasc. Surg. 78(2):208-216; Aug. 1979.

The effects of 1 and 2 hours of hypothermic anoxic arrest and cardioplegia induced by Mg-lidocaine, K-Mg, or K on left ventricular mitochondrial respiratory function, blood flow, and edema were studied in 41 mongrel dogs. Mitochondrial respiration was assessed by the indices of oxidative phosphorylation. Myocardial temperature recorded in ventricular septum was kept at 20°C during ischemic arrest and 10 minutes of reperfusion. Cardioplegic solutions did not influence noncoronary blood flow during cross-clamping of the aorta. Mitochondrial respiratory function remained at control levels after 1 hour of ischemia induced by hypothermia anoxic arrest or by Mg-lidocaine or K-Mg hypothermic cardioplegia. Mitochondrial state 3 respiration after 2 hours of anoxic arrest was significantly higher in Mg-lidocaine cardioplegia than in anoxic arrest ($p < 0.05$), but myocardial edema was equivalent in both groups. Mg in the cardioplegic solution suppressed mitochondrial nonphosphorylating oxygen consumption. These data suggest that mitochondrial function after 1 hour of ischemic arrest at 20°C and 10 minutes of reperfusion is not significantly depressed, but at 2 hours of ischemic arrest, mitochondrial respiration is significantly impaired. However, hypothermic Mg-lidocaine cardioplegia appears to be more effective in sustaining myocardial respiration than does simple hypothermic anoxic arrest when the anoxic period is extended to 2 hours.

421.

SZANTO, J. and E. Holeckova.

Increased susceptibility to infection with herpes simplex virus types 1 and 2 of cold-adapted L cells.
Acta Virol. (Prague) (Engl. Ed.) 22(2):113-122; 1978.

L [mouse] cells (L-As subline) were adapted to a temperature of 4°C. In the cold-adapted cells, designated LC3, greater amounts of infectious herpes simplex virus types 1 (HSV-1) and 2 (HSV-2) were synthesized than in the original L-As cells or in another control L-cell line. Two strains of HSV-1 reached higher infectious titers in LC3 cells grown at 36°C than in those grown at 32°C. The HSV-2 strain tested replicated in LC3 cells grown at 32°C better than at higher temperature. Increased reproduction of HSV in LC3 cells was not due to enhanced adsoption of virions on the cells as compared with control L cells. The multiplication of cold-adapted LC3 cells was and was not more intensive than that of L-As and control L cells, respectively. The virological results are confronted with known physiological properties of cold-adapted cells.

421a.

TALBOTT, J.H.

The Physiologic and Theraputic Effects of Hypothermia.
New England J. Med. 224:281-288;1941.

Observations on the experimental reduction of the internal temperature of the body as well as local application of cold constitute the basis of this report. A discussion of hypothermia is timely because the physiologic

changes and therapeutic implications associated with it have begun to be studied systematically only of late. During general hypothermia the internal body temperature may be lowered to 75°F. with subsequent recovery. It may be maintained continuously between 80 and 90°F. for as long as eight days. If local application of cold is employed, a circumscribed area of the body may be maintained betwen 40 and 50°F. for several months without damage or destruction of normal tissue. Relief of pain is probably the most important single effect of general hypothermia in patients with metastatic cancer. Regressive changes in tumor tissue have been reported following prolonged general hypothermia, but are observed more constantly following prolonged local hypothermia. Other conditions that have appeared to benefit from general hypothermia include morphine addiction, leukemia and schizophrenia. It should be appreciated that knowledge in the field of hypothermia is most fragmentary and that until a large amount of painstaking labor is expended, a full and comprehensive understanding of all the related facts will not exist.

422.

TALBOT, P.

Motility, acrosome morphology and fertilizing capacity of cold-shocked hamster spermatozoa.

J. Reprod. Fertil. 55(1):9-14; 1979.

When fresh epididymal spermatozoa were cold shocked for 10 or 30 min, then warmed to 24°C, sperm motility was normal. Cold shocking ejaculated or capacitated spermatozoa caused a significant decrease in the percentage of motile spermatozoa and, for capacitated spermatozoa, in the rate of motility. The acrosomes of motile fresh epididymal and ejaculated spermatozoa became crenulated after cold shock. The percentage of spermatozoa with crenulated acrosomes increased with longer periods of cold shock and was higher when spermatozoa were cold shocked in serum than in saline. When epididymal spermatozoa were cold shocked after incubation for 4 h at 37°C, the acrosomes on spermatozoa which did not undergo an acrosome reaction became swollen and elevated instead of crenulated. Epididymal spermatozoa which were cold shocked and then incubated for 4 h at 37°C exhibited acrosome reactions and activation of motility but had reduced fertilizing capacity when tested in vitro. Spermatozoa incubated in serum and cold shocked penetrated zone-free ova even though their tails were bent through 180°. Cold shock may decrease the fertilizing capacity of hamster spermatozoa by interfering with the ability of spermatozoa to bind to and/or penetrate the zone pellucida.

423.

TANAKA, M.

Metabolic and thermal responses of men wearing cold-protective clothing to various degrees of cold stress.

Eur. J. Appl. Physiol. Occup. Physiol. 39(2):137-144; 1978.

Subjects (5) were exposed in a climatic chamber for 1 h to air temperatures of 0, -10 and -15°C wearing cold-protective clothing. Heat production and mean skin and rectal temperatures were studied. During the first 5 min of cold exposure, heat production attained high values and then decreased. The peak levels of this initial metabolic rise were higher in lower air temperatures, while the corresponding mean skin temperatures showed no significant differences in any air temperature. The relationship between changes of heat production and mean skin temperature values during the first 5 min differs from those later in the experiments, which showed a good linear relationship ($r = 0.89$). The experimental condition required that the body be covered with thick clothes, immediate stimulation to the face and the respiratory tract must be greater than stimulation of whole body skin. The metabolic rise during the first 5 min may be related to abrupt cold stimulation to the face and mucous membrane of the respiratory tract and to the subsequent appearance of thermal muscular tone or tension. In contrast, mean skin temperature became lower during the later period even with the cold-protective clothing and heat production increased again at the onset of frank shivering. The heat production changes occurring during the later period showed that the stimulus to the shivering center from cold receptors in the skin is powerful enough to produce an increase in metabolism.

424.

TANSEY, W.A.

Medical aspects of cold water immersion, a review.

U.S. Nav. Submar. Med. Res. Lab., Rep. NSMRL 765, 15p. Sept. 19, 1973.

Whole body hypothermia is an acknowledged cause of death in victims of cold water immersion. Survivors of submarine escape must contend with this physiologic stress in the open sea. This report contains a concise statement of basic physiologic principles and modes of treatment and is considered a timely adjunct to training programs for submarine escape so that victims may better cope with hypothermic environments, and medical personnel may be better able to revive victims rescued from such accidents. (Author's abstract)

425.

TARNICK, V.M.

Results of the treatment in cases of cold urticaria, cold pruritus and cold rhinitis with Peritol® (Zyproheptadinhydrochlorid)

Dermatol. Monatsschr. 165(4):274-275; Apr. 1979.

Nineteen patients with cold urticaria, 5 with cold pruritus and 2 with cold rhinitis were successfully treated with peritol with the exception of one patient who suffered from a symptomatic pruritus due to polycythemia vera. Even in cases of recurrence the treatment was at once successful. Therefore peritol seems to be useful in the treatment of diseases due to cold.

425a.

TEITLEBAUM, A., and R.F. Goldman.

Increased energy cost with multiple clothing layers.

J. Appl. Physiol. 32(6):743-744; 1972.

The question of any increase in energy cost for walking with multiple clothing layers, apart from that increase as a result of added weight per se, was investigated with a seven-layer experimental clothing system. Eight subjects, wearing a standard T-shirt and shorts and fatigue uniform and combat boots (T-shirt and fatigue shirt = 2 layers) walked in randomized sequence on treadmills at 5.6 or 8.0 km/hr either wearing an additional five layers of clothing over the fatigues or carrying the 11.19-kg weight of these five layers as a lead-filled belt. Three 2-min respiratory samples were taken during each 20-min trial, at the 6-8, 12-14, and 18-20th min. A mean value of 514 $\pm$ 12.4 (se) W at 5.6 km/hr was obtained for the multiple-layer clothing system in contrast to 435 $\pm$ 12.9 W for the equivalent added weight carried at the same speed. At 8.0 km/hr the cost for the multiple-layer clothing system was 995 $\pm$ 32.3 W compared with 873 $\pm$ 24.9 W for the equivalent weight carried on the belt. These differences were very highly significantly different ($P < 0.001$), with each individual expending more energy walking with the multiple-layer system than with the equivalent weight carried as a belt.

426.

TEMPEL, G.E. and X.J. Musacchia.

Renal function in helium-cold hypothermic hamsters.

Physiologist 16:468; Aug. 1973.

Abstract only. Entire item quoted: Renal function in a depressed metabolic state was studied. Plasma and urine concentration of Na^+, K^+, and urea; and renal cortico-medullary concentration gradients of Na^+ and urea were examined. Hamsters were studied as follows: (C) control (T_{re} 37°C); (H) hypothermia, 48 hrs (T_{re} 7°C); (Rl) rewarming from hypothermia (T_{re} 18°C); and (R2) rewarmed from hypothermia (T_{re} 37°C for 2 hrs). Plasma Na and K appear unaffected by 48 hrs of hypothermia. In normothermia mean concentrations were 117.4 ± 7.0 and 6.5 ± 0.8 mEq/l for Na and K respectively. Mean values for H animals were 110.3 ± 12.6 mEq Na/l and 5.5 ± 0.7 mEq K/l. By contrast, plasma urea levels increased from 0.5 ± 0.05 mM/l for (C) animals to 0.8 mM/l for the (H) group. Urinary Na showed little difference between (C) and (H) hamsters. Mean concentrations were 99.4 ± 45.2 for the

former and 80.4 ± 37.7 for the latter. However, concentrations of K and urea were both reduced in samples obtained after 48 hours T 7°C. (C) hamsters demonstrated a K concentration of 299.2 ± 90.8 mEq/l which declined to a value of 78.3 ± 45.9 in (H) animals. Likewise, urea concentration declined from a control value of 98.1 ± 16.5 mM/l to levels of 1.8 ± 1.2 mM/l for the (H) group. Tissue slice analysis showed no solute gradient for either Na^+ or urea in hamsters hypothermic for 48 hrs. (R1) animals sacrificed at T_{re} 18°C also lacked a gradient. However, the normal gradients returned in (R2) animals.

427.

TEMPEL, G.E., I. Wolinsky and X.J. Musacchia.

Bone and serum calcium in normothermic, cold-acclimated and hibernating hamsters.
Comp. Biochem. Physiol. A Comp. Physiol. 61(1):145-148; 1978.

An examination of Ca homeostasis in a facultative hibernator, the golden hamster (*Mesocricetus auratus*) was made. Fresh bone length and weight, and ash bone Ca and P were examined in normothermic, cold-acclimated and hibernating hamsters. Although fresh bone weight changes were noted, when corrected for body weight, no change was seen in either hibernating or cold-acclimated animals. Bone Ca and P were similarly unaffected by these forcings. The data are supported by histologic studies of bone and constant plasma Ca values, and were discussed in terms of mechanisms underlying alterations in mineral balance.

428.

THEILADE, D.

The danger of fatal misjudgment in hypothermia after immersion.
Anaesthesia 32:889-892; Oct. 1977.

A case is reported of the successful resuscitation of a 6-year-old child after 25 minutes' immersion in water at 4°C. The difficulties of evaluating vital functions at low body temperatures, with the accompanying danger of fatal misjudgment, are pointed out. It is concluded that low body temperatures indicate that a considerably longer resuscitation procedure than normal should be undertaken, particularly in children, and that if the body temperature is above 30°C rewarming ought not to take place before satisfactory oxygenation and an efficient circulation have been established. (Author's summary)

429.

THENEN, S.W. and R.H. Carr.

Effects of thyroxine, epinephrine and cold exposure on lipolysis in genetically obese (ob/ob) mice.
Proc. Soc. Exp. Biol. Med. 159(1):116-120; 1978.

Treatment of ob/ob mice with T_4 [thyroxine] 24 h prior to cold exposure did not alter plasma concentrations of glucose, insulin and FFA [free fatty acids] during cold exposure, although ob/ob mice remained hyperglycemic and hyperinsulinemic when compared to nonobese mice. FFA content of and FFA release from isolated adipocytes were significantly elevated in T_4-treated obese mice after cold stress as compared to untreated obese mice. T_4 treatment also produced a marked increase in epinephrine-stimulated FFA release from fat cells of obese mice in vitro. Apparently, correction of the hypothyroid status of ob/ob mice with pharmacological doses of T_4 improved the in vitro lipolytic response of fat cells, but did not alter the circulating concentrations of important energy sources for thermogenesis in vivo.

430.

THERMINARIAS, A., M.F. Chirpaz, A. Lucas and M. Tanche.

Catecholamines in dogs during cold adaptation by repeated immersions.
J. Appl. Physiol. 46:662-668; Apr. 1979.

Dogs were immersed in cold water 1 h/day for 30 consecutive days. During the first immersion, oxygen

uptake increased approximately sevenfold and colonic temperature decreased; a large increase in plasma epinephrine and norepinephrine concentrations was found; plasma glucose, lactic acid, and free fatty acid (FFA) concentrations were also increased. An adaptive response to cold was evidenced during the 10th immersion by a further increase in oxygen uptake and a reduction in the fall of colonic temperature; plasma epinephrine, glucose, and lactic acid were diminished whereas FFA were higher. Consequently 10 h spent in cold are sufficient to induce an improved capacity for heat production. An enhanced ability to produce nonshivering thermogenesis mediated by epinephrine or norepinephrine is not obvious because after the 30th immersion no enhanced calorigenic response to epinephrine or norepinephrine infusion was found. In dogs mechanisms other than norepinephrine-enhanced sensitivity might be involved in this kind of cold adaptation. (Authors' abstract)

431.

THEVES, B.

Heat loss from the skin surface of the human body: Deduction from a symmetry of constant mean surface curvature.

Eur. J. Appl. Physiol. Occup. Physiol. 38(4):239-260; 1978.

For heat exchange processes a symmetry of constant mean surface curvature is adequate to the problem. Based on this a formula for the heat loss from the skin surface as a function of the mean skin temperature is deduced. The formula depends on the following parameters besides the skin temperature: body surface area, mean surface curvature, thickness of clothing, thickness of boundary layer, air temperature, water vapour pressure in the air, radiation temperature of the environment, air pressure, degree of wetness of the skin surface, direct sun and diffuse sky radiation of heat. Formulas for the above parameters of mean surface curvature, mean thickness of the convective boundary layer as a function of wind velocity and mean surface curvature, and for a partial climatic complex temperature ϑ are deduced, too. The introduction of ϑ leads to a greater simplification of the heat loss formula, since it represents the complete influences of all climatic elements with the exception of the wind velocity which appears directly in the heat loss formula. The possibilities of measuring of the different parameters are discussed and the possibility of direct measurement of ϑ is pointed out. The formulae are valid not only for an equilibrium between heat production and heat loss, but the skin temperature and all the other parameters can be time dependent. The general and complete presuppositions of the deduction of the heat loss formula allow its application not only for men of varying height and volume but in principle for other mammals living in similar environments, too.

432.

THEVES, B.

Penetration of external thermal perturbations into homeothermic organisms: II.

Eur. J. Appl. Physiol. Occup. Physiol. 38(2):115-132; 1978.

The penetration of external thermal perturbations into parts of the body with different surface curvatures was discussed. For areas with approximate rotational symmetry a theoretical treatment by means of the variation theory was possible. The mean surface curvature on the rotation axis was constant. The solution of the partial differential equation given in part I can be applied without change, if the correct value of the mean surface curvature of the body part is used. For an exponential form of alteration of the heat loss a solution was deduced. Combining small parts of sudden and exponential changes of heat loss it was possible to approximate almost any reasonable type of external thermal perturbation. Superimposing single solutions with different parameters allowed a complete solution of the problem. The importance of the theoretical results in view of homeothermia was discussed.

433.

THOMPSON, J.R., R.J. Christopherson, V.A. Hammond and G.A. Hills.

Effects of acute cold exposure on plasma concentrations of noradrenaline and adrenaline in sheep.

Can. J. Anim. Sci. 58(1):23-28; 1978.

Six acute cold trials were performed with mature wethers shorn to a fleece depth of 5-10 mm and maintained in a controlled environment chamber. Heart rate, hematocrit and plasma concentrations of glucose, noradrenaline (NA) [norepinephrine] and adrenaline (A) [epinephrine] were measured during each trial which consisted of a 90-min period at 25°C, a 150-min period of cold stress (to -19°C) and a 120-min warming period. All measurements and samples were taken from outside the controlled environment chamber by means of extended conduits to minimize animal disturbance. Mean values at 25°C were: heart rate 69 beats/min, hematocrit 26.7%, plasma glucose 62 mg/100 ml, NA 0.24 ng/ml and A 0.07 ng/ml. By 120- to 150-min cold exposure, mean values of all variables increased to: heart rate 223 beats/min, hematocrit 33.1%, plasma glucose 115 mg/100 mo, NA 1.11 ng/ml and A 0.24 ng/ml. Following cold exposure, mean values of all variables returned toward pre-cold period values as chamber temperature approached 25°C. A 7th trial performed at constant temperature (24°C) demonstrated the marked elevation in plasma catecholamine concentrations when an experimental animal was disturbed. Plasma NA and A concentrations in resting unrestrained ruminants are similar to those of other animals in the same state. It is important to minimize animal disturbance while studying catecholamines. The sympatho-adrenal medullary system is apparently involved in the physiological response of sheep to acute cold stress.

434.

THOMSON, E.M., A.M. Snoswell, P.L. Clarke and G.E. Thompson.

Effect of cold exposure on mammary gland uptake of fat precursors and secretion of milk fat and carnitine in the goat.

Q. J. Exp. Physiol. Cogn. Med. Sci. 64(1):7-16; 1979.

Measurements of mammary gland uptake of milk fat precursors and milk lipid secretion and composition were made in lactating goats exposed for 2 days to each of 3 different environments. These were designated thermoneutral (21°C), mildly cold (0°C, still air) and moderately cold (0°C with a wind speed of 3.6 m/s). Milk and blood carnitine concentrations were measured in lactating goats exposed for 1 day to thermoneutral and moderately cold environments. Exposure to cold significantly decreased milk secretion rate. During moderate, but not mild cold exposure mammary blood flow also was decreased significantly. Cold exposure caused a decrease in the arterial plasma concentrations of acetate and triglyceride but an increase in plasma free fatty acid concentration. Mammary gland uptake of acetate and triglyceride was decreased while net free fatty acid uptake was increased in the cold. Total milk triglyceride secretion rate was maintained in the cold, despite the fall in milk volume, but its composition was altered with the % of triglyceride fatty acids 16C and greater in length being increased while the % of fatty acids less than 16C in length was decreased. Blood carnitine concentration and carnitine secretion in milk was decreased during cold exposure. The effect of cold exposure on milk fat composition apparently is due to changes in the relative rates of supply and uptake of short and long-chain fatty acids by the mammary gland. The decreased availability of carnitine in the milk could have important consequences in the metabolism and survival of the offspring.

435.

THORNTON, R., C. Gordon and J.H. Ferguson.

Role of thermal stimuli in the diving response of the muskrat (*Ondatra zibethica*).

Comp. Biochem. Physiol. A Comp. Physiol. 61(2):369-370; 1978.

The effects of water temperature on diving bradycardia in muskrats was studied. Heart rate (HR) was determined by means of an ECG taken during the test period. When submerged in water at 20°C, the HR was suppressed to 34% (68 beats(b)/min) of resting HR (200 b/min). At 2° and 35°C the HR was 24% (48 b/min) and 50% (100 b/min), respectively. It is suggested that the thermal stimuli of water can affect the normal diving reflex of the muskrat.

436.

THURSTON, J.T., R.F. Burlington and G.A. Meininger.

Effect of low temperatures on rat myocardial Mg-ATPase and NaK-ATPase.

Cryobiology 15(3):312-316; 1978.

Preparations of microsomal Mg-ATPase and NaK-ATPase from rat hearts were assayed for ATP hydrolytic activity at 37, 25, 15 and 5°C. Both enzymes showed sharp decreases in activity with concomitant increases in apparent energies of activation between 15 and 25°C. NaK-ATPase is more temperature sensitive than Mg-ATPase over the entire temperature range. Mg-ATPase and/or NaK-ATPase may be important in limiting the lower temperature at which mammalian hearts can maintain functional contractility.

437.

TIMBAL, J., M. Loncle and C. Boutelier.

Mathematical model of man's tolerance to cold using morphological factors.

Aviat. Space Environ. Med. 47:958-964; Sept. 1976.

A mathematical model has been developed to anticipate the physiological responses and the thermal state of a naked human under exposure to cold, taking into account his morphological characteristics (skinfold, size, weight) and the environmental conditions (air or water temperature and velocity, barometric pressure and hygrometry). The skinfold conditions, the body's thermal conductance and the metabolism depends both on rectal (Tre) and mean skin (Tsk) temperatures. After being tested, this model was used to study the evolution of Tre. It shows the influence of the skinfold which accounts for most of the inter-individual differences. It also permits discussion of survival possibilities during immersion and completes data provided by previously established curves. (Authors' abstract)

438.

TIMBAL, P.J., M. Loncle, L. Bougues, and C. Boutelier.

Relation entre la ventilation et la consommation d'oxygene au cours du frisson thermique chez l'homme.

[The relation between ventilation and oxygen consumption during shivering in man exposed to cold air cold water.]

Biologie. Comptes Bendus. T. 168:6-7; 1974.

The relation between ventilation and oxygen consumption has been studied during shivering in man exposed to cold air cold water. Almost no significant difference has been observed between the two groups of experiments. The steady state results (after 90 minutes cold exposure) are closed enough to the extrapolations made from muscular exercise data. During the transient state, compared with the steady state values, we find some hyperventilation, followed from the 50th minute by a slight hypoventilation.

439.

TLEULIN, S.G.

Effect of stimulating the skin with different temperatures on the interneuron activity of the lateral horn of the lumbar segments of the spinal cord.

Fiziol. Zh. Sssr. 65(4):543-548; Apr. 1979.

Responses of interneurons in lateral horn to thermostimulation of skin was the same as the response to cooling of sympathetic fibers of the skin nerves.

440.

TOCCO, A., C. Lemaire and R. Sciarli.

Forage au Labrador.

[Drilling in Labrador].

Travail. Hum. 38(2):347-348; 1975.

Abstract only. Entire item translated: The oil industry has made major contributions to the diving profession in the last several years. Deep-sea exploratory and development drilling require the participation of divers both for one-shot operations (trouble shooting) and for work programs (construction). The special conditions of underwater work (cold water, great depths) necessitate the use of auxiliaries of physiological functions (breathing apparatus, thermal protection, etc.). Preliminary experimentation, in simulated laboratory dives permits the definition of the diver's new needs to assure his homeostasis. Methods and materials suitable for meeting these needs are then considered, and evaluation studies are undertaken. All this aims at allowing the diver to work efficiently (that is, at reduced physiological cost) and safety. Maximum precautions are taken to limit the risks of this dangerous profession. But in addition to characteristics of deep-sea diving which must be mastered there are also environmental factors; as this film, made in Labrador, shows, the work must sometimes be done in storms and amid icebergs. (Translated by MEMH/UMS)

441.

TODD, M.

Finding a warm way to stay off the bottom!
Diver 24:22; Apr. 1979.

Ways of controlling buoyancy and heat loss are discussed. The National Diving Committee of the British Sub-Aqua Club recommends that a life jacket be worn. This is defined as "a device which tends to float the wearer face upwards on the surface and which has an independent source of rapid inflation." It also recommends some means of compensating for loss of buoyancy at depth. There are, in the U.S., buoyancy compensators with CO_2 cartridges for emergency inflation which serve both purposes. Another solution is the addition of a small air cylinder to the life jacket. The variable volume dry suit, such as the Poseidon Unisuit, provides buoyancy control, but a life jacket should still be worn. A conventional dry suit with suit inflation over warm underwear is a practicable and comparatively inexpensive solution. There is also under design a new type of material for wet suits which has bubbles encapsulated in glass, thus becoming impervious to pressure. In a suit made of this material, there would be a minimal change in buoyancy and heat loss. (MFW/UMS)

441a.

TONJUM, S., R.W. Hamilton, A.O. Brubakk, R.E. Peterson, D.A. Youngblood et al.
Project Polar Bear: testing of diver thermal protection in a simulated "lost bell."
Bergen, Norway, Norwegian Underwater Inst., NUI-Rep 2-80, 74 p. Jan. 28, 1980.

The objective of this test exposure was to ascertain if any currently available thermal protection equipment could sustain divers for the 24 hours which might be needed for rescue in a "lost bell." The test conditions were those to be expected in a diving bell lost in the North Sea, 2-6°C in 90% helium at a total pressure of 16 bars. In all tests some type of protection from respiration heat loss was used, and these, plus mittens, hoods, thermal boots, etc., were comhined to make up survival "systems." Subjects were three NUI scientists and a physician tender. A rewarming protocol was worked out, but the study of hypothermia was not an objective; only evidence of either thermal stability or a definitive heat loss was sought. Two systems tested were based on survival suits, one for immersion and one a heat reflective outdoorsuit. These were not effective; the subjects lasted 1 or 2 hours and lost ½-1°C in core temperature. Two other bag systems used thick polyester fiber insulation (10-15 cm) and sustained the subjects with little heat loss but some discomfort for 8-10 hours. One of these bags was suspended, the other was on a foam mattress. The two effective respiratory protection devices tested both absorbed CO_2 and conserved the reaction heat. Breath heat conservation was shown to be essential but, with it and ample body insulation, it is entirely feasible to survive 24 hours in a "lost bell" with only passive protection. (Authors' abstract)

441b.

TRISHIKHIN, G.V.

Heat regulation reactions in animals in a helium-oxygen atmosphere.
Kosmicheskaya Biologiya i Meditsina 6(5):84-86; September-October 1972, Translated from the Russian.

It is well known that the literature contains studies on the possibility and desirability of using a helium-oxygen atmosphere in the manned compartments of spaceships (B.M. Savin; P.A. Gultayayev; V.M. Osipov, and many others). It has now been established that animals and man can live for a relatively long time in such an atmosphere and their physiological functions do not exhibit significant changes (V.V. Boriskin, et al.; A.G. Dianov and A.G. Kuznetsov; G.V. Troshikhin). One of the distinguishing characteristics of helium is its high heat conductivity; this increases the convective component in body heat exchange (Epperson, et al.; Fischer and Musacchia). In this study an attempt was made to ascertain the comfortable temperature range for animals in a helium-oxygen atmosphere.

441c.

TROUTMAN, S.J. Jr., P. Webb and J.F. Annis.

Estimating body heat loss from temperature changes during cooling.

In: Program and Abstracts, Undersea Medical Society, Inc., Annual Scientific Meeting. Undersea Biomed. Res. 6(Suppl.):27-28; Mar. 1979.

Abstract only. Entire item quoted: The reliable determination of net body heat loss during cold water exposures has been a long standing objective of the diving community. Experiments designed to simulate such exposures were calorimetrically conducted (i.e. with simultaneous measurement of heat production and heat loss) to establish the relationship between changes in body temperature and net changes in body heat content. Heat removal rates varied from 50-500 kcal/hr where the net body heat loss ranged from 50 to 300 kcal. The results were quite varied and, as was theorized, the temperature changes in each subject were directly related not only to size but to body composition, cooling rate, time of exposure, and level of induced hypothermia. A non-anatomical spherical model has been developed; it consists of a central core, represented by the rectal temperature, and a multifunctional outer shell/surface, represented by a system of mathematical expressions dependent on time, skin folds, body fat, lean body mass, total mass, surface area, and the environmental load. We present the concepts employed to develop a mathematical model where observed temperature changes in the central core can be related to changes in body heat content based on the evaluation of the environmental load, shell/surface responses, and shell/surface-core coupling with respect to time.

441d.

TRUSCOTT, D.G., W.B. Firor, and L.J. Clein.

Accidental profound hypothermia.

Arch. Surg. 106:216-218; 1973.

Successful recovery from accidental profound hypothermia (rectal temperature 22°C [71.6°F]) using bloodstream rewarming is described. Circulation and respiration had ceased prior to the initiation of extracorporeal circulation. Core rewarming is theoretically preferable to surface methods in that the central organs, particularly the heart, are rewarmed in advance of the increasing metabolic demands at the periphery. Precisely the opposite situation is obtained with surface rewarming. Nonetheless, mild accidental hypothermia or more severe degrees in which an effective circulation persists can be managed appropriately by surface rewarming techniques. If the circulation is inadequate when the patient is first seen or should fail during surface rewarming, we would currently regard bloodstream rewarming using peripheral cannulation, a pump-oxygenator, and a heat exchanger as the method of choice.

442.

TURCOT, J., J.L. Laurenceau, J. Le Blanc and J.G. Dumesnil.

Cardiovascular modifications after acute stimulation by cold of the hand and the face: An echocardiographic study.

J. Physiol. (Paris) 74(7):641-650; 1978.

The cardiovascular effects of cold stimulation of the face and hand were studied in 25 normal subjects, aged 25-35 yr. Echocardiography was used to estimate changes in cardiac output and changes in heart rate and peripheral blood pressure were measured. On the hand 1° cold stimulation was done in 13 subjects and resulted in increases of heart rate (+ 7 beats/mn; + 9%), cardiac index (+ 0.33 l/mn/m^2;

+ 9%), mean blood pressure (+ 15 mm Hg; + 16%) and peripheral vascular resistance (+ 6 units/m^2; + 21%). On the face 2° cold stimulation was practiced in 21 subjects and was associated with decreases of heart rate (-12 beats/mn; -15%) and cardiac index (-0.84 l/mn per m^2; -20%) and increases of mean blood pressure (+ 12 mm Hg; + 13%) and peripheral vascular resistance (+ 10 units/m^2; + 46%). In 5 subjects who had marked bradycardia after 3° cold stimulation of the face, this test and stimulation of the hand were repeated after incremental doses of atropine. During stimulation of the face the bradycardia and the increase in peripheral vascular resistance due to cold were progressively inhibited with higher doses of atropine. Cold stimulation of the hand after atropine resulted in higher increases of peripheral vascular resistance. Apparently cold stimulation of the face initially produces a vagal reaction and secondarily a sympathetic response, cold stimulation of the hand directly produces a sympathetic reaction.

443.

UCHIDA, S., K. Takeyasu, Y. Noguchi, H. Yoshida, T. Hata and T. Kita.

Decrease in muscarinic acetylcholine receptors in the small intestine of mice subjected to repeated cold stress.

Life Sci. 22(24):2197-2204; 1978.

The maximal contraction of the small intestine by acetylcholine greatly decreased during repeated cold stress. This change was mainly due to decrease in muscarinic receptors in the small intestine, whose amounts were measured by the binding of 3-quinuclidinyl benzilate. Injection of norepinephrine or a tricyclic antidepressant, carpipramine, during the exposure to the stress prevented this decrease in muscarinic receptors. The physiologic significance of this phenomenon was discussed in relation to vagal hyperactivity under the stress.

444.

UEDA, G.

On the cold adaptation.

J. Anthropol. Soc. Nippon 86(1):19-22; 1978.

To investigate cold adaptability, standard techniques including methods of local and/or general stimuli were established. The results are of value from the practical and the theoretical perspective. Mainly, 4 types of adaptation e.g., morphological, biochemical and artificial adaptations, can be distinguished. Cold adaptation increases the metabolic heat production and decreases the heat loss from the body surface. The parameters of a vasomotor reaction are used to measure the local index of cold tolerance. Usually, the larger the hunting reaction due to the cold stress, the stronger the local cold tolerance. Hormonal secretions caused by thyroid and adrenal reactions play very important roles in biochemical adaptation. The changes in the metabolism of free fatty acid, amino acid and glucose are also noticed. Adaptation in humans can be achieved by behavior, clothing, housing and heating. These artificial adaptations are sometimes intentionally devised in a very specialized way. When stress, over a limit of cold tolerance is applied, diseases or death will occur. Living in a cold environment e.g., Antarctica, has only recently become possible by physiological and artificial adaptation.

445.

UENOBE, F. and N. Yamamoto.

Experimental studies on vital response of mammals when exposed to unusual temperatures. II.

Mem. Osaka Kyoiku Univ. III Nat. Sci. Appl. Sci. 25(3):177-184; 1976.

Mice were administered a concentrated glucose solution which caused alloxan diabetes under thermal conditions (OT [optimum temperature]: 22°C, 55% humidity; HT [high temperature]: 35°C, 80% humidity; LT [low temperature]: 5°C, 80% humidity). Carbohydrate and lipid metabolism was studied. Liver respiration and SDH [succinate dehydrogenase] activity decreased under OT, but increased under LT. The circadian variation of SDH activity under OT and LT was high at night and minimum about

noon; it was unaffected by glucose administration. The average body wt did not vary after the i.v. injection of alloxan but it decreased gradually under HT. In fed mice, the amounts of the blood total cholesterol, triglyceride and fatty acid showed the highest values under HT, moderate under OT and the lowest under LT. These substances increased markedly in high cholesterol fed diabetic mice under HT conditions while of the substances SDH activity decreased.

446.

UNITED STATES NAVY, OFFICE OF NAVAL RESEARCH.

Navy-wide workshop on high pressure biomedical research.

ONR Rep. ACR 218, 63p. 1976.

The report represents a summary of scientific and operational matters relating to improving man's ability to work underwater. The bulk of the report is centered about eight relevant discussion panel sessions: Physiological Criteria for Equipment Design; Cold Protection; Performance; Decompression; Decompression Sickness; Oxygen Toxicity; HPNS and Narcosis; and Future Trends. (DD abstract)

446a.

VANGGAARD, L.

Physiological reactions to wet-cold.

Aviat. Space Environ. Med. 46(1):33-36; 1975.

Changes in extremity temperatures during general cold stress were investigated. The changes in local temperatures were found equal to those seen under circulatory arrest. In order to investigate the influence of these changes on motor function, the relation between local temperature and nervous conduction velocity in a peripheral motor nerve (n. ulnaris) was carried out in subjects exposed to a minor cold stress (to avoid the influence of Lewis hunting reaction). The decrease in conduction velocity was found to be 15 m/s per 10°C fall in temperature. At a local temperature of 8-10°C a complete nervous block was established. This leads to an explanation of the clinical findings in wet-cold situations, where the very rapid onset of physical impairment corresponds to the effect of a local cooling in the extremities and not, as commonly accepted, to a developing general hypothermia.

446b.

VARENE, P., J. Timbal, H. Vieillefond, H. Guenard, and J.L. Huillier.

Energy balance of man in simulated dive from 1.5 to 31 ATA.

In: Lambertsen, C.J., ed. Underwater Physiology. Proceedings of the 5th Symposium on Underwater Physiology, p.755-763. Bethesda, Md., Federation of American Societies for Experimental Biology, 1976.

Experimental determinations of animal or human metabolism in He-O_2 atmospheres are numerous in the literature. After the early work of Cook et al. (6) an increase in oxygen consumption ($\dot{V}o_2$), if any, is usually related to an increase in skin heat losses (2, 7, 8, 12, 18, 19, 25), rather than to a cellular effect, although He might alter metabolic pathways in some biological systems (20). Theoretical considerations show that skin convective heat losses must increase in the He-O_2 atmosphere at depth (9, 16, 23). However, few studies have been carried on in man to ascertain this point experimentally (17); the same remark holds true for the respiratory convective heat losses for which only predictive assumptions are available (22, 24). This paper describes an attempt to make an experimental determination of the different parameters in the body heat balance equation at several levels of ambient pressure and He-O_2 atmosphere.

446c.

VAUGHAN, W.S., Jr., and A.S. Mavor.

Diver performance in controlling a wet submersible during four-hour exposures to cold water.

Human Factors 14(2):173-180; 1972.

Six 4-hr open-sea test trials were conducted with a wet submersible. The purpose of these trials was to assess the effects of long exposure to cold (16.5°C) water on man's ability to perform basic submersible control tasks. The subjects were experienced submersible pilots who had a minimum of 20 hours training prior to the experimental trials. Skin and rectal temperatures were continuously recorded from both the pilot and rider of the submersible. A continuous record of vehicle depth and water temperature was also obtained. The pilot's task was to maintain a prescribed depth while performing a sequence of course changes for a 4-hr period of submergence. Depth error variance was correlated with pilot core and skin temperature changes over time, and although pilot core temperature fell as much as 1.83°C, no degradation in depth control performance was apparent.

447.

VAUGHAN, W.S. Jr.

Diver temperature and performance changes during long-duration, cold water exposure. Undersea Biomed. Res. 2:75-88; June 1975.

Twelve Navy divers participated in 4- and 6-hour open-water test trials of a 2-man wet submersible in 6°C water. Skin and rectal temperatures of the crews were continuously recorded and performance measures were taken in three task areas; pilot tasks, sonar-operator tasks, and crew-coordination tasks. Results suggest a complex, task-dependent effect of cold stress from deep body cooling. Rectal temperature change was relatively insensitive to differences in exposure conditions, however, and is probably a poor index of cold stress for use as a correlate of performance degradation between normal and clinically critical values of deep body temperature. (Author's abstract)

448.

VAUGHAN, W.S. Jr.

Distraction effect of cold water on performance of higher-order tasks. Undersea Biomed. Res. 4:103-116; June 1977.

Eight U.S. Navy-qualified scuba divers performed peripheral target detection and navigation problem-solving tasks continuously during 3-h exposures to moderate (15.5°C) and cold (4.5°C) water. Upon exiting the water, the divers did a series of arithmetic computations. Measures of physiological cold stress were periodically recorded, and estimates of changes in body heat content were calculated. Results suggest a significant distraction effect of cold water exposure on performance of higher-order tasks. Hour-to-hour comparisons of task performance between the two exposures showed no significant differences except for the in-water tasks during the first hour of exposure. Furthermore, individual performance levels achieved during second and third hours of cold water exposure were significantly correlated with levels achieved in moderate water and not with individual differences in body cooling. It is recommended that the psychologically mediated effects of cold exposure by given greater attention in both research and operations. (Author's abstract)

449.

VAUGHAN, W.S. Jr. and M.B. Strauss.

Exploratory analysis of predictors of diver performance decrement during 3-hour cold water exposures.

Landover, Md., Oceanautics, Inc., Tech. Rep. on Contract N00014-72-C-0309, 45p. Mar. 1975.

The current analysis was designed to further explore potential relationships between task performance decrement and body cooling, and between body cooling and physical characteristics of the test divers. Test divers were rank ordered on a variety of indices in each of three categories: physical fitness body cooling and performance decrement. . . . Individual differences in body cooling were significantly related to individual differences in four of eight indices of physical fitness: heart rate recovery, respiratory minute volume, forced expiratory volume, and the cold pressor response. Measures of this type appear to

have potential as predictors of diver body cooling. Rank orders based on levels of task performance under baseline conditions were significantly altered by the cold water exposure condition, but the differences in performance could not be attributed to individual differences in body cooling. Within the range of body cooling experienced by these test divers, 3-6% reduction of initial levels of body heat content, concomitants of cold water exposure other than body cooling may account for performance decrement in perceptual/cognitive tasks. Potential sources include individual differences in susceptibility to distraction, fatigue and motivational effects. (From DD abstract)

449a.
VAUGHN, J.A., E.A. Higgins, and G.E. Funkhouser.
Effects of body thermal state on manual performance.
Aerospace Medicine, 39:1310-1315; 1968.

Thirty-six young men were exposed for two hours to environmental temperatures of 10°, 26.7°, or 46°C. Measurements of rectal and skin temperatures, heart rate and respiratory rate were made, and average skin and average body temperatures were calculated. Manual performance consisted of standardized peg tests for hand and finger dexterity, and a written motor coordination test. Converted scores showed no significant differences in peg placing at any of the thermal states studied. Men exposed to the neutral environment scored highest in the finger dexterity tests, but values for motor coordination were greater in the heat than in the other two environments. These data suggest that coarse hand movements are independent of body thermal state, but that more discrete tasks involving hand and finger dexterity, and motor coordination, can be most efficiently performed in warmer environments which promote at least thermally neutral values of skin and deep body temperature.

450.
VAUGHN, L.K., W.L. Veale and K.E. Cooper.
Impaired thermoregulation in pregnant rabbits at term.
Pfluegers Arch. Eur. J. Physiol. 378(2):185-188; 1978.

Pregnant and nonpregnant female rabbits [*Oryctologus cuniculus*] were placed in hot (33°C) and cold (3°C) environments and their core temperatures measured. Three days pre-parturition, pregnant rabbits were less capable of maintaining normal body temperatures in thermally adverse environments than nonpregnant rabbits. This alteration in thermoregulatory ability may signal an environmental temperature change not dangerous to nonpregnant rabbits to be potentially harmful or lethal to both mother and offspring.

450a.
VAUGHN, P.B.
Local cold injury-menace to military operations: A review.
Military Medicine 145(5):305-311; May 1980.

Cold injuries are best treated by physicians knowledgeable in cold injury pathophysiology. A conservative therapy program consisting of rapid thawing where possible, avoidance of infection, continued active exercise with periodic elevation, prohibition of surgical debridement, and postponement of surgical intervention offers the best result. An organized approach, stressing active prevention methods formulated through cooperative medical and command efforts and emphasizing reversal of basic pathophysiology in casualty treatment, will minimize the cold injury menace to the wintertime Army.

451.
VAZQUEZ, R., A.M. Castro, M. Barahona and J.M. Riesco.
Response of the rat adrenal cortex to moderate and sustained cold.
Arch. Biol. 89(1):11-26; 1978.

After exposing rats to moderate cold (4°-6°C) for 1, 3, 5, 13, 21 and 31 days, certain cellular alterations were noted in different regions of the adrenal cortex. The glomerulosa layer showed few changes. Only the 13 day group had an increased number of liposomes in all its cells. In the zona fasciculata, there was a predominance of dark cells over clear cells except in animals exposed for 21 days, in which the clear cells predominated. In dark cells, many mitochondria and tubular smooth endoplasmic reticulum, were observed. The clear cells had fewer mitochondria and a vesicular appearance. There were many liposomes, particularly in the most superficial and deep layer of the zona fasciculata, which converged. In rats with prolonged exposure, the zona reticularis had many cells with modified mitochondria. Apparently moderate cold does not activate the adrenal cortex; it remains in a resting state.

452.
VAZQUEZ, R., F. Bermejo, A.M. Castro and M. Barahona.
Ultrastructural changes in the adrenal cortex of rats exposed to extremely low temperatures.
Anat. Histol. Embryol. 7(4):289-299; 1978.

The adrenal cortex response to low temperature in relation to exposure length was studied. The morphological changes in the adrenal cells, mainly in the zona fasciculata, were examined. White rats (30) of both sexes, divided into 6 groups, were exposed during time intervals of different lengths to -12-15°C temperatures. Cellular modifications, shown by EM at the level of the mitochondria, the smooth endoplasmic reticulum and the liposomes were analyzed and compared with gland function. An attempt was made to establish a correlation between morphology and function.

453.
VEGHTE, J.H.
Cold sea survival.
Aerosp. Med. 43:506-511; May 1972.

Two prototype three-man life rafts were evaluated during the winter months in Arctic waters off Kodiac Island, Alaska, to assess potential survival problems and determine tolerance limits. Each raft incorporated thermal characteristics specifically designed for cold water. Water and air temperatures varied from 0 to +2C and -5 to +1C respectively. Surface and core temperatures of each of the three subjects were monitored continuously during the 22-hr exposure in the TUL raft and the 6-hr exposure in the P-B raft. Each subject wore a different clothing assembly: a full pressure suit, light flight clothing and the ventile anti-exposure suit. All subjects were removed upon reaching subjective tolerance. The results showed that none of the clothing assemblies was adequate to maintain a person in comfort even with dry boarding. No significant biochemical shifts in the blood or urine were found. The TUL raft was found to be superior in its thermal characteristics and afforded better subject protection. General tolerance for cold water immersion, wet and dry and cold water raft exposures are depicted graphically, based on previously reported data. (Author's abstract)

454.
VOLZHINA-ATABEGOVA, N.G.
Glycolytic processes in the brain in interrupted and continuous adaptation to low temperatures.
Biol. Nauki. (Mosc.) (5):32-36; 1978.

Glycolytic processes were studied in brain tissue of white rats subjected to interrupted cooling (multiple

exposures to cold until a 19-20°C rectal temperature was reached) and continuous cooling (prolonged influence of moderately low temperatures). Changes in glycolytic processes in both types of adaptation were of the same type.

455.
VOLZHINA-ATABEGOVA, N.G.
Interrelationship of main pathways of carbohydrate transformation in the brain during hypothermia.
Vopr. Med. Khim. 24(3):330-334; 1978.

The main energy substrates of the brain glucose and glycogen, key enzymes of their conversion, hexokinase, amylase and phosphorylase and the main pathways of carbohydrate utilization respiration, glycolysis and pentosephosphate pathway, were studied in rat brain at various cooling phases. Phase alterations of metabolic reactions were observed in hypothermia. The hypothermia was accompanied by quantitative and qualitative alterations in relations between main metabolic pathways.

456.
VOLZHINA-ATABEGOVA, N.G.
Activity of brain oxidative enzymes of Krebs cycle in hypothermia.
Vopr. Med. Khim. 25(3):308-311; May-June 1979.

Cooling of rats down to the rectal temperature of 33-35° without the use of narcotic and neuroplegic drugs did not cause distinct alterations in activity of the oxidative enzymes of tricarboxylic acid cycle – isocitrate dehydrogenase, α-ketoglutarate dehydrogenase, malate-, succinate- and pyruvate dehydrogenases in brain tissue. At the same time, inhibition of the activity of these dehydrogenases occurred in profound hypothermia (cooling to 19-20°). In this case the activity of succinate dehydrogenase was decreased less distinctly as compared with the activity of NAD-dependent dehydrogenases. Succinic acid appears to be an especially important substrate for oxidation in brain of the chilled rats.

457.
WANDERER, A.A.
An 'allergy' to cold.
Hosp. Pract. 14(6):136-137; June 1979.

A familial disorder manifest as an allergy to cold has been described. A case is presented and a family tree of one family dating back to 1700's is shown. There is no treatment other than rewarming and there is no prophylaxis other than staying out of the cold. (CWS/UMS)

458.
WANG, L.C.H. and R.E. Peter.
Hypothermia by helium-oxygen and cold: Changes of plasma glucose, free fatty acids, Thyroxine, and Corticosterone.
Cryobiology 13(6):658-659; 1976.

Abstract only. Excerpts quoted: Unanesthetized rats exposed to a 79% helium and 21% oxygen ($He\text{-}O_2$) gas at ambient temperature (Ta) of -10°C became hypothermic and reached a body temperature (Tb) of 23°C after 3 hr. Spontaneous rewarming to normothermy was complete 4-6 hr after the Ta was increased to 19°C and $He\text{-}O_2$ replaced by normal air. Blood samples were withdrawn via a chronically implanted carotid cannula at times of day representing, respectively, pre-exposure to $He\text{-}O_2$ and cold (Tb = 38.2°C; S_1 0930 hr), during induction of hypothermia (Tb = 23.6°C; S_2 1300 hr), during recovery from hypothermia (Tb = 34.3°C; S_3, 1630 hr), and 22 hr after exposure to $He\text{-}O_2$ and cold (Tb - 37.7°C; S_4, 0800 hr, day 2). . . . The observed increases of plasma glucose, FFA, and corticosterone during the induction of hypothermia were qualitatively similar to those typical under acute cold exposure. During hypothermia and the recovery from it, normal blood glucose and hormone levels and elevated FFA levels

were maintained. This suggests that the integrity of at least some of the metabolic regulatory mechanisms are maintained during hypothermia induced by the present method.

459.

WANG, L.C.H. and R.E. Peter.

Changes in plasma glucose, FFA, corticosterone, and thyroxine in He-O_2 induced hypothermia.

J. Appl. Physiol. 42:694-698; May 1977.

Unanesthetized, male rats were exposed to normal air (NA) or NA and a 4 h-exposure of He-O_2 (79% helium, 21% oxygen) at ambient temperature (T_a) of 22 or -10°C. Blood samples from each individual were taken from a chronically implanted carotid cannula at 1) preexposure, 2) during exposure, 3) 2.5 h after exposure, and 4) 19-20 h after exposure. Exposure to He-O_2 at 22°C caused an increase in plasma free fatty acids (FFA) and corticosterone of 45% and 49%, respectively, with little change in plasma glucose and thyroxine. Exposure to He-O_2 at -10°C for 3 h invariably induced hypothermia with body temperature (T_b) decreased to 23.7 ± 0.5°C (N = 10). During hypothermia, plasma glucose, FFA, and corticosterone were significantly higher ($P < 0.05$) than those at preexposure and those after exposure to NA at -10°C. During spontaneous recovery from hypothermia, at T_a = 19°C and NA, glucose, corticosterone, and thyroxine returned to normal, but FFA remained significantly higher than at preexposure. The ability of animals to rewarm spontaneously from hypothermia and the quick return of metabolic substrates and hormones to normal after rewarming indicates the preservation of regulatory mechanisms for metabolism at depressed T_b when hypothermia is induced by He-O_2 and cold. (Authors' abstract)

460.

WANG, L.C.H. and J.W. Hudson.

Strategies in cold: Natural torpidity and thermogenesis.

Symposium, Jasper Park Lodge, Alberta, Canada, Oct. 3-8, 1977. 715p.

Twenty papers by contributing authors devoted to physiological and cellular aspects of natural torpidity and thermogenesis are included. The 1st section is concerned with comparative aspects and includes papers on the circannual cycles in hibernators; shallow, daily torpor as a thermoregulatory adaptation; energetic and field aspects of mammalian torpor and the economics of torpor and thermoregulation in nonmammalian organisms. The 2nd section includes papers on the role of the CNS including topics such as neuronal models in mammals, sleep and hibernation, thermosensitivity in preoptic neurons and autonomic regulation of hibernation. A section on cellular and biochemical adaptations follows, including membrane lipid phase-transitions, metabolic economy and metabolic and endocrine changes in hibernation. The remaining section considers thermogenesis and humans in cold environments and includes papers on thermogenesis in brown adipose tissue, nonshivering thermogenesis, thermoregulatory threshold deviations in thermal adaptation and cold adaptation in man. Diagrams, tables and references supplement the text. Individual papers are indexed in Bioresearch Index.

461.

WANG, L.C.H.

Factors limiting maximum cold-induced heat production.

Life Sci. 23(21):2089-2098; 1978.

A previous study indicated that respiratory and cardiovascular functions are not limiting factors for maximum thermogenesis in acute cold exposure. Exhaustion of cellular oxidative capability and substrate-related functions were investigated as limiting factors. Unanesthetized male rats were exposed to He-O_2 (20.94% O_2, balance He) at -10°C, which elicited maximum thermogenesis and mild hypothermia. To alter the endogenous substrate profile, each rat was either fed or not fed the night before the experiment (self-control). The data do not indicate that exhaustion of cellular oxidative capability is the limiting factor for maximum thermogenesis. In the fed state, the maximum rate of thermogenesis and total heat production were significantly greater ($P < .05$) than those found in the non-fed state,

resulting in significantly less ($P < .05$) depression of body temperature at end of cold exposure. Apparently substrate availability may act as a limiting factor for effective expression of maximum thermogenesis in acute cold exposure.

462.

WANG, T.C.

Decompression cycling effects on the shelf life of lithium hydroxide.
Mar. Technol. Soc. J. 9:36-40; Apr./May 1975.

The purpose of this study was to measure the change in CO_2 absorption capacity of lithium hydroxide due to cyclical compression and decompression. Since the lithium hydroxide shows the superiority of CO_2 removal at temperatures below 40°F, lithium hydroxide was considered as an effective absorbent for cold water diving operations. However, it was necessary to measure the chemical stability of lithium hydroxide in order to predict the effectiveness of its use in emergency operations in the submersible. An experiment was performed to measure this. Five grams of lithium hydroxide were packed in a plastic bag with a small hole in it. This was then placed in a compression chamber. The physical and chemical environment of the chamber was modified to simulate the conditions in the lock-out chamber of the submarine in operation at 150 feet. Sample bags from the chamber were used to perform the CO_2 absorption tests at room temperature and around 40°F, respectively. The results show about 1.5% of CO_2 absorption capacity was reduced due to each compression-decompression cycle. At the end of 25 cycles the efficiency was reduced to 70% of the initial reactive efficiency. (Author's abstract)

463.

WATTENBARGER, J.F. and J.R. Breckenridge.

Dry suit insulation characteristics under hyperbaric conditions.
In: Johnson, C.E., M.L. Nuckols and P.A. Clow, eds. Hyperbaric diving systems and thermal protection. OED Vol. 6, p.101-116. New York, N.Y., American Society of Mechanical Engineers, 1978.

The "dry" suit approach to cold water protective clothing for divers has been emphasized by the Diver Thermal Protection (DTP) project at the Naval Coastal Systems Center (NCSC). The insulative properties of several dry suits and associated undergarments were determined using a copper manikin immersed in water under various hyperbaric conditions and gas compositions. The neoprene foam suits provided greater insulation near the surface, but under pressure the insulation provided by these suits approached that of the rubber-coated polyester suits. The insulation values provided by the commercially available undergarments were comparable to each other and appeared slightly better than a sample of a developmental undergarment. The insulation values in helium environments were considerably less than those found in nitrogen environments. (Authors' abstract)

464.

WAYNE, M.A.

Conversion of paroxysmal atrial tachycardia by facial immersion in ice water.
J. Amer. Coll. Emergency Phys. 5:434-435; June 1976.

Based on the concept of the classic diving reflex, which produced bradycardia, a technique for treating uncomplicated, but symptomatic paroxysmal atrial tachycardia was developed. This technique consists of facial immersion for 15 to 30 seconds in water at 10°C (50F). Of ten patients 9 (90%) achieved rapid conversion without complications. This technique may be especially useful for those patients resistant to more conventional methods of inducing conversion of paroxysmal atrial tachycardia. (Author's abstract)

465.

WEARS, R.L.

Blood gases in hypothermia (letter).

JACEP 8(6):247; June 1979.

(To the Editor) Several excellent reviews on hypothermia have stressed the fact that blood gas results must be corrected for temperature, but have failed to provide the correction factors. Based on the work to which these papers refer, we have calculated the appropriate correction factors and provide them in the following table. Note that to obtain corrected pO_2 and pCO_2, one multiplies by the appropriate factor, but that for pH, the correction is added.

Temperature		Correction		
(F)	(C)	pCO_2	pO_2	pH
108	42.2	1.25	1.35	.08
106	41.1	1.19	1.26	.06
104	40.0	1.14	1.19	.04
102	38.9	1.08	1.11	.03
98.6	37.0	1.00	1.00	0
95	35.0	.92	.89	+.03
90	32.2	.82	.76	+.07
88	31.1	.78	.72	+.09
86	30.0	.74	.67	+.10
84	28.9	.71	.63	+.12
82	27.8	.68	.59	+.14
80	26.7	.64	.56	+.15
78	25.6	.61	.52	+.17
76	24.4	.59	.49	+.18
74	23.3	.56	.46	+.20
72	22.2	.53	.43	+.22

pH increases 008 units per degree F fall in temperature
pO_2 decreases 3.3% per degree F fall in temperature
pCO_2 decreases 2.4% per degree F fall in temperature

465a.

WEBB, P.

Body heat loss determined calorimetrically during cold underwater swims.

In: Aerospace Medical Association. 1973 annual scientific meeting, Las Vegas, Nevada, May 1973. Preprints, p.15-16. Published by the Association, 1973.

Three subjects swam underwater in a tank at temperatures of 5, 10 and 15°C. The exposures were to have lasted 60 minutes, but frequently they were shortened at the requests of the subjects. Mean voluntary exposure time at 5°C was 45 minutes, at 10°C, 48 minutes, and at 15°C, 58 minutes. They wore dry rubber suits and thick long cotton underwear. Rewarming was accomplished by passing warm water through the tubes in the underwear and gradually lowering the water temperature as thermal balance was restored. Mean estimated heat loss in Keal was 210 at 5°C, 216 at 10°C and 203 at 15°C. The degree of heat loss was considerably higher than was expected from previous studies in cold air. Changes in surface and deep body temperatures could not be used to estimate heat loss. This was done by adding the heat input from warm water and the metabolic heat generated during rewarming. (MFW/BSCP)

465b.

WEBB, P.

Body heat loss in undersea gaseous environments.
Aerospace Med. 41(11):1282-1280; 1970.

Men who spend days in undersea hyperbaric gas environments require warm gas temperatures, typically above 29°C (85°F). They lose heat mostly by convection, despite a narrow skin-to-fluid temperature gradient. Empirical data in comfortable temperatures are arranged on a scale of "convective character" for fluids ranging from air at 1 Ata to water, which is 167 times more convective. Respiratory heat loss is greatly increased when breathing hyperbaric gases; during dives to 600 feet and deeper, the heat drain from the respiratory tract may become large enough to require heated breathing equipment. Prolonged stays in hyperbaric environments produce slight but consistent increases in resting metabolism, heart rate, and internal temperature, accompanied by loss in body weight despite adequate food intake. It is postulated that a chronically increased convective and respiratory heat drain is matched by a persistent increase in metabolic heat production.

465c.

WEBB, P.

Current concepts of metabolism and thermophysiology.
In: Bachrach, Ed. Underwater Physiology VII. p 493-500.
Bethesda, MD. Undersea Medical Society, 1981.

A review of what is now known concerning metabolism and thermal physiology, largely hypothermia. The following section headings give a concise picture of what was covered: Metabolic Response to Hyperbaric Gas; Weight Loss in Saturation Diving; Metabolic Response to Cold Exposure; Thermophysiology in Hyperbaric Gas Environments; Body Temperature Change And Heat Loss in Diving; Rewarming; Performance of Divers in Cold Water. (CWS/UMS)

465d.

WEBB, P., E.L. Beckman, P. Sexton and W.S. Vaughan.

Proposed thermal limits for divers: A guide for designers of thermally protective equipment.

Yellow Springs, Ohio, Webb Associates, Rep. on Contract N00014-72-C-0057, 32p. July 1976.

This report is the result of a conference held at Webb Associates, Yellow Springs, Ohio, in May 1976. Its emphasis is on the physiological and behavioral aspects of the exposure of man to cold water, with the purpose of defining the physiologically acceptable limits of cooling. The table of contents is as follows: Thermal limits; Physiological factors: total body heat loss, respiratory heat loss, change in core temperature, surface temperature change, hands and feet, shell and core relationships, metabolic effects, secondary effects of exposure to cold, heating the body; Performance factors: distraction effects, peripheral cooling effects on sensory and psychomotor performance, deep body cooling effects on perceptual and cognitive performance, dysfunction effects; Evaluation of protective equipment; Further thoughts; Research needs. (MFW/UMS)

466.
WEBB, P.

Rewarming after diving in cold water.

Aerosp. Med. 44:1152-1157; Oct. 1973.

Rewarming was studied in three lightly clothed divers who had swum submerged in water of 5°, 10°, and 15°C for 45 to 60 minutes, reaching the limit of subjective tolerance to cold. Heat for rewarming the men after the dive came from warm water being circulated through a water cooling garment, plus their own metabolic heat. Both of these heat quantities were measured, and it was found that an average of 210 kcals (range 165-292 kcals) was needed to replace the heat lost during the dives. The completion of rewarming was signalled by: the release of body heat when previously it had been conserved by the cold subject; a rise in heart rate and the return of cutaneous vasomotor control of body heat loss; and a restoration of the normal balance between heat produced and heat lost. Over-warming led to sweating. None of the following body temperatures reliably indicated completion of rewarming: rectal, ear canal, esophageal, skin (mean or any of 8 sites), calf or chest subcutaneous temperature, or calculated mean body temperature. (Author's abstract)

467.
WEBB, P.

Thermal problems in diving.

The sixth Undersea Medical Society workshop, Webb Associates, Yellow Springs, Ohio, May 2-3, 1974. Bethesda, Md., Undersea Medical Society, Inc., Rep. WS-12-1-74; 36p.

This summary report presents briefly the currently accepted knowledge of the effects of cold water exposure. Points that were especially useful, or new, are emphasized. Rewarming and thermal protection are separately treated, as are limits for experimental cold exposures and selection of subjects for such exposures. There are also brief sections on diver effectiveness in cold, and on the thermal problems of hyperbaric living. (Author)

468.
WEBB, P.

Cold exposure.

In: Bennett, P.B. and D.H. Elliott. The physiology and medicine of diving and compressed air work; Second Edition, p.285-306. Baltimore, Williams and Wilkins Co., 1975.

Heat loss in cold water is discussed first: heat transfer from skin to water, vasoconstriction, the protective effect of subcutaneous fat, body heat loss, conductance, shivering, tolerance limits, and adaptation. The other serious thermal effect in diving is respiratory heat loss. This is not affected by the aforementioned thermoregulatory responses; the loss of heat is from the core of the body. Convection is its dominant component. Breathing cold hyperbaric gas can result in dangerous lowering of core temperature without any loss at all in surface temperature. Heating of the breathing mixture is now recognized as essential. Hypothermia occurs when the rectal temperature is below 35°C. Symptoms are mental confusion, lethargy, poor speech articulation, hallucinations, decreased sensation, and impaired motor function. When hypothermia occurs in diving, rapid rewarming is called for. The patient should be placed in a tub of hot water or into a water-heated suit. There are complicated medical means of rewarming which are impossible to carry out in the field. The water should be constantly stirred, and maintained at a temperature of 40 to 42°C. When the rectal temperature is 36°C, the patient may be removed. Cold is a contributing factor in decompression sickness, and has a detrimental effect on performance. Means of thermal protection include electrically heated suits (unsatisfactory so far) hot water heated suits (reasonably satisfactory) and heating by various means of the respiratory gas. The author concludes with a discussion of comfort and thermal drain in dry hyperbaric environments, and the interesting question of weight loss. (MFW/UMS)

469.

WEBB, P., E.L. Beckman, P. Sexton and W.S. Vaughan.

Proposed thermal limits for divers: A guide for designers of thermally protective equipment.

Yellow Springs, Ohio, Webb Associates, Rep. on Contract N00014-72-C-0057, 32p. July 1976.

This report is the result of a conference held at Webb Associates, Yellow Springs, Ohio, in May 1976. Its emphasis is on the physiological and behavioral aspects of the exposure of man to cold water, with the purpose of defining the physiologically acceptable limits of cooling. The table of contents is as follows: Thermal limits; Physiological factors: total body heat loss, respiratory heat loss, change in core temperature, surface temperature change, hands and feet, shell and core relationships, metabolic effects, secondary effects of exposure to cold, heating the body; Performance factors: distraction effects, peripheral cooling effects on sensory and psychomotor performance, deep body cooling effects on perceptual and cognitive performance, dysfunction effects; Evaluation of protective equipment; Further thoughts; Research needs. (MFW/UMS)

470.

WEBB, P.

Human tolerance to thermal extremes.

In: Egstrom, G.H., ed. Thermal problems in diving. Proceedings of a seminar held at Commercial Diving Center, Wilmington, California, March 19-20, 1976, p.17-28. Wilmington, Calif., Commercial Diving Center, June 1977.

The author discusses tolerance to extreme heat and cold. Tolerance has several aspects: first, the individual's voluntary limit to endure discomfort; second, the effect of temperature on performance; third, physical incapacitation–disorientation, extreme weakness, or unconsciousness; fourth, tissue damage–reversible (e.g., frost-bite) or irreversible (e.g., brain damage). The ultimate intolerance is death. The tolerable range in each direction is 200 kcal for a man still able to perform, and 300-400 kcal for a man who is helpless but can survive if rescued and treated. Fatigue is one of the main responses to either heat or cold. The principles of body heat storage and body heat loss are discussed, as is clothing, cold water survival, and precooling as protection. A man's tolerance to heat exposure can be nearly doubled by placing him in cold water (temperature unspecified) for a period of 30, 60, or 90 minutes before heat exposure. (MFW/UMS)

471.

WEBB, P.

Calorimetric analysis of cold exposure in diving.

In: Shilling, C.W. and M.W. Beckett, eds. Underwater physiology VI. Proceedings of the sixth symposium on underwater physiology, p.107-113. Bethesda, Md., Federation of American Societies for Experimental Biology, 1978.

Our objectives are to quantify the body heat loss that occurs during diving and to understand the energetics, the temperature changes, and the responses of men during cooling and during rewarming. Using a water cooled suit as a direct calorimeter, and with continuous monitoring of deep and surface temperatures, of metabolic free energy conversion from oxygen consumption, and of heart rate, we have studied men during and after a cold underwater swim in the laboratory. We have also produced cooling at various rates with the cooling suit. Experiments were carried to the point of voluntary tolerance for cold, which occurred at a number of levels of heat loss and of decreases in body temperature. During the underwater swims, men lost an average of 210 kcal of heat in an hour; during slow suit cooling of 1-2 hrs, men lost from 200 to more than 300 kcal; during fast suit cooling, heat losses well above 300 kcal occurred. There is excellent correlation between the quantity of heat lost and change in either deep body temperature ($r = 0.95$) or mean body temperature ($r = 0.98$); the men appeared to be in very early

hypothermia–not the deep hypothermia that demands immediate medical intervention. Strong shivering became fatiguing after an hour. There was some anxiety felt by subjects during the strongest cooling runs, and some loss of cognitive functions was reported. We would guess that deeper hyperthermia than we produced would be hazardous to a working diver. Rewarming was done by heating the water circulating through the suit, and its completion was signalled by a return of normal thermoregulatory and circulatory functions. (From Sixth symposium program and abstracts)

471a.

WEBB, P., S.J. Troutman, Jr. and J.F. Annis.

Heat loss and body temperature change during measured cooling.

In: Program and Abstracts, Undersea Medical Society, Inc., Annual Scientific Meeting. Undersea Biomed. Res. 6(Suppl.):27; Mar. 1979.

Abstract only. Entire item quoted: It would be useful to be able to estimate heat loss from given changes in body temperature, or, conversely, to be able to predict body temperature for given amounts of heat loss. Having measured both heat loss and body temperature during numerous laboratory cold exposures similar to those encountered in diving, we find that the relationship between heat loss and body temperature is strongly affected both by the physical characteristics of the subject's body and by the rate of cooling. We illustrate the importance of these two effects with data from experiments in which we cooled men in a calorimeter while also measuring metabolic rate and temperatures of the core and surface. Rates of heat extraction varied from about 50 kcal/hr to over 500 kcal/hr. Accumulated net heat losses (total heat loss minus heat production) ranged from about 100 kcal to over 300 kcal. As expected, the tolerability of a given amount of heat loss was greater for a large man, and greater for a man with considerable body fat. Unexpectedly, very slow cooling to a given high level of heat loss, e.g. 300 kcal, was not only more tolerable than the same loss rapidly incurred but also body temperatures stayed high and metabolic response was less. To be able to estimate heat loss from body temperature change and vice versa requires formulations which take into account the cooling rate and the physical characteristics of the subject. Such formulations are discussed in a companion presentation.

471b.

WEBB, P.

Thermal problems in underwater gaseous environments.

In: Egstrom, G.H., ed. Thermal problems in diving. Proceedings of a seminar held at Commercial Diving Center, Wilmington, Calif., March 19-20, 1976, p.29-33. Wilmington, Calif., Commercial Diving Center, June 1977.

In order to deal with thermal problems in undersea gaseous environments a magic number was invented called "convective character of the gas." This number is a "multiple of the density which is usually expressed in gm/liter and specific heat at constant pressure which is cal.gm–°C and k for thermal conductivity in cal/min–cm–°C." They are multiplied together and then divided by the viscosity in centipoises. The values are in standard handbooks for helium, nitrogen and oxygen. Density varies directly with pressure. Specific heat does not change much from pressure, nor do thermal conductivity and viscosity. (CWS/UMS)

472.

WEIHE, W.H. and R. Beglinger.

The influence of exposure to cold on the incidence of gastric ulcers after reserpine in rats. Int. J. Biometeorol. 22(4):295-302; Dec. 1978.

Groups of female rats (n = 20) exposed from 0 to 13 days to T_a's from 8.0° to 29.0°C were given 2.5 mg/kg reserpine i.p.; T_{re} and gastric ulcers (GU) were recorded 24 h afterwards. At exposure temperatures below 21.0°C there was a highly significant positive correlation between T_a and T_{re} ($r = 0.85$) and a negative correlation between T_a and GU ($r = 0.92$). The GU rate after reserpine was not affected by temperatures above 21°C up to 29°C. Below 16.5°C a difference of the reserpine response was found

between rats with less and more than 3 days acclimation to a given T_a. In rats with less than 3 days acclimation the mean T_{re} after reserpine was 1.0°C lower and the mean GU rate was 1.7 ulcers/rat higher than in rats with more than 3 days acclimation. The correlation of T_{re} with GU rate revealed that the mean number of GU increased with decreasing T_{re}. T_{re} and GU were negatively correlated in both series of experiments: $r = 0.92$ for non-acclimated rats and $r = 0.95$ for $>$ 3d acclimated rats. Cold acclimation of rats for 8 days at 13.0°C or 13 days at 10.0°C did not significantly affect T_{re} and the GU rate if the rats were taken to 21.0°C after reserpine administration. The results show that with and without cold-acclimation the extent of hypothermia in rats after a standard reserpine dose depends on the prevailing ambient temperature below the comfort range and the GU rate depends on the extent of the hypothermia.

473.

WEIHL, A.C., H.C. Langworthy, R.P. Layton, P.F. Hoar and L.W. Raymond.
Metabolic responses of resting divers immersed in 25.5°C and 33°C water.
In: Program and Abstracts, Undersea Medical Society, Inc., Annual Scientific Meeting. Undersea Biomed. Res. 5(Suppl.):31-32; Mar. 1978.

Abstract only. Entire item quoted: Previous studies from this laboratory have reported the physiological responses of divers working in 25.5°C water. The current study investigated plasma norepinephrine, epinephrine and cortisol, as well as rectal temperature (T_{RE}), O_2 consumption ($\dot{V}O_2$), CO_2 production ($\dot{V}CO_2$) and minute ventilation ($\dot{V}E$) in unprotected air breathing diver immersed in 25.5°C or 33°C water at a depth of 3 meters. At the end of three 14 min. exposure periods in 25.5°C water, the divers were shivering uncontrollably; they remained euthermic and comfortable at 33°C. Results obtained in 25.5°C water showed a significant ($p < .001$) rise in plasma norepinephrine from a baseline of 384 ± 183 (S.D.) pg/ml to 1542 ± 538 pg/ml at the end of three 14 min. exposure periods. Plasma epinephrine declined from a baseline of 45 ± 14 pg/ml to 29 ± 10 pg/ml at the end of the first 14 min. exposure ($p < 0.01$), then returned to baseline levels. T_{RE} decreased 0.74 ± .48°C. Cortisol showed no change from baseline levels. In 33°C water, norepinephrine was unchanged but epinephrine declined from a baseline of 48 ± 17 pg/ml to 14–17 pg/ml at the end of the exposure periods ($p < .001$). Cortisol was again unchanged, as was the T_{RE}. $\dot{V}O_2$, $\dot{V}CO_2$ and $\dot{V}E$ were significantly higher during 25.5°C exposure, (.494, .333 and 12.37 l/min. respectively) when compared to values obtained in 33°C water (.336, .224 and 8.16 l/min.) $p < 0.05$. We conclude that the catechol response observed in 25.5°C water is due to peripheral release of norepinephrine from nerve endings, not due to an adrenal response, as indicated by the absence of a rise in epinephrine and cortisol. The observed fall in epinephrine may explain the reports by others that plasma renin falls during water immersion, associated with a fall in aldosterone as well.

473a.

WEIHL, A.C., H.C. Langworthy, A.R. Manalaysay and R.P. Layton.
Metabolic responses of resting man immersed in 25.5°C and 33°C water.
Aviat. Space Environ. Med. 52(2):88-91; 1981.

This study was undertaken to determine the hormonal responses to disabling hypothermia as a result of cold water immersion. Thermally unprotected male divers trained by the U.S. Navy were subjected to total body immersion in water at 25.5°C and 33°C. Plasma epinephrine, norepinephrine, growth hormone, and cortisol were measured. Other variables monitored included oxygen consumption, carbon dioxide production, minute ventilation, and rectal temperature. Immersion without cold stress caused suppression of plasma epinephrine without affecting plasma norepinephrine. Cold stress combined with immersion caused a significant increase in plasma norepinephrine in the absence of other indicators of a generalized stress reaction. The degree of chilling seen in this study will produce disabling hypothermia within 1-2 h and may be shown initially only by an increase in plasma norepinephrine. (Authors' abstract)

474.

WELTON, D.E., K.L. Mattox, R.R. Miller and F.F. Petmecky.

Treatment of profound hypothermia.

JAMA 204(21):2291-2292; 17 Nov. 1978.

Many lives were lost due to accidental hypothermia during the severe winters of 1977 and 1978. The alcoholic, the trauma victim, and the elderly with underlying medical disorders are at risk of losing consciousness outdoors and therefore are prone to the development of this medical emergency. All physicians who might encounter hypothermic patients should be reminded that this disorder is completely reversible even when complicated by refractory ventricular fibrillation. Because the profoundly hypotensive patient often appears lifeless, the definition of death in this syndrome has been restated as failure to revive with rewarming. Thus, a vigorous attempt at rewarming is mandatory. Although the outlook for the patient may appear grim, the physician should not abandon hope until every available resource of the emergency medical system has been exhausted.

474a.

WEST, George C., E.R.R. Funke, and J. S. Hart.

Power spectral density and probability analysis of electromyograms in shivering birds.

Canadian J. Physiol. and Pharmacol. 46(5):703-706; 1968.

The spectral analysis of electromyograms from evening grosbeaks, *Hesperiphona vespertina*, and common grackles, *Quiscalus quiscula*, revealed a statistically significant higher upper cut-off frequency during shivering in the former species. There was also a statistically significant decrease in the upper cut-off frequency with lowering of temperature in the evening grosbeak, but not in the grackle. The frequency of occurrence of various amplitudes during shivering followed the normal distribution closely in both species. The presence of frequencies in the range from 6 to 600 c.p.s. necessitates the use of wide-band instrumentation for fidelity in measuring species differences.

474b.

WEYBREW, B.B., L.M. Dean and E.M. Noddin.

Attitude changes during a cold weather combat exercise: an exploratory study.

Report Number 907, Naval Submarine Medical Research Laboratory, Submarine Base Groton, Conn.

Exploratory in nature, this study was designed to identify some of the personality trait configurations and attitude change patterns related to individual differences in cold coping capacity (CCC). Three enlisted marines participated in a week-long cold weather North Atlantic Treaty Organization (NATO) combat exercise in upper Norway. The Minnesota Multiphasic Personality Inventory (MMPI) was administered prior to the exercise. Designed to measure the attitudes and expectancies associated with exposure to cold, a 50-item Cold Exposure Attitude Scale (CEAS) was administered to the 3 subjects before and after the exercise. The results showed that attitudes related to the perceived disorganization of the mission and its justification changed most negatively. On the other hand, attitudes regarding the encumbrance of cold weather gear and risk to health changed the most in a positive direction. Based upon selected patterns of MMPI scores, 2 of the subjects were assumed to typify persons with low and high cold coping capacity (CCC). Arguing at least for preliminary validity for this typology were significantly (5% level) different patterns of CEAS item changes (pre- and post-cold exposure) for the two types. The results of the study suggest novel methodological approaches to analyzing "cold" data and, at the same time, provide some plausible hypotheses as to possible trait configurations predictive of individual differences in CCC.

474c.

WEYBREW, B.B., H.B. Molish and R.P. Youniss.

Prediction of adjustment to the Antarctic.

U.S. Nav. Med. Res. Lab. Rep. No. 350, Bur. of Med. and Surgery, Navy Dept., Research Project MR005.14-2100-3.05.

The predictive validities of several psychometric tests as well as trait ratings by teams of psychologists and psychiatrists were examined with respect to criteria of adjustment to the Antarctic during the "wintering-over" period of 1957. Thirty-three subjective symptoms reported monthly together with three other attitudinal criteria were intercorrelated and factor analyzed. The total N was 109. Using factor scores computed for each of the five factors extracted from this matrix as adjustment criteria, it was found that men with the following characteristics had the greatest adjustment potential for the Antarctic conditions: high intelligence test scores, low interest in organized sports, rated high with respect to "ability to communicate," low with respect to "overt hostility," high with respect to "ability to cope with aggression," to have less than a college education, to be single and over 25 years of age, and to have come from the southern section of the U.S. The methodological importance of the application of factor analytic techniques to repetitively collected subjective data is emphasized.

474d.

WEYMAN, A.E., D.M. Greenbaum, and W.J. Grace.

Accidental hypothermia in the alcoholic population.

Am. J. Med. 56:13-21; 1974.

Thirty-nine cases of accidental hypothermia are reviewed. Data indicate that mortality varies with the presence of underlying disease rather than with the degree of hypothermia or the methods of rewarming. In 31 patients with hypothermia alone (average temperature 85°F) mortality was 6.25 percent. In eight patients with hypothermia and another primary condition (average temperature 84°F) mortality was 75 percent. Intractable cardiac arrhythmia has been reported as the primary cause of death in hypothermia. In these patients, death during hypothermia resulted from pulmonary complications. Ventricular arrhythmias, when they occurred, were responsive to routine measures such as electrical cardioversion and myocardial suppressant drugs. Methods of treatment are discussed.

474e.

WILCOCK, S. and V. Flook.

A computer model designed to make rapid predictions of diver temperature changes.

VIIth International Hyperbaric Physiology Symposium 555-563; 1981.

Reports a mathematical model of thermal balance designed to be used on-line to a computer so that a rapid estimate of rate of change of body temperature can be made once details of environmental conditions have been supplied. (CWS/UMS)

475.

WILDENTHAL, K., S.L. Leshin, J.M. Atkins and C.L. Skelton.

The diving reflex used to treat paroxysmal atrial tachycardia.

Lancet (1):12-14; Jan. 4, 1975.

Induction of the diving reflex, by immersion of the face in cold water (2°C) while the breath was held, converted paroxysmal atrial tachycardia to sinus rhythm within 15-30 seconds in seven patients (aged 22-66). Four had histories of attacks that had previously required vasopressor therapy, and two had been digitalised; three had no history of prior paroxysmal atrial tachycardia or heart-disease. The reported procedure, which is convenient, non-invasive, and can be self-administered by the patient after brief instruction, may offer a useful adjunct to carotid-sinus massage and intravenous infusion of vasopressors for the treatment of paroxysmal atrial tachycardia. (Authors' summary)

476.

WILL, D.H., I.F. McMurtry, J.T. Reeves and R.F. Grover.

Cold-induced pulmonary hypertension in cattle.

J. Appl. Physiol. Respir. Environ. Exercise Physiol. 45(3):469-473; 1978.

The frequency with which cattle develop right-heart failure during the winter at high altitude suggested that cold might contribute to hypoxic pulmonary hypertension. In a preliminary study conducted out-of-doors during early spring, 2 calves with known hyperreactive pulmonary vessels showed elevated pulmonary arterial pressures attributed to their prior exposure to nighttime cold (-5°C). In a 2nd study 5 hyperreactive calves had increases in mean pulmonary arterial pressure from 29-45 Torr (+55%) during 48 h of exposure to cold (0 to -5°C) in a climatic chamber. Calves (3) with less reactive lung vessels increased their pressures from 25 to 36 Torr (+44%). In a more complete study, 6 calves selected as potential hyperresponders showed increases in pulmonary arterial pressure (+60%), blood flow (+18%) and vascular resistance (+38%) during 48 h of cold exposure. Arterial PO_2 (partial pressure of O_2) decreased (-10 Torr) and P_{CO_2} (partial pressure CO_2) rose (+6 Torr) suggesting hypoventilation). O_2 breathing returned pulmonary pressures and resistance to near control values, suggesting that cold had induced a hypoxic pulmonary vasoconstriction and in increased blood flow. A cold produced pulmonary hypertension in cattle at the modest altitude of 1524 m and the pressor responses were greater in calves with more reactive lung vessels.

476a.

WILLISCROFT, R.G.

Heater and humidifier for breathing apparatus.

NOAA Diver 3(1):5-6; Feb. 15, 1979.

One major, and often overlooked, source of body heat loss while diving is that which is lost as heat and water vapor during respiration. . . .For umbilical-connected divers using hot water suits, the hot water is easily routed through a heat exchanger with the breathing mixture to keep the diver's temperature at the proper level. A technique for warming a scuba diver's air has been more difficult to develop. . . A simple solution to this problem has been developed by the Foundation for Ocean Research, a non-profit foundation headed by John D. Isaacs, Director, Institute of Marine Resources, Scripps Institution of Oceanography. Warming and humidification is done by adding a small portion of hydrogen (0.5% - 1.3%, less than ¼ the explosive level) to the breathing gas supply and by inserting a small canister containing a suitable catalyst (e.g., platinum) just upstream of the second-stage regulator. As the hydrogen-breathing gas mixture passes through the catalyst, the hydrogen reacts with a small portion of the mixture's oxygen releasing heat and water vapor. In standard compressed air, such as that used for scuba applications, each addition of 0.1 percent hydrogen to the mixture theoretically results in a temperature increase of about 0.05 percent increase in water vapor (the actual increase in temperature is about 5°C when heat loss, heat of expansion, etc., are taken into account). The relative humidity of the resultant mixture depends upon temperature and pressure, increasing with depth and decreasing with a loss in temperature. (Author)

476b.

WILSON, Ove, Donald C. Fink, George W. Molnar, and Ralph F. Goldman.

Measured and calulated cooling times to frost nip of the second digital phalanx.

Although models exist for predicting the time it takes from the start of an exposure to cold to the appearance of a frost nip (i.e. freezing) of human skin, there are considerable difficulties in such predictions. This paper presents measured cooling times in some 249 frost nip exposures, compares the actual time to frost nip with the predicted time using a 1 cm radius model finger, and discusses a variety of factors which might account for the differences, which are significant. The reason for the observed times being shorter than predicted is largely due to the non-Newtonian nature of the initial cooling, which is about twice as rapid for the finger as for the model.

476c.

WILSON,OVE and Ralph F. Goldman.

Role of air temperature and wind in the time necessary for a finger to freeze.

J. Appl. Physiol. 29(5):658-664; 1970.

The time to freeze exposed finger skin was measured at wind speeds of 5, 10 and 15 m/s at -5, -15, and -25°C. Fifty exposures resulted in freezing; in twenty-two other exposures the skin temperature leveled off and cyclic rewarming, by cold-induced vasodilatation (CIVD), set in. Marked supercooling, usually below -10°C, occurred prior to freezing as well as during CIVD. If CIVD occurred, freezing did not take place. There is no well-defined value of wind-chill index above which freezing regularly occurs, although it rarely occurs below a wind chill of 1400. Air temperature is the main factor in determining whether freezing, or CIVD, occurs at wind-chill indices predicting risk for freezing. This implies that, whatever the wind chill, the skin very often will not freeze above the temperature to which it readily supercools, which is probably between -10 and -15°C.

476d.

WILSON, OVE, Ralph F. Goldman, and George W. Molnar.

Freezing temperature of finger skin.

J. Appl. Physiol. 41(4):551-558; 1976.

In 45 subjects, 154 frostnips of the finger were induced by cooling in air at -15°C with various wind speeds. The mean supercooled skin temperature at which frostnip appeared was -9.4°C. The mean skin temperature rise due to heat of fusion at ice crystallization was 5.3°C. The skin temperature rose to what was termed the apparent freezing point. The relation of this point to the supercooled skin temperature was analyzed for the three wind speeds used. An apparent freezing point for a condition of no supercooling was calculated, estimating the highest temperature at which skin freezes at a given wind speed. The validity of the obtained differences in apparent freezing point was tested by an analysis of covariance. Although not statistically significant, the data suggest that the apparent freezing point with no supercooling decreases with increasing wind velocity. The highest calculated apparent freezing point at -15°C and 6.8 m/s was 1.2°C lower than the true freezing point for skin previously determined in brine, which is a statistically significant difference.

477.

WING, D.R. and W.D.M. Paton.

Effects of acute Δ^1-tetrahydrocannabinol treatment, of hypothermia and of ambient temperature on choline incorporation into mouse brain.

Biochem. Pharmacol. 28(2):253-260; 1979.

[Me-^{14}C]-choline was injected intravenously in mice after acute i.p. treatment with Δ^1-THC and the uptake of radioactive label by brain was measured in its aqueous and lipid extracts. The endogenous plasma choline level of 4.96 μg/ml was not affected by Δ^1-THC treatment. At an ambient temperature of 22° only the higher dose of Δ^1-THC (15 mg/kg) influenced the appearance of label in the brain: incorporation into the lipid fraction fell by 52 percent, and into the brain as a whole by 23 percent. Phenobarbitone (300 mg/kg) showed similar effects. Both drugs, when administered to mice housed at 22°, caused a marked lowering of rectal temperature for the duration of the radioactive studies. At an ambient temperature of 33.5°, most or all of the hypothermic effects of Δ^1-THC (15 mg/kg) and phenobarbitone were abolished. At this temperature, Δ^1-THC (15 mg/kg) inhibited radioactive incorporation into the brain lipid fraction by 19 percent. Phenobarbitone also had a smaller effect but also inhibited incorporation into the whole brain in both its aqueous and lipid fractions (by 19% and 23% respectively). At 33.5° the lower dose of Δ^1-THC (3.75 mg/kg) caused an increase in incorporation into the brain aqueous (26%) and lipid (25%) fractions. These different responses are discussed in relation to the effects of (a) hypothermia, which caused decreased radioactive incorporation into brain, (b) ambient temperature, which increased incorporation when high, and (c) the spontaneous motor activity of the mice.

478.

WIRSEN, C.O. and H.W. Jannasch.

Activity of marine psychrophilicbacteria at elevated hydrostatic pressures and low temperatures.

Mar. Biol. (Berlin) 31(3):201-208; 1975.

Uptake and metabolic turnover of a variety of radioactively labelled substrates by a number of bacterial isolates from several depths in offshore Atlantic waters were studied in laboratory experiments. The variable conditions were hydrostatic pressures (1 - 400 atm), temperature (1.5° - 15.0°C) concentration of substrate (2 - 500 g/ml) and time of incubation (4 h - 8 wk). Elevated hydrostatic pressure and low temperature retarded the rate of metabolism (bio-synthesis more than respiration) in all isolates tested, but considerably less in those of psychrophilic character. (© BA)

478a.

WIRTHLIN, M.R., Jr.

Cold Weather Dentistry: A Review U.S. Navy Medicine, V. 71. April 1980; p.12-15.

Despite all preparations, dental problems can be a cause of non-effective days for military units in the field. In one two-week training exercise in cold weather there were 155 dental cases in an average strength of 9,870 personnel. Most common after that were 600 orthopedic and 47 cold complaints. (37) The conclusions to be made are that dental support in the field is not merely a morale factor for the troops. The best preparation is a high level of dental health maintenance before beginning military operations in the cold.

479.

WISSLER, E.H.

Simulation of thermal transients during deep diving.

In: Proceedings of the 1977 summer computer simulation conference, Chicago, Ill. July 18-20, 1977, p.477-488. Published by the Conference, 1977.

This paper describes a mathematical model which has been developed to predict the thermal response of deep sea divers working at depths as great as 1000 feet. Under these conditions, divers are subjected to extreme thermal stress because the water temperature is approximately 0°C; the gas used for breathing and in the suit is helium which has a high thermal conductivity. Increased mass flow rate through the respiratory tract promotes heat loss when the breathing gas is not warmed. Since the experimental evaluation of new systems designed to protect divers is a difficult, time consuming process, it is worthwhile to have a reliable mathematical model for predicting diver performance under various conditions. The mathematical model described in this paper subdivides the human into 15 cylindrical elements representing the head, thorax, abdomen, and proximal, medial, and distal segments of each arm and leg. Within each element the transient-state heat conduction equation is solved to obtain temperature profiles. Mass balances are also computed for oxygen, carbon dioxide and lactic acid. The program permits one to specify various kinds of wet and dry suits with either open or closed circuit heating. Representative results are presented. (DD abstracts)

479.a

WISSLER, E.H. and M.L. Nuckols.

Integration of physiological and physical factors in the design of passive thermal garments for divers.

In: Program and Abstracts, Undersea Medical Society, Inc., Annual Scientific Meeting. Undersea Biomed. Res. 6(Suppl.):28; Mar. 1979.

Abstract only. Entire item quoted: Optimal design of thermally protective systems for divers requires careful evaluation of both physiological and physical factors. Included in the first category are the range of allowable skin and central temperatures, rate of shivering, and metabolic rate. Important physical

factors are water temperature, depth, composition of the breathing gas, time of exposure, and thermal properties of the suit. One purpose of this paper is to describe a comprehensive mathematical model which incorporates both physiological and physical factors into a computer program for analyzing diver performance under various conditions. Partial verification of the model has been accomplished by comparing calculated and measured values for a number of cases. The second purpose of this paper is to present a rational basis for the design of passive garments. Recent experimental work has resulted in more accurate characterization of various thermal garments, including those constructed of some attractive new materials. When these results are incorporated into the mathematical model mentioned above, one has the capability of analyzing various combinations of materials for suitability under given conditions. Results of several case studies are discussed to illustrate the limits of performance to be expected when purely passive garments are used. One problem with the passive garment is that it is difficult to satisfy the requirements of the diver during both resting and working conditions with a single suit. Possible solutions for this problem are discussed.

480.

WITHERSPOON, J.M., R.F. Goldman and J.R. Breckenridge.

Heat transfer coefficients of humans in cold water.

J. Physiol. (Paris) 63:459-462; May 1971.

It is stated that "a good estimate of both total and regional heat transfer should be possible on the basis of calculated convective coefficients and measured surface temperature gradients. Using an equation worked out by Fand for heated cylinders in cross-flowing water, the authors have calculated heat transfer coefficients in water for the trunk, the legs, the arms, the toes, and the fingers (forced convection only). The coefficient increases as the diameter of the body segment decreases, and as the motion of the water increases. Humans immersed in cold water undergo both forced and free convection heat transfer. The combined heat transfer coefficients for a 70 Kg. man in 20° water at rest and during strenuous exercise are calculated. They are highest at point of exhaustion on the beach after strenuous swimming. The problem encountered in determining the surface gradients and calculating the rate of change of body heat storage are briefly discussed. (MFW/BSCP)

481.

WON, W.D., H.C. Ross and E.F. Deig.

Influence of cold or hyperbaric helium-oxygen environments on mouse response to a respiratory viral infection.

Aviat. Space Environ. Med. 47:704-707; July 1976.

In investigating the stress effects of chilling (2-3°C) and hypothermia (2-3°C drop in body core temperature mediated by exposure to hyperbaric helium-oxygen atmosphere) on mouse resistance to "influenza," it was noted that these stresses adversely affected the course of pulmonary infection produced by aerosols of the NWS strain of influenza virus. Comparatively, respiratory LD_{50} values for control animals were about 25 virus plaque-forming units (PFU) with median mortality occurring on day 13. The LD_{50} values for mice chilled at 203°C were about 15 PFU with median mortality on day 7, and for mice exposed to hyperbaric helium, about 12 PFU with median mortality on day 6. Cold or hyperbaric stress impaired interferon production. Impairment was observed at 24 h but not at 12 h post-challenge and persisted for several days until mice became moribund. (Authors' abstract)

481a.

WOOD, V.

Severe Hypothermic Survival.

JACEP 6(9):429; 1977.

Report of a case who when picked up had a rectal temperature of 21c (69.8F) and who was barely alive. Treatment consisted of surface rewarming with blankets, and 5000cc of warm saline and 500 cc of warm blood. She responded well and had no sequalae. (CWS/UMS)

481b.

WOODRUFF, L.M.

Survival of hypothermia by the dog.
Anesth. 2:410-420; 1941.

From data derived from a series of experiments involving the subjection of dogs to low temperatures for prolonged periods, the following points may be summarized: (1) Dogs are unable to survive hypothermia sufficiently long to make protracted metabolic studies feasible. (2) The lowest body temperature at which a dog survived was 72°F, all of the animals dying between this point and 78°F. Between these limits the survival time varied from one-quarter hour to twenty-six hours and averaged about seven hours. (3) Respiratory failure was a frequent cause of death and could not be prevented by oxygen therapy. (4) Circulatory failure occurred in all dogs that avoided respiratory failure. It was associated with cardiac dilatation, loss of tone, and anhydremia. (5) Digitalis apparently was effective for some hours in preventing circulatory failure and, in fact, appeared to be the most effective of any procedure in prolonging life. (6) Even at very low temperatures, no significant changes were found in the blood content of chloride or CO_2. A trend toward hypoglycemia was, however, apparent. (7) The metabolic rates observed in 2 dogs showed the direct effects of internal cooling and suggested the complete loss of protective heat producing reflexes. (8) Blood concentration showed two marked increases, initial and terminal, attributable respectively to normal protective reflexes and to increased capillary permeability, as in shock.

482.

WRIGHT, J.S., R.G. Hicks and D.C. Newman.

Deep hypothermic arrest: observations on later development in children.
J. Thorac. Cardiovasc. Surg. 77(3):466-468; Mar. 1979.

Thirty-two children were reviewed following closure of ventricular septal defect in infancy. Fifteen had undergone continuous perfusion and 17 had been subjected to core cooling followed by deep hypothermic arrest. Parental and professional evaluations of intellectual and motor development, at periods between 7 and 72 months following operation, suggest that there is a higher incidence of developmental abnormality in the subgroup treated with deep hypothermic arrest.

483.

YAHATA, T., M. Kurahashi, T. Ohno and A. Kuroshima.

Modified metabolic effects of adrenaline in cold-acclimation.
Hokkaido J. Med. Sci. 52(4):343-352; 1977.

In an attempt to clarify the physiological significance of adrenaline (epinephrine) on non-shivering thermogenesis in cold-acclimated (CA) rats, changes in colonic, liver, muscles and brown adipose tissue temperatures, and in blood metabolites after the injection of adrenaline (A) or noradrenaline (norepinephrine) (NA) (20 μg or 40 μg/100 g i.m.) were investigated. Lower dose of A or NA (20 μg/100 g) elevated body and tissue temperatures to the same extent in both warm-acclimated (WA) and CA rats. Higher dose of A or NA (40 μg/100 g) did not evoke further increases in body and tissue temperatures in WA rats, while in CA rats rises in body and tissue temperatures were significantly higher as compared with those after the injection of lower dose of A or NA (20 μg/100 g). Cold acclimation could enhance a capacity for catecholamine-induced thermogenesis. Thermogenic effect of A was not significantly different from that of NA in either WA or CA animals. The effects on temperatures of A and NA were noticeably suppressed by propranolol and to lesser extent by phentolamine. A and NA increased blood FFA (free fatty acid) levels in both WA and CA rats, but significantly less in CA rats. Blood β-hydroxybutyrate level was increased by A but not NA in WA rats, while it was not affected either by A or NA in CA ones. Blood glucose was similarly elevated by A in both WA and CA rats but not by NA in WA rats and rather decreased in CA ones. Blood lactate level was not affected by A and rather decreased by NA in both WA and CA rats. A also contributes to an enhanced non-shivering thermogenesis in cold acclimation through an increased sensitivity of the organism to its metabolic action, mainly on lipid metabolism.

484.

YEHUDA, S. and R. Frommer.

Effects of *d*-amphetamine on the set point of the thermoregulatory system in rats. Psychopharmacology 57(3):249-252; 1978.

Exposing a rat's tail to an ambient temperature lower than that sensed by the rest of the body causes an increase in body temperature. Pretreatment with *d*-amphetamine (i.p.) causes an even greater increase in body temperature. While control rats perceive any ambient temperature below 20°C as cold, amphetamine-treated animals only perceive ambient temperatures below 20°C as cold. This effect of *d*-amphetamine was found when the body temperature of the rats was 20°C, and also when the body was kept at ambient temperatures of 15°-4°C. Because this effect of *d*-amphetamine, i.e., shifting of the reference point among treated rats, was found in 2 other situations (behavioral thermoregulation and in studying the anorexic effects of *d*-amphetamine among rats kept at different ambient temperatures), the best explanation is that in addition to the effects of the drug on some thermal sensory roles, it also causes a change in the value of the set point of the thermoregulatory system, and drug-treated rats perceive ambient temperatures of 10°C as normal.

485.

YOSHIMURA, H.

Review of studies on cold adaptation with special references to those in Japan. Environmental Stress, pp. 293-298; Academic Press ISBN 0-12-261350-3; 1978.

These are outlines of present Japanese studies in the field of environmental physiology. Many problems remain to be solved in this field. Many geophysicists predict the imminent approach of a glacial epoch. Survival of Homo sapiens may depend on their cold adaptability through this crucial period. As was suggested by a Japanese physiologist, our adaptability to the cold tends to be reduced by being habituated to a comfortable climate produced artificially. We must keep our cold adaptability at a strong level similar to that which enables Homo sapiens to tolerate the cold environment after the Wurm IV glacial epoch, about 25,000 years ago. For this purpose, our future studies on cold adaptation should clarify the mechanism of cold adaptability in more detail and devise methods to strengthen this ability. (CWS/UMS)

485a.

YOUNGBLOOD, D.A.

The immediate management of thermally unbalanced casualties in the field.

In: Egstrom, G.H., ed. Thermal problems in diving. Proceedings of a seminar held at Commercial Diving Center, Wilmington, Calif., March 19-20, 1976. Wilmington, Calif., Commercial Diving Center, June 1977.

The real challenge is the preventative aspect of diving medicine. Thermal balance is important, for both judgment and psychomotor skill are compromised by either hyperthermia or, particularly, hypothermia. Other preventative measures are physical fitness, proper diet, and no alcohol. The story of the Johnson-Sea-Link submarine entrapment is an example of several mistakes. Many other examples of both hyper- and hypothermia are given. (CWS/UMS)

486.

ZEVEKE, A.V. and V.L. Shaposhnikov.

Activity in myelinated nerve fibers of a cat cutaneous nerve in response to cooling. Biull. Eksp. Biol. Med. 86(10):400-403; Oct. 1978.

The afferent activation in cat cutaneous nerve fibers in response to cooling was analyzed using the collision method and the method improving the signal-to-noise ratio in the antidromic action potential neurogram. It was found that the nerve fibers of groups $A\delta_1$ and $A\delta_2$ were activated under cutaneous receptors cooling. The activity of a small group of nerve fibers with conduction velocity 13.0-7.5 m/s

was inhibited in response to cooling. A group of "mixed" fibers inhibited mainly its activity, but only an insignificant part of these fibers activated in response to cutaneous receptors cooling.

487.

ZHEHUNOV, H.F., A.H. Maksyna, L.H. Artemova, V.I. Orlov and A.M. Bilous.

Changes in sarcoplasmic reticulum membrane structure under the effect of low temperatures.

Dopov. Akad. Nauk. Ukr. Rsr. Ser. B Heol. Khim. Biol. Nauky. (10):924-926; 1978.

The effect of low temperature on rabbit sarcoplasmic reticulum (SPR) membrane was studied. EM and spin label methods were used to show that the SPR membrane is distorted after rapid freezing to -196°C and rewarming. As observed by EM, the SPR vesicles swell, the membrane becomes thinner and electron-dense globules that may be aggregated proteins are revealed on the membrane. The method of EPR with a covalent label was used to show that the Ca-ATP ase structure changed after freezing. The fatty acid labeling showed that the degree of the membrane lipid fatty acid order decreased following freezing. In addition, a lipid structural transition shift was observed from +18° to +15°. There were damages in protein-lipid interactions and distortions in the structure of the Ca-ATPase protein-lipid complex of freezing that may result in functional changes in SPR membrane Ca-transport system.

488.

ZHIGACHOVA, I.V. and E.N. Mokhova.

Concentration of cytochromes in the liver at different stages of adaptation to cold.

Biofizika 23(2):285-289; 1978.

Cytochrome concentration in the liver of adult male rats was studied during acclimation to cold. A group of rats was kept at about 24°C, another at 2-4°C. After a mo. of acclimation to cold the cytochrome concentration in the liver increased, but the mitochondrial concentration of cytochrome remained unchanged. Three steps of cytochrome concentration changes can be distinguished; on the 9th day of acclimation to cold, cytochrome concentration increased 1.5-2 times; by the 14th day the cytochrome concentration decreased (to the control level and lower); after about 1 mo. of acclimation to cold the cytochrome concentration increased again. In the skeletal muscle it increased on the 14th (but not on the 9th) day.

489.

ZORIN, N.A.

Excretion of sialic acids with urine in frost-bites.

Klin. Med. (Mosk) 56(8):93-95; Aug. 1978.

The author studied sialoproteinuria in 16 patients with frost-bites. With frost-bites of the I-II degree the level of urine excretion of sialic acids during all the periods of observation did not deviate from the normal value. Marked hypersialoproteinuria was noted in frost-bites of the II-III degree; with injuries of the III-IV degree it was short-term and comparatively mildly expressed. Causes of the mentioned differences and possibilities of using excretion of sialic acids with urine for early differential diagnosis of frost-bites are discussed.

490.

ADOLFSON JA, Berghage TE.

Perception and performance underwater.

New York, John Wiley and Sons, 1974, 359 p.

In the introduction, the authors discuss physical and physiological aspects of the underwater environment and the hyperbaric environment, underwater technological research and development, man as a system component, and the classification of man's sensory subsystems. Chapter II deals with vision, III with audition, IV with spatial orientation (vestibular function is covered in this chapter), V with chemical and somesthetic senses and effects of cold under water, VI with communication, and VII with human performance. Each chapter has its own summary. There is a ten-page glossary at the end, 23 pages of references, an author index, and a subject index. (MFW/UMS)

491.

AFANASIEVA RF, Terentieva GV.

Hygienic requirements to winter clothing for girls living in the far north.

Gig Sanit 11:35-37; Nov 1980.

Calculations and physiologic-hygienic studies in the North (city of Yakutsk) have made it possible to formulate requirements to clothing designed to protect girls from cold taking into account meteorologic factors, the time of continuous exposure to cold, the level of energy expenditure, and thermoregulatory responses. (Authors' abstract)

492.

AGISHI Y, Saito K, Itoh S.

Some endocrine responses to hot and cold water immersion in man with special reference to the circadian differences of the responses.

J Interdispl Cycle Res 7(4) :261-267; 1976.

Young male subjects were immersed in water up to the chin while seated. In the hot water test the temperature was 42 ± 0.5°C. They were returned to the recumbent position in bed. Venous blood was taken from the antecubital vein before and at intervals during immersion. Hot water immersion resulted in a gradual decline of plasma 11-OHCS in the 09.00 h experiment, but had the opposite following the 21 h experiment. Cold water immersion had the opposite effect of hot water immersion. The plasma growth hormone concentrations, on the other hand, did not seem to be related to the circadian factor. Hot water immersion caused a marked rise in plasma growth hormone, and cold water immersion showed a much less significant rise. It is assumed that "the circadian variation in the responses of adrenocortical function to thermal stimuli is closely related to that of different phases of thermoregulatory processes." It is also assumed that "growth hormone predominantly participate in some metabolic processes for supplying energy substrates independently of the time of day. (MFW/UMS)

493.

ALEKSANDROV, I.A., V.B. Kostkin, B.S. Dashevskii, B.I. Sokolovskii and L.A. Sirotina.

Porazhayushchee deistvie temperaturnogo faktora v usloviyakh povyshennogo davleniya geliokislovodnoi sredy.

[Adverse effect of temperature in a high-pressure helium-oxygen environment].

Dokl. Akad. Nauk. SSSR 256(1):225-227; 1981.

Deepsea divers working in high atmospheric pressure in a He-O_2 gas mixture are exposed to a higher than normal environmental temperature due to the high thermoconductivity of helium. It sometimes exceeds the comfort threshold for man. To assess this danger, the authors conducted a series of experiments on guinea pigs placed in a closed chamber containing He-O_2 under high pressure. The temperature inside the chamber ranged from 22°C to 40°C, with a median range of 30-36°C considered normal. In the lowest (close to 22°C) and highest (close to 40°C) ranges many of the animals perished. The closer the temperature was to the extremes, the more animals died and the shorter was their survival time. However, not a single animal was lost in the moderate 30-36°C range. It was also noted that the body temperature of the animals at the time of death was abnormally

low or high, respectively, in accordance with the environmental temperature. The authors concluded that in a high pressure He-O_2 environment, the thermoregulatory system of the body may break down resulting in hypo- or hyperthermia which can be fatal to warm-blooded animals, including man. Therefore, the stress effect of temperature changes in such environments is a very important factor in the morbidity of deepsea divers. (English abstract OLC/UMS)

494.

ALEXANDER L.

The treatment of shock from prolonged exposure to cold, especially in water.

Washington, DC, Combined Intelligence Objectives Subcommittee, G-2 Division, SHAEF, CIOS Target No 24; Dept of Commerce, 68 p, plus appendices, July 1945.

Data from animal and human experiments performed by German scientists were investigated in order to determine the most effective rewarming technique for cold exposure victims. Attempts to obtain information on the human experiments included a visit to Germany, review of available documents, searches for additional documentation, and a visit to Dachau concentration camp in search of remaining experimental apparatus and eye witnesses. Based on analysis of the available human and animal data from Germany, it is concluded that rapid and intensive rewarming in a hot bath of 40 to 50°C is the most effective means of resuscitation for victims of shock produced by cold exposure. The commonly used gradual rewarming methods endanger life by allowing an excessive after-drop in body temperature. Victims should be undressed, immersed in a hot bath for 10 minutes, and then dried and placed in heated blankets. If body temperature does not continue to rise, the hot bath treatment should be repeated until a steady rate of rewarming is achieved. Eight related documents are appended. (RW/UMS)

495.

ALTHAUS U, Aeberhard P, Schüpbach P, Nachbur BH, Mühlemann W.

Management of profound accidental hypothermia with cardiorespiratory arrest.

Ann Surg 195(4): 492-495; 1982.

Complete recovery following rapid rewarming is described in three tourists who were admitted in a state of profound hypothermia with total cardiorespiratory arrest (rectal temperature ranging from 19 to 24°C). In all three patients, respiration and circulation had ceased during the rescue operation. Rapid core rewarming was achieved by thoracotomy and continuous irrigation of the pericardial cavity with warm fluids in one patient, whereas in the other two patients rewarming was accomplished with extracorporeal circulation using femoro-femoral bypass. In the first patient, the heart could not be defibrillated earlier than 90 minutes following thoracotomy; in the other patients rewarming was attained very rapidly, and within half an hour after institution of bypass, resuscitation of the heart was successful. The patients fully recovered their intellectual and physical abilities, despite the prolonged periods of circulatory arrest lasting from 2½ to 4 hours. We conclude that rapid core rewarming is the adequate therapy for profound accidental hypothermia with circulatory arrest or low cardiac output. If feasible extracorporeal circulation represents the method of choice because it combines the advantage of immediate central rewarming with the benefit of efficient circulatory support, the heart is rewarmed before the shell, thus preventing the "rewarming shock" due to peripheral vasodilatation. Resuscitative efforts should be promptly initiated and vigorously pursued, even in the state of clinical death; in profound hypothermia neurologic examination is inconclusive regarding prognosis. (Authors' abstract)

496.

ANDERSON KL, Hammel HT, Hildes JA, Wilson O.

A field study of physiological adjustment to increased muscular activity with and without cold exposure.

Acta Univ Lund Sect II Med Math Sci Rerum Nat 20 :9 pgs; 1966.

The results of a study of the role of physical training in adaptation to cold are summarized. After a five-week conditioning period of physical training, 19 men were either exposed to cold for the duration of the night or spent the night in a comfortably warm environment. The variables measured included maximal oxygen uptake, thermal and metabolic responses during a night of moderate cold exposure at about 5°C, sleep and muscle activity during a night of moderate cold exposure, hand and foot circulation during standard cold exposures, pressor response to ice water immersion of the hand, metabolic rate and thyroid function, corticosertoids in plasma, tolerance to heat and sweating during work in the cold, and peripheral circulation. Physical training was found to elevate the basal and resting metabolism rates, increase maximal oxygen uptake by about 6%, and increase blood flow to the skin in warm environments. A greater metabolic compensation for cold was

observed after training. The increase in electrical muscle activity in the cold observed after physical training suggests that the muscles may be the site for this increased metabolic compensation. The physical training was found to affect the physiological response pattern to a night of cold and make the subjects more tolerant of cold exposure. Trained subjects showed a tendency toward better sleep and less wakefulness during the cold night. Findings suggest that vigorous physical training is a potential means of increasing tolerance to a cold environment. (RW/UMS)

497.

ANGUS RG, Pearce DG, Buguet AGC, Olsen L.

Vigilance performance of men sleeping under arctic conditions.

Aviat Space Environ Med 50(7) :692-696; Jul 1979.

This study investigated the effect of cold exposure on vigilance performance in men working and sleeping under Arctic conditions. The results were compared with changes in the amount of REM sleep. EEG sleep recordings were made on six subjects during five baseline nights in laboratory conditions, 16 experimental nights in Arctic conditions, and four recovery nights in the laboratory. Vigilance tests were administered every second day during the experimental period and two time during each of the baseline and recovery periods. During the first night in the Arctic, the amount of REM sleep fell to 50% of baseline and a large decrement occurred in detection performance on the following morning. During the remaining nights in the cold, REM deprivation averaged about 25% with somewhat greater deprivation occurring during colder nights. Reaction time measures generally increased throughout the experimental period and subsequently showed incomplete recovery. However, detection performance gradually improved during the experimental period but showed some regression following colder-than-usual nights, when REM deprivation increased. This suggested that performance on this type of task may be related to temperature variations and changes in REM deprivation. (Authors' abstract)

498.

ANNIS JF.

Core temperature changes during cooling at rest and working.

In: Program and abstracts, Undersea Medical Society annual scientific meeting, May 25-29, 1981. Undersea Biomed Res 8(1-Suppl): A 95; Mar 1981.

Abstract only. Entire item quoted: Three men were cooled in a suit calorimeter while resting and again while working at a mild rate. The net heat deficits produced in the experiments were determined from the difference between continuous direct and indirect calorimetry. By varying the temperature of the water entering the suit, subjects were cooled at two different rates while at rest. The cooling rates were repeated when the subjects pedalled a bicycle ergometer at 50 watts. At the milder cooling rate, the net heat loss over 60 to 90 min averaged 184 kcal when the subjects rested and 135 kcal when they worked. The change in T_{re} averaged $-0.8^{\circ}C$ and $+0.2^{\circ}C$ respectively at the end of the cooling period. When the faster cooling rate was used, the net heat loss averaged 270 kcal at rest over the same time period, yet the fall in T_{re} was slightly less ($-0.6^{\circ}C$) than at the milder cooling rate. When working at the higher cooling rate, subjects lost an average of approximately 200 kcal, but T_{re} increased nearly $0.7^{\circ}C$ over the same time period. The results indicate that changes in T_{re} are not simply related to levels of heat loss. During mild work, T_{re} may be maintained at precooling levels or be increased, despite net losses approaching 300 kcal.

499.

ANONYMOUS.

Severe accidental hypothermia.

Lancet 1 237; Jan 29, 1972.

The need for medical and lay rescuers to be familiar with emergency treatment of severe accidental hypothermia is discussed. The main need for awareness is to aid people who appear dead from hypothermia since such people can often be saved through active rewarming. People with hypothermic cardiac arrest are likely to die without active rewarming. They may recover if placed in a bath of hot water at $42^{\circ}C$. Once a patient is improving steadily, the safest course is to remove him from the bath and allow rewarming to continue slowly. If practicable it is desirable to monitor the electrocardiogram, arterial pressure, and rectal temperature. On the rare occasions when extra ventilation is called for, expired air is safest. It is concluded that the principles of treatment in severe accidental hypothermia are simple, involving a quick start to rewarming and then monitoring with a minimum of interference as the patient recovers. (RW/UMS)

500.

ANONYMOUS.

Discussion following cold/wet survival symposium held on November 4 & 5, 1971. J R Nav Med Serv 59 :11 p; Spring 1973.

A question and answer period following a symposium discussion on cold/wet survival is presented. The discussion stresses the distinction between acute hypothermia and chronic hypothermia. For acute hypothermia, the treatment of choice is rapid rewarming, while such treatment is likely to be fatal for chronic hypothermia. Among the other topics discussed are the differences between immersion foot and frostbite, the effects of rapid rewarming upon tissue metabolism, different treatments for short and long term hypothermia, and the measurement of core temperature. (RW/UMS)

501.

ANONYMOUS

Thermal problems.

Individuals and laboratories working in the field. Report on N00129-79-M-3196, Naval Submarine Base, New London, Groton, CT, 4 p (n.d.) and Part 14 of the National Plan for the Safety and Health of Divers in their Quest for Subsea Energy, Undersea Medical Society, Bethesda, MD, 10 p, Jan 1976.

Laboratories and individuals doing research on hypothermia are listed and research priorities in the area of thermal stress and diving safety are identified. The topics discussed include: human thermal tolerance; heat exchange in divers; thermal monitoring; insulating materials; rewarming; power sources; gas properties; improved CO_2 absorbents; performance, body temperature, and heat loss; and evaporative heat transfer. These topics are of primary importance in removing the limits imposed on diving safety by thermal problems. The lack of adequate thermal protection is a major obstacle to the effectiveness of many diving operations. Cold endangers life, adversely affects diver efficiency, causes discomfort, and limits the amount of time a diver can spend in the water. (RW/UMS)

502.

ANONYMOUS.

Death in the cold environment: a practical preventive research program.

Washington, DC, Naval Medical Research Institute, National Naval Medical Center, Bethesda, MD, 36 p; Sep 1976.

A program of research investigating the reasons for cardiovascular collapse during rewarming of accidental hypothermia victims is proposed so that more effective therapy may be developed. Existing evidence bearing on possible mechanisms underlying hypothermic mortality is reviewed on the topics of: contactile behavior of isolated hypothermic heart muscle, subcellular morphology and biochemistry of hypothermic heart muscle, subcellular energtics of hypothermic heart muscle, systemic circulatory derangements in the hypothermic organism, and pulmonary circulatory derangements. In each of these areas research proposals are made which specify purpose, approach, types of studies, and technical aspects. Each part of this integrated research program investigates one step in the process which leads to ventricular fibrillation and death. The goal of each proposed study is to identify physiological abnormalities produced by hypothermia and therapeutic mechanisms to counter the lethal effect of these abnormalities. (RW/UMS)

503.

ANONYMOUS.

Cold injury.

Washington DC, Depts of the Army, the Navy, and the Air Force, TB MED 81, NAVMED P-5052-29, and AFP 161-11, 15 p; 30 Sept 1976.

As part of the Armed Services Professional Medical Material this bulletin provides information regarding cold injury and is a guide to its prevention and management. Cold injury is defined as tissue trauma produced by exposure to cold. The importance of cold injuries in military operations has been recorded for thousands of years. In the winter of 1950-1951 as many as 8,000 time-loss injuries of US troops in Korea were reported. Major sections of this paper deal with the subjects of epidemiology, duration of exposure, prevention, patho-

genesis, clinical manifestations, treatment, general hypothermia, and sensitization. In treatment, precedence is placed on treatment of life-endangering wounds over cold injuries. First aid, initial or emergency treatment, and definitive treatment in the hospital are described. Several drugs in the treatment of cold injury are suggested. The possible beneficial effects of these drugs have not be substantiated clinically nor experimentally. Included are drugs such as rutin, antihistamines, corticotropin, cortisone, anticoagulants, vasodilators, intravascular cellular aggregation inhibitors, and the plasma expander, low-molecular weight dextran. (EP/UMS)

504.

ANONYMOUS.

Aviation medicine report: Evaluation of aircrew cold water immersion suits.
Point Cook, Australia, Rep of Royal Australian Air Force, Inst of Avia Med 12 p; Dec 1976.

Three anti-immersion suits were evaluated for adoption for aircrew use. The USN CWU 21/P and the RAF MK10 dry suits and the Canadian U-VIC civilian "wet suit" jacket were compared in controlled conditions in 7°C water, in 10°C sea water and in aircraft cockpits under operational conditions. All three suits provide significantly greater protection than normal flying clothing if the pilot is immersed in water below 20°C, as may be expected around the southern and south-eastern Australian coasts during much of the year. Wide variation in the response of subjects to hypothermia make recommendations on each suit's efficiency difficult. However the results of this evaluation indicate that the three suits provide similar thermal protection. The U-VIC jacket offers considerable benefits over the dry suits examined in the areas of pilot comfort (therefore promising greater aircrew acceptance and hance utilization), bouyancy characteristics, heat stress, ability to provide protection despite damage, maintenance and purchase cost. It was found that there is considerable potential for further improvement in the design of the U-VIC jacket in its adaptation from a civilian-orientated design to an item of aircrew safety equipment. (Author's summary)

505.

ANONYMOUS (editorial).

Rewarming for accidental hypothermia.
Lancet 1 (8058) :251-252; 1978.

A brief review of some cardiovascular problems, especially ventricular fibrillation, associated with rewarming in accidental hypothermia is offered. The following rewarming techniques are mentioned with regard to their effectiveness, limitations, and complications: peritoneal dialysis, hemodialysis, cardiopulmonary bypass, warmed air ventilation, heating by intragastric balloon, and hot water baths. Certain techniques are recommended as more effective for the acute immersion incident (rapid surface rewarming) whereas others are more useful for cases of prolonged hypothermia (slower rewarming by air). The use of less difficult but effective techniques (surface rewarming methods), which introduce less trauma to the patient, is advocated for routine use. It is recommended that radical methods of circulatory rewarming be reserved for special cases. (CDR/UMS)

506.

ANONYMOUS.

Too cool for comfort.
Emergency Medicine p 59; Sep 15, 1979.

Hypothermia as a stress reaction to illness results from a failure of the normal thermoregulatory system. In acute thermoregulatory failure, there is a progressive fall in body temperature but peripheral blood flow is not decreased, there is no shivering, and no thermal discomfort is experienced. The syndrome has been observed in conjunction with such conditions as cerebrovascular disease, congestive heart failure, and pneumonia. Six cases were observed in which hypothermia occurred in association with drug overdose, pneumonia, chronic renal failure, hypoglycemia, and congestive heart failure. The underlying disorders were compounded by various hypothermia-induced complications, but these disappeared in response to rewarming measures. Since this type of hypothermia can occur even in a warm environment, the possibility is not always apparent. The first signs may be coldness to the touch or unexplained somnolence. When the shivering response is intact, passive rewarming can be used, but when the thermoregulatory response is blunted, active rewarming is indicated. Once the patient has been rewarmed and the underlying illness treated, further treatment for hypothermia is rarely required. (RW/UMS)

507.

ANONYMOUS.

Symposium on first aid, treatment, and transport of diving casualties.

In: Proceedings of the South Pacific Underwater Medicine Society's annual meeting in Melbourne, Australia, 1980.

In a symposium at the 1980 annual meeting of the South Pacific Underwater Medicine Society, the management of hypothermia in diving accidents was discussed. Assessment, monitoring, and rates and methods of rewarming were considered. One panelist advocated slow rewarming for mild hypothermia while another panelist recommended rapid rewarming. In mild hypothermia after immersion accidents, the central body temperature continues to drop after recovery. Therefore, a patient recovered from the water in apparently good condition can die if not rapidly rewarmed. A case of anuria in a patient recovered after 18 h in the water is briefly described. (RW/UMS)

508.

ANONYMOUS

Hypothermia conference sheds new lights on cold related deaths.

Mariners Weather Log 24(3)203-204; May-June 1980.

Some of the guidelines formulated at this conference were as follows: Do not rely on a thermometer to measure hypothermia, but be guided by the behavior of the patient. Mild hypothermia exists at temperature of 90° and over, and symptoms include subjective cold discomfort and violent shivering. Severe hypothermia is indicated when the patient appears drunk and mentally confused. Great care should be exercised in moving the victim, since a heart attack may occur if he is severely jarred. Rewarming treatment should be continued after patient begins to feel warm, to insure that internal rewarming takes place. The airways should be kept clear and the pulse should be taken. Many believe that cardiopulmonary resuscitation should not be administered unless there is no pulse. (MFW/UMS)

509.

ANONYMOUS.

Treatment of frostbite.

Med Lett Drugs Ther 22(26) :112-114; Dec 26, 1980.

This review of frostbite was prompted by the continually increasing number of winter sports participants. Wind chill, exhaustion and damp clothing, and touching bare skin to cold metal are some causes of frotsbite that are mentioned. Adequate layers of clothing that trap warm air and do not constrict blood flow to the extremities are recommended for outdoor activity. Staying dry is of the utmost importance in prevention. Treatment in the field of "frost nip" should begin immediately by placing the blanched skin in a warm place (i.e. in one's axilla, or inside a companion's parka). Care should be taken to avoid thawing of deep frostbite injury until any danger of refreezing is past. Hypothermia is often associated with frostbite patients. Once in shelter, the injured tissues should be promptly and thoroughly rewarmed in a warm-water bath (104-108°F) until the tissue is fully flushed. Supportive therapy includes: daily whirlpool baths, gentle cleansing, and extreme care to prevent abrasions and infections. Surgical intervention should be postponed, in the absence of infection, until all natural tissue separation of the healing process has ceased. (CDR/UMS)

510.

ANONYMOUS

Thermal recovery capsule.

Diver 26(3):37; Mar. 1981.

Entire item quoted: A thermal recovery capsule for emergency treatment of hypothermia has been developed by Domtex, Ltd., Batley, W. Yorkshire, U.K. Called the Decupad, the capsule is a cocoon of high-pile, flourescent orange material designed to reduce bodily heat loss, and absorb excess water from the victim's clothing. It can be strapped to a conventional rescue stretcher, or used as a stretcher in its own right by inserting suitable poles; it can also be attached to a cradle to be lifted from a helicopter.

511.

ANONYMOUS.

"Lost bell" incident: surviving hypothermia.

SPUMS J., p. 3-5, Apr.-June 1981.

The umbilical of a bell (SDC) operating from a well-equipped vessel began to leak gas while the bell was at 515 fsw, and ruptured during raising procedures. The bell wire remained intact. During the raising of the bell it lost pressure dramatically at 165 fsw; relief was obtained by urgent lowering to 400 fsw. The two divers trapped in the bell reported that they were cold and shivering but the true severity of their hypothermia was not appreciated until after the rescue. Ship/bell communication difficulties were experienced. Survival was the result of the high state of training of all concerned and the availability of two survival kits in the bell for each diver. An improved (Mark II) 2 W Survival Kit was used. Rescue was effected by Comex divers operating from a bell lowered from another diving ship; transfer in a strong current was made possible by a swim line between the two bells. Post-decompression helicopter flight to shore was followed by a simple knee bend in one diver. (Information provided by Wharton Williams Taylor Diving Contractors) (Author's abstract)

512.

ANONYMOUS

Biomedical consequences of extreme thermal environments.

In: Proceedings of thermal seminar programs, US Navy - Naval Special Warfare Group One and Civil Engineering Laboratory, Coronado and Port Hueneme, CA, 39 p, Nov 1981.

Guidelines for the protection of health and safety in extreme thermal environments during warfare are listed. The guidelines were presented at thermal seminars conducted by the U.S. Navy in 1981. The guidelines for hot environments cover: appropriate clothing, equipment, the handling of water supplies, nutritional requirements, transportation, medical care and treatment of casualties, and biomedical research needs. A separate set of cold environment guidelines addresses: clothing, equipment, transportation, water supplies, nutrition, medical and emergency care, and research needs. (RW/UMS)

513.

ANONYMOUS.

Hydrogen-fueled back-pack heater.

Faceplate 13(1): 5; Spring 1982.

Entire item quoted: A hydrogen-fueled back-pack heater for divers that provides up to 2 kilowatts of heat for as long as 6 h at depths of 450 fsw is described. Designed by Battelle Columbus Laboratories as part of the Diver Thermal Protection Program at the Naval Coastal Systems Center, the heater contains a catalyst bed of aluminum oxide/platinum pellets over which a recirculating flow of oxygen is maintained by a gas ejector. When heat is required, a small flow of gaseous hydrogen is introduced into the catalyst bed. The hydrogen burns flamelessly in the presence of oxygen. Other than heat, the only combustible by-product is water. A water jacket removes heat from the catalyst bed. A pump powered by thermoelectric elements circulates heat to the diver's suit. An internal protection system that prevents overheating and hydrogen buildup is incorporated into the design. While propane heaters have been developed previously, they were depth-limited because of propane's low vapor pressure. The new hydrogen heater does not have this limitation.

514.

ARNOLD JW, Eichenberger CH.

The hydraulic sarong: emergency treatment device for accidental hypothermia.

JACEP 4(5) :438-439; Sep/Oct 1975.

A simple device, suitable for rewarming victims of accidental hypothermia, is described. The "hydraulic sarong" has been designed to be used at the site where a victim of hypothermia is found. Minimum training is required to familiarize rescue personnel with its use. The total weight of the apparatus has been reduced to 2.7 kg making it easily portable. Three cases in which it has been successfully used to restore normal body temperature are described. (Authors' abstract)

515.

ARNOLD JW (letter).

Hypothermia.

Ann Intern Med 90(2) :273; 1979.

To the Editor: I wish to comment on an additional method of treatment of hypothermia. This may supplement the suggestions made by Dr. Reuler in his very thorough review (Ann Intern Med 89 :519-527, 1978). When weather and terrain combine to force treatment of hypothermia in the place where the victim is found, adequate equipment has always been a definite problem to rescuers. Since 1970, the Bellingham Mountain Rescue Council has successfully used a lightweight rewarming blanket on several patients with severe hypothermia. This device, which has acquired the nickname "hydraulic sarong," is capable of delivering 2.5 kcal/min. It is a manifold of Teflon tubing sewn into a light cloth blanket. Water, heated by a "backpacker's" stove, is circulated through it by means of a small hand pump. Inhaled air can also be heated by wide-bore tubing traversing the blanket. We believe, however, that in situations where the blanket is useful, the heated air that prevents additional cooling is not in itself adequate. This equipment has recently been described.

516.

ARTHUR, D.C.

Hypothermia: An educational manual for instruction of the fleet duty corpsman accompanying personnel performing operations in cold water or cold weather.

U.S. Nav. Submar. Med. Res. Lab., Rep. 943, 73p. Nov. 1980.

Hypothermia connotes the abnormal lowering of body core temperature (the internal temperature of the body; that of the core organs) the effects of which are in a gradient from only a mild decrease in motor and cognitive functions to the severe reactions of cardiac and respiratory failure. Hypothermia becomes important to the corpsman who will accompany personnel into the thermally stressful environments of cold weather and cold water. This presentation is designed to provide the corpsman with a basic understanding of the body's normal thermoregulatory mechanisms, their methods of adaptation to cold stress and the clinical syndrome which results. Knowledge of the basic pathophysiology will allow the corpsman to interpret the subtle objective indicators of hypothermia and to recognize the vague subjective indicators as voiced by the victim. This background will facilitate prompt treatment and relief of a potentially dangerous malady. (Author's abstract)

517.

ASHMORE, L.

Women are different!

Diver 26(2):14-15; Feb. 1981.

This is a somewhat superficial discussion of women in diving which says, essentially, that women should accept and adapt to their differences rather than try to out-do men. It recognizes the differences in body size and structure that affect the suitability for women of much diving equipment now available. Even oxygen consumption by women during maximum exertion is 15-25% less than men, yet very small backpacks and breathing gas cylinders are especially hard to find. Other differences are cited: women generally have poorer circulation, which may explain why they seem to feel cold more keenly despite a wide-spread belief that female subcutaneous fat protects them; women are subject to physiological changes during menstruation but these generally should not prohibit diving; many women take birth control pills which may produce a sludging effect in the microcirculation that might mean a greater risk of decompression sickness. Research has indicated, in fact, that women tend to suffer more DCS than men, so they are urged to monitor their dive profiles with particular care. While few women dive while pregnant – and deep diving should be avoided because of possible danger to the fetus – there are benefits as well as risks; the author feels that pool diving down to 15m should be allowed. Diving can be resumed six weeks after delivery but women divers are cautioned to pamper their back muscles for a time. The article concludes with brief discussions of training, noting the inevitable competition between the sexes, and of the problems of diving with families. (LET/UMS)

518.

AVTANDILOV, G.G., S.G. Sukhanov and L.A. Veresova.

[Mathematical simulation of pathomorphological alterations in the spinal cord during prolonged cooling].

Biull. Eksp. Biol. Med. 92(10): 505-507; Oct. 1981.

Experiments were made on 72 rabbits exposed to daily 10-12 hour cooling at a temperature of −3 to 5°C for 1, 2, 4, 8 and 12 weeks. A complex of morphometric methods was used to study neuro-capillary, neuroglial relationships and nucleoprotein metabolism in the cervical, thoracic and lumbosacral parts of the spinal cord. The data obtained were processed on computers, and the changes in the parameters examined were depicted mathematically by the equation $Y = A_0 + A_1X + A_2X^2$. Differences were revealed in the responses of different parts of the spinal cord to cold exposure to attribute the cervical segments to the increased risk area for the development of unfavorable pathomorphological alterations. (English abstract)

519.

BAKER ER IV, Harnett RM, Ringuest JL.

An evaluation of human thermal models for the study of immersion hypothermia protection equipment.

Washington, DC, Dept of Transportation, US Coast Guard, Final Rep No CG-D-80-79, 102p, Oct 12, 1979.

This report presents an evaluation of mathematical models of a man in a cold environment. The models are evaluated for their ability to predict the effectiveness of anti-exposure equipment used during cold water immersion. The evaluation is done by comparison of model results to those observed during in vivo cold immersions with a wide range of anti-exposure equipment. The models evaluated are those, available in the literature, which employ a metabolic rate control submodel. Model results obtained with modified and experimental submodels are discussed. (Authors' abstract)

520.

BAKER S, Atha J.

Canoeists' disorientation following cold immersion.

Br J Sports Med 15(2): 111-115; 1981.

As an initial step to a broader study of the disorientating effects of cold water immersions on top class competitive canoeists, a survey was made of the incidence of hazardous immersions among a majority sample of the better canoeists in the country. Virtually the entire entry to one of the most important national competitive meets was canvassed. A total of 288 canoeists in the 1st and 2nd divisions were identified and asked to participate. Replies were received from 247 (86%). All those responding had had extensive experience of canoeing in winter spate and were capable of fast and efficient first-time canoe rolls in cases of capsize. Particular interest was focussed on the 85 (34%) who had experienced at least one capsize in cold water during training or competition in mid-winter. Respondents viewed the winter capsize seriously. Despite their familiarity with the conditions in which they trained, all 85, recalling their capsize experiences, reported being concerned, most (79%) only modestly so, but a significant proportion (21%) confessed to feelings of extreme alarm. A number of marked physical symptoms that regularly attend on a capsize were widely reported, the most usual of which was severe pain in the forehead (89%) and breathing and speaking difficulties when afloat (64%). Additionally, 62% reported sensory problems including visual difficulties, dizziness and disorientation. Five canoeists admitted fainting. Despite these hazards, few preventive measures were taken and clothing with negligible thermal insulation properties was commonly worn. It is concluded that transient cold immersions can be disturbing, and can disorientate the canoeist, but although conscious of this, and to his own potentially high cost, he takes little notice of it in his desire to compete successfully. (Authors' abstract)

521.

BANGS CC.

Early recognition and treatment of chronic cold injuries.

In: Proceedings of 8th NASAR Conference, Sept 9-12, 1976, Cheyenne, Wyoming. 7 p; 1976.

Suggestions for the early recognition and treatment of hypothermia and frostbite are outlined. Clues to the rec-

ognition of hypothermia include oral or rectal temperature, an acetone odor on the breath, impaired mental functions, lethargy, confusion, depressed pulse and blood pressure, reduced respiration, and loss of muscle coordination. Early signs of frostbite include an extremity that appears frozen to the touch, slow return of skin color after pressure, swelling or blisters, pain or numbness. Early hypothermia treatment involves gentle handling and prevention of further heat loss. Improper rewarming can be dangerous, and rewarming should be postponed if possible until the patient is taken to a hospital. In the field, rewarming should be slow and concentrate on the core. Ventilation assistance and use of advanced life support are discussed. Early treatment of frostbite involves rapid thawing in hot water and gentle treatment of the extremity after thawing. If treatment facilities are nearby, the limb should not be thawed until the facilities are reached, as much damage can occur after thawing. While frozen, a limb can be walked on without sustaining much damage. (RW/UMS)

522.

BANGS CC.

Immersion hypothermia: Preventing unnecessary deaths.
Emergency p 43-45, Jan 1980.

The proper immediate care for accidental immersion hypothermia victims is described and illustrated with an account of a death from a rafting accident. Victims with a temperature of 90°F or above will generally complain of being cold and be lethargic but will be able to move about and be oriented. At body temperatures below 90°F, victims will be uncoordinated, confused, lethargic, and may have stiff muscles, be unconscious, and appear to be dead. If not properly handled, up to 65% of this group will die. After removal from cold water, the victim should be kept from moving, be handled extremely gently, have wet clothing removed, and be protected from wind. The patient should not be given hot liquids or alcohol by mouth. Rewarming should proceed until the patient shows signs of improvement. All victims should be evaluated at a medical facility to prevent later complications. (RW/UMS)

523.

BANGS C, Hamlet M.

Out in the cold - management of hypothermia, immersion, and frostbite.
Top Emerg Med 2 :19-37; 1980.

The recognition and management of hypothermia and frostbite are detailed. Different types of hypothermia are categorized in several ways: mild and severe hypothermia; acute exposure, subacute exposure, and chronic hypothermia; land-based and water immersion hypothermia; urban hypothermia; and immersion hypothermia involving protected or unprotected individuals. Physiological responses to hypothermia, including laboratory test results are described. Specific aspects of hypothermia management discussed include: recognition, required baseline laboratory tests, rewarming techniques, blood volume expansion, airway management, cardiac arrhythmia and acidosis management, gentle handling, immediate care, and advanced life support. Factors that predispose to frostbite, progression of injury, clinical presentation, rapid thawing, treatment after thawing, medication, aftercare, and management of frostbite with coexisting hypothermia are detailed. (RW/UMS)

524.

BARBOUR HG, McKay EA, Griffith WP.

Water shifts in deep hypothermia.
Am J Physiol 104 :9-19; 1943.

Exposure to cold with retention of protective reflexes leads to a gain of intracellular water throughout the body. When, however, the central nervous system becomes so chilled as to cause general neuro-muscular depression, the effect on the hypothalamus is to abolish the reflex responses to cold, which process includes a reversal of the water shift with increased extracellular fluid. Subcutaneous edema tends to occur and is augmented on rewarming the animal, which procedure increases greatly the hydration of blood, at least relatively. (Authors' conclusion)

525.

BASS DE.

Metabolic and energy balances of men in a cold environment.
In: Cold Injury. New York, Josiah Macy Jr. Foundation, 1960, p 317-337.

Two experiments investigating the metabolic and energy balances of men living only partially clad in a cold environment are reported. In the first experiment, after living in a room at 26°C for 3 weeks, the room tempera-

ture was dropped to 14°C with a 3 mile per hour wind for 12 days, followed by a 2 week recovery period. The second experiment was similar but involved less clothing and the monitoring of rectal temperature. In a panel discussion, the following topics are addressed: the influence of partial clothing upon subject's behavior, caloric intakes and body weights during continuous cold exposure, motivation to eat under various cold and recovery conditions, changes in water and other body fluid balances during continuous cold exposure, renal acid-base regulation during continuous cold exposure, and the effect of continuous cold exposure on the diurnal pattern of resting oxygen consumption. It is concluded that although food intake increased about 25 percent during cold exposure with parallel increases in energy output, the metabolic balance remained unchanged. There was no evidence of any catabolic response. (RW/UMS)

526.

BAUM I, Brück K, Schwennicke HP.

Adaptive modifications in the thermoregulatory system of long-distance runners.
J Appl Physiol 40(3) :404-410; 1976.

In seven long-distance runners (42 km or more) the thermoregulatory responses to acute external cooling and heating, under resting conditions, were recorded and compared with those in physically untrained controls. Sweating as well as shivering thresholds were significantly decreased in the runners when compared either in terms of mean body temperature (T_b) or esophageal temperature (T_{es}); T_b and T_{es} were reduced in the runners at rest under thermoneutral conditions. Moreover, cold sensation in the runners occurred at lower T_b. The runners thus behaved as if the "set point" of their thermoregulatory system had been reset to a lower level. As for the sweating threshold, the shift is quantitatively comparable to that found in heat adaptation. The described modifications in long-distance runners would prolong the time period until a dangerous body temperature–one of the important limiting factors in physical endurance–is reached during heavy exercise. (Authors' abstract)

527.

BEHNKE AR, Yaglou CP.

Physiological responses of men to chilling in ice water and to slow and fast rewarming.
J Appl Physiol 3 :591-602; 1951.

Two nude subjects were immersed shouder-deep in ice water for about one hour until the toes became numb, then the exposure was terminated. The average water temperature varied from about 42°F in the winter to as high as 50°F in the summer. Following this drastic chilling the subjects were rewarmed by exposure to air at 73° to 100°F or to water at 100° to 102°F. A third subject dressed in outdoor winter clothing was chilled in a cold chamber at -20°F for about 3 hours, until his toes became numb. He was then rewarmed in air at 100°F without changing clothes. Skin temperatures fell abruptly upon entering the cold bath, and the subjects experienced excruciating pains all over the body during the transitory period of vasoconstriction. Rectal, gastric and oral temperatures after an initial rise fell continuously during the chilling period, despite violent shivering and a sixfold increase of metabolic rate. In rewarming of chilled subjects, skin temperatures rose abruptly, while deep temperatures continued falling for some time at a rate that was even greater than that during the preceding immersion period. A second cold shock was experienced during the first stage of rewarming which was even more distressing than the initial immersion shock. Its duration depended on the rapidity of rewarming. Rewarming in air at 70° to 100°F consumed several hours, and unnecessarily prolonged the agony from shaking chills. Best results were obtained by rapid rewarming in water at 100° to 105°F. Under the conditions of our experiments, the need for rapid rewarming to prevent a precipitous after-drop of deep temperatures, and associated distress, is imperative. (Authors' summary)

528.

BERAN AV, Shinto RA, Proctor KG, Sperling DR.

Effect of inhalate thermal conductivity and high O_2 in producing hypothermia.
J Appl Physiol: Respirat Environ Exercise Physiol 47: 228-232; 1979.

The effect of an increase in inhalate thermal conductivity and the fraction of inspiratory O_2 (FIO_2) on the rate of cooling and rewarming using a surface-inhalate heat exchange method was evaluated. Male New Zealand White rabbits were divided into three groups: those ventilated with air, those with 20% O_2 + 80% He, and those with 100% O_2. All animals were cooled to an esophageal temperature of 22.5°C (or for 180 min maximum). Following a 15-min exposure to room air, the animals were connected to the humidifying and warming system. He-O_2 had the highest thermal conductivity and the animals ventilated with it had the fastest cooling rate. One hundred percent O_2 and room air had similar thermal conductivites, but the animals ventilated with 100% O_2 had signi-

ficantly lower cooling rates. These data indicate that, while maintaining a constant surface heat exchange, the rate of heat exchange across the lung can be modified by altering the thermal conductivity of the inhalate gas mixture. Total heat exchange can also be modified by hyperoxemia-induced hemodynamic changes. (Authors' abstract)

529.

BLACK AK, Eady RA, Graeves MW, Kehey TM, Sibbald G.

Treatment of acquired cold urticaria by prednisone: dissociation of histamine release and clinical improvement.

Br J Clin Pharm 9(1):116-117; Oct 1980.

The production of erythema and wealing in cold urticaria is associated with elevated histamine levels in the blood draining the affected areas. Since conventional antihistamine therapy is ineffective, the clinical response to 20-25 mg oral prednisone, a drug that inhibits the release of histamine from skin *in vitro*, was determined. Prior to therapy all patients showed elevated venous histamine levels on cold challenge. Prednisone was found to suppress venous histamine, but showed little improvement of erythema and edema, although itching associated with this cold hypersensitivity was relieved. No correlation of clinical improvement with suppression of venous histamine was found suggesting that histamine may not be the principal mediator of the vascular response in cold urticaria. (CRR/UMS)

530.

BLAIR E, Swan H, Virtue R.

Clinical hypothermia: a study of the icewater surface immersion and short-wave diathermy rewarming technics.

Amer Surg 22:869-879; 1956.

Study has been made of the surface immersion cooling and short-wave diathermy rewarming of human subjects. The rate of cooling was variable and was primarily a function of body size and shape (surface area). During surface immersion cooling, temperature exchange is accomplished largely by conduction, but convection by agitation of the ice water is important. Upon exposure to ice water (0-5 C) an initial delay in the fall of 1 C in sigmoid temperature was noted. This lag is due to a "temperature barrier", consisting of a diminished peripheral blood flow. The subsequent development of peripheral vasodilatation, due to the direct effect of cold, allows cooling to proceed as a function of time and mass. An "after-fall" in the sigmoid temperature of 2 to 5½ degrees centrigrade occurred upon removal from the ice bath. This is due to the redistribution of heat within the body as internal temperature gradients are lessened by the circulation. "After-fall" could not be predicted with precision, and was not related to any identifiable variable. Rewarming by short-wave diathermy was effective. It is not a surface technic and is not associated with large internal gradients or specific peripheral circulatory changes. Hypothermic anesthesia developed at varying temperature levels, usually below 31 C sigmoid temperature, thereby permitting the cessation of other anesthetic agents. Hypothermic anesthesia was adequate for open chest procedures and lasted throughout most of the period of rewarming. In 9 of 15 patients, supplementary nitrous oxide was required for the final stages of the procedure. Different physiologic states exist during cooling and rewarming when surface and perfusion technics are used, although during the stable state of hypothermia the physiologic situation probably is the same with both methods. (Authors' summary and conclusions)

531.

BLATTEIS CM, Lutherer LO.

Cold-induced thermogenesis in dogs: its reduction by moderate hypoxia.

J Appl Physiol 35(5) :608-612; 1973.

The increased thermogenesis normally evoked by exposure to cold is abruptly reduced in most mammals when they breathe air low in O_2. This study was conducted using dogs to determine whether this hypoxic effect might be related to concurrently induced changes in circulating substrate levels. Control measurements were obtained first at 26°C and then at 6°C, with all animals breathing room air. Experimental data were collected during further exposure to 6°C with some dogs breathing 12% O_2. The increase in Vo_2 induced by cold in air was suppressed immediately by hypoxia. There was, however, a gradual recovery of the Vo_2 during the continuing hypoxic exposure, and this usually was accompanied by vigorous shivering. Breathing 12% O_2 had no demonstrable effect on plasma glucose, lactate, pyruvate, free fatty acid, and ketone levels, although the cold-induced rise in the latter two occurred earlier in hypoxia than in air. The present findings suggest that the reduced metabolic response to cold during moderate hypoxia might be related to an impaired capacity to greatly accelerate substrate oxidation rather than to a diminished substrate mobilization. (Authors' abstract)

532.

BLATTEIS CM, Lutherer LO.

Effect of altitude exposure on thermoregulatory response of man to cold.
J Appl Physiol 41(6) :848-858; 1976.

The thermoregulatory responses to 10°C (for 3 h) were investigated in 1) 12 natives from sea level (lowlanders) at 150 m, and on arrival at 3,350 and 4,340 m; 2) 6 of these during a 6-wk sojourn at 4,360 m, and on return to sea level; and 3) 5 natives from each of the two altitudes (highlanders) in their respective habitat, and after descent to 150 m. The cold-induced increase in the rate of O_2 consumption (Vo_2) of the lowlanders was significantly smaller at both altitudes than at sea level. It did not recover substantially during the 6 wk at altitude, but was restored to its initial rate on return to sea level. By contrast, visible shivering activity was augmented on arrival at altitude. It persisted throughout the 6 wk there, but was greatly depressed on return to seal level, despite the increased Vo_2. Mean skin temperatures (T_{sk}) stabilized in the cold at significantly higher values at altitude. Rectal temperature (T_{re}) decreased similarly at all altitudes. Vo_2 of the highlanders in the cold was significantly greater at sea level than at their resident altitudes, although shivering activity was less intense; T_{sk} stabilized at significantly lower levels at 150 m than at either altitude. These results indicate that altitude exposure reduced the calorigenic response of man to cold, and that this effect is not moderated by acclimatization to altitude, yet is reversible immediately on descent to sea level. The component of cold thermogenesis which appeared to be reduced by altitude exposure was nonshivering thermogenesis rather than visible shivering. (Authors' abstract)

533.

BLAYO, M.C., Y. Lecompte and J.J. Pocidalo.

Control of acid-base status during hypothermia in man.
Respir. Physiol. 42:287-298; 1980.

Abstract only. Entire item quoted: Rahn's concepts of acid-base balance during hypothermia were tested in humans by studying eleven men who required extracorporeal cooling for surgery. Hypothermia was moderate (27-28°C) and maintained for 60-70 min. Extracorporeal blood perfusion (ECBP) was performed with a bubble-oxygenator which allowed changes in blood flow and gas concentrations. Arterial pH (pHa) at the person's body temperature was controlled by varying CO_2 flow to the oxygenator in order to maintain *in vitro* pH measured at 37°C in the normal range. During hypothermia and after rewarming to 37°C, bicarbonate concentration and total CO_2 content of arterial and mixed venous blood remained constant. A physiologic solution was introduced into the peritoneal cavity which was used as a tonometer; the values of equilibrated CO_2 content in peritoneal fluid were constant. Neither metabolic acidosis nor hypercapnia developed. Blood acid base balance *in vivo* during hypothermia was therefore identical to the behavior of blood *in vitro*. In addition, the interpretation of the results of acid base studies in humans with abnormal central temperature is facilitated when measurements are performed at 37°C. (J. Appl. Physiol.)

534.

BLOCH M (letter).

Accidental hypothermia.
Br Med J 1(548) :376; 1967.

The author replies to Thomson's (1 April p. 51) suggestions that hypoxia and respiratory acidosis, complications secondary to shivering, may be clinically relevant in the rewarming of victims of accidental hypothermia. While he agrees that shivering should be controlled during rewarming, he suggests that these complications are not due to shivering per se. Several references are cited that support the idea that shivering is only an occasional complication during rewarming of both accidental and induced hypothermia in neonates, adults, and dogs. Two case histories of prolonged hypothermia (8 days, rectal temperature 30°C) are described suggesting that disturbances of ventilation and acid-base balance are unlikely to be a problem. Comments concerning the previously recognized mortality associated with active rewarming following prolonged hypothermia and the introduction of prolonged induced hypothermia in clinical medicine are included. (CDR/UMS)

535.

BOLSTAD, G., A. Brubakk, B. Holand and A. Pasche.

Effect of cooling on maximal isometric force in human skeletal muscle during saturation diving.
Bergen, Norway, Norwegian Underwater Inst., Rep. 45-80, 11p. Dec. 29, 1980.

During a simulated helium/oxygen saturation dive to 250 msw the effect of cooling on maximal voluntary

isometric contraction (MVC) of two different muscle groups were investigated. Chamber temperature was lowered from 28.6° to 22.7°C in about 160 minutes, producing an average fall in skin and vastus lateralis muscle temperature of 7° and 4°C, respectively. MVC of knee extensors decreased by an average of 17% while the corresponding value for the handgrip muscles tended to increase slightly, reaching a value of 116% of control by the rewarming period. The observed difference in the reaction pattern of the two muscle groups may be related to possible differences in muscle temperature or fibre-types composition. (Authors' summary)

536.

BOND NA Jr.

The cod war and human protection against cold.
Eur Sci Notes 36(1): 1; 1982.

The British/Icelandic fishing waters dispute has led to developments in personal protection against cold water and weather. Icelandic rammings of British ships caused flooding of compartments, and repairs often required long periods of work in near-freezing water. As a result, new low-cost garments of polyurethane-coated nylon were developed, and changes were made in life raft design to reduce the effects of cold. The garment was tested in a simulated cold water task and found to produce a mean skin temperature rise of 5°C or more in comparison with a control group wearing ordinary clothing. In addition, the suited subjects were comfortable and did not shiver while the controls shivered uncontrollably. The new life raft model was designed with a seat which raises the buttocks off the floor and an improved canopy to provide better dead-air insulation. The seats were shown to raise buttock temperature by several degrees, and the canopy raised ambient raft air temperatures by 5 to 10°C. The canopy also led to toxic CO_2 buildup, but the periodic opening of a port alleviated this problem. New developments in cold protection under combat conditions have potentially widespread benefits in light of the massive impact of cold casualties during recent wars. (RW/UMS)

537.

BOUWMAN DL, Morrison S, Lucas CE, Ledgerwood AM.

Early sympathetic blockade for frostbit– is it of value?
J Trauma 20(9):744-749; Sep 1980.

Sympathectomy has been advocated in the therapy of acute frostbite because ischemia is one determinant of injury severity. Among 66 frostbite victims treated from 1976 through 1978, a group of 15 patients with acute, bilaterally equal injuries judged to be third or fourth degree were treated with immediate intro-arterial resperpine (IAR) in one limb and ipsilateral sympathectomy. Three additional patients who were excellent candidates underwent immediate sympathectomy. The average interval from injury to IAR injection was 3 hours (range 1 to 24 hours). The average interval from injury to sympathectomy was 3 days (range 12 hours to 10 days). Efficacy of therapy was assessed by comparison of the sympathectomized limbs compared with those treated with IAR. One patient demarcated more rapidly and one other patient appeared to be protected from recurrent injury. Sympathectomy was not effective therapy for acute frostbite even when achieved early with IAR. Late protection against subsequent cold injury appears to be the only benefit of sympathectomy for frostbite.(Authors' abstract)

538.

BRADLEY ME.

The interaction of stresses in diving and adaptation to these stresses.
In: Scripps Institution of Oceanography. Human performance and scuba diving. Proceedings of the symposium on underwater physiology, La Jolla, Calif, April 10-11, 1970, p 63-69, Chicago, The Athletic Institute, 1970.

At shallow depths a diver may be subjected to stresses which are qualitatively similar to those encountered during deep diving. In deep diving and in certain types of shallow diving, these stresses can be severe and can interact to endanger the diver and degrade his capacity for physical exertion. Avoidance or minimizing the effects of these stresses enhances diver productivity and safety. Proper diver selection and training will improve a diver's ability to cope with the rigors of diving. The equipment that a diver uses must support him physiologically. His thermal balance must be maintained by a thick, well fitting wet suit or by providing supplemental heat. The underwater breathing apparatus that a diver uses should incorporate characteristics of low flow resistance, minimal dead space, and minimal hydrostatic imbalance in order to lessen work of breathing. (Author's conclusions)

539.

BRENNAN WJ.

Winter!

Nat Ocean Atmos Adm Newsline 12(1) :11-12; Winter 1982.

Winter cold is responsible for an average of 450 deaths per season, many of which could be prevented by common sense. People should avoid going out during winter storm warnings. When car travel is necessary, the car should be equipped with a shovel, chains, extra warm clothing, sleeping bags, a first aid kit, a flashlight, and a bag of sand or gravel. If stranded in a car, motorists should resist the temptation to try to walk to safety, keep a window slightly open for air supply, and periodically clear snow from the exhaust pipe. People who go outside on foot should wear several layers of wool clothing, a hat, gloves, and warm footwear. It is also important to be aware of the effect of wind chill and the sudden cold phenomenon, during which the temperature can drop as much as 50°F in an hour at the onset of a winter storm. (RW/UMS)

540.

BRISTOW G, Smith R, Lee J, Auty A, Tweed WA.

Resuscitation from cardiopulmonary arrest during accidental hypothermia due to exhaustion and exposure.

Can Med Assoc J 117 :247-249; 1977.

A 16-year-old boy with accidental hypothermia and cardiopulmonary arrest due to exhaustion and exposure was resuscitated after warming measures – hot wet towels, hot water bottles, and hot water enemas and gastric lavage – had increased his rectal temperature from 25.2 to 28.0°C. Despite prolonged cardiopulmonary arrest, recovery was almost complete, with no evident cerebral damage. Cardiopulmonary resuscitation procedures should not be abondoned until the body temperature is more than 30°C, because the prognosis in cases of accidental hypothermia without associated disease is excellent if cardiac function can be re-established. (Authors' abstract)

541.

BRISTOW G (letter).

Resuscitation from cardiac arrest during accidental hypothermia.

Can Med Assoc J 117(9): 1000; 1977.

Enthusiasm is shared for rapid core rewarming in the treatment of hypothermia, but additional data, Laufman (1965), is cited for passive external rewarming. Treating three additional nonarrested modestly hypothermic patients by simply covering them with a warm blanket in a warm room by the author resulted in an uneventful recovery. It is agreed that in most cases active, rapid core rewarming is preferred to passive external rewarming. However, humidified heated oxygen, in animals, resulted in a heat gain of only 0.5 to 1.0°C per hour. The author reiterates that for nonarrested hypothermic victims, the shell method of circulating hot water in blankets is used for patients whose core temperature is greater than 30°C and peritoneal lavage if their temperature is less than 30°C. He now believes that peritoneal lavage represents the most rapid, safe method in hospitals for patients with cardiorespiratory arrest. (EP/UMS)

542.

BRISTOW G (letter).

Treatment of accidental hypothermia with peritoneal dialysis.

Can Med Assoc J 118:764; 1978.

The author takes issue with Dr. L.S. Soung and colleagues relative to the article on the use of peritoneal dialysis in the treatment of accidental hypothermia (Can Med Assoc J 117:1415; 1977). Dr. G. Bristow indicates that Soung and associates are wrong to state that peritoneal dialysis has not been used in the treatment of hypothermic individuals with cardiovascular stability and cites Grossheim's report (1973). In addition, Bristow questions the statement that peritoneal dialysis, hemodialysis, and partial cardioplumonary bypass are all relatively simple methods of internal rewarming that are readily available in most hospitals. He reiterates that the ideal method of core rewarming in the hypothermic patient, particularly if there is cardiac arrest or the core temperature is 30°C or less, is peritoneal dialysis or lavage. (EP/UMS)

543.

BRUBAKK AO, Tonjum S, Holand B, et al.

Heat loss and tolerance time during cold exposure in heliox atmosphere at 16 ATA.
Undersea Biomed Res 9(2) :81-90; June 1982.

Heat loss and tolerance time during cold exposure in heliox atmosphere at 16 ATA. Undersea Biomed Res 1982; 9(2) :81-90.–Four different types of protective clothing and three different methods of heat conservation protection were evaluated during an exposure to 4°C cold in a heliox atmosphere at 150 msw. The divers using protective systems with little insulation had to quit the test after 1-2 h due to uncontrollable shivering and an extreme feeling of cold, whereas the divers using the heavily insulated clothing were able to stay in the chamber for 8-10 h. However, even with adequate protection against convective heat loss from the skin, respiratory convective heat loss will be high unless inspired gas is heated. This can be adequately done by using a combined heat-exchanger and scrubber where the heat produced by CO_2 absorption is used to warm the inspired gas. (Authors' abstract)

544.

BRÜCK K, Wünnenberg W, Gallmeier H, Ziehm B.

Shift of threshold temperature for shivering and heat polypnea as a mode of thermal adaptation.
Pfluegers Arch 321: 159-172; 1970.

Newborn guinea pigs were divided into three groups and kept for several weeks at one of the following environmental conditions: 1. 28°C, WA-animals; 2. 3°C, CA-animals; 3. 12 hrs daily at 3°C, 12 hrs at 28°C, CWA-animals. At the age of 4-7 weeks threshold temperatures were determined for shivering (electrical muscle activity) and heat polypnea, and the maximum amount of nonshivering thermogenesis was measured using the noradrenaline test. In the CA-animals both shivering and heat polypnea threshold were found to be decreased in comparison with WA-animals by about 1°C; for these studies the animals were placed and immobilized in a climatized respiratory chamber. In another series of studies, in which the animals were unrestrained, the mean colon temperature of CA-animals was about 0.5°–1°C lower than in WA-animals when exposed to ambient temperatures of 22.5 and 30°C for 24 and 2 hrs, respectively. At 15°C ambient temperature there was a similar but smaller temperature difference. Hence, both types of studies would indicate that the "set point" of the temperature control system was set to a lower level in CA-animals. In CWA-animals the shivering threshold was decreased as in CA-animals; the heat polypnea threshold, however, remained as high as in the WA-animals. This "widening of the interthreshold zone" in CWA-animals is shown to provide a more economical temperature regulation when the animals are subjected to fluctuating environmental conditions, as they are enabled to tolerate body temperature changes to some extent before they actuate their cold or heat defense mechanisms. With regard to the ability of NST (i.e. metabolic cold-adaptation) CWA-animals were not different from CA-animals. (Authors' summary)

545.

BUCKINGHAM IP, Kuehn LA (letter).

Diagnosing and treating hypothermia.
Can Med Assoc J 126(11) :1276-1277; Jun 1982.

The optimal temperature for a warm-water bath, to rewarm hypothermic navy divers (cold water immersion), may be as low as 37 to 38°C. Higher temperatures were found uncomfortable and possibly dangerous, causing vasodilation and hypotension in some divers, which could result in syncope or myocardial infarction in susceptable persons. The authors state that divers who are borderline hypothermic after in-water decompression and rewarm themselves under a hot shower on the back of the head and neck, change their core tempterature very little and may be risking hypothermia in another dive on the same day. This rewarming practice tends to suspend shivering in some persons, leaving them to think they are normothermic. Low reading clinical thermometers are available in Canada through Master Marketing Co. Ltd., Box 7127, Station E, Calgary, Alta. T3C 3L8. (CDR/UMS)

546.

BUDD GM.

Effects of cold exposure and exercise in a wet, cold antarctic climate.
J Appl Physiol 20(3) :417-422; 1965.

Six men were studied before and after 6 weeks of strenuous outdoor work and cold exposure–often in wet clothing–on Heard Island in the Antarctic. Physical fitness increased significantly, while subcutaneous fat and

arterial blood pressure decreased significantly. The response of rectal temperature and shivering to a 2-hr period of whole-body cooling did not change significantly (although shivering tended to decrease), suggesting that the reduction in insulation caused by loss of fat was balanced by an increase in the insulation of other tissues. Finger temperature fell more rapidly, there was less cold vasodilatation, and the gradient of skin temperature between elbow and finger increased significantly, suggesting that heat was conserved by means of countercurrent heat exchanges and enhanced vasoconstriction. Discomfort from cold did not change. These results support those of a previous study at Mawson, Antarctica. Frostbite of one subject's hands, which grossly impaired touch sensation and caused marked intolerance to cold, produced no obvious changes in the response to cold of finger temperature. (Author's abstract)

547.

BUGUET AGC, Livingstone SD, Reed LD, Limmer RE.

Cold-induced shivering in men with thermoneutral skin temperatures.

J Appl Physiol 41(2) :142-145; 1976.

Twenty-two male Caucasians, aged 20 47 yr, were exposed in a cold room to air temperatures of -33°C while lying in sleeping bags for 2 h. Skin and rectal temperatures as well as electromyographic activity of the chin, forearm, and thigh, were recorded. Shivering occurred in all the subjects, even though skin temperatures were maintained between 31 and 33°C. It is suggested that a counter-current heat exchange occurs whereby the warm blood of the common carotid artery is cooled by cool venous blood in the jugular veins. This cooled arterial blood, in irrigating the hypothalamus, causes shivering. (Authors' abstract)

548.

BUGUET AGC, Livingstone SD, Reed LD.

Skin temperature changes in paradoxical sleep in man in the cold.

Aviat Space Environ Med 50(6) :567-570; Jun 1979.

Mean skin temperature (T_{sk}) calculated from seven sites and rectal temperature (T_{re}) were recorded every minute for a total of 88 man-nights in eight young men sleeping at night in both cold (during the Arctic winter) and neutral (laboratory) environments, and were related to the EEG stages of sleep, especially to paradoxical sleep (PS). In the neutral environment, T_{re} was always above 36°C and T_{sk} increased during PS. In the cold conditions, during PS, T_{sk} increased when T_{re} was high, and decreased when T_{re} was below 36°C. It was concluded that, although it is not known why a core temperature of about 36°C is the critical point of change in the direction of T_{sk} variations during PS, the direction in which T_{sk} will vary during PS is dependent on the core temperature at the time. (Authors' abstract)

549.

BULLARD RW.

Hyperventilation and shivering activity.

Life Sciences 3:395-405; 1964.

The causative factors in the shivering increase in voluntary hyperventilation were investigated. Oxygen consumption, various body temperatures, shivering activity, and other physiological factors were measured during control cold exposure periods and cold exposure periods combined with voluntary hyperventilation. The experiments consisted of a 75 min cold exposure in a room controlled at 5°C, with hyperventilation of cold and warm air, with and without air fortified by 6% carbon dioxide. After a brief inhibition, shivering greatly increased in all cold air hyperventilation experiments by the second min of hyperventilation. When subjects hyperventilated with air warmed to 37°C shivering activity increased to well above control levels between the second and fourth min of hyperventilation. Hyperventilation of warmed, saturated air bolstered with carbon dioxide did not increase shivering. The highest oxygen consumptions were obtained with hyperventilation of cold air and the lowest with hyperventilation of 6% carbon dioxide. Temperature changes were not great in the 10 min period of hyperventilation, with the largest decline of rectal temperature occurring with hyperventilation of cold air. It is concluded that hyperventilation is complicated by respiratory cooling and hypocapnia. (RW/UMS)

550.

BURSE RL, Stroschein LA.

Metabolic and temperature responses of men working partially immersed in very cold water.

Fed Proc 38(3 Part 1) :1227; 1979.

Abstract only. Entire item quoted: Three young men with different body builds and fat content (S1: medium

frame, 12% fat; S2: large frame, 21% fat; S3: medium frame, 19% fat) wore utility shirt, trousers, boots, helmet and 10.5 kg pack load while immersed in cold water to waist or chest for up to 2 hr. Metabolic rate (MR) was measured during repeated 20 min bouts of bench stepping (43 cm, 10 steps • min^{-1}, MR = 415-700 W), separated by 10 min standing rest (MR = 140-220 W). In 10C water to waist or chest, all 3 Ss maintained $T_{re} \geqslant 36C$ for 2 hr. In 5C water to waist, T_{re} of S1 (leanest) fell below criterion for removal (35C) in 21 min; S2 (fattest) could not continue stepping after 36 min, presumably from neuromuscular cold block. In 7.5C water to chest, S2 suffered calf cramp after 101 min while S3 tolerated 2 hr; both T_{re} remained $\geqslant$ 35.7C. S3 repeated 7.5C exposure with 50 min work -10 min rest cycle for 2 hr with final T_{re} 0.4C higher and T_{sk} 1.9C lower. Shivering progressively increased exercise MR throughout each exposure, by an average of 10% at 10C and 46% at 7.5C. Resting MR increased only during chest immersions, by an average of 86% at 10C and 110% at 7.5C. Working HR was low (82-124 beat • min^{-1}), presumably from vasoconstrictive enhancement of venous return. Despite progressively increased MR throughout exposure, working HR increase averaged only 4% during work while resting HR decreased 1%. (Authors' abstract)

551.

BURTON, DR.

Underwater engineering research at CSIRO.

In: Proc Joint SPUMS and Repub of Singapore Navy Underwater Medicine Conference. SPUMS (Suppl) 22-24; 1981.

High body heat loss and the hypothermia that develops with increasing duration in diving is a problem of scientific importance in physiology, psychology and engineering. A study of the engineering aspects of diver thermal support soon indicates that the most commonly used type of thermal insulation is inadequate for deep diving. Supplementary heating technology currently in use by the industry serves to overcome the problem of inadequate insulation, but supplying the necessarily large amounts of energy through umbilical hoses can have disadvantages, especially for non-industrial applications. The research program at CSIRO aims to demonstrate the technical feasibility of generating supplementary heat locally on the diver. A successful preliminary program involving the use of local chemical heating pads for supplementary heating of the hands was the first stage of this work. A second stage will use a manned cold water environmental facility to investigate supplementary heating of the whole body, using both the local heating pads and prototype closed circuit liquid conditioned suits as alternative approaches for heat distribution. A parallel program on high performance thermal insulation has commenced recently. (Author's conclusions)

552.

CABANAC M, Massonnet B.

Thermoregulatory responses as a function of core temperature in humans.

J Physiol (LOND) 265(3): 587-596; 1977.

Six healthy humans were immersed sequentially in baths maintained at a steady temperature of either 28 ± 1 or 38.8 ± 1°C. Metabolic heat production was calculated by respiratory gas analysis. A ventilated capsule was placed on the forehead and sweat secretion was calculated from psychrometric recordings. Convective heat loss from one hand to a water-perfused glove provided a continuous measurement of vasomotor response. Heat production, sweating, and vasomotor heat loss were proportional to core temperature. Sweating and vasomotor response were parallel. Vasoconstriction was complete, before the onset of shivering. The thresholds for heat loss and heat production were superimposed, without a 'dead band' core temperature. (Authors' summary)

553.

CAMPBELL IT.

Energy intakes on sledging expeditions.

Br J Nutr 45(1):89-94; Jan 1981.

Previous measurements of energy intake on sledging journeys in Antarctica have given a mean intake of 14.2 MJ(Acheson, 1974; Campbell, 1975), markedly lower than values reported earlier (see Edholm & Goldsmith, 1966). The technique used (individual weighed-diet survey) was more detailed and could be assumed to be more accurate than most of the earlier work where intakes had been largely inferred from the known energy content of food boxes. In the present study an individual weighed-diet survey was carried out on male subjects during a summer manhauling journey on the east coast of Greenland Mean daily energy intake of six subjects over 33 d travelling was 16.5 MJ. Mean weight loss was 2.3 kg, probably accounted for entirely by fat loss. Weight loss occurred despite the presence of excess food. Mean daily energy intake rose gradually but persistently over the 5 weeks of the journey despite a constant level of activity and to 20.1 MJ during the 4 d

rest at the end of the journey. Intakes were thus higher than those found in the earlier Antarctic studies (Acheson, 1974; Campbell, 1975) but not as high as intakes reported previously (see Edholm & Goldsmith, 1966). The fact that weight loss occurred despite the presence of excess food was ascribed to the monotonous nature of the diet. The fact that energy intake rose persistently over the 5-week study period may imply that a new state of balance of intake and expenditure was reached.(Author's summary)

554.
CARDEN DL, Nowak RM (letter).
Disseminated intravascular coagulation in hypothermia.
JAMA 247(15) :2099; Apr 1982.

Disseminated intravascular coagulation (DIC) is a recognized complication of hypothermia; several references are cited. Hematologic studies have characterized DIC in hypothermia by a low platelet count and low serum fibrinogen. As Mahajan et al (246:2517; 1981) suggests, DIC in hypothermia may be related to the release of tissue thromboplastin from cold ischemic tissue. The current authors disagree however, that the rewarming rate is solely responsible for DIC since both rapid core and slow passive rewarming techniques have had associated coagulopathies. They hypothesize that DIC is due to circulatory collapse, a frequent complication in hypothermia. (CDR/UMS)

555.
CHAN, C.Y.L. and D.R. Burton.
A portable thermochemical heat source for divers.
In: Society for Underwater Technology. Proceedings, International Conference "Divetech '81," Workshop A, London, Nov. 24-26, 1981, 15p. Published by the Society, 1981.

A simple and effective method of heating divers in extreme cold water has been developed. The local heating concept utilizes a uniformly distributed granular mixture of magnesium and iron particles packed in small sachets. Upon activation by sea water, the two-metal mixture behaves as a multitude of short-circuited electrolytic cells, producing thermal energy rather than electrical energy. The 45 mm-square sachets may be placed where heating is required on the diver's body, thus giving rise to the term "local heating;" obviously, the heating system requires no pumping device or distribution network. Heating rate and duration of output of the sachets are controlled by particle size, and mixture ratio of the constituent Mg and Fe particles. This paper describes the development, testing and performance of the heating sachets. Results of live tests in different dive situations are also presented and discussed. (Authors' summary)

556.
CHANDLER M.
Personal protection against cold environments.
J R Nav Med Serv 67(3):150-155; 1981.

The most cursory glance at history will indicate that the local and general effects of cold can seriously impair operational efficiency, often leading to permanent damage in otherwise fit, healthy troops. This paper discusses the reasons for evaluating protective clothing and equipment scientifically, during the design stage, and reviews some of the recent work along these lines undertaken by the Institute of Naval Mecicine.(Author's abstract)

557.
CHANG CB, Shoemaker WC.
Effect of hypothermia on red cell volumes.
J Thorac Cardiovasc Surg 46(1) :117-124; 1963.

A decreased plasma volume and an increased arterial hematocrit after hypothermia was confirmed in a series of dogs. More impressive changes, however, were observed in labeled red cell studiies. There was a delayed mixing of injected, labeled red cells, indicating the appearance of a slowly moving volume of red cells. The rapidly circulating red cell volume was calculated using compartmental analysis; this volume was found to be greatly reduced after total body cooling. Only 76 percent of the animals' red cells were circulating rapidly enough to be mixed with the labeled red cells in the usual 10 minute equilibration period. This failure of red cell circulation is similar to that observed in hemorrhagic shock and thermal injury. (Authors' summary)

558.
CHATONNET J, Minaire Y, Pernod A, Vincent-Falquet JC.
Inhibition of glucose uptake by epinepherine in dogs during cold exposure.
J Appl Physiol 32(2):170-175; 1972.

Intravenous infusion of glucose-^{14}C at a constant rate was used to measure plasma glucose production (R_a), utilization (R_d) and standardized utilization (R'_d) in normal and adrenal-demedullated dogs exposed to a cold ambient temperature(-25°C). The dogs remained normothermic and exhibited an intense and sustained shivering with an increased O_2 consumption and plasma glucose turnover, respectively, 5.2 times and 2.5 times more than that of resting levels. Between two control periods, epinephrine was infused for 90 min at a dose of 0.1 μg/kg·min. In adrenal-demedullated dogs, epinephrine induced an immediate and significant rise in plasma glucose (32%, $p < 0.001$) and lactate (206%, $p < 0.001$) concentrations. Hyperglycemia was accompanied by a significant reduction in R_d (-11%, $p < 0.01$) and R'_d (-31%, $p < 0.001$) without any increase in R_a. In normal cold-exposed dogs, the rise in glucose (16%, $p < 0.001$) and lactate (52%, $p < 0.05$) was far less marked and only a reduction in R'_d (-15%, $p < 0.05$) was noted. It was concluded that epinephrine secretion during cold exposure has two major effects: a rise in muscalur glycogenolysis and an inhibition of glucose uptake during muscular activity.

559.
CHEN RY, Chien S.
Plasma volume, red cell volume, and thoracic duct lymph flow in hypothermia.
Am J Physiol 233 :H605-H612; 1977.

The effects of hypothermia on plasma volume (^{125}I-albumin), red blood cell volume (^{51}Cr-RBC), and capillary permeability (thoracic duct lymph flow and protein concentration) were determined on dogs anesthetized with pentobarbital, paralyzed with succinyl-choline, and mechanically ventilated. Red blood cell volume and plasma protein concentration did not change significantly after cooling. Reductions in plasma volume and total plasma proteins indicate that whole plasma was excluded from the effective circulating blood volume. Except for a lesser increase in hematocrit, chronically splenectomized dogs showed essentially the same changes as normal dogs in response to hypothermia. Following application of ice bags, there was a biphasic response in lymph flow. The early increase in lymph flow accompanying a slight decrease in plasma volume was attributable to transcapillary fluid loss into interstitial space, probably due to cold-induced sympathetic activity. The later decrease lymph in lymph flow in hypothermia resulted from a decrease of lymph production secondary to a decrease in available capillary diffusion area. This decrease in lymph flows and the continued reduction in plasma volume suggest an intramuscular sequestration of whole plasma. (Authors' abstract)

560.
CHUITON JL.
Les problemes thermiques en plongee profonde.
[Thermal problems in deep diving].
Med Aeronaut Spat Med Subaquatique Hyperbare 20(80): 353-359; 3rd quarter 1981.

Thermal problems in saturation diving are discussed. The diver's hostile environment is described from a thermal point of view. Water temperatures in various geographical regions, ranging down to 0° C at the surface at the poles, are presented. The physiological effects of cold, including heat loss in a hyperbaric heliox environment and respiratory heat loss, are analyzed and methods of protection from the cold are reviewed. Photographs of equipment used by divers to counter heat loss are included in the article. (LET/UMS)

561.
CIPRIANO LF, Goldman RF.
Thermal responses of unclothed men exposed to both cold temperatures and high altitudes.
J Appl Physiol 39(5) :796-800; Nov 1975.

Six resting men were exposed to three temperatures (15.5, 21, 26.5°C) for 120 min at three altitudes (sea level, 2,500 m, 5,000 m). A 60-min sea-level control at the scheduled temperature preceded the nine altitude episodes. Comparison of the base-line results at any one temperature showed no differences between rectal temperatures (T_{re}) or mean weighted skin temperatures (T_{sk}). After 120 min, T_{re} and T_{sk} not only depended on ambient temperature but also altitude. The initial rate of fall in T_{re} increased with altitude and equilibrium occurred

earlier. At 15.5°C, T_{re} was 0.3°C lower at 5,000 m and 0.2°C lower at 2,500 m than at sea level. T_{sk} was almost 2°C higher at 15.5°C at 5,000 m and 1°C higher at 2,500 m than at sea level. Similar, smaller differences were observed at 21°C. Mean weighted body temperature showed no change with altitude, but, since the gradient between core and shell was reduced, a shift of blood toward the periphery is implied. (Authors' abstract)

562.

COMMONWEALTH OF NATIONS.

Concepts of clothing and equipment for cold, adverse conditions.

In: Handbook of the 12th Commonwealth Defence Conference on Operational Clothing and Combat Equipment p 121-136; Ghana, 1978.

Based on a recommendation placed before the 11th Commonwealth Defence Conference to provide information to compare concepts for clothing, personal movement and field living under cold, adverse conditions and report upon experiences derived from new equipment having military application, five papers are presented. Three papers by the UK reflect experience gained from several season's training and trail in North Norway and deal with military clothing and equipment for cold, adverse conditions; energy and oversnow movement; and gloves and the problem of hand dexterity. Two papers by India describe the clothing systems developed by India for use by combatants under adverse cold conditions and address concepts of clothing under cold adverse conditions; and the combat boot for Arctic conditions. A summary of specific comments during a discussion after each presentation is given, with a general discussion taking place after all five papers were presented. (EP/UMS)

563.

COOPER KE, Martin S. Riben P.

Respiratory and other responses in subjects immersed in cold water.

J Appl Physiol 40(6) :903-910; 1976.

Subjects have been immersed in water at 27°C and 10°C and while immersed their respiratory rates, minute volumes, and end-tidal PCO_2 levels were measured. Measurements were made with the subjects at rest, exercising at approximately 0.8 liter oxygen • min^{-1}, and very vigorously at 1.8-2.0 liters oxygen • min^{-1}. Immersion in the cold water caused an increase in respiratory rate and a fall in end-tidal PCO_2. At the moderate rate of exercise the hyperventilation persisted in relation to the oxygen demand and there was still a significant reduction in end-tidal PCO_2. At the greatest rates of exercise, the end-tidal PCO_2 did not differ from that obtained in similar rates of exercise in warm water. Preheating the subject in a sauna so as to increase skin temperature, with minimal change in body temperature, greatly attenuated the ventilatory and end-tidal PCO_2 responses to cold water immersion. The significance of these findings is discussed. (Authors' abstract)

564.

COOPWOOD TB, Kennedy JH.

Accidental hypothermia.

Cryobiology 7 :243-248; 1971.

A retrospective survey of 11 patients who were admitted with a core temperature below 28°C between January 1967 and February 1970 has been reported. Five patients died while hypothermic; two patients left the hospital alive. Of four patients treated with active rewarming (Thermorite blankets), one survived. Seven patients were permitted to rewarm at ambient temperature. Of these, one left the hospital alive. Vigorous treatment, including active rewarming, ventilatory support, fluid replacement, pharmacological control of arrhythmias and hypertension, and correction of blood hydrogen ion concentration on the basis of arterial blood pH corrected for the patient's temperature, is recommended. The most important factors in survival were age and co-existing (or causative) diseases. (Authors' summary)

565.

COOPWOOD TB, Kennedy JH.

Accidental hypothermia.

Cardiovasc Res Cent Bull 12 :104-111; 1974.

A retrospective survey of 11 patients who were admitted with a core temperature below 91°F between January 1967 and February 1970 has been reported. Five patients died while hypothermic; 2 patients left the hospital alive. Of 4 patients treated with active surface rewarming, 1 survived. Seven patients were permitted to rewarm at ambient temperature. Of these, 1 left the hospital alive. Vigorous treatment, including active rewarming,

ventilatory support, fluid replacement, pharmacologic control of arrhythmias and hypotension, and correction of blood hydrogen ion concentration on the basis of arterial blood pH corrected for the patient's temperature, is recommended. The most important factors in survival were age and co-existing (or causative) diseases. (Authors' summary and conclusion)

566.

COUGHLIN F.

Heart-warming procedure (letter).
N Engl J Med 283:326; 1973.

A heart warming procedure useful for medical facilities that lack the ability to perform partial cardiopulmonary bypass is described. Heart warming may be performed by means of thoracotomy with open chest cardiac massage and pleural irrigation with warm saline solution. This method was used in a case of a 35-year-old man who presented with a temperature in the 21.1°C range and ventricular fibrillation. Over a period of three to three and one-half hours of continuous cardiac massage, the patient had refractory ventricular fibrillation despite the use of electrical defibrillation attempts and drugs. After it was recognized that hypothermia accounted for this condition, two bottles of warm saline were poured on the heart and a few normal beats occurred. After extensive irrigation in warm water the body temperature rose and a normal sinus rhythm began. Final recovery was complete with no neurologic damage. (RW/UMS)

567.

CRAIG AB Jr, Dvorak M.

Thermal regulation of man exercising during water immersion.
J Appl Physiol 25:28-35; 1968.

Ten subjects were selected and studied during head-out immersion in different water temperatures ranging from 24 to 35°C while exercising. With a light work load, the Vo_2 averaged 70 liters/min for the hour of immersion, and with the heavier work load it was .92 liters/min. Changes in ear temperature indicated that the increased heat production associated with the exercise effectively buffered the cooling of immersion. With the light load the changes in rectal temperature were the same as noted previously in resting subjects, but with the heavier load the rectal temperature did not decrease as much. In this range of temperatures there was an indirect linear relationship between the changes in ear temperature and the water temperature. Pulse rate for a given work load was less for subjects in cool rather than in warm water. These observations are interpreted as indicating that in this range of water temperature increasing heat production by exercise is a more effective way of preventing a decrease in heat stores than the vasomotor responses which provide protection for the resting subject. (Authors' summary)

568.

CRAIG DB, Pask BA.

Safety modifications to mobile hypothermia units.
Can Anaesth Soc J 26(6):510-512; Nov 1979.

Major safety deficiencies of older mobile hypothermia units are described. Problems include absence of high or low temperature output limitation or of visual warning of abnormal operating temperatures. Modifications described provide two high temperature thermostats and one low temperature thermostat., which shut the unit down if the temperature limits are exceeded. Visual and auditory alarms were also added. Operators of mobile thermal units should be aware of the safety deficiencies of some older models, and should insist on either modification, where appropriate, or replacement.(Author's summary)

569.

CROSS, M.R. and L.A. Booth.

The biochemical assessment of hypothermia.
In: Society for Underwater Technology. Proceedings, International Conference "Divetech '81," Workshop A, London, Nov. 24-26, 1981, 6p. Published by the Society, 1981.

In an attempt at a long-term assessment of minor degrees of hypothermia, which has always been a difficult problem, a research team performed a study on divers at the Fort Bovisand (U.K.) Diving School. Blood was taken at various intervals during their training to determine the changes in the concentrations of mitochondrial enzymes. At the same time the divers were asked to assess the extent to which they felt cold as their training progressed. After the first week they said they no longer experienced the cold, yet the exposure parameters had

not been altered. The authors believe that metabolic adaptation has a role in the subjective assessment of "coldness," and that this may be of considerable importance in saturation diving. In assessing any potentially prolonged hypothermic stress (such as occurs during saturation diving), the biochemical assessment of hypothermia in terms of induced thyroidal response may be superior to any other method of assessment. The authors further theorize that the pancreas may be the best organ to monitor in the detection of very mild forms of hypothermia. (LET/UMS)

570.

D'AMATO HE, Hegnauer AH.

Blood volume in the hypothermic dog.

Am J Physiol 173 :100-102; 1953.

The plasma volume of dogs subjected to immersion hypothermia under pentobarbital anesthesia is diminished by about 12% at 20°. There is under the same conditions no change in erythrocyte volume, nor is there an over-all change in plasma protein concentration. The fate of the lost plasma has not been definitely established. The more probable explanation is that it has been trapped in minute peripheral vessels from which erythrocytes are excluded. Evidence is presented which makes suspect any prediction of erythrocyte volume change in hypothermia from hematocrit and plasma volume data. (Authors' summary)

571.

D'ANNA L.

Inhibition of shivering obtained by peripheral stimulation.

Experientia p 638-639, 1966.

It is concluded that peripheral stimulation inhibits the EMG activity produced by the shivering attack. This muscular influence is a generalized one and affects both flexor and extensor muscles. It differs from the flexor activation observed when stimulation was performed in absence of shivering. The characteristics of the late phenomenon suggest a process occurring at a spinal level and a simple reflex in nature. The inhibition of shivering, on the contrary, could be an inhibitory process set up by afferent inputs on the hypothalamus or the reticular formation. (Author's conclusions)

572.

DANZL DF, Vicario S, Thomas DM.

Accidental hypothermia–advanced life support.

J KY Med Assoc 79(12) :795; 1981.

This article is written at the request of the Kentucky Medical Association as part if its CME program. The authors define hypothermia as a core temperature below 35°C (95°F), list unique pathophysiologic factors to consider to successfully treat it and suggest treatment. Treatment choice is based on the degree of hypothermia, presence of underlying or precipitating factors, and duration of exposure. They state that active external rewarming is mandatory below 30°C (86°F), and limit its application to the patient's trunk. The occurrence of "core temperature afterdrop" is noted. Current method of choice is the inhalation of heated humidified oxygen because it is simple, effective, and only requires readily available equipment. Conditions for active core rewarming by hemodialysis or mediastinal irrigation and peritoneal dialysis are presented. (EP/UMS)

573.

DAUGHERTY CG.

Fall hypothermia: On the condition of being too cold.

Commercial Diving J, p 5-6, Fall 1981.

Physiological mechanisms for maintaining the body's heat balance during dives in cold water are described. The hypothalamus regulates body temperature through the autonomic nervous system. If vasoconstriction does not sufficiently reduce heat loss through the skin, the body produces more heat, usually through shivering. Hard exercise can also produce heat but concurrently increases heat loss through motion and breathing. Heat loss through breathing can be alleviated by heating the diver's breathing mixture. If the body is unable to maintain its heat balance, the core temperature begins to drop. At about 97°F an awareness of discomfort occurs, and at 95°F shivering is noticeable and people will not voluntarily remain in the water at that level of discomfort. Mental effects such as confusion will be noted below 95°F and conciousness will be lost at about 89°F. People who appear dead when rescued from cold water can often be revived without permanent injury. In planning repetitive dives, adequate rewarming between dives must be emphasized. If the hands are unprotected in water

colder than 50°F, heat may be lost through the phenomenon of cold vasodilation in the hands, even while the rest of the body is protected. There is no evidence that females are less vulnerable to cold than males. (RW/UMS)

574.

DAUNCEY MJ.

Influence of mild cold on 24 h energy expenditure, resting metabolism and diet-induced thermogenesis.

Br J Nutr 45(2):257-267; Mar 1981.

It has been suggested previously that people in developed countries do not expose themselves to cold severe enough to induce a metabolic response. The energy expenditure, as both heat production and total heat loss, of nine women was therefore measured continuously while each lived for 30 h in a whole-body calorimeter on two occassions, one at 28° and the other at 22°. All subjects followed a predetermined pattern of activity and food intake. The environmental conditions were judged by the subjects to be within those encountered in everyday life. In the standard clothing worn, 28° was considered to be comfortably warm but not too hot, while 22° was judged to be cool but not too cold. Heat production for 24 h was significantly greater at the lower temperature, by (mean ±SE) 7.0±1.1%. The range was between 2 and 12%. Total heat loss was also significantly greater, by 6%, and there was a large change in the partition of heat loss. At the lower temperature sensible heat loss increased by 39%. Resting metabolism measured in the morning 12-13 h after the last meal was significantly greater at 22° than at 28°, whereas there was no difference when the resting measurement was made for 2.5 h following a meal. In conclusion: (*a*) environmental temperature may play a more important role than was previously recognized in the energy balance of those living in this country, and (*b*) there is an indication of at least a partial replacement of cold-induced by diet-induced thermogensis in man.(Author's summary)

575.

DaVEE TS, Reineberg EJ.

Extreme hypothermia and ventricular fibrillation.

Ann Emerg Med 9(2): 100-102; Feb 1980.

A 31-year-old white man with a core temperature of 60.8°F (16°C) and ventricular fibrillation was successfully resuscitated using active core and external rewarming techniques. Rectal temperature at the time of reestablished electromechanical cardiac activity was 68°F (20°C), a temperature previously thought to be incompatible with successful resuscitation from venticular fibrillation. We are not aware of previous case reports describing survival following a lower documented core temperature.(Authors' abstract)

576.

DAVEE TS (letter).

Extreme hypothermia and ventricular fibrillation, author's reply.

Ann Emerg Med 9(9) :496; 1980.

There has been debate as to whether ventricular fibrillation, in the face of severe hypothermia, will convert to sinus rhythm at a core temperature lower than 25°C. In our report, conversion to sinus rhythm occurred at a rectal probe temperature of 20°C. Experimental data suggest that conversion to sinus rhythm will depend on intramyocardial temperature gradients and that the presence of a small, or no, temperature gradient between the left and right ventricle provides the setting for more likely conversion to sinus rhythm at any temperature (between 12°C and 20°C in dogs). I am not aware of thermistor probe recordings of intramyocardial temperatures in accidental hypothermia. Rewarming in the hypothermia patient, as evidenced by our paper, combined core rewarming, warmed peritoneal dialysis fluid, warmed humdified intrathoracic gas exchange using a volume respirator, warmed intravenous fluids, and external warming with heated blankets. We think the aggressive combination of the described methodology was fully effective in producing rapid and safe rewarming. Further, all the above are available in virtually all small and medium-size community hospitals where hemodialysis or a thoracic surgical service may not be available. We believe that peritoneal dialysis is certainly as effective as intrathoracic irrigation with warmed saline and avoids the operative morbidity associated with such procedures.

577.

DAVIDSON JM (letter).

Resuscitation from cardiac arrest during accidental hypothermia.
Can Med Assoc J 117(9): 998-1000; 1977.

Issue is taken with Dr. Bristow's and his colleagues' statement (Can Med Assoc J 117: 247; 1977) that passive rewarming in treating hypothermia is the treatment of choice. The author cites articles in which mortality rates are high for both, rapid active external rewarming, and passive external rewarming. The use of heated humidified oxygen and lung alveoli as heat exchangers had been advocated previously and its advantages are discussed. A treatment regimen is listed that was used by Ledingham and Mone (1972) in which a combination of external and core rewarming resulted in a high overall survivor rate of 70%. (EP/UMS)

578.

DAVIDSON M, Grant E.

Accidental hypothermia: a community hospital perspective.
Postgrad Med 70(5) :42-49; 1981.

Hypothermia, especially in an urban environment, is often an unsuspected and therefore underdiagnosed clinical entity. Of 60 cases recorded over a two-year period in a typical community hospital in Philadelphia, 26 (43%) involved patients under 60 years of age; ambient air temperatures at admission exceeded 50 F (10 C) in 28 (47%) of the 60 cases. Hypothermia thus cannot necessarily be attributed to advanced age or cold climates or seasons. The severity of hypothermia did not correlate with either the season of the year or the ambient air temperature. Diabetes and alcohol abuse appear to be risk factors for hypothermia, being present in 18 (30%) and 14 (23%) of the patients, respectively. Every emergency department should have a protocol for identification and management of the hypothermic victim to allow timely institution of appropriate rewarming techniques. (Authors' summary)

579.

DAVIS FM, Judson JA.

Warm peritoneal dialysis in the management of accidental hypothermia: report of five cases.
NZ Med J 94(692) :207-209; 1981.

Five patients with accidental hypothermia are reported. Admission rectal temperatures ranged from 24°C to 31.7°C and two patients had suffered circulatory arrest. Ages ranged between 25 and 77 and predisposing factors included alcoholism, glutethamide poisoning, pancreatitis and cerebro-vascular accident. Along with respiratory and circulatory management in an intensive care unit the patients were actively rewarmed by peritoneal dialysis with fluid at 37°C. Rewarming was rapid, smooth and free of complications. All five patients made a good recovery. (Authors' summary)

580.

DAVIS TRA.

Shivering and nonshivering heat production in animals and man.
In: Cold Injury. New York, Josiah Macy Jr Foundation, 1960, p 223-269.

The possibility of non-shivering thermogenesis is reconsidered in an examination of heat production mechanisms in man and animals. In a panel discussion the following topics are addressed: the effect of exposure to cold on the duration of survival in hereditary obese-hyperglycemic mice and controls, temperature and shivering activity in rats exposed to cold, the effect of diathermy intensity upon temperature and oxygen consumption, curare and diathermic fractionation of rat metabolism in the cold, fractions of metabolism that contribute to the cold induced metabolism during cold acclimation of the rat, patterns of shivering in man exposed to cold air or seawater, and the effect of seasonal change upon metabolism and shivering. (RW/UMS)

581.

DEDENKO II, Ustiushin BV, Lytkin BG.

Physiologic evaluation of the thermal status of miners.
Gig Sanit 12:20-22; Dec 1980.

The thermal status of miners in the Far North of the USSR in the different seasons is evaluated. In winter, these workers show increased heat production and decreased heat losses. Involvement of the cardiovascular and respiratory systems in the observed changes in thermoregulation is pointed out. (Authors' abstract)

582.

DeLAPP TD.

Taking the bite out of frostbite and other cold-weather injuries.
Am J Nurs 80(1):56-60; Jan 1980.

Local cold injury can occur when a causitive combination of cold wet, wind, and altitude exists. The course and severity of injury depend on the severity and duration of exposure and the susceptibility of the individual. Exposure of the skin to cold results in peripheral vasoconstriction, decreased blood flow, and gradual anoxia of peripheral tissues, which results in ischemic injury. Muscle weakness and loss of local sensation are early signs of cold injury due to decreased blood supply. Superficial tissues are injured first, followed by muscles, nerves, and vessels. Connective tissues and bone are relatively resistant to cold injury. The extremities and facial skin, especially the ears, cheeks, and nose are most susceptable. Non-freezing cold injuries include chilblain and immersion foot injury, whereas frostbite is a true freezing cold injury. While the type and severity of cold injuries is exposure related, the treatments have similar characteristics. Gradual rewarming of the extremity in a warm-water bath (100-108°F) followed by supportive care is the current regime. Daily cleansing and antiseptic handling of frostbite and immersion foot injuries is required to avoid infection. The sequelae of cold injuries include: hypersensitivity to cold, pains in weight bearing, paresthesia, and in severe cases of frostbite, extensive tissue loss and/or extremity dysfunction. Avoidance of early surgical intervention in frostbite management decreases the danger of retraction and infection and reduces the need for later skin grafting. The best approach to cold injury is prevention. Education of potential victims by health professionals in schools, clinics, and industry may help reduce the number of serious exposure-related injuries.(CDR/UMS)

583.

DEMBERT ML, Dean LM, Noddin EM.

Cold weather morbidity among United States Navy and Marine Corps personnel.
Milit Med 146(11) :771-775; 1981.

A basic descriptive investigation was conducted to assess archival cold weather morbidity among US Navy and Marine Corps personnel. Data were presented and summarized in four categories: inpatient hospitalization, medical board, physical evaluation board, and outpatient morbidity and mortality. Although the sample populations studied were very small in comparison with other reported medical conditions, not surprisingly it was found that frostbite (especially of the feet) and orthopaedic problems are common in cold weather military operations, especially for the younger, lower-rated, enlisted Service member. For statistical research purposes, an analysis of cold weather medical morbidity among US Navy and Marine Corps personnel can be performed by using existing official data. While data on inpatient hospitalizations, medical boards, and physical evaluation boards are fairly complete, applicability for research purposes has some major limitations. Difficulty in the consistent interpretation and usage of cause codes (from BUMEDINST 6300.1) are a problem in selecting certain cases. The Monthly Outpatient Morbidity Report provides data of definite value, but limitations in the command reporting of environmentally-related morbidity on the MOMMR form can lead to variable interpretation of officially-reported data for analysis purposes, a problem which has also been addressed in other studies. Because outpatient fleet medicine reflects the status of success of operational medicine in maintaining medical readiness, continued effort should be maintained in updating the existing outpatient reporting form to fit the needs of the military medical, line, and research commands. (Authors' summary)

584.

DENNY-BROWN D, Gaylor JB, Uprus V.

Note on the nature of the motor discharge in shivering.
Brain 58 :233-237; n.d.

The existence of relationships among the character, intensity, and location of the muscular contractions of

shivering was investigated. In several human experiments, balloons were attached between the teeth and over the belly of the left biceps brachii and quadriceps femoris. The pressure within each balloon was registered optically by manometer and mirror and recorded on a moving strip of bromide paper. Shivering was induced by rapidly cooling the right upper and lower limbs by ice water after the subject had been warmed until sweating had occurred. As body temperature fell, the first indication of shivering onset was usually an isolated twitch of the masseter. This preliminary twitch was followed by others at variable intervals of 0.2 to 1.6 S. Bouts of clonic twitching occurred at rates from 4 to 6 a second and gradually increased in length. The shivering at this and later stages could be voluntarily stopped in any muscle group by contraction of that group or bracing of part of the body combined with cessation of respiration. As the twitching became fused into clonic outbursts in each muscular group, respiration became irregular with periods of apnea. The intensity and time of onset of shivering appear to be related mainly to the amount of other contraction present. The manner in which shivering gives way to voluntary movement allows it to fulfill the requirements of promotion of metabolism without the necessity for a particular posture of interference with willed efforts. (RW/UMS)

585.

DE ROUBAIX JAM.

Successful resuscitation in severe accidental hypothermia: a case report.
S Afr Med J 57(10):374-376; Mar 8, 1980.

Accidental hypothermia has a mortality rate of 30-80% and should always be borne in mind with comatose, hypotensive patients. It is a preventable condition when adequate safety measures are ensured. One should act in the case of early sympotoms, because collapse may soon follow and evacuation of a patient on a stretcher is time-consuming, dangerous and a major undertaking. In severe cases absence of respiration and circulation should not preclude resuscitation. Resuscitation should be continued until the patient is warm and all biochemical abnormalities have been corrected and intoxication has been ruled out. Resuscitation may be successful in primitive, adverse conditions, as illustrated by this case of a 13-year-old boy with cardiopulmonary arrest and a core temperature of only 25°C, who was successfully reanimated.(Author's summary)

586.

DESMEULES H, Blais C.

Accidental hypothermia: treatment of a case using peritoneal irrigation.
Can Anaesth Soc J 26(6) 506-509; 1979.

A case of accidental hypothermia is reported. This patient was rewarmed by using a peritoneal irrigation. Rewarming was rapid and without complication. The patient was discharged from the hospital free from any sequellae. Peritoneal irrigation constitutes a fast and effective technique of core body rewarming in cases of moderate or severe hypothermia. Another advantage of this method is that it can be accomplished without complicated equipment and that it can be used even in small community hospitals. (Authors' abstract)

587.

DIKSHIT PK, Anand BK, Boparai MS.

Oxygen requirements for thermogenesis during cold adaptation at high altitude.
Indian J Physiol Pharmacol 16(1): 31-45; 1972.

Experiments were carried out in human subjects during winter months (D.B. Temp −5°C) at an altitude of 3,660 m (12,000 ft) in Ladakh, India, to explore the possibility of further reduction in oxygen utilization for thermogenesis during the non-shivering phase. Oxygen consumption for resting, bicycle ergometer activities, and field marching activities were measured on repeated cold exposures in reduced clothing spread over a period of 6-7 weeks. Basal oxygen consumption and maximal oxygen consumption of these subjects were also recorded. The basal O_2 consumption was initially increased significantly during winter at high altitude, while at the end of 7 weeks stay it was about the same as at sea level. Maximal O_2 consumption was significantly reduced at high altitude and did not improve even after 6-7 weeks stay, while work output during the maximal test showed some improvement. The oxygen requirement for thermogenesis reduced by change over from shivering to non-shivering; and further reduced significantly even during the non-shivering phase, on repeated exposures to cold. These findings bear special significance as the increased economy in oxygen utilization for work in cold at high altitude will reflect on better physical performance at high altitude. (Authors' summary)

588.

DINGWALL RHM, Dundas CR, Norman JN.

A technique for evaluation of respiratory heat exchangers at simulated depth.

In: Abstracts, VIIth International Congress on Hyperbaric Medicine, Sept 2-6, 1981, Moscow, p 431-432.

Abstract only. Entire item quoted: Severing of the umbilical to a diving bell results in the loss of support services such as power and hot water. The immediate threat to the diver is body heat loss. At a depth of 150 msw, the ambient temperature in the bell will rapidly fall to about 4-6°C. At this depth and with inspired gas temperatures of about 6°C, respiratory heat loss becomes a large proportion of total body heat loss which is itself greatly increased in a heliox atmosphere. Many devices have been developed that recover heat lost from the respiratory tract. We have constructed a breathing simulator for use at hyperbaric pressure in a diving chamber which will be used to compare the efficiency of these respiratory heat exchangers. Alterations in pressure within a steel box drive a lung simulator which produces tidal volumes. These pass over a heater/humidifier. The "expired" gas exits through the heat exchanger into a "cold box" containing heliox at 4-6°C. The inspiratory phase draws up the cold heliox gas. Thermocouples are placed on either side of the exchanger being tested. Tidal volume, respiratory rate and carbon dioxide production can all be altered to reproduce the values expected in men under cold stress in a "lost" diving bell. The heat exchangers will be ranked according to their thermal efficiency in a cold helium-oxygen mixture under pressure at various depths.

589.

DOOLITTLE W, Hayward J, Mills W, Nemiroff M, Samuelson T.

In: Proceedings of the conference on hypothermia and cold water near drowning, Anchorage, Alaska, 10 p; July 11-12, 1981.

The major points addressed at a 1981 conference held in Anchorage, Alaska and attended by five participants, are summarized. The medical treatment of hypothermia, its evaluation and treatment by the first responder, guidelines for the emergency medical technician I or II, guidelines for small clinics and hospitals, common problems, and criteria for transferring patients to tertiary care facilities are discussed. In regard to near drowning in cold water, evaluation and treatment, hospital care, and patient transfer are outlined. (RW/UMS)

590.

DORSEY JS (letter).

Venoarterial bypass in hypothermia.

JAMA 244(17):1900; 1980.

The author comments on Southwick and Dalglish's (243:1250;1980) review of prolonged asystolic cardiac arrest in profound hypothermia and their noninclusion of cardiopulmonary bypass as an aid in resuscitation and rewarming. A personal case experience is related that describes the failure of several rewarming techniques during prolonged asystole, but venoarterial bypass (right femoral artery and vein; flow rate 800-1000 ml/min) was successful. References are cited that advocate the use of cardiopulmonary bypass for core rewarming in profound hypothermia.(CDR/UMS)

591.

DUDGEON DL, Randall PA, Hill RB, McAfee JG.

Mild hypothermia: its effect on cardiac output and regional perfusion in the neonatal piglet. J Pediatr Surg 15(6):805-810; 1980.

Cardiac output and regional perfusion was measured in neonatal piglets using radionuclide labeled microspheres. Measurements made at normal core body temperature (38-39°C) were compared to those obtained after a 4-5°C reduction in temperature. There is a significant reduction in cardiac output and in the myocardial, renal, pancreatic, and adrenal blood flow. The separated layers of the gastrointestinal tract wall are subject to varying decreases in blood flow. The mucosa of the distall small intestine demonstrated the most significant decreases in blood flow during mild hypothermia.(Author)

592.

DUEKER, C.W.

Water temperature and diving.

Undersea J., p.26-27; 1st quarter 1981.

This article, of particular interest to sport divers, discusses water temperature and the dangers of hypothermia. The mechanism by which a diver's body becomes chilled is explained as a combination of higher conductivity of temperature in water than in air, and the low temperature of the ambient water itself. The body's defenses against cold are described in simple terms – the role of subcutaneous fat, of shivering, of heat exchange in the blood, etc. The difference between skin temperature and central (core) temperature is noted, and the progressive stages of chilling from initial discomfort to critical malfunction. The ways in which sport divers can prevent injuries from hypothermia are enumerated; wearing a wet or dry suit, hood and gloves helps but most important is an awareness of the dangers and gradual onset of hypothermia and adherence to safe diving procedures. (LET/UMS)

593.

DUFF G. (letter).

Central rewarming in hypothermia.

Lancet 2(8185) :91; Jul 12, 1980.

Sir,–Mr. Ledingham and his colleagues (May 31, p. 1168) reported interesting findings on central rewarming using a modified Sengstaken tube in anaesthetised dogs. The rate of rewarming will, to some extent, depend upon the integrity of autonomic reflexes which tend to restore normal body temperature. Anaesthetic agents disrupt normal temperature regulation, and it is not surprising that the temperature of the control animals did not rise during the four hour study, notwithstanding the radiant heat bulb. From the temperature curves shown of one rewarmed dog, the high skin temperature seen when the core temperature was only 35°C, highlights this point. The technique would appear to be of great value in the type of case described, where a patient is effectively poikilothermic as a result of the traumatic or drug induced brain dysfunction, but the response may be different in hypothermia induced by exposure to low ambient temperature in otherwise normal people.

594.

DULA DJ (letter).

Use of IV bicarbonate in hypothermia.

JACEP 8(1) :48; Jan 1979.

Interpreting arterial blood gases in hypothermic patients involves consideration of an additional variable that was probably overlooked in the case reported in "Accidental Hypothermia: Peritoneal Dialysis" (6:556-561, 1977). In this case, while the body temperature was 24.4 C (76 F), the arterial blood gases were pH 7.20, pCO_2 49, and pO_2 412. An initial interpretation of these arterial blood gases would be an acidosis with both respiratory and metabolic components. Thus, the administration of 44 mEq of bicarbonate intravenously (IV), as was done, may seem warranted. However, acid base equilibrium is temperature-dependent at a rate of .008 units change in pH for each 1 F temperature change from body temperature. Using this formula would make the corrected pH 7.37. Only if there is a metabolic acidosis after this correction for temperature would the use of IV bicarbonate be indicated.

595.

DULA DJ (letter).

Interpreting blood gases of hypothermic patients.

Ann Emerg Med 9(4) :232; Apr 1980.

Much attention has been drawn to the fact that blood gases must be corrected for temperature of the patients to correct the changes in the PO_2, PCO_2, and pH that occur as a result of changes in temperature. An easy way to determine the effective temperature on arterial blood gas values is to allow the blood gas machine to do the work. Arterial blood gas samples are injected into the blood gas machine and warmed to 37 C. Once the blood reaches this temperature, the PO_2, PCO_2, and pH are measured and displayed. If the patient's temperature is higher or lower than 37 C, the corrected arterial blood gas value can be computed automatically by the blood gas machine. (Excerpts from letter)

596.

DUNFORD R, Hayward J.

Venous gas bubble production following cold stress during a no-decompression dive.
Undersea Biomed Res 8(1) :41-49; Mar 1981.

The effect of cold stress on venous gas bubble production was studied using Doppler ultrasonic monitoring. Ten subjects participated in four exposure regimes carried out at 78 fsw on an underwater platform for 38 min of light exercise in 10°C water. Two cold exposures (1/8-in. wet suit) and two warm exposures (insulated dry suit) were each followed by rewarming in a heated bath or by endogenous heat production while insulated in a sleeping bag. Results showed that for the cold dives compared to warm dives, air consumption increased 29%, rectal temperature dropped 0.8°C by the end of the dive, mean skin temperature dropped 11°C, and cooling rate correlated with mean skin fold and endomorphy ($P < 0.001$). A threefold increase in bubble scores ($P < 0.025$) was observed following the warm dives compared to the cold dives. The results suggest that inert gas uptake is reduced as a result of peripheral vasoconstriction when the cold stress is induced at the onset of the dive and maintained throughout. (Authors' abstract)

597.

EARLY P.

Life-saving suits.
The Washington Post, Watchdog: Recent Federal Enforcement Actions, A19(col 1) Washington, DC; July 14, 1982.

Entire article quoted: The U.S. Coast Guard has begun drafting regulations that will require workers on U.S. offshore drilling rigs in cold waters to have access to special survival suits. The Coast Guard and National Transportation Safety Board held a joint news conference to endorse the suits that, they said, could have save some of the 85 workers killed Feb. 15, when the 14,913-ton Ocean Ranger oil rig capsized 170 miles off the coast of Newfoundland. Only 22 bodies have been recovered from that accident, and investigators said all died of hypothermia (rapid loss of body heat) in water that was 31 degrees Fahrenheit. NTSB member Patrick Bursley said workers could have survived in the water for as long as two hours if they had been wearing the suits, which are made of a foam rubber-like material called neoprene. Ocean Drilling & Exploration Co., the owner of the rig, announced simultaneously that it was voluntarily equipping its employees with the suits and has ordered 3,400 of them at a cost of $1.4 million. NTSB and the Coast Guard are continuing their investigation of the rig disaster, but Bursley said the agencies decided to endorse the survival suits in advance because they could save lives. The Coast Guard said its regulation should be ready in September. It added that it should take a worker only a minute to put on one of the suits, but when an employee tried at the news conference, the zipper on the suit stuck and he had to be helped.

598.

EDSALL DW (letter).

Treatment of hypothermia.
JAMA 244(17):1902; 1980.

The author cites Southwick and Dalglish (243:1250;1980) as having failed to mention the use of warmed humidified ventilation as a safe, effective method to accomplish core rewarming in profound hypothermia. This technique has been found to be effective to reverse mild hypothermia in the operating room. In the author's experience this method is also effective in severe hypothermia by bypassing the upper airway via an endotracheal tube and ventilating with a 39°C humidified breathing mixture.(CDR/UMS)

599.

EGSTROM GH. (ed).

Thermal problems in diving.
Proceedings of a seminar held at Commercial Diving Center, Wilmington, CA, Mar 19-20, 1976. Published by Commercial Diving Center, June 1977, 114 p.

This seminar was held as a result of an unprecedented accident in the North Sea in which two divers lost their lives due to hypothermia. The seminar was organized with the intention of identifying the factors which bear on thermal balance and to distribute the conclusions arrived at to the international diving community and to the public. Individual papers will be found under the following author entries: Alexander, J.; Behnke, A.R.;

Egstrom, G.H.; Raymond, L.W. (two); Webb, P. (two); Youngblood, D.A. A paper by Bullard, R.W. and G.M. Rapp was reprinted from Aerospace Medicine, November 1970, and has appeared in one of our earlier bibliographies. (MFW/UMS)

600.

ELLIOTT DH, Golden F St C.

Thermal stress in relation to diving. A workshop of the Diving Medical Advisory Committee held at The Institute of Naval Medicine, Gosport, Hants, UK, Mar 19-20, 1981.
Bethesda, MD, Undersea Medical Society, 1982. 39p.

At a workshop attended by an international group of experts in the field of diving physiology, the practical problems and thermal requirements of divers were addressed. New and more sophisticated equipment, new breathing gas combinations and longer times at pressure have been accompanied by numerous accidents which had no obvious, clear cause. The group considered whether too much has been expected of the diver under current diving conditions, whether cold stress may cause physiological changes that can lead to human error, and what the specific effects of cold stress, and of mild and more severe hypothermia, are likely to be. Solutions to the problems of deep heliox diving, such as heated suits and respiratory gas, were discussed as were ways to save isolated divers in a lost bell or hyperbaric lifeboat. The final session dealt with the problems of surface-oriented diving. Published by the Undersea Medical Society at the request of the DMAC, the workshop was supported by the Norwegian Petroleum Directorate and the Association of Offshore Diving Contractors. (LET/UMS)

601.

EMSLIE-SMITH D, Sladden GE, Stirling GR.

The significance of changes in the electrocardiogram in hypothermia.
Br Heart J 21: 343-345; 1959.

Heart deflection patterns were studied in hypothermic patients with normal hearts and by the use of direct epicardial electrodes in hypothermic dogs. Five anesthetized patients were cooled by ice bags laid on the skin in preparation for craniotomy. While the temperature fell the multiple lead cardiogram was continuously monitored in a cathode ray oscilloscope. In dogs, electrocardiograph tracings were recorded during cooling but before any cardiac surgery was begun. In the human patients, the heart rate slowed with falling temperature, with the characteristic slowly inscribed deflection appearing in the early part of the S-T segment in some leads from all patients, though differing in degree and in the temperature at which it appeared. It was directed upward in leads related to the left ventricle. It grew in amplitude as the temperature fell and was most conspicuous in the thinnest patient. (RW/UMS)

602.

FELDMAN SA.

Profound hypothermia.
Br J Anaesth 43 :244-247; 1971.

The use of induced profound hypothermia for cardiac surgery is described. The technique involves cooling the patient to a nasopharyngeal temperature of 12 to 20°C permitting a period of cardiac arrest of up to one hour for cardiac surgery. The technique introduced the concept of using two separate pumps to take over the work of the two ventricles during the cooling period. The effects of cold upon the various enzyme systems of the body, the anesthetic technique used for preparing the patient for profound hypothermia, and the advantages and disadvantages of the approach are discussed. It is concluded that pump oxygenators are more useful than the profound hypothermia technique only for children under the age of five. (RW/UMS)

603.

FELICETTA JV, Green WL, Goodner CJ.

Decreased adrenal responsiveness in hypothermic patients.
J Clin Endocrinol Metab 50(1):93-97; Jan 1980.

We have performed ACTH simulation tests in a total of 14 subjects who were hypothermic at the time of initial presentation. Plasma cortisol values were measured before and 1 h after an IV dose of 25 U synthetic ACTH. The cortisol response was depressed in these subjects, with a mean rise of 32% and an absolute mean rise of 5.0 microgra/dl. There appeared to be temperature threshold effect, with only minimal responses observed below

32°C. A subgroup of 5 patients with sluggish responses to ACTH while hypothermic (mean cortisol rise, 12.5%) were retested after warming and responded normally (mean rise, 166%). Thus, ACTH stimulation tests may be misleading in the hypothermic patient and should be performed only after body temperature has returned to normal.(Authors' abstract)

604.

FISHBECK KH, Simon RP.

Neurological manifestations of accidental hypothermia.

Ann Neurol 10(4) :384-387; 1981.

In a series of 97 patients with accidental hypothermia, alcohol abuse and Wernicke's encephalopathy were prominent causes. Pulse, systolic blood pressure, and respiratory rate were all found to decline with decreasing temperature, and there were significant changes ($p < 0.01$) in level of consciousness, pupillary response, reflexes, and muscle tone. However, even in the lowest temperature range (20° to 27°C, or 68° to 80°F), 6 of 18 patients remained verbally responsive and 10 had intact reflexes. Neither eye movement abnormalities nor extensor plantar responses correlated directly with the degree of hypothermia. (Authors' abstract)

605.

FITZGERALD FT.

Hypoglycemia and accidental hypothermia in an alcoholic population.

West J Med 133(2) :105-107; Aug 1980.

Hypoglycemia is but one of a number of causes of hypothermia, but is important to keep in mind as a possible precipitating or concurrent event even in those cases in which there are other obvious explanations for decreased body temperature (exposure, alcoholism, starvation, sepsis or hypothyroidism). Hypoglycemia may occur in as many as 40 percent of very cold patients, and be clinically unrecognized because symptoms are masked by the hypothermia itself. Although serum glucose levels are depressed, a cold-induced renal tubular glycosuria may occur. Glucose in the urine, therefore, cannot be used as assurance of hyperglycemia in a hypothermic patient. And, although cold protects against serious end organ damage from hypoglycemia by decreasing tissue metabolic need for glucose, a serum specimen should be drawn for glucose determination in all hypothermic patients and a 50 percent glucose solution immediately given intravenously. If this is not done, serum glucose levels may plummet as the patient is rewarmed and begins to shiver. (Author's abstract)

606.

FORAY J, Baisse PE, Mont JP, Cahen C.

Le traitement des gelures de montagne. Analyse des résultats obtenuns sur vingt gelés par le chlorhydrate de buflomedil.

[Treatment of frostbites. Analysis of results in twenty patients with buflomedil chlorhydrate].

Sem Hop Paris 56(9-10):490-497; Mar 8-15, 1980.

Twenty cases of mountain frostbites of various degrees are presented, showing that buflomedil hydrochloride allows an improvement of the usual treatment of frostbites. Two protocols were used: 1) in 8 patients, after the usual treatment (bath at 38°C, dextran perfusion, heparintherapy, antibiotherapy), buflomedil hydrochlorhydrate was administered by perfusion of 8 vials/day, during 10 days; 2) in 12 patients, buflomedil was injected directly by intravenous route on their arrival in the Emergency room. When the injection was given early, a potentiation of the effects of the warm bath is observed, and in two cases, this therapy has perhaps allowed to avoid the amputation.(Authors' summary)

607.

FORAY J, Schmitt M, Renaud S.

Thermographie et gelures de montagne: a propos de 39 cas observes a l'hopital de Chamonix-Mont-Blanc.

[Thermography and mountain's frostbites. About 39 cases observed in Chamonix Mont-Blanc Hospital].

Chirurgie 106(5):301-306; 1980.

To try and improve the precocity of the prognosis of mountain frost bites the authors used thermography. Out of 426 frost bitten patients 39 were thermographied. Thermography gives us two pictures: a lesional one and a perilesional one. Both of them appear with hyperthermy, a vasomotor consequence of the frost bites. Thanks to

thermography, the authors thought they would be able to define the center of the blood circulation block therefore the area of necrosis. It's nothing of the kind, yet this investigation may be useful in the preventive action, but detecting, at little cost, the subjects with frost bites diathesis.(Authors' summary)

608.
FORAY J, Cahen C.
Les hypothermies de montagne: apports therapeutiques nouveaux.
[Mountain hypothermia: current therapeutic measures].
Chirugie 107(4):305-310; 1981.

Therapeutic principles applied to treat a series of 60 cases of hypothermia from exposure after mountain accidents are described, emphasis being placed on an exceptional procedure which can be life-saving in some injured patients: thoracotomy to enable massage and reheating of the heart. Hypothermia following mountain accidents is sometimes so marked that the limits of currently available therapeutic measures are reached. Prevention is therefore of the utmost importance, and the authors have suggested a type of apparatus capable of supplying hot air to an injured patient trapped in a crevasse. The use of the air passages to obtain reheating is discussed in relation to this method.(Author's summary)

609.
FORESTER D (letter).
Extreme hypothermia and ventricular fibrillation.
Ann Emerg Med 9(9) :496; 1980.

To the Editor: In response to the article by Davee and Reineberg, entitled "Extreme Hypothermia and Ventricular Fibrillation" (9:100-102, 1980), ventricular fibrillation in the face of severe hypothermia (lower than 25°C) will not convert to sinus rhythm until the myocardium is rewarmed. CPR will be necessary throughout the entire rewarming process until successful defibrillation is possible. The use of emergency drugs, except for lidocaine, may not have much effect because of the patient's sluggish metabolism. Drugs may first be utilized upon rewarming, manifesting drug toxicity. Rewarming alone may correct the arrhythmia. Direct heating of the body core would have warmed the heart more rapidly than surface rewarming. Core rewarming increases cardiac output, while surface rewarming produces peripheral vasodilatation, decreasing venous return and cardiac output, hypotension, and further central cooling from chilled, acidotic peripheral blood (rewarming collapse). Core rewarming avoids the paradoxical cooling from the surface and the acidosis with its risk of ventricular fibrillation. The methods of core rewarming superior to those utilized by Davee and Reineberg would be intrathoracic irrigation with warm saline, hemodialysis, or IV infusion of warm fluids.

610.
FRANK DH, Robson MC.
Accidental hypothermia treated without mortality.
Surg Gynecol Obstet 151(3):379-381; Sep 1980.

Accidental hypothermia, a core temperature below 34°C., is frequently fatal, particularly in the ill and elderly. Traditional treatment methods result in reported mortalities of between 45 and 100 percent. Despite these terrible statistics, advocates of slow rewarming persist. They cite the shock and vascular collapse which can occur with peripheral dilation as reasons to avoid rapid external rewarming. Isolated successes using internal core rewarming, such as hemodialysis or cardiopulmonary bypass, are spectacular but not practical in the usual clinical situation. By combining methods used for resuscitation of burn injury with the treatment principles for frostbite, a highly effective treatment protocol results. Agressive fluid resuscitation, rapid immersion rewarming and careful systematic monitoring have been used to treat ten consecutive patients without a single death. Concomitant problems of alcoholism, stroke, myxedema, tuberculosis and paraplegia were also treated. Rapid external rewarming by immersion can result in a low mortality in patients with severe hypothermia. (Authors' summary)

611.
FRASER IC, Loftus JA (letter).
"Trench foot" caused by the cold.
Br Med J 1(6169) :1017; Apr 1979.

Sir,—With reference to the letter (3 March, p 622) from Dr. Paul Marcus, we have read it with interest and he does make some valid points, particularly in respect of the wind chill factor, which was without doubt of signifi-

cance in the injury we described in our letter (10 February, p 414). It was difficult to decide, when our case presented some six days after the initial injury, whether it was or was not of frostbite; but on balance, because of the rather diffuse and ill-defined area of circulatory disturbance and the lack of tissue necrosis other than the two small blisters referred to, we considered that it was a case of "exposure foot," which might be a better title than trench or immersion foot. Interestingly, some four months after the initial injury, there is still a sluggish capillary response of the upper surface of the affected foot from 2.5 cm proximal to the digital webs, and a reduction in the dorsalis pedis pulse on that foot. There is no evidence of any sensory loss of other neurological involvement. The patient himself is unaware of any difference in the two feet, other than the affected foot still gets a little "puffy" by evening. On balance we think our original diagnosis was correct, although we cannot be certain.

612.
FREEMAN J, Pugh LG.
Hypothermia in mountain accidents.
Int Anesthesiol Clin 7 :997-1007; 1969.

The incidence and treatment of accidental hypothermia occurring during recreational mountain climbing are discussed. The symptoms and predisposing factors associated with accidental hypothermia are considered and it is noted that most cases occur on trips that would be considered easy in fine weather. The metabolism and circulation of climbers are described emphasizing the circumstances leading to less fit persons becoming exhausted and prone to hypothermia. Prevention and management are best accomplished by not getting wet through and taking shelter or leaving the mountain before reaching dangerous levels of exposure. First aid measures are cited including the treatment of fractures and head injuries, and management in the hospital is considering covering such points as rewarming methods and monitoring. Criteria for mountain rescue operations are briefly listed. (RW/UMS)

613.
FREY, M.A.B., R.M. Siervogel, E.A. Selm and P. Kezdi.
Cardiovascular response to cooling of limbs determined by noninvasive methods.
Eur. J. Appl. Physiol. 44:67-75; 1980.

Cold, even local exposure to a limited portion of the body, is a stress to man which elevates arterial pressure, thereby intensifying cardiac workload. The sequence of cardiac events following local cooling was noninvasively studied by observation of changes in cardiac interval, left ventricular ejection time, time from Q wave of electrocardiogram to the peak of the dD/dt of the carotid pulse wave (which includes pre-ejection period), and amplitude of the pulse wave from a photoelectric cell on the earlobe, along with arterial pressures. Twelve subjects, aged 22 41 years, exposed a hand or foot to cold water for 1 min while seated and while supine (four experiments each). Results indicate that arterial pressure is monotonically elevated throughout the minute of exposure. Cardiac intervals are initially abbreviated, then return towards control. This may indicate an initial response to the cold, followed by a baroreflex at the heart. Subject posture and limb exposed also affect cardiac responses. (Authors' summary)

614.
FUKUSMI H, Adolph RJ.
Effect of dextran exchange upon the immersion hypothermic heart.
J Thorac Cardiovasc Surg 59 :251-263; 1970.

Effects of dextran exchange at 25°C were examined in anesthetized dogs during immersion hypothermia. Dogs given dextran reached a temperature of 18°C twice as rapidly as control animals, suggesting improved skin flow. Intravascular red cell aggregation was seen in the tongue and palpebral conjunctiva below 28°C, but was prevented by dextran. Dextran significantly reduced the incidence of ventricular fibrillation in hypothermic dogs and permitted survival to significantly lower temperatures (19.2°C ± S.E. 1.4, control; 16.4°C ± S.E. 1.9, dextran; 16.8°C ± S.E. 1.4, low molecular weight dextran). Serium calcium was unchanged during cooling but was markedly lowered by dextran. If hypocalcemia were prevented, ventricular fibrillation was the mode of death. Dextran prevented tall peaked T waves which otherwise preceded ventricular fibrillation. During cooling to 25°C, coronary sinus blood flow decreased progressively to 46 percent of the control value and the coronary arteriovenous oxygen difference decreased about 8 percent. Following administration of dextran, coronary sinus flow increased sharply but coronary A-V oxygen difference decreased markedly, reflecting a further decrease in myocardial oxygen consumption. These results and viscometric studies indicate that increased blood viscosity is an important determinant of impaired cardiovascular performance during deep hypothermia. Dextran improved the microcirculation by reducing blood viscosity and red cell aggregation. (Authors' summary)

615.

GABIBOV MM, Emirbekova AA.

Sul ' fgidril ' nye gruppy belkov i obshchee soderzhanie belkov v vodorastvorimoi fraktsii mozga pri mnogokratnyk sovmestnykh vozdeistviyakh gipotermii i giperoksii.
[Sulfhydryl groups of proteins and total content of proteins in brain water soluble fraction during multiple combined effects of hypothermia and hyperoxia].
Ukr Biokhim Zh 46(5) :602-605; 1974.

The content of sulfhydryl groups of rat brain water soluble proteins decreased after hypothermia (20-19°C) and/or hyperoxia (3 atm). There was no synergy between the effects of hypothermia and hyperoxia. (© BA)

616.

GAGGE AP, Herrington LP.

Physiological effects of heat and cold.
Annu Rev Physiol 90:409-428; 1947.

Research reported during 1945 and 1946 on the physiological effects of heat and cold is reviewed. Particular attention is given to the Dachau concentration camp experiments conducted with at least 103 humans, of whom 7 died. Prisoners were immersed in water of 2 to 12°C or exposed nude to air temperatures of -6°C for as long as 14 h. Thermal data, clinical observations, respiration, heart action and circulation, and resuscitation technique are described. Other human and animal studies of cooling in air and water are noted. Heat stress studies reviewed address such topics as: standard thermal stress and equivalent physiological response; sweat, body fluids, and metabolites; and climate related problems encountered by civilians. (RW/UMS)

617.

GAGGE AP, Stolwijk AJ, Hardy JD.

Comfort and thermal sensations and associated physiological responses at various ambient temperatures.
Environ Res 1(1): 1-20; 1967.

Sensory estimates of comfort and thermal sensation for resting-sitting unclothed subjects have been compared with the associated physiological responses for the range of ambient temperatures (12°-48°C) under steady-state and transient conditions. For steady exposure to cold and warm environments, thermal comfort and neutral temperature sensations lie in the range for physiological thermal neutrality (28°-30°C), in which there is no physiological temperature regulatory effort. Discomfort increases more rapidly below 28°C than above 30°C, while thermal sensation for both heat and cold increases rapidly each side of neutral. Discomfort correlates best with lowering average skin temperature toward cold environments and with increased sweating toward hot environments. In general, discomfort is associated with a change of average body temperature from 36.5°C. The same conclusion follows for transient changes when the subject goes from comfortable to uncomfortable, neutral to cold, and neutral to warm. When these transients are reversed (i.e., cold to neutral, hot to neutral), the sensations of comfort and temperature "lead" the body temperature changes and are thus "anticipatory." This hysteresis effect is most striking in the cold and less so for warmth. For transients from cold to warm, the rate of rise of skin temperature causes a sensation that compensates for and predominates over the sensation of discomfort caused by a low skin temperature itself. Finally, thermal discomfort is an excellent stimulus for behavioral activity by man. As a sensation, it gives man both an early and anticipatory drive for conscious action that may effect changes in his body's microclimate rather than having him depend on natural but short-term means of thermal protection—sweating, vasodilation, vasoconstriction and shivering. (Authors' summary)

618.

GALBO H, Houston ME, Christensen NJ, et al.

The effect of water temperature on the hormonal response to prolonged swimming.
Acta Physio Scand 105(3) :326-337; 1979.

The relationship between thermoreception, hormonal secretion and muscular activity was studied. 6 men swam 60 min in 21, 27 and 33°C water at a speed requiring 68% of V_{O_2} max (determined in 27°C water). Rectal temperature increased in 33°C (1.3 ± 0.2°C, mean and S.E.) and 27°C (0.7 ± 0.1°C) expts. but decreased in 21°C expts. (0.8 ± 0.3°C). Changes in esophageal and muscle temperatures parallelled changes in rectal temperature. Plasma noradrenaline was higher in 33°C than in 27°C expts. and growth hormone, cortisol and glucagon concentrations increased in 27°C and 33°C expts. only. Insulin concentrations were uniformly depressed during swimming at the different water temperatures. In 21°C expts. noradrenaline and adrenaline concentrations were

higher than in 27°C expts. V_{O_2}, carbohydrate combustion and peak lactate were slightly lower in 33°C expts. Plasma glucose decreased slightly and FFA and glycerol concentrations increased identically in all expts. Heart rate increased continuously during swimming in 27°C and 33°C expts., but not in 21°C expts. In conclusion the rise in body temperatures normally observed during exercise enhances the exercise induced increases in the plasma concentrations of noradrenaline, cortisol, growth hormone and glucagon. Decreased body temperatures may elicit catecholamine secretion as a direct consequence of thermoreception. Shivering may account for previously observed decreases in insulin secretion during cold stress but not for increases in cortisol and growth hormone. (Authors' abstract)

619.

GICHEV YP, Polyakov YV, Khasnulin VI, Neustroeva TS, Kim YO, Kaznacheev VP.
Biochemical changes in healthy persons during a short stay in the polar regions.
Human Physiol (Engl Transl Fiziol Chel) 5(2) :199-203; Mar-Apr 1979.

The data given above are evidence that the ecologic conditions of the Far North (cold, geomagnetic disturbances, polar night, etc.) bring about the rapid activation of adaptive reactions of the body, evidently through a change in free-radical processes and lipid metabolism. The study of processes of adaptation of the human body and their direction under polar conditions provides a basis for the development of measures for the early diagnosis and prevention of diseases, the prediction of likely pathological states, and the creation of individual "health schedules." (Authors' conclusions)

620.

GIRLING F, Topliff EDL.
The effect of breathing 15%, 21%, and 100% oxygen on the shivering response of nude human subjects at 10°C.
Can J Physiol Pharmacol 44 :495-499; 1966.

The shivering responses of human subjects exposed to cold while breathing various oxygen mixtures was investigated. Six volunteer subjects wearing swim trunks were exposed to an ambient temperature of 10°C for 90 minutes or less. Each subject was exposed three times, once each while breathing 15%, 21%, and 100% oxygen. Minute ventilation and oxygen consumption were measured and visual observations were made of shivering onset and degree. No consistent pattern of minute ventilation response was found nor was oxygen consumption rate found to differ between the three gas mixtures. Times until onset of shivering were observed to be less at the lower oxygen concentrations and greater at the higher concentrations, although times for onset of shivering varied widely between individuals. In terms of onset times, shivering can be said to be inhibited by higher oxygen concentrations. However, once severe continuous shivering has been attained, no consistent difference can be seen in either minute ventilation or oxygen consumption at the various oxygen levels. Individual differences in onset of shivering are attributable to degree of cold acclimatization. In conclusion, the mechanism of the effect of oxygen on the shivering response requires further clarification. (RW/UMS)

621.

GLICKMAN M, Mitchell HH, Keeton RW, Lambert EH.
Shivering and heat production in men exposed to intense cold.
J Appl Physiol 22(1) :1-8; 1967.

Heat production and integrated electrical activity of skeletal muscles related to shivering and muscle tenseness were simultaneously observed in 10 experiments on 9 healthy, clothed male subjects seated in a cold room (-28.9 C) for 4 hr. The integrated electrical activity and heat production generally increased with time, reached a peak 2.25-3 hr after entrance, and then fluctuated. Heat production and electrical activity, heat production and expired air volume, and electrical activity and expired air volume had high coefficients of correlation, +0.875, +0.916, and +0.802, respectively, for 142 paired variates. There was no evidence of increased heat production without an increase in muscle tenseness and/or shivering. Heat production during the 1st, 2nd, 3rd and 4th hr averaged 54, 72, 92, and 96 kcal/m^2, per hr, respectively. Respiratory quotient declined slightly during the exposure. Mean rectal temperature declined during the 2nd and 3rd hr, but was relatively unchanged during the 4th hr. The psychogenic factor was noted during the final 15 min of exposure, i.e., the ability to cease shivering, and in some cases to become relaxed, when the suggestion to relax was given. Accompanying this cessation of shivering was a corresponding drop in heat production. (Authors' abstract)

622.
GOLDEN FStC.
Cold water immersion.
In: Cold/wet survival symposium. J Roy Nav Serv 58 :195; Winter 1972.

This is a summary of a brief talk on the rewarming of hypothermia casualties. After the individual is removed from the cold water, an "after drop" always occurs. In most cases, this drop reached its lowest point eight to 12 minutes after immersion in a hot water bath. Every effort must be made to reduce the afterdrop during the rescue phase. (Author's summary)

623.
GOLDEN FStC
Problems of immersion.
Br J Hosp Med 371-383; April, 1980.

All immersion casualties should be admitted to hospital for observation. If water has been inhaled and there are clinical signs in the chest they should be admitted to an ITU. Attempts at resuscitation should always be made in apparently dead hypothermic immersion victims and only abandoned if unsuccessful after rewarming has occurred. Always consider the possibility that an underlying pathological disturbance caused the incapacitation that led to the immersion incident. If ventilatory support is required positive end expiratory pressure (PEEP) should be instituted as early as possible. (Author's summary)

624.
GOLDEN FStC, Hervey GR.
The mechanism of the after-drop following immersion hypothermia in pigs.
J Physiol (LOND) 272:26P-27P; 1977.

Lightly anesthetized pigs weighing approximately 60 kg were immersed in water at 7.5°C. When blood temperature had fallen to 31°C they were transferred to water at 41°C. Gastric and rectal temperature showed an after-drop which became smaller as the recording site moved outward through the body shell. The central venous blood temperature rose before that of the other core sites and there was no evidence of a bolus of cold blood returning from the periphery. When circulation was stopped during cooling, gastric and rectal temperatures continued to drop, although more slowly. On subsequent transfer to hot water the core temperatures again showed after-drops with rectal and gastric temperatures lower than central venous. The occurrence of an after-drop did not appear to depend on the existence of a circulation, but could be explained by a thermal conduction mechanism. (RW/UMS)

625.
GOLDEN FStC, Rivers JF.
The immersion incident.
Anaesthesia 30 :364-373; 1975.

The ever increasing participation in aquatic recreational activities is a major factor in the increasing number of deaths due to accidental immersion. Some of these deaths occur while undergoing resuscitative efforts immediately following rescue, on admission to hospital, or even up to 19 days after the immersion. Drowning, either acute or its delayed effects, is chiefly responsible for these deaths, but in a number, hypothermia occurring alone or complicating drowning, is the likely explanation. This paper examines the problem and proposes a regime of management. (Authors' summary)

626.
GRAHAM AD, Christopherson RJ, Thompson JR.
Endocrine and metabolic changes in sheep associated with acclimation to constant or intermittent cold exposure.
Can J Anim Sci 61(1) :81-90; 1981. (©BA)

Abstract only. Entire item quoted: Plasma noradrenaline [norepinephrine] (NA), adrenaline (A) [epinephrine] and dopamine (DA) concentrations and cortisol metabolism were studied in 3 groups of 3 sheared year-old wethers exposed for 50 days to either 22-26°C, 8-9°C or to 19-24°C from 0900-2100 h and -2-4°C from 2200-

0800 h. Plasma samples for catecholamine and cortisol determination were taken weekly, 3 h following the daily 0800 h and 1700 h feeding periods. Midway and near the end of the 50 day exposure period, cortisol entry rate and metabolic clearance rate (cMCR) were estimated using a ^{3}H-cortisol continuous infusion technique. Respired gas analysis was used to estimate the heat production (HP) of all sheep 51 h after feeding at a thermoneutral temperature. An increase in thermoneutral HP following 27-30 days of cold exposure indicated that sheep of both cold treatment groups had developed some form of cold acclimation. Exposure of sheep to 8-9°C resulted in a 3- and 2-fold increase in plasma NA and A levels, respectively, which remained elevated throughout the experiment. Initially, nightly cold exposure of the intermittent-cold-exposed sheep increased daytime plasma NA levels but this effect declined with time. Intermittent cold exposure did not significantly affect plasma A level and neither of the 2 cold treatments significantly affected plasma DA level. Chronic exposure to 8-9°C but not intermittent cold exposure caused an increase in cMCR and plasma cortisol level. Cortisol entry rate did not differ significantly between treatment groups. Intermittent as well as constant chronic cold results in a metabolic acclimation of sheep.

627.

GRAHAM, T.E.

Thermal and glycemic responses during mild exercise in +5 to −15°C environments following alcohol ingestion.

Aviat. Space Environ. Med. 52(9): 517-522; Sept. 1981.

Male volunteers (3 groups of 6) were tested once after drinking alcohol (alc) and once after consuming a placebo. The subject drank 2.5 ml of 40% alc/kg in 30 min and, wearing a sweat suit, entered an environmental chamber (+5°, −5°, or −15°C; one group at each temperature). Intermittent, bicycle exercise was performed for 3 h (40% $\dot{V}O_{2max}$, 20 min work − 10 min rest repeated 6 times). Peak blood alc (11.87 ± 0.82 mM/occurred at 87.4 ± 7.5 min; there were no differences between the three temperature groups. Based on pulmonary $\dot{V}O_2$ and RQ, neither environmental temperature nor alcohol affected metabolism, but blood glucose was significantly ($p < 0.05$) lower with alcohol from 105 min until the end of the 3 h. Mean body temp was lower ($p < 0.05$) in the −15°C group and alcohol resulted in lower ($p < 0.05$) body temperature in all three groups for the first 2 h. However, subjects did not perceive the increased heat loss or lower body temperatures. In contrast to cold water immersion studies, alcohol ingestion followed by mild exercise in a cold air environment results in enhanced heat loss and lower blood glucose levels. (Author's abstract)

628.

GREGORY RT, Patton JF, III (letter).

Treatment after exposure to cold.

Lancet 1 :377; 1972.

Identification of apparently dead hypothermic individuals who are amendable to successful resuscitation may be aided by electrocardiogram. Objective evidence of life can be determined with a low-reading thermometer and electrocardiographic activity. While external rewarming techniques have a high mortality rate, internal methods have been remarkably successful. This high success rate may be attributable to improved cardiovascular function, avoidance of rewarming shock, and avoidance of core temperature after-drop. The recommended management approach for accidental hypothermia is: determination of core temperature and evaluation of electrocardiogram, rapid initiation of respiratory and general support care, and internal rewarming. (RW/UMS)

629.

GREGORY RT, Patton JF, McFadden TT.

Cardiovascular effects of arteriovenous shunt rewarming following experimental hypothermia.

Surgery 73:561-571; 1973.

The cardiovascular response associated with a simple method of hematogenous rewarming from induced hypothermia was evaluated. Cardiovascular function was measured in anesthetized dogs prior to the induction of hypothermia, after three hours at a core temperature of 24.4°C, and following hematogenous rewarming with an arteriovenous (AV) shunt and interposed heat exchanger. Rewarming resulted in a sequential rise in internal temperatures. Cardiac temperature, esophageal temperature, rectal temperature rose in that sequence. Average time to raise all internal temperatures from 24.4 to 35°C was 53 min; 120 cal. per kilogram per minute of heat were transferred. Significant hemolysis was not identified. Electrocardiographic changes seen during hypothermia become normal during rewarming. Heart rate and arterial blood pressure returned to prehypothermic levels immediately after rewarming. Total peripheral resistance and left ventricular work improved but did not return

completely to control levels. Cardiac output (CO) increased from 42 to 76 percent of the prehypothermic value immediately after rewarming, representing the most rapid initial improvement in CO yet reported by rewarming methods not using pump assistance. Further improvement in CO was seen at 12 hours after rewarming. The possible application of an AV shunt in the treatment of clinical accidental hypothermia would appear to be an effective, practical method of rewarming, accomplishing rapid restoration of cardiovascular function. (Authors' summary)

630.
GROSSHEIM RL.
Hypothermia and frostbite treated with peritoneal dialysis.
Alaska Med 53-55; March, 1973.

Four patients were severe accidental, hypothermia had rapid core rewarming with warmed peritoneal dialysis. All patients also had frostbitten extremities. All patients survived and the only extremity parts lost were attributed to secondary infection. The method proved effective, rapid and easy to implement. During core rewarming with peritoneal dialysis, the biochemical status stabilized. The recommended steps in treatment of accidental hypothermia and frostbite are: Accurate diagnosis by being alert to the possibility; a predetermined plan of action with necessary equipment, i.e. low recording thermometer, peritoneal dialysis unit, standard dialysate, EKG and capability of performing tests for pH and electrolytes; initial general supportive measures such as nasal O_2, I.V. fluid and any cardio pulmonary resuscitation if necessary; warmed peritoneal dialysis as soon as possible. (Remember to have attendant place dialysate in warming bath as soon as diagnosis is made; rapid rewarming of frozen extremities as soon as a central rewarming response is noted. Use rewarming bath 100-108°F. (Author's summary)

631.
GRUA P.
Lutte contre le froid et adaptation rapide aux conditions de plongees dans des eaux froides: Kerguelen.
[Struggle against the cold and rapid adaptation to submersion to cold water. Kerguelen].
Biometeorology 2 (Pt 2) :831-836; 1967.

During a biological oceanographic expedition to Kerguelen, in which deep water diving was used extensively, special precautions were taken against the effect of cold. In addition to insulation of the body by rubber suits, measures had to be taken to increase the blood circulation and to reduce the cooling of the inhaled air. (Author's summary) (© Biol. Abstr.)

632.
GUILLERMIN, M. and J.-L. Failly.
Survie en environnements hostiles: resultats de deux exercices par temps froid et d'un exercice en mer.
[Survival in hostile environment: results of two studies in cold weather and one exercise at sea].
S.S.A. 79 Trav. Scient. No. 1(6-9); 1979.

Aviation and naval units of the French army participated in a series of three studies of survival in extremely cold environments. The two aviation exercises were conducted under conditions simulating an abandoned airplane in a cold, snowy climate. The maritime exercise recreated conditions of a ship abandoned on the high seas in extremely cold weather. Endurance of the crew was evaluated on the basis of psychological, physiological and biochemical measurements. The adequacy and efficiency of survival equipment, of food and water rations, were also studied. Exercises were planned for up to three days each, but symptoms of severe hypothermia forced some crew members to drop out earlier. The following findings were recorded: physical discomfort was mainly due to exposure to extreme cold; psychological symptoms included loss of orientation in time and space, anxiety, feeling of being abandoned, loss of will to survive, etc. Biochemical and medical changes were based on chemical analysis of blood and urine samples. Data could not be considered definitive, however, due to the limited number of exercises and participants, and to the complexity of equipment and difficulties in accurate monitoring. (OLC/UMS)

633.

GURKOFF JF, Jones RO.

Frostbite with main reference to the feet: a case report.

J Am Podiatry Assoc 71(4) :219-221; Apr 1981.

Frostbite is a preventable injury. If it occurs, it should be diagnosed and treated promptly and throughly. The military classifies frostbite into four degrees, whereas other authorities classify the injury into superficial or deep. Surgical debridement or amputation is usually initially contraindicated until the injury has completed its course. (Authors' summary)

634.

HAIGHT JSJ, Keatinge WR.

Failure of thermoregulation in the cold during hypoglycaemia induced by exercise and ethanol.

J Physiol (LOND) 229:87-97; 1973.

After young men had exercised for approximately 2 hr at 70% maximum O_2 uptake, and taken 28 ml. ethanol by mouth, their mean blood glucose fell to 2.17 mM. It fell further to 1.77 mM during a 30 min exposure to air at 14.5°C. Plasma lactate, glycerol, β-hydroxybutyrate and free fatty acid concentrations increased. Rectal temperature fell to reach a mean level of 34.49°C by the end of the cold exposure; oesophageal temperature fell to as low as 33.00°C in one case. Virtually no increase in metabolic rate and no visible shivering occurred during the cold exposure. Administration of glucose (mean 60.4 g) prevented the falls in temperature, and restored metabolic response to the cold to the size found in control experiments without exercise or ethanol. Neither exercise without ethanol or ethanol without exercise significantly lowered the blood glucose or impaired the maintenance of body temperature in the cold. One obese subject showed almost as great a fall in blood glucose and depression of metabolic response to cold as the thinner men, but no fall in body temperature. (Authors' summary)

635.

HALL JR, Jr.

Prediction of tolerance in cold water and life raft exposures.

Aerosp Med 43:281-286; 1972.

A model based on net effective thermal insulation, assumed metabolism, surface area, and body mass is presented. The model permits prediction of tolerance time for clothed aircrewmen to attain specified limits (90, 125, 180 kcals) of body heat loss during: (a) cold water and (b) life raft exposures at various water or ambient air temperatures. The variables of hydrostatic compression, decreased insulation by wetting, and increased body cooling rate in water were considered and can be included in the tolerance predictions for water exposures. Factors of life raft air (Ia) and thermal insulation of a wet canopy type life raft are also included by assuming reasonable estimated values concerning air movement within the life raft and thermal insulation of the wet canopy type life raft respectively. Predictive tolerance curves based on net effective insulation and three body heat loss limits are presented for cold water and life raft exposures. (Author's abstract)

636.

HAMILTON SJC (letter).

Hypothermia and unawareness of mental impairment.

Br Med J 280(6213) :565; Feb 1980.

Sir,—The report by Professor W R Keatinge and others on hypothermia during saturation diving in the North Sea (2 February, p 291) ends by commenting on the unawareness of mental impairment in the hypothermic state. I wish to report my own experiences during my student elective period testing aspects of helicopter survival units. After two hours in such a unit at a water temperature of 4°C in the local river my core temperature (as measured by a continuous-reading rectal thermometer) had fallen to 34.5°C. Although I had suffered from violent shivering earlier, I felt fully mentally alert and was astonished to discover my total inability to complete successfully simple mental tasks—namely, subtracting serial sevens from 100. The five other people taking part had similar experiences and I would fully concur with Professor Keatinge's suggestion that such mental confusion could readily account for unexplained incidents in working dives.

637.

HAMLET MP.

Resuscitation of accidental hypothermia victims.
Natick, US Army Research Institute of Environmental Medicine, 30 p; June 1976.

Accidental hypothermia or whole body cooling is a serious medical emergency. The physician is often faced with a critically ill patient and is often uncertain of how to approach the clinical management and resuscitation of these patients. This paper outlines the physiology of hypothermia and describes the major decision making points in the resuscitation procedure and attempts to define the approach to returning these patients to a normal physiologic state and temperature. Special reference is given to utilization of internal methods of rewarming, in particular, warm peritoneal dialysis and its effect on hypothermic patients. (Author's abstract)

638.

HAMMERLE AF, Hortnagl H, Geissler D, Hackl JM.

Plasma catecholamines in accidental hypothermia.
Wien Klin Wochenschr 92(18):654-657; 1980.

The plasma levels of adrenaline and noradrenaline were measured by a radioenzymatic method in 3 patients with accidental hyperthermia and followed up until normal body temperature was achieved. In all 3 patients the hypothermia was accompanied by markedly elevated levels of noradrenaline, whereas adrenaline increased considerably only in 1 of the 3 patients. During normalization of body temperature the elevated catecholamine levels started to decrease. In 2 of the 3 patients nearly normal catecholamine levels were measured, when body temperature had normalized. In spite of the high levels of catecholamines in plasma the heart rate was strikingly low at the lowest temperature. During the increase of the lowered body temperature the heart rate increased in contrast to the decreasing catecholamine levels. The increase of the catecholamine levels in plasma in patients with accidental hypothermia can be explained either by an augmented stimulation of the sympathetic nervous system or by a decreased metabolism. On the basis of the high endogeneous catecholamine levels the use of beta-sympathomimetics appears contraindicated in case of hemodynamic insufficiency develops during the course of accidental hypothermia.(Authors' translation)

639.

HAMPTON WR.

Hypothermia in winter and high altitude sports.
Conn Med 45(10) :633-636; 1981.

Hypothermia, defined as a core temperature of less than 95°F/35°C, occurs when factors contributing to heat loss exceed mechanisms of heat production. Conduction, convection, radiation, evaporation, and respiration are the principal causes of heat loss, and are influenced by intrinsic and extrinsic factors. Metabolic processes of heat production as well as exercise capability and shivering can be impaired by disease processes and nutritional status. The pathophysiological consequences of hypothermia involve the cardiovascular, respiratory neuromuscular systems, and are associated with metabolic and respiratory acidosis. The manifestations of altitude sickness further complicate associated hypothermia. Rewarming methods in the field and in the hospital setting will prevent further heat loss, while protecting the irritable myocardium. Peritoneal dialysis is probably the most practical method of active internal rewarming. (Author's abstract)

640.

HANNA JM, Strauss RH, Itagaki B, et al.

Marijuana smoking and cold tolerance in man.
Aviat Space Environ Med 47(6) :634-639; 1976.

Ten men who were marijuana users served as subjects in a study of the effects of marijuana smoking on response to cold. Cold water (28°C for 60 min) and cold air (20°C for 120 min) mediums were utilized with three exposures in each medium. The three exposures followed smoking marijuana, smoking placebo, and a no-smoking control period. Additionally, a breathhold experiment preceded and followed the four smoking periods. Marijuana and placebo smoke were inhaled from a spirometer with each man receiving the smoke of 0.739 g of marijuana and placebo. Smoking marijuana did not greatly modify body heat content, since rectal temperature and most peripheral temperatures were not altered. However, temperatures over voluntary muscles likely to be involved in shivering were elevated. Heat production also greatly increased after marijuana, suggesting that it had stimulated shivering. Marijuana also produced tachycardia and abolished apneic bradycardia. The mechanism of this action is not clear, but some sympathetic involvement is indicated. (Authors' abstract)

641.

HARDY JD, Stolwijk JAJ.

Partitional caolrimetric studies of man during exposures to thermal transients.
J Appl Physiol 21(6) :1799-1806; 1966.

Three young men dressed in shorts were exposed for 1 hr at a neutral temperature of 28°C, then quickly transferred for a 2 hr exposure at 22 or 18°C, followed by another hour at 28°C. Similar transfers were made between 18 and 22°C, and 43°C. The effect of a 4-hr exposure at 18 and at 13°C was also studied. Tympanic membrane temperature, rectal and average skin temperature, metabolic rate, and evaporative heat loss were measured. Heat balances were made for each 5-min period by partitional calorimetry. During exposures to air temperatures 43°C (sweat freely evaporated) the total increase in body heat content was limited to less than 30 kcal/m^2. In the cold (13-18°C) net heat loss continued at the rate of 20-40 kcal/m^2 per hr even at the end of a 2-hr exposure when the body heat content had already decreased by 100 kcal/m^2. Shivering was not observed at 18°C after 2 hr. Sweating occured if the average skin temperature was above 33.5°C and the tympanic membrane temperature was above 36.6°C at the same time. Evaporative heat loss during the thermal transients and the steady state could be accounted for by the product, [70 (T_{skin}−33.5) X (T_{ear}−36.6] kcal/m^2 per hr if both terms are positive. (Authors' abstract)

642.

HARNETT RM, Sias FR, Pruitt JR.

Resuscitation from hypothermia: a literature review.
Washington, DC, Dept of Transportation, US Coast Guard Final Rep CG-D-26-79, 61 p, Feb 1979.

The basic and clinical medical and research literature on slow and rapid rewarming techniques for hypothermia victims is reviewed. The techniques, advantages, risks, and contraindications of peritoneal irrigation, intragastric and intracolonic balloons, extracorporeal blood rewarming, inhalation therapy, and diathermy are evaluated. The rapid versus slow warming debate, passive rewarming, active surface rewarming, and the application of first aid and subsequent therapies are examined. The literature on resuscitation from accidental hypothermia is split between rapid and slow rewarming advocates. Conclusive evidence on the effects of various techniques on profoundly hypothermic individuals cannot be obtained from survival statistics or from studies of animals and moderately cooled humans. Of the rapid rewarming techniques considered, diathermy, inhalation of warm humid gases, and intragastric balloons show the most promise for use as first aid treatments in the field and should be investigated further. Immersion in hot water is safe and effective but impractical for field use. Extracorporeal blood rewarming would be highly dangerous for field first aid use. (RW/UMS)

643.

HARNETT RM, O'Brien EM, Sias FR, Pruitt JR.

Experimental evaluations of selected immersion hypothermia protection equipment.
Washington DC, Dept of Transportation, US Coast Guard, Final Rep No CG-D-79-79, 171 p, Oct 12, 1979.

This report summarizes an experimental test program conducted with state-of-the-art hypothermia protection equipment. Tests included the following attributes: cold-protection effectiveness, mobility reduction, fatigue induction, ease of donning, buoyancy, aesthetic appeal/wearer confidence, flame resistance and reliability. Cold-protection effectiveness is expressed in terms of survival-time estimates for individuals, with selected body structures, wearing the test articles in 1.7°C (35°F) water. The data from these investigations is intended to collectively support the selection of equipment best suited for use by recreational boaters, Coast Guard crewman and merchant mariners. (Authors' abstract)

644.

HARRIES, M.G., F. St. C. Golden and M. Fowler.

Ventricular fibrillation as a complication of salt-water immersion.
Br. Med. J. 283(6287): 347-348; Aug. 1, 1981.

Ventricular fibrillation is a well-recognized complication of severe hypothermia (where core temperature is below 30°C), especially during resuscitative procedures. In deaths from immersion, however, cardiac arrest usually occurs before the temperature has fallen to a level where ventricular fibrillation takes place spontaneously. The authors describe two cases of moderate hypothermia in which ventricular fibrillation occurred after relatively

short salt water immersion. They infer that some protective mechanism akin to the diving response maintains cardiac activity until severe cooling has occurred. This reinforces reports of other incidents where successful resuscitation was possible after long periods of immersion, and the importance of performing an ECG promptly – preferably at the site of the accident – before death is pronounced. (LET/UMS)

645.

HART JS.

The problem of equivalance of specific dynamic action: Excercise thermogenesis and cold thermogenesis.

In: Cold Injury. New York, Josiah Macy Jr Foundation, 1960, p 2[illegible]01.

The equivalence of exercise and cold thermogenesis is examined. Equivalence is considered in terms of the efficiency of metabolic replacement: two sources of heat are equivalent if one can substitute metabolically for the other in a cold environment. In a panel discussion, the following topics are addressed with reference to animal and human experiments: the origin of heat production during exercise, comparisons of metabolic rate and body temperature during rest and exercise at various temperatures, the influence of exercise on reduction of body insulation, the differences between shivering and non-shivering cold thermogenesis, comparison of the effects of exercise and cold on elevation of lactic acid, energy expenditure in humans with various types of clothing and performing various levels of exercise, and the relationship between exercise and sweating in a cold environment. (RW/UMS)

646.

HARTUNG GH, Myhre LG, Nunneley SA.

Physiological effects of cold air inhalation during exercise.

Aviat Space Environ Med 51(6) :591-594; Jun 1980.

Selected physiological responses of six normal subjects were observed, during rest and exercise, while they breathed a) ambient, and b) cold (-35°C) air. All experiments were 10 min in duration, and the exercise experiments consisted of pedalling a bicycle ergometer at loads requiring approximately 60% and 75% of each subject's Vo_2 max. Heart rates and minute ventilations during the most strenuous exercise averaged approximately 170 bpm and 70 l, respectively. Diastolic blood pressure was significantly higher, and expired air temperature was significantly lower, during cold air inhalation. Oxygen uptake, respiration rate, and rectal temperature were not affected by cold air breathing; and no subject complaints were attributable to cold air inhalation. Recent studies in the literature suggest that cold air is not fully warmed in the upper respiratory passages; however, the present study observed only slight changes in measured physiological responses to rest and exercise with cold air breathing. (Authors' abstract)

647.

HASKELL, E.H., J.W. Palca, J.M. Walker, R.J. Berger and H.C. Heller.

Metabolism and thermoregulation during stages of sleep in humans exposed to heat and cold.

J. Appl. Physiol. 51(4): 948-954; Oct. 1981.

Electrophysiological stages of sleep, oxygen consumption ($\dot{V}O_2$), and skin (T_{sk}) and rectal (T_{re}) temperatures were recorded from six virtually naked male subjects exposed to ambient temperatures (T_a) of 21, 24, 29, 34, and 37°C. $\dot{V}O_2$ increased during sleep as a whole as T_a departed from thermoneutrality (29°C) and was significantly greater during rapid-eye-movement (REM) sleep than during adjacent nonrapid-eye-movement (NREM) periods at low and high T_a but not at 29°C. T_{sk} showed small but significant increases during REM sleep at 29, 34, and 37°C, but T_{re} did not change during REM sleep at any T_a. Shivering was present during wakefulness at 21 and 24°C but occurred only occasionally during stages 1 and 2 sleep at 21°C. The increases in $\dot{V}O_2$ and the absence of marked changes in vasomotor tone during REM sleep in the cold were unexpected and possibly indicate that REM sleep is not as thermally disruptive in humans as in other mammals. (Authors' abstract)

648.

HAYDUCK AW.

Increasing hand efficiency at cold temperatures by training hand vasodilation with a classical conditioning-biofeedback overlap design.

Biofeedback Self Regul 5(3):307-326; Sep 1980.

The prolonged exposure of hands to cold environments leads to substantial cold pain and severe deterioration of

manual desterity, finger desterity, hand strength, and tactile sensitivity. This study taught volunteers to warm their hands at -14°C and measured the hand efficiency effects. The subjects were six male and female nonsmoking volunteers. All research was conducted in a cold chamber during the warm summer months to eliminate seasonal factors. A combined multiple-baseline/ABA single-subject design with multiple replications was used. Each subject's hand performance was obtained for both hands in warm and in cold conditions. One hand was trained and both hands were retested in the cold. The second hand was trained and both hands were retested in the cold. Finally, the subject inhibited warming while in the cold (treatment removal) and both hands were tested again. The treatment itself used biofeedback instrumentataion to extend and enlarge previously classically conditioned vasodilative episodes. The procedure was found to be effective for bringing about temperature changes in the cold. Large treatment effects were found on all hand efficiency measures. The results suggest wide implications for the workplace, for theory, and for future research.(Author's abstract)

649.

HAYDUCK AW.

The persistence and transfer of voluntary hand-warming in natural and laboratory cold settings after 1 year.

Biofeedback Self Regul 7(1):49-52; Mar 1982.

Hayduk (1980) used a classical conditioning-biofeedback overlap (CBO) design to teach six volunteers to warm their hands in an ambient temperature of -14°C. He found voluntarily warmed hands to be more dexterous more sensitive, and less painful in the cold laboratory setting than unwarmed hands. The present paper reports a 1-year follow-up of five of Hayduk's original six volunteers. Ability to hand-warm was reevaluated, both at room temperature and at -14°C and was found to be essentially unchanged from post-training performance of the previous year. The effects of hand-warming on performance, sensation, and cold pain were remeasured in the cold laboratory and found to be essentially unchanged from the effects following training the previous year. Finally, the folunteers were asked to describe the degree to which they had used their hand-warming, and the circumstances under which they had used it, in natural settings throughout a Canadian winter. The volunteers reported only minimal use of hand-warming, primarily to reduce cold pain.(Author's abstract)

650.

HAYES, P.A. and E. Bramham.

Physiological and engineering aspects of diver thermal protection and rewarming.

In: Proceedings, International Diving Symposium '81, New Orleans, LA, Feb. 1981, p. 73-87. Published by Association of Diving Contractors, 1981.

The physiological and engineering criteria required to provide optimal thermal protection for a diver in cold water are examined. Physiological criteria analyzed are body temperature, changes in heat storage, rates of heat transfer, and extremes of environmental and inspired temperature which are considered safe. Engineered systems must maintain the working diver in thermal balance during a hyperbaric emergency in bell or lifeboat and should prevent further deterioration of an already hypothermic diver. Existing surface-supplied open-circuit hot water systems and an alternative closed-circuit system which is bell-mounted and consumes less electrical power are described. Heating of respiratory gas is discussed as is the Airways Rewarming Device for use in emergency survival situations. The authors conclude with a strong endorsement of the use of electricity underwater, including a return to the electro-mechanical umbilical, as the most economical procedure and one that has been proven safe in recent years. (LET/UMS)

651.

HAYES, P.A. and E.H. Padbury.

Respiratory heat transfer and oxygen consumption when breathing warm humidified gas at 250 m (26 bar) following cold-water diving.

J. Physiol. (Lond.) 308(0): 110P; 1980.

Abstract only. Entire item quoted: Inhalation rewarming using humid air has been used as a clinical procedure for the hypothermic elderly (Lloyd, 1973) and as an experimental technique following cold-water immersion (Morrison, Conn & Hayward, 1979). An increased rate of respiratory heat transfer is likely to occur with gases of high density and specific heat such as hyperbaric oxyhelium, where a larger convective than condensatory component is expected. Three Royal Navy divers made cold water (4°C) excursions at 80, 180 and 250 msw depth when wearing conventional dry-suits and breathing HeO_2. Divers left the water at the limit of peripheral cold endurance, represented by combined toe and hand temperatures falling below 16-18°C or either one below 5°C. Their rectal temperatures could still be above 37°C as the rigors of dressing had previously elevated body

temperature up to 38.1°C. After leaving the water divers breathed saturated gas at a mean maximum comfortable temperature of 42°C. Respiratory heat transfer was calculated from the product of ventilation ($\dot{V}$) (l. min^{-1} BTPS), specific heat, density and the temperature differential between inspired (Ti °C) and expired (Te °C) gas. Oxygen consumption ($\dot{V}O_2$) (l. min^{-1} STPD) was calculated from inspired and expired gas fractions. Heat gained during respiration varied from 4.5 to 15.3, 3.9 to 34.5 and 8.9 to 40.4 W for 80, 180 and 250 m respectively. Corresponding heat transfer rates in air for Ti = 45-48°C were 9.5 to 19 W. The $\dot{V}O_2$ at start of rewarming was 0.47 in air and 0.74, 0.75 and 0.74 at the various depths, decreasing to 0.33 (air), 0.19, 0.21 and 0.35 l. min^{-1} (mean, n = 3) after 40 min of rewarming. The total heat available, that transferred in addition to generated, is over 300 W when $\dot{V} > 40$ l. min^{-1}, but the magnitude of both heat sources gradually decreases as the stimulus to thermogenesis is lost. In air about 86-88% of the heat transferred is attributable to latent heat, whereas 95-97% is due to convective transfer at 26 bar. Divers felt more comfortable during rewarming at greater depths. The initial findings suggest that inhalation rewarming is a valid procedure for administering some form of first aid to the hypothermic diver inside the chamber. When core temperature is recognized as between 28 and 33°C, this procedure may prevent further deterioration of the diver when hot-water immersion is unavailable or contra-indicated.

652.

HAYES, P.A. and E.H. Padbury.

Rewarming after diving to the limit of cold (4°C) endurance down to 300 m.

In: Program and abstracts, Undersea Medical Society annual scientific meeting, May 25-29, 1981. Undersea Biomed. Res. 8(1-Suppl.): A31; Mar. 1981.

Abstract only. Entire item quoted: A number of excursions into cold water were made at depths of 80, 180, 240 and 300 m. The purpose was two-fold. (1) to analyze the physiological variables that determine the limit of cold endurance when hot water suit heating is lost, and (2) to ascertain any advantage of offering heated humidified gas as an aid to rewarming the chilled diver, or perhaps as a first aid measure for the hypothermic victim in hyperbaric surroundings. The maximum ventilation rates while swimming reached 47.7 L min^{-1} (BTPS) at 180 m, and resting values of 41.0 L min^{-1} were obtained after 45 minutes of cooling and give some indication of the level of shivering thermogenesis. Cold exposure at greater depths (> 180 m) was primarily limited (8-27 mins) by problems associated with respiratory losses in excess of 150-200 W. Shallow exposures tend to be limited (27-50 mins) by peripheral cold stress when mean skin temperature (5 sites) had fallen to about 16°C. In only two cooling runs out of 19 did rectal temperature (T_R) fall to 36.7°C. Upon entry into the water T_R was usually > 37.6°C. The effect of breathing warm wet gas on the recovery of T_R was highly variable and probably of little consequence under these conditions of elevated core temperature. The size and presence of an afterdrop is unlikely anyway to be a good indication of impending hypovolemic shock or index of survival. Respiring the conditioned gas added 6.3 ± 1.0 (s.e.m.) W to the body whereas chamber gas represented a deficit of 31.8 ± 3.1 W. Average $\dot{V}O_2$ was 0.59 L min^{-1} (STPD) during shivering alone and 0.57 during assisted rewarming. However, the most significant factor is the increase in net heat available to the body ($H_{metab} \pm H_{resp}$) from when shivering alone (149.2 ± 8.0 W) to that when supplemented by airway rewarming (205.9 ± 10.4 W).

653.

HAYES P, Padbury E, Atherton P.

Validation of emergency procedures – the lost bell situation.

In: Society for Underwater Technology. Proceedings, International Conference "Divetech '81," Workshop B, London, Nov 24-26, 1981, 19p. Published by the Society, 1981.

Operational trials of diver survival systems were conducted by the Admiralty Marine Technology Establishment, Physiological Laboratory (AMTE-PL) in conjunction with the Royal Navy use of the diving facilities on MV SEAFORTH CLANSMAN. The objective of the trials was not to compare one protective suit system to another but to assess which items appeared satisfactory and how a system might be configured and improved to provide effective protection for dry and wet divers for long periods. Sea water temperature was 7-8°C at depths of 50-90 msw during the trial period. Bell pressure was equivalent to 250 msw although actual bell depth was 50 msw. Three diver subjects, each in a different survival system, were used during the trials. After donning their survival gear, they positioned themselves on a net strung from six points at the widest diameter of the bell. Core and skin temperatures as well as other physiological parameters were monitored continuously. A list of recommendations for improvements, ranging from better access to rebreather/heater units to contents of an optimal survival system, is attached. (JN/UMS)

654.

HAYWARD JS.

Thermal protection performance of personal flotation devices: Assessment of representative types.

Victoria, BC, Univ Victoria, Dept Biol Rep on Contract No 97559, TB No 721820, File No 9410-5, 22 p Nd

Personal Flotation Devices which are commonly used by the recreational and occupational public do show a wide range of performance with regard to thermal protection in cold water. The majority can be considered "poor" in this respect. Several types do afford a "fair" degree of thermal protection by increasing predicted survival time in cold water by about 50%. Two PFDs tested illustrate that relatively "good" thermal protection (nearly four times the predicted survival time afforded by wearing the "poor" PFDs) can be obtained by special design features. It is likely that greater degrees of thermal protection by a PFD can be attained only at the sacrifice of wearability and reasonable cost. Consumers of PFDs require more education in water safety relative to the danger of death from hypothermia. One aspect of this safety concern pertains to the thermal protection provided by different PFDs. With better understanding of the problem, consumers can assess their risk of hypothermia depending on their boating habits and the water temperature and apply their level of risk to their choice of a PFD. (Author's conclusion)

655.

HAYWARD MG, Keatinge WR.

Progressive symptomless hypothermia in water: possible cause of diving accidents.
Br Med J 1(6172): 1182; 1979.

Forty-two unexplained deaths have occurred in British waters. A case is reported in which a thin 20 year-old man immersed in water whose temperature was equivalent to tropic waters (29°C) suffered a drop in rectal temperature from 37.20°C to 34.70°C in 112 minutes. As cox of a rowing eight he had been exposed to cold air, close to or below 0°C for about one and a half hours three times a week for a month before the experiment. Failure of adequate metabolic response and vasoconstriction caused the hypothermia. The previous exposures may have altered the response in a complex way, its commonest effect is to reduce reflex response to cold. This kind of "silent" hypothermia may lead to confusion and bad judgement during a dive and indicates a desirability for monitoring body temperature even with its practical difficulties. (EP/UMS)

656.

HEDBLOM EE.

Polar manual: Arctic and antarctic living conditions, personnel selection, hygiene and sanitation, clothing, nutrition, supplies, and equipment, visual disabilities and cold injuries, first aid, safety, and survival.

Bethesda, MD, US Naval Medical School, Dept of Cold Weather Medicine. Fourth edition, 160 p. 1965.

Guidelines for the prevention of accidents, illness, and cold related injuries among Arctic and Antarctic personnel are presented. The topics covered include: polar living conditions, personnel selection, physiological responses to cold, hygiene in the cold, psychological adjustment, body heat conservation, clothing requirements, nutritional requirements, sanitation, modes of transportation, handling of supplies, polar visual disabilities, cold injuries, first aid, the individual first aid kit, basic medical supplies, dental care, safety, polar do's and don't's and Antarctic mortality. The polar medical problems discussed are snow blindness, chillblains, frostbite, freezing, immersion foot, general hypothermia, immersion hypothermia, frostbite of the lungs, and anoxia. (RW/UMS)

657.

HEGNAUER AH.

Lethal hypothermic temperatures for dog and man.
Ann NY Acad Sci 80:315-319; 1959.

The LT_{50} for the anesthetized dog subjected to immersion hypothermia is approximately 17°C; for unanesthetized man it appears to be close to 27°C. A somewhat lower value obtains in man for cold air exposure. The nature of death in unanesthetized man appears to be VF (ventricular fibrillation) whereas, in the anesthetized dog, it may be either VF at any temperature below 25°C, or asystole in the range 18 to 14°C. (Author's summary)

658.

HELLON, R.F.

Neurophysiology of temperature regulation: problems and perspectives.
Fed. Proc. 40(14): 2804-2807; Dec. 1981.

The neuronal basis of thermal regulation has been intensively studied. Certain neurons in the hypothalamus and elsewhere are extremely sensitive to changes in local and/or external temperature. Recent in vitro work indicates that membrane potentials rather than synaptic events may be the basis of the local sensitivity. Other central sites outside the central nervous system are also now being recognized as sources of thermal information to the thermoregulatory system. The skin thermal input relays to the nucleus raphe magnus and probably passes from there to the hypothalamus. There is still much uncertainty about how and when the skin and deep thermal receptors provide input to the temperature controller. (Author's abstract)

659.

HELLSTROM B, Berg K, Lorentzen FV.

Human peripheral rewarming during exercise in the cold.
J Appl Physiol 29(2) :191-199; 1970.

Five healthy young naked men with widely different Vo_{2max} rested for 20 min and exercised for 60 min at various intensities on a bicycle ergometer at 0° and 10°C ambient temperature. One hand was covered by a mitten. Skin, rectal, and tympanic membrane temperatures as well as oxygen uptake were measured. At work intensities corresponding to about 40-65% of the aerobic power all subjects obtained a marked, sustained rewarming of the fingers in the 0°C environment. This thermoregulatory rewarming was usually followed by rewarming of the dorsum of the hand, was significantly delayed in the coldest (unprotected) fingers, and was possibly controlled by both skin and core thermosensory information. The toes did not rewarm as readily as the fingers. Marked interindividual differences in finger rewarming and core temperature during exercise were not related to individual differences in Vo_{2max}. (Authors' abstract)

660.

HELWIG C, Gray R.

Sub arctic diving operations.
In: Progress into the sea. Transactions of the symposium 20-22 October 1969, Washington, DC, Marine Technology Society, 1970.

The authors state that water temperature is the most critical of all the factors affecting a diver's performance. Poor temperature control not only affects the diver's performance, but may result in poor gas diffusion from areas of low circulation, thus causing bends. Suits heated with hot water and with steam are described. A diving bell was heated by diverting the diver water flow to a finned tube heat exchanger mounted on the wall. A deck chamber was heated by pumping electrically heated hot water through coils under the floor. These methods have proved satisfactory in the sub arctic temperatures of 36-40°F. Improvised methods of heating oil rigs are described. (MFW/BSCP)

661.

HENSCHEL A.

Energy balance in cold environments.
In: Cold Injury. New York, Josiah Macy Jr Foundation, 1960, p 303-315.

Caloric expenditure in a cold environment is discussed. In a panel discussion the following topics are addressed: the relationship between caloric intake and environmental conditions, body weight changes during Subarctic bivouac, the influence of work and exercise activities upon caloric intake in varying environmental conditions, relationship between food composition and caloric intake during Arctic bivouac, and research on the caloric intake of Eskimos. It is concluded that expenditures in cold environments are lower than commonly believed and seldom exceed 4,500 calories per day. (RW/UMS)

662.

HENSEL H, Banet M.

Adaptive changes in cats after long-term exposure to various temperatures.

J Appl Physiol 52(4): 1008-1012; 1982.

Two groups of cats were exposed to 5 and 30°C, respectively for 24 mo in climatic chambers under artificial illumination. Then the ambient temperatures were reversed for both groups for another 36 mo. The group adapted to cold for 36 mo showed an increase in fur growth (+35%), an increase in resting metabolism (+20%), and a shift in threshold of the cold-induced metabolic response to 8°C lower ambient temperatures. Norepinephrine (0.4 $mg \cdot kg^{-1}$) elicited nonshivering thermogenesis (+37%) in the cold-adapted animals but was ineffective in the warm-adapted ones. Fur insulation at thermoneutrality was 55% higher in the cold-adapted cats. During acute exposure to −5°C, tissue insulation decreased in both groups; fur insulation increased by 34% in the warm-adapted cats but remained nearly constant in the cold-adapted animals. At all ambient temperatures cold-adapted cats had higher (+0.4°C) rectal temperatures. Body weight was not significantly different in both groups, although the cats living in the cold had a 45% higher metabolism. This was compensated by an increased food consumption. (Authors' abstract)

663.

HEYL F.

Staying alive in the Arctic.

American Petroleum Institute, Bulletin 7401 (2nd ed) 61 p, Sept 1976.

Guidelines for surviving in and adapting to long stays in the Arctic are presented. The guidelines address adaptation, travel, cold weather hazards, care of the injured in the cold, animal hazards, emergency procedures, and ten basic rules for survival. The specific topics discussed include: the effects of cold and wind, the need to stay dry, clothing requirements, vehicle emergency equipment needs, weather and travel, first aid kits, emergency signals, emergency shelter and water, and fire building in emergency conditions. The causes, prevention, symptoms, and treatment of frostbite, hypothermia, immersion hypothermia, immersion foot, snowblindness, and sunburn in the Arctic are outlined. Burns, severe bleeding, carbon monoxide poisoning, accidents, physical condition, and dehydration are also considered. The basic survival rules emphasize self-reliance, emergency preparedness, traveling only with companions, knowledge of first aid and survival skills, and heat conservation. (RW/UMS)

664.

HILLMAN H (letter).

Treatment after exposure to cold.

Lancet 2 :1257; 1971.

The importance of attempting to revive patients apparently dead from cold exposure is stressed. There is only one certain criterion for establishing death from cardiac arrest in hypothermia: the irreversibility of death. It has been found that vigorous attempts to revive apparently dead cold exposure victims can result in full recovery, especially in previously healthy children and young adults. The recommended treatment includes artificial respiration, abdominal pumping to improve circulation, intracartoid centripetal perfusions, and slow warming. (RW/UMS)

665.

HIRVONEN J, Penttinen J, Huttunen P, Saukko P.

Changes in the myocardium and skeletal muscle in guinea pigs in cold exposure with and without ethonal.

Z Rechismed 84(3):195-207; 1980.

The effect of hypothermia with and without ethanol on the myocardium and skeletal muscle was studied. Changes were observed in both muscle types. The mildest lesions were discoloration of the muscle cells with acid fuchsin and Heidenhain's iron hemotoxylin staining, these being more marked in the skeletal muscle. Waving and contraction bands in the muscle were seen in hypothermia. The most severe lesion was a focus with edema and hemorrhage. A reduced reaction of beta-hydroxybutyrate dehydrogenase and fragmentation of the muscle cells, and this was more frequent in the myocardium. Occasionally discoloration, contraction bands and waving were also seen in the controls killed by a blow on the neck. The changes were more numerous in the guinea pigs given ethanol before cold exposure, and serum creatinine phosphokinase was elevated in the same group. Urinary

excretion of adrenaline increased in cold exposure, but noradrenaline did not change significantly. Hypoxia, catecholamines, and sludging of the blood are discussed as possible etiological factors for the lesions.(Author's abstract)

666.

HOCKADAY TDR.

Hypothermia.

Br J Hosp Med 8:279-282; 1972.

The main decision in caring for a hypothermic patient concerns the rate and route of warming. Three methods of rewarming have been used and may be classified as external active, warming the body's surface; internal active, rewarming the blood; and passive, involving careful insulation of the patient. For chilling caused by immersion or exposure, rapid rewarming is the treatment of choice. In cases of hypothermia due to regulatory failure, rewarming is the treatment of choice. In cases of hypothermia due to regulatory failure, gradual rewarming is generally recommended. With hypothermia due to severe illness the assisted passive rewarming is indicated. General measures to be observed regardless of the cause of hypothermia include regular turning of the patient, maintenance of the airways, and elevation of the foot of the bed if hypotension is marked. There is no need for intravenous therapy below a temperature of 33°C. When patients present cardiac dysrhythmia the ECG should be monitored. It is noted that in elderly patients with primary hypothermia, the body temperature may drop surprisingly even in relatively warm rooms. (RW/UMS)

667.

HOHTOLA E, Hissa R, Saarela S.

Effect of glucagon on thermogenesis in the pigeon.

Am J Physiol 232(5):E451-E455; 1977.

The effects of glucagon injection on temperature regulation and some metabolic parameters were studied in the pigeon. Glucagon (100 μg/kg) always inhibited shivering and caused a fall in the oxygen consumption and body temperature of the unanesthetized pigeon at + 6°C. At + 34°C, the same dose of glucagon had no effect on these parameters. At 22°C, glucagon produced an elevation in plasma free fatty acid (FFA) and blood glucose levels. The rise in FFA at 22°C coincided with the suppression of shivering at 6°C. The glucagon-medicated rise in plasma FFA, but not glucose level, was potentiated by cold ambient temperature. Adrenergic blocking agents given prior to glucagon did not abolish its effects. Phentolamine even prolonged the absence and accelerated the suppression of shivering. A glucagon suppress shivering is suggested. Although mobilizing energy reserves, glucagen does not seem to be calorigenic in the pigeon at this dose. The interpretation of the changes in plasma FFA levels is discussed in relation to fuel consumption during shivering.(Authors' abstract)

668.

HONG S-I, Nadel ER.

Metabolic responses to cold and exercise in man.

Fed Proc 37(3) :929; 1978.

Abstract only. Entire item quoted: To determine whether the voluntary contractions of exercise interfere with the involuntary contractions of shivering, four subjects were each exposed to 10°C for 60 min of rest followed by 30 min of exercise at 0, 60 or 120 W, with each intensity performed twice. Esophageal temperature (T_{es}), eight skin temperatures (T_{sk}), oxygen uptake (V_{O_2}) and EMG (neck muscle) were continuously monitored, with data averaged over 5 min periods. Pedalling flushed cold blood into the body core, causing T_{es} to decrease rapidly at a rate and magnitude directly related to the exercise intensity. Maximal decreases of T_{es} were 0.85°C in 4 min. Once shivering thresholds were attained, thermogenic V_{O_2} (attributable to shivering metabolism) and EMG were inversely related to T_{sk} during rest, when T_{es} was constant, and to T_{es} during exercise, when T_{sk} was constant. A given decrease in T_{es} produced around 15 times the increase in response as did the same decrease in T_{sk}. The slope of the thermogenic V_{O_2}/T_{es} relation was significantly suppressed by increasing exercise intensity. Reductions were to around 30% of the O W exercise slope at 60 W and to around 20% at 120 W. Even though thermogenic V_{O_2} was increasingly inhibited during heavier exercise, the greater overall heat production restored T_{es} to an elevated level more rapidly. We conclude that thermoregulatory shivering can be largely overriden by voluntary muscular activity. (Authors' abstract)

669.

HONG S-I, Nadel ER.

Thermogenic control during exercise in a cold environment.

J Appl Physiol: Respirat Environ Exercise Physiol 47(5) :1084-1089; 1979.

To determine whether the voluntary contractions of exercise interfere with involuntary shivering contractions, four male subjects were each exposed to a 10°C environment for 60 min of rest followed by either another rest period or 30 min of cycle-ergometer exercise. On different days exercise was performed at zero load, light load, and moderate load. Each experiment was performed twice, resulting in a minimum of eight experiments for each subject. Esophageal temperature (T_{es}), eight skin temperatures (T_{sk}), oxygen uptake (Vo_2), and the integrated electrical activity from a neck muscle (EMG) were continuously monitored. Pedaling flushed cold blood into the body core, causing T_{es} to fall. The rate and absolute magnitude of the decrease in T_{es} was proportional to the intensity of exercise. Thermoregulatory Vo_2 (attributable to shivering) and EMG were inversely related both to T_{sk} during rest, prior to any changes in T_{es}, and to T_{es} during exercise, when T_{sk} was constant, once shivering thresholds were surpassed. The slope of the thermoregulatory Vo_2-to-T_{es} relation was significantly suppressed by increasing exercise intensity. The slope of the EMG-to-T_{es} relation was similarly suppressed; since the neck muscles are not involved in the additional activity of exercise, we concluded that the graded inhibition of shivering during exercise was of central origin rather than from the rhythmic contractions required to sustain exercise. (Authors' abstract)

670.

HOROWITZ JM.

Concurrent neural control of shivering and nonshivering thermogenesis.

Isr J Med Sci 12(9): 1082-1085; 1976.

Data obtained from single unit studies are consistent with the concept of parallel pathways for controlling modes of heat production, but are insufficient to rule out alternative possibilities. Observations from rats and guinea pigs, wherein the individual modes are directly or indirectly monitored, provide more convincing evidence that parallel processing occurs in these mammals. It remains to be determined, however, whether such processing can be generalized to more animals. Nevertheless, available data demonstrate that signals from different thermosensitive areas can be processed centrally in diverse ways and not simply lumped as a common signal for cold. (Author's summary)

671.

HOROWITZ JM, Erskine LK.

Central regulation of temperature in cold environments. 1. A dynamic model with two temperature inputs.

Comput Biomed Res 6(1): 57-73; 1973.

A preoptic-hypothalamic network representing neural regulation of temperature in cold-stressed animals has been modeled using CSMP (a program for real time processes). The calculated outputs of this model can be readily compared with experimental data, and the neural regulator can be integrated with other homeostatic regulators. The calculated outputs consist of signals for activating shivering and nonshivering heat production as the effect of a pyrogen-induced fever, a parameter in the model is varied to alter the temperature sensitivity of one class of hypothalamic neurons. Finally, calculations are included to allow a critical comparison of this model with other thermoregulatory models for cold-stressed animals. (Authors' summary)

672.

HORVATH SM.

Exercise in a cold environment.

Exercise Sport Sci Rev Vol 9:221-263; 1981.

Behavioral and physiological responses are considered in a thorough review of human responses to exercise in a cold environment. One hundred and nine references are cited and major headings include exposure to cold air and cold-water exposure. Subheadings for exposures to cold water are exercise in cold air environments, physical fitness and cold tolerance, and maximal aerobic capacity in cold environments. Subheadings for cold-water exposure are submaximal exercise in cold water, endocrine responses to cold-water immersion, and other aspects of cold water exposures. Of interest to the diving community, in discussing other aspects of cold water exposures is the author's statement that, "The problem of working in cold-water environments may be simply one of adequate insulation and the fear that hypothermia might develop when work (exercise) is performed. A major

problem that must be addressed concerns the need to differentiate between the heat losses related to cold exposure, the physiological mechanisms employed to modify the heat loss, and whether metabolic heat input via shivering or external work is sufficient to alter the physiological adjustments required to maintain thermal equilibrium. Cold exposure remains an unquestionably severe physiological stress, with major questions unanswered regarding operative controls, the role of prior adaptation, and what interrelationships between various systems are required to make it possible for the human organism to respond adequately to a challenge."(EP/UMS)

673.

HOSKIN R, Goode R, Layton PP, Kuehn LA.
An evaluation of three rewarming methods for mildly hypothermic subjects.
In: Program and Abstracts, Undersea Med Soc, Inc, annual scientific meeting June 1-5, 1982, Undersea Biomed Res 8(1-Suppl) :A 20; Mar 1982.

After one-to-two hour-long exposures of nine totally-immersed nearly-nude diver subjects in stirred water of 20, 25 and 30°C temperature in a bath calorimeter at one atmosphere, the subjects were rewarmed from the resulting mild hypothermia (1-2°C rectal temperature decreases; approximately 300 kcal of heat loss) by one of three techniques: blanket, hot tub or blanket in concert with respiratory heating. Extensive temperature and heat flow measurements from 15 body sites on each subject plus analysis of ECG and metabolic rate have resulted in the following preliminary findings: 1) Warming of the hypothermic subject in a blanket on a cot in a closed room at 20°C air temperature does not immediately occur; the thermal state of the subject continues to decline for the first hour and the treatment can at best be described as a "holding" or "maintaining" technique. 2) The hot tub is an efficacious method of rapid rewarming but the temperature of the tub water is crucial in determining the willingness of the subject to rewarm; a temperature of 37°C was the maximum that would be tolerated and, even at this temperature, few subjects wished to stay for the entire rewarming period, several leaving early with complaints of heat discomfort and sweating (while still hypothermic) and others experiencing heat syncope. 3) The use of respiratory heating with totally-humid warm air (40°C) in concert with a blanket did not appear to increase speed of rewarming and was fraught with difficulties of application, ranging from gagging on the muggy air to concern for the toxicological hazard to be experienced with the usually-available steam sources. (Authors' abstract)

674.

HUANG Z, Sun Q, Shen M.
Rewarming with microwave irradiation in severe cold injury syndrome.
Chin Med J 93(2) :119-120; Feb 1980.

After experiments on 20 piglets, 28 severe cases of cold injury syndrome were rewarmed with microwave irradiation with good effects, 20 recovered. During warming the temperature rose gradually an average 1 C after 6 to 7 minutes. 8 infants died, a fatality rate, of 28.6% (Authors' abstract)

675.

HUDSON MC, Robinson GJB (letter).
Treatment of accidental hypothermia.
Med J Aust 1:410; 1973.

The inspiration of heated humidified air is inadequate as a rewarming technique for accidental hypothermia. It is calculated that this method would increase the patient's temperature by only 0.3°C per hour, assuming zero heat loss from the surface of the body. However, inhalation of heated water vapor may be useful for maintaining body temperature during prolonged surgery. (RW/UMS)

676.

HUNT PK (letter).
Management of hypothermia.
Can Med Assoc J 118(6): 618; 1978.

Reference is made to Dr. J.B. Rueler's article (Can Med Assoc J 117:1372; 1977) on resuscitation of a patient with profound hypothermia. Dr. Rueler's remarks relative to the treatment of hypothermia by core rewarming are endorsed by the author. He refers to his earlier articles on work in a community hospital when less literature was available. External rewarming is advocated only when facilities for core rewarming are not available. (EP/UMS)

677.

HYACINTHE, R.

Accidental exposure to cold during deepsea diving: prevention, protection, rescue.
Med. Aeronaut. Spat. Med. Subaquatique Hyperbare 19(74):161-163; 2nd quarter, 1980.

One of the dangers of deepsea diving in the cold climate of the North Sea is accidental exposure to cold, largely due to equipment failure. The Association of Diving Contractors recently recommended a 24-36 hr autonomous survival system for the use of divers in the North Sea, to offset the heat loss that occurs by respiration and skin evaporation. (In a hyperbaric helium environment, respiratory and cutaneous caloric loss is especially intense.) The survival gear made by Kinergetics, USA, and tested by the Norwegian Underwater Institute, consists of a hooded vest, a respiratory device for reheating exhaled air and absorbing exhaled CO_2, and a suspension harness equipped with foot rest. The diver produces heat essentially by shivering. In deep diving, however, shivering may not be effective if the breathing gases are not rewarmed or if the subject is not sufficiently insulated from the cold. Emphasis should be on efficient reheating of exhaled air and of the water circulating inside the protective clothing. This water should be well isolated from the body by dry undergarments, as the diver's skin must be kept dry. In experiments on divers, central body temperature below 35°C resulted in memory loss and confusion, and a study on mountaineers exposed to cold demonstrated that temperature below 32°C causes disorders of consciousness and cardiac arrhythmia. In a study of recuperation after hypothermia, the reheating of the body to 37°C led to prompt recovery. However, after chronic hypothermic exposure, recovery took place only 5 hrs after the body temperature reached 37°C. (OLC/UMS)

678.

IRVING L.

Field studies on cold adptation.
In: Cold Injury. New York, Josiah Macy Jr Foundation, 1960, p 339-360.

Field research studies on human adaptation to a cold environment are reviewed. In a panel discussion, the following topics are addressed: differences in metabolic rate between acclimated and control subjects, shivering rates in cold adapted individuals, comparisons of Whites' and Australian Aborigines' physiological functions in the same cold environment, elevation of nocturnal metabolism and retention of increased resting metabolic rate in acclimated subjects, and the influence of foot temperature in cold adptation. It is concluded that some experiments on Australian and Central American natives' responses to cold demonstrate methods of observation which can lead to significant studies of acclimation and physiological distinctions among various groups of the human species. It is suggested that experimental results may demonstrate true adaptation as compared to acclimation. (RW/UMS)

679.

JESSEN K, Hagelsten JO.

Peritoneal dialysis in the treatment of profound accidental hypothermia.
Aviat Space Environ Med 49(2) :426-429; 1978.

Profound accidental hypothermia is an unintended lowering of the body temperature below 30°C caused by exposure to cold and/or wet surroundings. In the treatment of this dangerous condition, an "after-drop" of the body-core temperature should be avoided, as should the development of hypopotassaemia, which can be very pronounced during the rewarming period. Successful treatment of profound hypothermia requires: 1) rapid rewarming with fluid, 2) central rewarming to avoid after-drop, 3) rapid correction of electrolyte balance, particularly potassium, during rewarming, 4) elimination of toxic agents during rewarming since many patients are hypothermic because of drug-overdosage, 5) related symptomatic treatment, such as artificial ventilation, external cardiac massage, defibrillation, etc., and 6) no part of the treatment should, per se, expose the patient to severe risk. Peritoneal dialysis is a very effective method to rewarm the body-core in advance of the shell. It is possible to correct "automatically" the hypopotassaemia by use of a dialysate with a normal content of potassium and, at the same time, remove toxic agents from poisoned patients. In most modern hospitals, this treatment can be instituted quickly and easily, it does not interfere with other symptomatic treatment, and it is almost without risk while it offers many therapeutic advantages for these high-risk patients. Some examples of cases treated successfully by this method are described. Peritoneal dialysis is recommended for the treatment of profound accidental hypothermia when the body-core temperature is below 30°C. (Authors' summary)

680.

JESSEN K.

Immersion and accidental hypothermia.
Acta Med Port 1(2) :225-237; 1979.

The immersion or near-drowning syndrome is discussed and found to be closely related with accidental hypothermia. Pathophysiology and clinical picture of both are discussed, and particular emphasis is done to the treatment. The emergency care includes cardiopulmonary ressuscitation, and control of the pulmonary oedema, initial acidosis, hyperpotassemia and hypocalcemia, and late hypopotassemia, but, most important of all, the rewarming. Hot water bath, hot moist air or oxygen breathing, extracorporal circulation can be used, but peritoneal dialysis is shown to be technically simple and very efficient. Three clinical cases are described. (Author's summary)

681.

JOHNSON CE, Collins JD.

The development of predictive engineering formulations for diver heating (Vols 1 and 2).
Durham, NC, Duke Univ Rep on contract N000014-79-C-0379, 437p; 1982.

Predictive heat transfer equations have been developed to estimate the local supplementary heating necessary to support a resting diver. These formulations consider the diver's passive thermal protection in the form of a diving dress and the effects of his ambient environment upon the dress' thermal resistance. The mathematical model performs a numerical analysis on discrete composite layers comprised of the skin, dry protective suit, breathing gas mixture, and the surrounding fluid environment. The parametric properties associated with the heat transfer correlations were obtained from validated experimental heat flux and skin temperature data collected under specific environmental conditions. Equations were developed by numerically analyzing twelve segmental skin temperatures recorded from five resting subjects exposed to a 20°C, 95% helium - 5% oxygen hyperbaric chamber environment pressurized to the equivalent of 200 meters of seawater. The supplementary heating that is required to maintain a diver is obtained by determining the heat flux that would be lost were he not heated and subtracting from this the normal heat flux expected from a resting euthermic subject. Applying this principle to each of the 12 segmental regions, it is possible to predict the supplementary heating necessary to compensate for an excessive flux. The mathematical model was written as an interactive computer program. The program collects information on the diver's posture and the ambient environment, and then generates estimates of the required regional supplementary heating. The program also allows the comparison of predicted temperatures, heat fluxes, overall heat transfer coefficients, normalized temperatures, and Biot numbers to values computed from experimental data. (From authors' abstract)

682.

JOHNSON CE, Collins JD, Piantadosi CA.

Equations for predicting diver regional skin temperatures as a function of mean skin temperature.
Undersea Biomed Res 9: 59-74; Mar 1982.

A series of linear algebraic equations have been derived from those of Kerslake (Flying Personnel Research Committee Memo 213, R.A.F. Institute of Aviation Medicine. 1964) for predicting the regional skin temperatures of a quasi-euthermic diver having pronounced vasoconstriction. The equations were developed by numerically analyzing twelve regional skin temperatures recorded from five resting subjects exposed to a hyperbaric chamber environment of 20°C, 95% helium, and 5% oxygen pressurized to the equivalent of 200 msw (650 fsw). The independent variable of the basic correlation is an arbitrarily defined mean skin temperature; the empirical equations were developed for the purpose of assisting a designer in estimating regional supplementary heating requirements for a diver wearing a thermal protection garment of known composition. The developed equations were authenticated by comparing the predicted normalized regional temperature with the respective experimental normalized temperature obtained from several sets of physiological data collected during the evaluation of the Naval Coastal System Center's diver thermal protection garment (DTP). The results of these comparisons of nondimensionalized temperatures indicated that the derived correlations should accurately predict the skin temperature of the principal regions as a function of mean skin temperature with a nominal error of no more than 15%. (Authors' abstract)

683.

JOHNSON DJ, Moore S, Moore J, Oliver RA.

Effect of cold submersion on intramuscular temperature of the gastrocnemius muscle.
Phys Ther 59(10):1238-1242; Oct 1979.

This study investigated the effect of a 30-minute, 10°C water bath on the intramuscular temperature of a lower leg and the contralateral lower leg. Intramuscular temperature was measured in 10 subjects using hypodermic thermistor probes inserted 25.3 mm into the lateral head of the gastrocnemius muscles of both legs. One lower leg was submersed in a 10°C cold bath with the water level maintained 5 cm above the patella and with the subject in a nonweight-bearing position. Intramuscular temperature significantly decreased in both lower legs during treatment, although the intramuscular temperature of the treatment lower leg was significantly lower than that of the contralateral lower leg. A temperature difference continued for four hours after treatment; however, the temperature of both lower legs was significantly lower after four hours than it was before the cold bath treatment.(Authors' abstract)

684.

JOHNSON LA.

Accidental hypothermia: peritoneal dialysis.
JACEP 6(12):556-561; Dec 1977.

Accidental hypothermia may develop within a few minutes by immersion in cold water, in a matter of hours by exposure to cold weather, and in a matter of days in debilitated victims by continuous exposure to milder cold stress. The prognosis in accidental hypothermia depends on the patient's premorbid condition, the depth and duration of the hypothermia and the degree of exhaustion and metabolic acidosis that result from physiologic attempts to compensate for the heat loss. For deep hypothermia (deep body temperature below 20°C, 82.4°F), internal rewarming is strongly recommended as a means of supporting function in body core organs and minimizing the risk of "rewarming shock". For lesser degrees of hypothermia, recoverability depends more on the adequacy of supportive care than on the method of rewarming. The rapid and complete recovery experienced in the case presented is not surprising since the patient's premorbid condition was good, chilling had been rapid, metabolic exhaustion was mild, internal rewarming was accomplished without delay, using heated peritoneal dialysis.(Author's abstract)

685.

JOHNSON RH, Spalding JMK.

The role of a central temperature receptor in shivering in man.
J Physiol (LOND) 184(3) :733-740; 1966.

Five subjects with spinal cord transections and one subject unconscious from a head injury have been studied when the deep tissue temperature ('central' temperature) was artificially lowered but normally innervated skin was kept warm, usually 34-36°C. Shivering and/or increased metabolism was evoked when the central temperature was 34.9-37°C. These observations are compatible with the view that there is a central receptor which can cause shivering when stimulated by a fall in central temperature. (Authors' summary)

686.

JONES, S.B.

Myocardial norepinephrine turnover during induced hypothermia and rewarming.
J. Appl. Physiol. 50(5): 962-966; May 1981.

Norepinephrine (NE) turnover in myocardial tissue was measured in male golden hamsters (*Mesocricetus auratus*) during 1) continuous hypothermia, 2) rewarming from hypothermia initiated by exposure to 22°C ambient, and 3) normothermic control state. Hypothermia was induced by exposure to 80% He-20% O_2 atmosphere at 0 to −10°C. At sequential periods after tritiated norepinephrine ([^{3}H]NE) infusion, hamsters were killed by cervical transection and hearts were removed and analyzed for NE and [^{3}H]NE content. Rate constants, turnover times, and turnover rates were determined from regression analysis of [^{3}H]NE/μg NE tissue decay. Myocardial concentrations of NE were constant during NE-turnover measurements in each group. However, myocardial NE levels were reduced by 37% in both continuous hypothermia and rewarming from hypothermia compared with normothermic controls. NE turnover was highest during rewarming from hypothermia (0.34 $\mu g \cdot g^{-1} \cdot h^{-1}$), but no decay in myocardial [^{3}H]NE was detectable during continuous hypothermia. Control animals had turnover

values of 0.15 $\mu g \cdot g^{-1} \cdot h^{-1}$. Turnover data indicate severe depression in myocardial sympathetic nerve activity during hypothermia but a significant increase above normothermic control levels during rewarming from hypothermia. (Author's abstract)

687.

JUSTIN-BESANCON J, Pequignot H, Etienne J-P.
Un cas de refrigeration a 23.5 suivi de guerison.
[A case of freezing to 23.5°C followed by recovery].
Sem Hop Paris 34 :63-69; 1958.

Observation of a case of accidental freezing to 23.5°C followed by recovery is thoroughly reported. Without doubt the freezing was produced by the absorption of a large amount of alcohol. On admission to the hospital the state of the patient seemed hopeless: complete coma, lack of reflexes, considerable hypertonia, respiratory rhythm at 8, heart rate at 22, no detectable pulse. After a bath at a temperature of 38°C rewarming was very rapid, but led to an alarming collapse which only responded to transfusions. In the following days, the situation remained very serious, pneumonia with congestion of the pleura, complicated by delirium tremens. Besides an examination of the ECG we obtained a whole series of clinical laboratory findings at different temperatures. The more notable anomalies were: 24°C, incoagulability of blood; at 32.5°C, a drop in hematrocit and prothrombin; the day after hypothermia, hypoglycemia. (Authors' abstract translated by EP.)

688.

JUSTIN-BESANCON L, Pequignot H, Etienne J-P.
Les hypothermies accidentelles profondes chez l'adulte: a clinical and biological study.
[Deep accidental hypothermia among adults: a clinical and biological study].
Sem Hop Paris 34 :69-81; 1958.

To support a personal observation and stress similar cases published in the literature, the authors can state precisely the essential characteristics of deep accidental hypothermia among adults: circumstances of the cooling (more frequently with acute alcoholism), clinical picture of hypothermia, description and chronology of the difficulties of the cooling phase and the period of rewarming. Contrary to those who have affirmed for a long time, but never demonstrated, most of the authors today are in favor of rapid rewarming of the frozen individuals in a warm bath at 40°C. Recovery, after it occurs, is without sequellae. Human observations and animal experiments allow to describe essential biological perturbations of deep hypothermia; initial hyperglycemia, followed by hypoglycemia, hyperleucocytosis which disappears at very low temperatures; tendency to acidosis; elevated hematocrit and moderate reduction of plasma volume; changes in coagulation. On the other hand, electrolytes and oxygen content of blood are little disturbed. The exact mechanisms of death due to hypothermia remains not well know. (Authors' abstract translated by EP.)

689.

JUSTIN-BESANCON L, Pequignot H, Etienne J-P, Laurent D.
Les modifications de l'ectrocardiogramme au cours des hypothermies spontanees. Essai physio-pathologique.
[Changes of the electrocardiogram during sponteneous hypothermia. Physio-pathological testing].
Sem Hop Paris 34 :82-96; 1958.

The authors report electrocardiographic observations of spontaneous hypothermia in an adult, from whom the initial trace was registered at 24°C. They compare the observed anomalies during spontaneous hypothermia to those met in animal experiments. Inhibition of the centers of cardiac excitability, decrease of conduction at all levels, elongation of electrical systole, and major difficulties of ventricular repolarization are absolutely superimposed in human pathology and during experiments. The physio-pathology of these difficulties is not unique for these different electrical problems. The blockage of elimination of CO_2, the drop of blood pH, very certainly play an important role in the genesis of the difficulties of repolarization that are not explained by coronary insufficiency attributable to cold, from which the reality does not rest on sufficient proof. This myocardial ischemia happens unexpectedly, however, below a critical temperature, as attested by the occurrance of ventricular fibrillation. The latter could, however, possibly be the result of cardiac dilatation without any relation to difficulty with myocardial perfusion. (Authors' abstract translated by EP.)

690.

KANE KA, McDonald FM, Parratt JR.

The effect of aminosteroid, Org 6001, on hypothermia induced ventricular fibrillation in a cat.
Br J Pharmacol 66(4);609-618; Aug 1979.

The effect of the antidysrhythmic aminosteroid, org 6001, on hypothermia-induced ventricular fibrillation was investigated in cats anesthetized with pentobarbitone. Org 6001 (total dose, 10 mg/kg, by intravenous injection) reduced both the incidence of fibrillation and the temperature at which it occurred. The number of animals that survived to 16°C was increased. This protective effect of org 6001 could not be explained by changes in respiratory acidosis, plasma concentrations of sodium and potassium, or by changes in the action potential of excised hypothermic ventricular muscle. The hypothermia-induced elevation of blood lactate was less in cats treated with the aminosteroid. Over a limited temperature range, org 6001 prolonged the P wave and QRS duration and shortened the QTC interval. St segment elevation was slightly reduced in the drug-treated group. J deflections were observed but were not correlated with the development of fibrillation. The onset of fibrillation was not considered to be due to temperature differences between the micocardium and arterial bood or between localized areas of the left ventricular wall.(Authors' abstract)

691.

KANG BS, Song SH, Suh CS, Hong SK.

Changes in body temperature and basal metabolic rate of the ama.
J Appl Physiol 18:483-488; 1963.

Oral temperatures of Korean diving women (ama) were measured before and after diving work in four seasons of the year. Their basal metabolic rate, measured in four seasons, was compared to that of nondiving women who lived in the same community and ate the same diet as the ama. Average oral temperatures declined to 35 C after 70 min of work in summer (water temp., 27 C) and to 33 C after 15 min of work in the winter (water temp., 10 C). Average body temperature, computed from weighted oral and average skin temperatures, declined to 34.6 C in summer and to 30 C in winter. Duration of work periods was determined principally by water temperature, since oral temperature declined at a rate inversely proportional to water temperature. The lower deep body temperatures which the ama endure in winter do, however, prolong their winter work period. The BMR of nondiving women was the same as the Dubois standard throughout the year. However, the BMR of ama varied with the season, ranging from +5 of the Dubois standard in summer to +35 in winter. We conclude that the elevated BMR of ama during the winter is cold adaptation, induced by repeated immersion in cold water. (Authors' abstract)

692.

KANG BS, Han PS, Paik KS, et al.

Calorigenic action of norepinephrine in the Korean women divers.
J Appl Physiol 29:6-9; July 1970.

Norepinephrine (NE) was infused at a rate of 0.150 μg/min per kg in eight each of women divers (ama) and of nondiving women (control) while they were resting in supine position at room temperature of 20-25°C in both winter and summer. The oxygen consumption (VO_2) increased slightly during NE infusion in ama in winter ($P < 0.025$), but showed no significant changes in other series. The magnitude of extra VO_2 attributable to NE was only 12 ml/min per m^2, equivalent to approximately 7.5% of the pre-NE VO_2. Neither the skin temperatures nor the skin heat fluxes showed any significant changes. NE caused a reduction in the heart rate and an increase in the blood pressure, but the magnitude of these changes was not different either between groups or between seasons. While the excretion of epinephrine showed no seasonal changes, the excretion of NE increased slightly in ama in winter. Although these findings suggest a slight calorigenic action of NE in ama in winter, when they are subjected to a severe daily cold-water stress, its magnitude is too small to indicate the development of nonshivering thermogenesis. (Authors' abstract)

693.

KANG BS.

Metabolic adaptation to cold.
Seoul, Korea, Yonsei Univ Dept Physiol Rep 3, ARDG (FE)-J-292-3, 23 p, June 1971. (AD726,467)

Experiments on thermoregulatory responses to cold immersion stimulus were carried out in September 1968, (summer studies) and February 1969 (winter studies). Eight each of ama and control subjects were selected at random from a same community in Yong-Do Island, Pusan. The rate of fall in muscle temperature of forearm

during a 30-minutes immersion in 6°C water bath was significantly slower in the ama in winter and was about the same in the two groups in summer. However, the magnitude of change in the skin temperature and the heat fluxes observed during immersion period was not significantly different either between groups or between seasons. Both finger blood flow and skin temperature during one hour immersion in 6°C water bath decreased significantly in the ama as compared to the control. The magnitude period was significantly greater in the control in winter. The magnitude of reactive hypermia after a five min arterial occlusion in both air and 15°C water bath was significantly lower in the ama than in the control. In control subjects, post-occuluded blood flow to resting values in the air was faster in the ama than in the control but was the same in the two groups. The results suggest that vasoconstrictor tone increased in the ama in winter, indicating the development of vascular adaptation as a part of cold acclimatization. (Author's abstract)

694.

KANG DH, Kim PK, Kang BS, Song SH, Hong SK.
Energy metabolism and body temperature of the ama.
J Appl Physiol 20:46-50; 1965.

Rectal temperature and oxygen consumption were determined in the ama while diving during the summer and winter. In addition, a dietary survey and a physical-fitness test were conducted. The average rectal temperature fell to 35.3 C after 45 min of work in summer (water temp., 22-26 C) and to 34.8 C after 30 min of work in winter (water temp., 10-13 C). The lowest rectal temperature was 33.2 C in summer and 34.3 C in winter. V_{O_2} increased to nearly 1 liter/min in summer and to 1.4 liter/min in winter. One can calculate that the total extra energy expenditure for diving work is approximately 1,000 kcal/day in both winter and summer. The actual dietary survey showed that the total caloric intake of the ama is 3,000 kcal/day in both summer and winter, which exceeds the daily requirement for nondiving women of comparable age by 1,000 kcal. The protein intake was not different between summer and winter. Physical fitness, as judged by the score of Harvard step-up test, was significantly better in the ama than in the control in both summer and winter. Moreover, physical fitness was poorer in winter as compared to summer in the control, whereas it was excellent throughout a year in the ama. (Authors' abstract)

695.

KAPLAN R, Thomas P, Tepper H, Strauch B.
Treatment of frostbite with guanethidine.
Lancet 2(8252) :940-941; Oct 24, 1981.

In treating frostbite a daily sympathetic neural blockade is recommended until no further improvement is shown (usually 10-14 days). To preclude daily sympathetic blockade use of intravenous guanethidine provides long-standing sympathetic blockade. In a case of hand frostbite using a Bier technique (Arch Klin Chir 86:1007; 1908) 20 mg guanethidine in 20 ml of 0.5% lidocaine was injected into a forearm vein with the tourniquet inflated for 20 min. Sympathetic blockade was obtained for up to 2 weeks. A potential hazard exists if the tourniquet malfunctions. A triphasic response in blood pressure is described and use of an alpha adrenergic vasopressor for hypotension and/or a vasodilator such as nitroprusside for severe hypertension is recommended. (EP/UMS)

696.

KATS BA.
Accidental hypothermia in man.
The Canadian Family Physician June, 1974.

Much is yet unknown on the pathogenesis of accidental hypothermia in man. Data are mainly derived from comparative physiological studies in mammals, but some knowledge has been obtained from direct clinical observation and the experience gained with induced hypothermia in anesthesia. The usual criteria of death do not apply to hypothermia and awareness of the altered physiology under such conditions is essential for quick and effective treatment. There appears to be a shift in rewarming procedures from superficial rewarming by conservative methods to the more aggressive forms of central rewarming. Despite practical limitations the latter methods, especially peritoneal dialysis, are more effective and decrease mortality. (Author's summary)

697.

KAZNACHEEV VP, Kulikov VY, Panin LE, Lyakhovich VV.

Some aspects of human adaptation at high latitudes.

Hum Physiol (Engl Transl Fiziol Chel) 5(2) :193-199; Mar-Apr 1979.

The results suggest that besides adaptive changes typical of a state of stress in man living in high latitudes, an important place is occupied also by specific changes, the initial component of which is connected with the structures of the cell. It is not yet sufficiently clear how the receptive-reflex mechanisms operate in the structural components of the cells. However, it is certain that they essentially modify the character and effectiveness of adaptive reactions. If an attempt is made to combine the phenomena of "stress" at the submolecular and molecular levels described above, it is clear that on the whole they bring the cells of organs and tissues into a state of function under unique stress. These mechanisms include readjustment of energy fluxes which regulate antioxidative activity, and also of the genetic mechanisms determining synthesis of antioxidants of enzymic nature. All these adaptive mechanisms are combined with many other adaptive responses aimed at providing and maintaining the flows of energy, plastic materials, and information in the body as a whole. In our view there are thus grounds for considering that a man at high latitudes the state of unique chronic stress develops, which can be called a "polar stress syndrome." This syndrome is characterized by the features enumerated above, which reflect mechanisms of adaptation aimed largely at stabilizing cell structures in a state of modified vital activity. The interpretation of mechanisms of adaptation in high latitudes described above raises a number of new general problems regarding biological and physiological mechanisms of adaptation as a whole. A more penetrating investigation of the adaptive features distinguishing indigenous inhabitants of the Far North is clearly important, for the most effective and economical adaptive reactions to the special cosmic, geomagnetic, and other ecologic conditions of the Arctic must have evolved and become genetically consolidated in them. (Exerpts from authors' conclusions)

698.

KAZNACHEEV VP, Kulikov VY, Kolosova NG, Buraeva LB.

Some biophysical mechanisms of human adaptation in the extreme north regions.

Vestn Akad Med Nauk SSSR (6):3-11; 1979.

Adaptation of the newcomer population in the Extreme North is accompanied by phasic changes in the antioxidative activity, an increase in the content of readily oxidized classes of lipids. In hyperlipidemia this created conditions for activation of free-radical lipid oxidation, manifestation of toxic properties of oxygen, and the development of hypoxia condition in the tissues. The indigenous population, yakuts, were found to have a high anti-oxidative activity indicating a peculiar qualitative composition of lipids in the biological membranes. A relationship between the anti-oxidative activity value and the nature of food of the indigenous population was demonstrated. Investigations of the circadian rhythms of some values in the newcomer population showed low temperatures and unusual light periodicity to influence the reactions of free-radical oxidation of lipids, their intensity, and time parameters. In the development of the "syndrome of polar stress" the important role was shown to belong to changes at the molecular and cellular levels which could in the first place participate in the magnetic field reception, and to modifications in the capacity of biological membranes to change the nature of intercellular interactions and the body response to the effect of the extrme environmental factors as a whole. (Authors' abstract)

699.

KEAHEY TM, Greaves MW.

Cold urticaria: dissociation of cold-evoked histamine release and urticaria following cold challenge.

Arch Dermatol 116(2):174-177; Feb 1980.

Nine patients with acquired cold urticaria were studied to assess the effects of β-adrenergic agents, xanthines, and corticosteroids on cold-evoked histamine release from skin in vivo. The patients, in all of whom an immediate urticarial response developed after cooling of the forearm, demonstrated release of histamine into the venous blood draining that forearm. Following treatment with aminophylline and albuterol in combination or prednisone alone, suppression of histamine release occurred in all but one patient. In some patients, this was accompanied by a subjective diminution in pruritus or burning, but there was no significant improvement in the ensuing edema or erythema. In one patient, total suppression of histamine release was achieved without any effect on whealing and erythema in response to cold challenge. Our results suggest that histamine is not central to the pathogenesis of vascular changes in acquired cold urticaria.(Author's abstract)

700.

KEATINGE WR.

The effect of general chilling on the vasodilator response to cold.

J Physiol (LOND) 139:497-507; 1957.

A method is described for following changes in the blood flow and heat loss of fingers in ice water. Vasodilatation develops even in generally chilled people in response to local cooling, but at a rate which differs widely from person to person and in some is very slow. These individual differences are slight when people are hot. All subjects then achieved approximately maximal blood flows in response to local cooling and at about the same rate. Once cold vasodilatation has developed in generally cold people it is little affected by vasoconstrictor reflexes or by adrenaline. Cold vasodilatation occurs in the fingers of people immersed in cold water. Individual differences in the reaction observed in the fingers appeared to be present in the rest of the immersed skin. (Author's summary)

701.

KEATINGE WR

The effects of subcutaneous fat and previous exposure to cold on the body temperature, peripheral blood flow and metabolic rate of men in cold water.

J Physiol (LOND) 153 :166-178; 1960.

The fall in the rectal temperature of each of ten young men immersed motionless for 30 min in stirred water at 15°C varied little in successive immersions and was closely related to the man's subcutaneous fat thickness by the equation $T = 11.7/F - 0.62$ (where T = fall in rectal temperature in °C and F = mean skinfold thickness in mm, measured at four standard sites). The falls bore relatively little relation to the men's finger blood flow, which was always low during immersions, but both were slightly greater when the men were hot than when they were cool at the time of immersion. The men's metabolic rates during immersion were substantially lowered by a small increase in their body temperatures at the time of immersion, and were increased by exposure to cold air, though not by moderate exercise, several hours before immersion. In the first 10 min of immersion the metabolic rates of thin men were little higher than those of fat men, and there were a number of substantial and consistent individual differences in metabolic rate which were not related to the individual's fat thickness or to his fall in rectal temperature. In the last 20 min of immersion the metabolic rates of the thin men increased substantially but those of fat men did not. (Author's summary)

702.

KEATINGE WR.

The effect of work and clothing on the maintenance of the body temperature in water.

Quart J Exper Physiol 46:69-82; 1961

Twelve young naval ratings were repeatedly immersed in water at temperatures between 5 and 37.8°C. Their temperatures, both rectal and oesophageal when measured, fell more rapidly when they worked than when they stayed still in water at 5 or 15°C. This was so whether the men worked as hard as possible or at a slower rate, whether they wore clothes or not, and whether or not the water (at 15°C) was stirred when they were still. The fattest man suffered relatively small falls in rectal temperature at both 5 and 15°C whether he worked or was still. Work had no significant effect on the rectal temperatures of unclothed men in water at 25°C and caused a rise in water at 35°C. Work had no important effect on the falls in surface or mean temperature during 20-min. immersions at 5° and 15°C when the men were unclothed and the water (in the still experiments) was stirred, but it increased the falls in mean temperature when the immersions lasted 40 min. and increased both when the men were clothed. Clothing substantially reduced the men's falls in both surface and deep temperature, particularly in water at 5°C. This effect was prolonged when the men were still, but when they worked it was relatively slight after the first few minutes. (Author's abstract)

703.

KEATINGE WR.

Death after shipwreck.

Br Med J 2:1537-1541; 1965.

The probable cause of the heavy loss of life when the liner Lakonia was abondoned near Madeira has been investigated by questioning survivors and others concerned in the incident. Only approximately 11 of the 124 deaths could be accounted for by injury or by accidents in the Lakonia. All the passengers had life-jackets, and the

reports provide strong evidence that most of the other 113 deaths were caused by immersion hypothermia leading to helplessness and unconsciousness with drowning only a terminal event. Ten out of a group of 15 people who had survived immersion and were able to swim had swum about, eight of them aimlessly or in the belief that it would keep them warm. Most people who entered the water were wearing warm clothes, but some wore night-clothes or nothing at all. Five out of 18 had taken off outer clothing before entering the water. In view of experimental evidence that exercise normally accelerates the rate at which the body temperature falls during cold immersions lasting 20 minutes or more, and that warm clothing greatly retards body-cooling in the water, the findings suggest that loss of life at sea could be significantly reduced by advising those at risk to put on warm clothing before entering the water and to float still unless they can see land or rescue ships close enough to be reached by swimming. (Author's summary)

704.

KEATINGE WR, Hayward MG.

Sudden death in cold water and ventricular arrhythmia.

J Forensic Sci 26(3) :459-461; Jul 1981.

We describe a case in which a young man collapsed with no pulse but continuing respiration immediately after a cold swim that lasted only a few seconds: death ensued despite attempts at resuscitation. We also describe an experiment in which ventricular ectopic beats were precipitated by facial immersion during trunk immersion. (Authors' abstract)

705.

KEEN G, Gerbode F.

Observations on the microcirculation during profound hypothermia.

J Thorac Cardiovasc Surg 45:252-260; 1963.

Profound hypothermia is not accompanied by sludging so long as the arterial pressure is at all times maintained at near normal levels. Should the pressure fall to below 50 mm. Hg, sludging will follow, but return of blood pressure to its previous level will reverse this change. (Authors' conclusions)

706.

KELLER AD.

Reducing a large efficient homotherm to a poikilothermic status.

In: Cold Injury. New York, Josiah Macy Jr Foundation, 1960, p 13-55.

The effects of a heavy cooling load upon a dog's core temperature and related physiological mechanisms were investigated. The dogs were placed in a refrigerated room at a temperature of 3°C and physiological responses were monitored. Six experimental variables were examined including removal of the vertebral sympathetic chains, sectioning the nerve fibers that take origin and descend from the hypothalamic level, and an anterior hypothalamectomy. In a panel discussion the following topics were considered: core temperature responses to anterior hypothalamectomy, maintenance of non-shivering heat retention ability, relationship between oxygen consumption and heat production, recovery of resistance to hypothermia following transection through the caudal extent of the pons, and integration at a level higher than the midbrain of compensatory responses to cold. (RW/UMS)

707.

KENNEDY WL (letter).

Hypothermia.

Ann Intern Med 90(4) :721-722; 1979.

To the editor: I would like to comment on the statement in the review by Reuler, "Hypothermia: Pathophysiology, Clinical Settings, and Management" in the October issue that the "J" wave is pathognomic of hypothermia. The term pathognomic implies one can make a diagnosis when the sign or laboratory value in question is found. I feel that this term is becoming less useful as its limitations are being recognized in clinical medicine. Instead of using pathognomic, one should probably think in terms of probability of the entity in question being found. When the "J" wave is present, it "may" be associated with hypothermia. In fact, the "J" wave has been found with central nervous system lesions, with and without hypothermia and during local cardiac ischemia. Interestingly, the "J" wave has been termed the Osborn wave, which illustrates a point about medical terminology and history. Many terms and syndromes bear the name of the person who popularized them rather than the name of the describers. For example, the "J" wave was first described in 1938 by Tomaszewski and discussed in the

literature years before Osborn's work on experimental hypothermia and its effect on respiration and blood pH. The "J" wave need not be present when a patient presents with hypothermia, and in these instances other electrocardiographic clues to the probable presence of hypothermia may be useful. These include atrial fibrillation, sinus bradycardia, and T-wave inversions, as mentioned in Reuler's article, and more specifically QT prolongation, QRS prolongation with or without the "J" wave, and muscle tremor artifact, even in the absence of visibly obvious muscle tremors. These electrocardiographic findings are interesting, even though not completely understood. The diagnosis of hypothermia, however, is not made by the electrocardiogram, but rather by a rectal probe or glass thermometer that measures sufficiently low temperatures rather than standard thermometers.

708.

KIESS HO, Lockhart JM.

Effects of level and rate of body surface cooling on psychomotor performance.
J Appl Psychol 54(4) :386-392; 1970.

Twenty-four Ss were tested on four psychomotor tasks at four levels of mean weighted skin temperature (MWST) attained at two different rates while normal hand skin temperatures were maintained. MWSTs employed were: 85°, 78°, 74°, and 70°F. attained after either 15 or 90 min. of cooling. The lowering of MWST impaired block stringing (BS) and Purdue Pegboard assembly performance but not knot tying or two plate tapping performance. Rate of cooling was an effective variable only at lower MWSTs and only for the BS task. Subjective ratings of discomfort and task interference due to cold stress were obtained and related to task performance. The Ss tended to overestimate their performance decrements at lower MWSTs. The results suggested that hand warming may preserve psychomotor dexterity despite moderate decrements in MWST. (Authors' abstract)

709.

KING, J.

Hypothermia – the other diving hazard.
Subaqua Scene (26): 24; Feb.-Mar. 1982.

This summary of hypothermia, written for the sport diver, seeks to convince the reader first of the seriousness of the condition. It begins with a physiological explanation for the drop in core temperature that defines hypothermia, continues with a mention of preventive measures, and concludes by describing its treatment. Rather than listing all the details for diagnosing hypothermia, the author advises the assumption of at least minor hypothermia if a diver is shivering, seems confused or disoriented or has had a long dive in cold water. Immediate rewarming is called for, airways should be cleared if the diver is unconscious but external cardiac massage should be avoided unless it is certain the heart has stopped. Emergency evacuation to a hospital should take place promptly. (LET/UMS)

710.

KLINTSEVICH GN.

Etiologiya i profilaktika porazheniya kholodom na flote.
[Etiology and prevention of cold exposure in naval personnel].
Voennomed Zh (8) :58-59; Aug 1971.

There are two main causes of freezing: the lowering of the environmental temperature and the presence of factors reducing the body's local or general resistance to cold. Exposure to cold is a frequently occurring danger to naval personnel and deepsea divers. At the depth of 30-40 m the water temperature sinks to or below 4°C. Exposure to such temperatures for more than an hour can be extremely dangerous. In divers it may cause common cold, prohibiting further underwater activity, as well as decompression sickness by inhibiting the dissolution of blood gases. The author lists various measures for the prevention of freezing. He points out the importance of systematic intensive physical training of divers and naval personnel, as well as education in self preservation and mutual assistance, especially in cases of shipwreck. (OLC/BSCP)

711.

KNIGHT J.

Cold and the diver.

In: Proc Joint SPUMS and Repub of Singapore Navy Underwater Medicine Conference. SPUMS (Suppl) 16-21; 1981.

Many divers get cold and suffer degradations of their motor skills and some suffer slowing of their thought processes and amnesia. Few sports divers suffer from serious hypothermia if they conduct normal dives. But those who spend a long time in the water are at risk from heat loss. Hypothermia does slow down thinking and this with the effects of cold on muscular power has contributed to diving deaths. Cold induced dysfunction is probably a potent cause of drowning. The core temperature of the cold diver will go on dropping even after warming has been started. (Author's conclusions)

712.

KOCH P.

[Diagnostic and therapeutic measures in hypothermic patients].

Fortschr Med 99(8) :262-267; 1981.

A symposium on hypothermia during disasters at sea was held in Cuxhaven between April 25 and 27, 1980. In this article various organic and functional disorders, pathological laboratory results, diagnostic and therapeutic measures at the site of disaster as well as during the following clinical treatment are discussed. (Author's summary)

713.

KOLB P, Roken U.

Electrocardiographic changes in hypothermia.

Med Klin 72(41):1677-1679; Oct 1977.

Survey of electrocardiographic changes in hypothermia, especially the pathognomonic J wave, and report of a case of accidental hypothermia in an 83-year-old woman.(Authors' abstract)

714.

KONSTANTINOV VA.

Effects of hypothermia and hypoxia on activity of hypothalamic heat-regulation centres.

Fiziol Zh SSSR 53(1) :35-41; 1967.

Stimulation of the medial preoptic region of hypothalamus in the rabbit has been shown to inhibit thermal shivering. Reduction of oxygen level in inspired air to 10 percent is found to enhance the inhibitory effect on shivering. Stimulation of the posterior dorsomedial region of hypothalamus raises the ≪heat regulating tone≫ and thermal shivering. This effect diminishes sharply on reduction of oxygen level in inspired air. It is assumed, that the mechanism suppressing chemical heat regulation in hypoxia depends on impaired function of hypothalamic centres. (Author's abstract)

715.

KOWAL JP.

Cold and the diver.

Sea Frontiers 16:42-47; 1970.

The author discusses the investigations carried on by Dr. Hugh M. Bowen, made in a flooded rock quarry in Rhode Island using a movable platform which tested divers at 65°F and 45°F. Touch sensitivity, gross manual dexterity and hand and eye coordination, mental and memory function, and group assembly capability were tested on dry land and at both water temperatures. The water effect, noticeable at 65°F consisted of simple motor impairment, due to instability, neutral buoyancy, water resistance and lowered sensory functions. The cold effect, which occurs at temperatures lower than 55°F in a normal wet suit during a 30-min. dive, consists of marked lessening of touch sensitivity, finger dexterity and grip strength, and impairment of mental and memory function. The more complex the task, the greater the deterioration. The degree of impairment varies greatly among individuals. An attempt will be made to determine what factors contribute to this variation. Provided the

diver is protected against narcosis, cold is the single greatest deterrent to performance. Heated suits as they presently exist relieve the cold stress but are so cumbersome that they greatly impair motor function. (MFW/BSCP)

716.

KRAUSZ, S. and S.F. Sullivan.

Cardiorespiratory effects of hypothermia and bicarbonate alkalosis.
Pfluegers Arch. 388:79-81; 1980.

Abstract only. Entire item quoted: The cardiorespiratory effects of reducing body temperature to 30°C (by packing in ice) and subsequent metabolic alkalosis (by infusion of $NaHCO_3$) were studied in six anesthetized, paralyzed, and artificially ventilated ($F_{I_{O_2}}$ = 0.4) dogs. Heart rate decreased from 135 ± 6 beats/min (mean ± S.E.) at 37°C to 84 ± 4 at 30°C; it increased to 96 ± 4 after 2 h alkalosis. Cardiac output decreased from 1.84 ± 0.14 to 0.66 ± 0.08 l/min and then increased to 0.83 ± 0.07. pH*a* increased, as expected on cooling, from 7.41 ± 0.07 to 7.49 ± 0.03; with bicarbonate it increased to 7.79 ± 0.03. Pa_{CO_2} decreased on cooling from 32.9 ± 1.4 to 21.7 ± 1.2 torr, increasing with bicarbonate to 27.9 ± 1.4 torr. $\dot{V}_{O_2}$ decreased from 104.9 ± 5.1 $ml \cdot min^{-1} \cdot m^{-2}$ at 37°C to 51.3 ± 2.0 at 30°C; with alkalosis it increased by 16.2% to 59.6 ± 3.3 $ml \cdot ml^{-1} \cdot m^{-2}$, an increase identical to that seen in normothermic alkalosis. Thus, the mechanism of the alkalosis-induced increase in oxygen consumption is not suppressed by the decrease in $\dot{V}_{O_2}$ seen in hypothermia, and the increase in $\dot{V}_{O_2}$ appears to be a consequence of the change in relative alkalinity rather than the increase in pH. (J. Appl. Physiol.)

717.

KROESEN G, Balogh D.

Comparative studies of the warming capacity of 2 blood warmers.
Infusionsther Klin Ernaehr 5(2):105-108; April 1978.

The warming effect of two apparatuses using dry heat and of one apparatus with blood warming by microwaves is measured at the entry of the blood into the venous circulation. The following facts were compared: the time needed to prepare the apparatus, any occurring technical hazards, the relationship between blood temperature and blood flow, and finally the economy of the equipment. The results show alternative indications, on one hand for the use of warmers with dry heat, on the other hand for those with microwaves. The low flows are of interest in the warming procedure of patients with hypothermia following trauma and the blood transfusion applied to infant anaesthesia. (Authors' abstract)

718.

KRYSA I.

Effect of heat and cold on the cardiovascular system: comprehensive review.
Fysiatr Reumatol Vestn 56(5) :289-299; Oct 78.

The author summarizes views from the available literature covering the past 15 years on the pathophysiology of overheating and cooling in relation to the cardiovascular system. He discusses in particular the effect of heat and cold on the cardiovascular system of experimental animals, in healthy subjects and cardiovascular patients. He draws attention also to some biochemical changes caused by heat and cold and to problems of the effect of heat on the mineral metabolism and water economy. (Author's summary)

719.

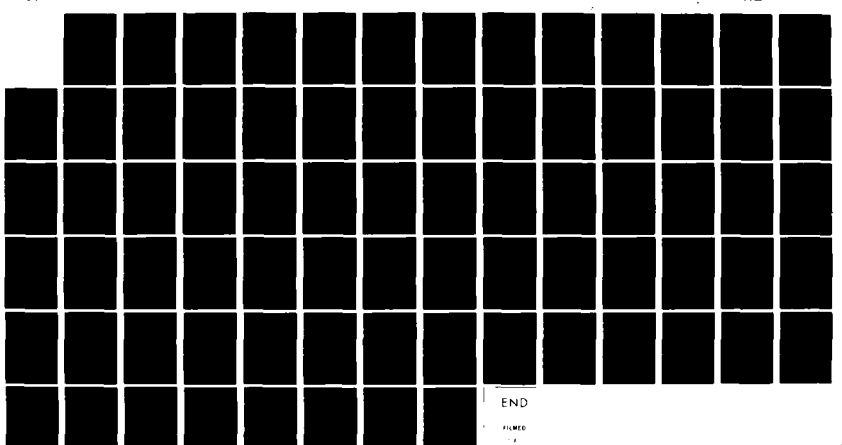
KUEHN, L.A.

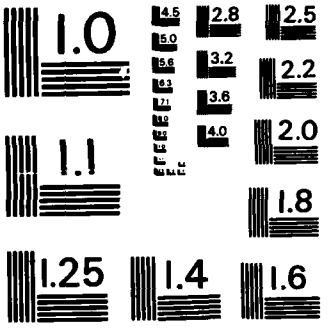
Thermal constraints in diving.
The twenty-fourth Undersea Medical Society workshop, Bethesda, MD, 3-4 Sept. 1980. UMS Publ. 44 WS(TC) 4-1-81, Bethesda, MD. Published by the Society, 1981. 431p.

Scientific and medical researchers, technologists and engineers participated in this workshop, which was concerned with all performance and physiological data produced during the six years since the previous UMS meeting on the subject. The new findings are divided into four main categories: 1) physiological limits of cold water diving, in particular such aspects as shivering; 2) new technology in support of cold water diving, emphasizing life support in chambers or diving bells; 3) modeling for conducting hypothermic experiments, and 4) the survival of the trapped bell diver. Individual papers presented at the workshop are included, along with illustrative charts and photos of equipment, and a transcript of the discussions following each session. (LET/UMS)

AD-A121 441 MAN IN THE COLD ENVIRONMENT A BIBLIOGRAPHY WITH INFORMATIVE ABSTRACTS UPD.. (U) UNDERSEA MEDICAL SOCIETY INC BETHESDA MD C W SHILLING 01 SEP 82 4/4

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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS - 1963 - A

720.

KUGELBERG J, Schuller H, Berg B, Kallum B.
Treatment of accidental hypothermia.
Scand J Thor Cardio Surg 1:142-146; 1967.

A case of severe, chronic hypothermia (body-temperature 21.4°C) was successfully treated by means of extracorporeal circulation containing heat-exchanger and oxygenator. Thoracotomy was avoided. As far as we know, this is the first patient to survive such a low temperature without any residual disability. (Authors' abstract)

721.

KUNG M, Tachmes L, Birch SJ, Fernandez RJ, Abraham WM, Sackner MA.
Hemodynamics at rest and during exercise in comfortable, hot and cold environments. Measurements with a rebreathing technique.
Bull Eur Physiopathol Respir 16(4):429-441; Jul-Aug 1980.

ABSTRACT: The hemodynamic effects of exercise during short-term exposure to a cold, hot and comfortable environment were studied in normal subjects. Seven untrained males (19 to 34 years) exercised on a bicycle while exposed to temperatures of 7°C. 22°C and 41°C inside an environmental chamber. Values for oxygen consumption ($\dot{V}o_2$), pulmonary capillary blood flow ($\dot{Q}c$), pulmonary capillary and tissue volume ($Vt+c$) and pulmonary diffusing capacity for CO (DL) were obtained using a non-invasive rebreathing technique. These parameters and heart rate (HR) were measured at 15 min of sitting exposure and during three episodes of exercise (50, 75 and 100 W) for 5 min each. Resting $\dot{V}o_2$ at 7°C was 31% higher than at 22°C ($p < 0.01$) and 43% higher than at 41°C ($p < 0.05$). During exercise, $\dot{V}o_2$ increased independently of temperature. While all measured hemodynamic parameters were similar during exercise at 7°C and 22°C, HR was consistently higher and stroke index lower during exercise at 41°C. At 95% of maximum heart rate (HR max.) at 41°C, $\dot{Q}c$ was 13% lower than 22°C ($p < 0.01$) and 14% lower than 7°C ($p < 0.05$). $Vt+c$ and DL increased during exercise and were not affected by temperature. In normal man: central hemodynamic changes at rest are more pronounced during short-term cold than during similar heat exposure; $\dot{V}o_2$ during moderate and severe exercise is independent of ambient temperature; $\dot{Q}c$ near HR max. is decreased in hot environment; and exercise induced increases in DL and $Vt+c/kg$ appear to be independent of ambient temperature.(Authors' abstract)

722.

KUZMINA, G.I. and L.E. Burachevskaya.
Uchastie vestibulyarnogo apparata v regulirovanii kholodovogo tremora.
[Role of the vestibular apparatus in cold shivering control].
Byull. Eksp. Biol. Med. 91(4):396-398; Apr. 1981.

Participation of the vestibular apparatus in the control of bioelectrical activity and function of muscle motor units was studied in experiments with cold shivering in cats. It was shown that the shivering was suppressed by limitation of the vestibulospinal effects whereas stimulation of the vestibular apparatus enhanced it. Suppression of the shivering after delabyrinthation manifested both in the increased frequencies of impulses in the active motor units and in the recruitment of new units, previously "silent." Participation of the vestibular apparatus in cold shivering control and the mechanism by which the animal's posture is formed, thereby restricting the heat-release surface, are discussed. (English abstract)

723.

LANDYSHEVA IV, Ushakov VF, Yas'kov EN.
Changes in the system of external respiration (the mechanics of breathing) during adaptation to cold.
Human Physiol (Engl Transl Fiziol Chel) 6(4) :283-288; Jul-Aug 1980.

Under the conditions studied a compensatory increase in elastic work, accompanied by an increase in oxygen consumption, by hyperventilation, and by a decrease in the depth of respiration, was observed in subjects doing heavy physical work in the open air, in connection with a decrease in the compliance of the lungs. In subjects working under warm conditions (group 2) a marked decrease (compared with subjects of the control group and of group 1) in compliance and in the maximal elastic pull of the lungs was observed, and it was accompanied by an increase in the specific work of respiration (on account of the elastic work of respiration). Under the influence of the cold test, a greater increase in the elastic work of respiration and in the oxygen con-

sumption were found in subjects of group 2 compared with those of group 1. Investigations of the mechanical properties of the lungs can determine changes in the system of external respiration under the influence of cold at the stage before any changes have taken place in the basic indices of ventilation of the lungs (VC, MPV, FVC – 1 sec). (Authors' conclusions)

724.

La VERDE R, Giulianelli G.

Thermic stress: dangers, tolerance, prevention, and treatment.
Minerva Med 71(43) :3138-3188; Nov 1980.

The Authors, after a description about the thremoregulation processes and after having considered the tolerance of the human body to the thermic stress, point out the dangers of the expsoure to the high or low temperatures in some labour conditions and, in particular; in the aerospace ambient. A great importance is attached to the method of prediction of individual tolerance to varied temperatures. Lastly the Authors discuss the prevention and treatment of heat-stroke and of frost-bite. (Authors' summary)

725.

LAXAR K, Rogers W, Moeller G.

Cold weather field study of Marine Corps emergency medical treatment.
Nav Submar Med Res Lab Rep 977, 14p. Apr 19, 1982.

To assess the extent and sources of impairment due to cold weather field conditions, times to complete an emergency medical treatment scenario (EMTS) and a standardized test of manual dexterity were measured for 21 Navy corpsmen and Marines. These studies were conducted at the U.S. Marine Corps Mountain Warfare Training Center, Pickel Meadow, Bridgeport, California, in January and February, 1980. The environmental testing conditions ranged from a snowstorm with temperatures near 22°F (−5.6°C) to clear weather around 47°F (8.3°C). Results showed that performance under the milder conditions was not seriously affected, but under the most severe cold conditions performance on the EMTS was substantially impaired. It was also shown that practice significantly improves medical treatment performance, and that even a small amount of practice is beneficial. In addition, better performance was found to be related to previous cold weather medical training and experience. These findings, and the comments of the subjects, have led to suggestions for continued field training, and for improved handwear and trousers with padded knees for corpsmen. Observations were also made of various means of medical evacuation. [Most of the recommendations concern above-ground conditions, but results of the performance tests should also be relevant to undersea activity in cold waters.] (From authors' abstract)

726.

LAYTON RP

Data acquisition and analysis software for thermal stress studies.
Naval Medical Research Institute, Bethesda, MD, Rep No 82-3, 100 p; Apr 1982.

A system to monitor cutaneous heat flow and temperature at individual body sites using heat flux transducers has been previously reported. Data acquisition for this system has been automated using a desktop computer. Programs have been developed to aid in the scaling, plotting, and analyzing of experimental data. The details of this software package are the subject of this report. (Author's abstract)

727.

LeBLANC J, Cote J, Dulac S, Turcot F.

Age, sex and fitness, and the response to local cooling.
In: Folinsbee, LJ, et al, ed Environmental Stress p 267-277, New York, Academic Press, 1978.

Cardiovascular responses to hand and face stimulation by cold were examined. A cold hand test consisted of placing the hand in water at 5°C for two min while the cold face test involved two min of exposure to 0°C and 40 mile per h wind. The effect of age, sex, and physical training on the response to these stimuli were examined. Using subjects of varying ages and amounts and types of physical training, it was found that the important individual factors in response to cold are adaptation and training, whereas age and sex are relatively less important. It is suggested that personality profiles or other inherited characteristics may explain the large variations in the individual responses to cold stress. (RW/UMS)

728.

LeBLANC, J. and A. Labrie.
Glycogen and nonspecific adaptation to cold.
J. Appl. Physiol. 51(6): 1428-1432; Dec. 1981.

Exposure to moderate cold for a few weeks causes adaptation through the development of nonshivering thermogenesis primarily in the brown adipose tissue. Exposure to severe cold by repeated short exposures also causes adaptation but by mechanisms that seem to be different. These latter results were confirmed in mice. It was also found that this type of adaptation is nonspecific because it can be produced by other stresses such as swimming or fasting. Simultaneous determinations of glycogen in the liver and soleus and tibialis muscles indicated a possible role for this substrate in cold resistance. Repeated cold exposure (8 times at $-15^{\circ}C$ for 10 min), swimming for 3 h, or fasting for 48 h – all reduced the glycogen stores when measured immediately after the stress. However, the levels of glycogen were significantly increased above the initial values ($P < 0.01$) when the determinations were made 24 h later. Cold tolerance measured by resistance to hypothermia at $-5^{\circ}C$ was improved only when the test was done 24 h after the stress had taken place. Thus, cold resistance, as described in this study, is nonspecific and our results suggest that glycogen stores could serve as a rate-limiting substrate. (Authors' abstract)

729.

LEDINGHAM I McA, Mone JG (letter).
Accidental hypothermia.
Lancet 1 :391; 1978.

Of 38 patients with moderate to severe accidental hypothermia, with 71% having a core temperature of less than $30^{\circ}C$, 35 were successfully rewarmed to normal body temperature. An additional 8 patients died subsequently. The most important factors in the treatment were respiratory support, insertion of an arterial and venous catheters for monitoring and warmed fluid insertion, control of metabolic acidosis, and rapid external rewarming. Drugs had little place in initial treatment, and internal rewarming was used in only one case, a patient with a core temperature of $23^{\circ}C$ and ventricular fibrillation. The universal use of this regimen, preferably in an intensive care unit, is recommended. Internal rewarming techniques are indicated only when the external rewarming rate is inadequate or ventricular fibrillation occurs below $28^{\circ}C$. (RW/UMS)

730.

LEDINGHAM IM, Mone JG.
Treatment of accidental hypothermia: a prospective clinical study.
Br Med J 1102-1105; 1980.

A 15-year prospective study was carried out of 44 patients with accidental hypothermia (mean age 60 years) admitted to an intensive therapy unit. The lowest core temperature recorded in each patient ranged from 20.0 to $34.3^{\circ}C$. The precipitating factors were poisoning (by drugs, alcohol, or coal gas) in 25 cases and various illnesses in 19. Rewarming was achieved in 42 patients by applying a radiant heat cradle over the torso, and in two patients by mediastinal irrigation with warmed fluids. Twelve patients died, but only two during the period of rewarming. Thus rewarming may be consistently and safely achieved irrespective of the cause of hypothermia, and normal body temperature may be regained as rapidly as is compatible with adequate tissue perfusion and oxygenation. Surface rewarming of the torso is perhaps the simplest technique available, but internal rewarming procedures may be desirable or essential in the presence of, for example, profound hypothermia, severe hypotension, or ventricular fibrillation. Mortality was attributable to underlying factors or disease and not to hypothermia. (Authors' summary and conclusions)

731.

LEDINGHAM IM, Routh GS, Douglas IHS, MacDonald AM.
Central rewarming system for treatment of hypothermia.
Lancet 1(8179) :1168-1169; May 31, 1980.

A new method of rewarming hypothermic patients has been studied in the laboratory, and has been used successfully in one patient. The system consists of a modified Sengstaken tube through which Ringer lactate solution is circulated in the oesophageal and gastric balloons at $41^{\circ}C$. In this way the central organs are rewarmed before the peripheral tissues. This new technique will probably be most useful for patients with central temperatures

below 32°C. Active surface rewarming is a suitable method for patients with central temperatures between 32°C and 35°C, whereas heat exchange with a cardiopulmonary bypass offers patients with ventricular fibrillation the best chance of survival. (Excerpts from article)

732.

LEON DF, Amidi M, Leonard JJ.
Left heart work and temperature responses to cold exposure in man.
Amer J Cardiol 26:38-45; 1970.

Resting normal men respond to various types of cold exposure by somewhat different mechanisms. Cold air breathing evokes an increase in stroke volume without changing heart rate or peripheral resistance. Left ventricular ejection time does not change, and so the principal response may be viewed as an increase in the mere rate of left ventricular ejection. On the other hand, exposure to a cold environment evokes an increase in peripheral resistance without changing cardiac index or heart rate. In both cases cardiac work and pressure-time relations increase, implying an increased myocardial oxygen utilization. These various responses are probably attributable to catecholamine effects; at rest they occur in the absence of cooling of the left heart chambers and of the subsequent coronary perfusate. It is likely that exercise in a cold environment results in reduction in the temperature of the left heart chambers and of the coronary perfusate. (Authors' summary)

733.

LEVY LA.
Severe hypophosphatemia as a complication of the treatment of hypothermia.
Arch Intern Med 140(1):128-129; Jan 1980.

Severe hypophosphatemia (less than 1.0 mg/dl) has been described in only a few well-defined clinical situations. Reported here is the first case, to my knowledge, of severe hypophosphatemia occurring during the rewarming of a profoundly hypothermic patient. Urinary excretion of phosphorus was minimal, implying a shift of phosphorus into the intracellular space.(Authors' abstract)

734.

LEWIN S, Brettman LR, Holzman RS.
Infections in hypothermic patients.
Arch Intern Med 141(7):920-925; June 1981.

Of 59 adults admitted to Bellevue Hospital, New York, between 1968 and 1979 because of hypothermia due to exposure, 24 (41%) had 32 serious infections. Nine infections were not diagnosed at the time of admission. Infected patients warmed to higher peak temperatures were more likely to be comatose and had lower lymphocyte counts. At admission, physicians gave antibiotics to only one of nine patients with occult infection but to ten of 35 uninfected patients, this failing to identify which patients required prompt antibiotic therapy. Delay in therapy contributed to the death of two patients. Since infection is frequently masked in hypothermic patients, careful repeated evaluations should be carried out to identify early infections. Although the proper use of antibiotics in patients with hypothermia is unresolved, we believe that prompt empiric antibiotic therapy is appropriate.(Authors' abstract)

735.

LIGHT IM, Norman JN.
The thermal properties of a survival bag incorporating metallised plastic sheeting.
Aviat Space Environ Med 51(4) :367-370; Apr 1980.

Five male subjects were exposed to a cooling environment equivalent to 1082 W/M^2. The subjects wore a clothing assembly with insulation properties of 1.55 clo. A casualty bag incorporating metallised plastic sheeting was provided for additional insultion. Deep body temperature fell 1.2°C and mean skin temperature 2.6°C over the 2-h period. Metallised plastic sheeting did not prevent heat loss through the clothing assembly, as indicated by the falls in body and skin temperature and an increase in metabolic heat production. From measurements

made during the exposure, the calculated insulation value of the complete assembly of 2.93 clo was close to the predicted value of 2.80 clo calculated from the thermal resistance of the assembly layers. It is concluded that the metallised plastic sheeting in this casualty bag did not provide significant additional thermal insulation. (Authors' abstract)

736.

LIGHT IM, McKerrow W, Norman JN.
Immersion coveralls for use by helicopter passengers.
J Soc Occup Med 30(4) :141-148; Oct 1980.

The thermal properties of three helicopter passenger survival suits were evaluated by the immersion of human subjects in water at 5°C. Superior thermal protection was offered by those suits utilizing the dry suit principle. Assessment of one of the suits was discontinued owing to the precipitate fall in the rectal temperature of more than 2°C h^{-1} that occurred in the subjects during the first five immersions. Metabolic heat production, skin surface temperature and changes in stored heat were investigated as indices of the thermal demand of the environment. The particular problems relevant to the choice of a survival suit for use by helicopter passengers are considered. Attention is drawn to the possible errors concerning the validation of an immersion suit by testing only one suit of a particular kind. (Authors' abstract)

737.

LIPTON JM.
Thermosensitivity of medulla oblongata in control of body temperature.
Am J Physiol 224(4) :890-897; 1973.

When the temperature of the medulla oblongata (T_m) of conscious rats was altered, changes occurred in rectal temperature (T_r) and in thermoregulatory behavior that were generally similar to those produced by altering the temperature of the preoptic/anterior hypothalamic (PO/AH) "thermoregulator." In the majority of rats with thermodes implanted in the lower brainstem, manipulating T_m for 20-min periods caused changes in T_r that were proportional to brain temperature. In other animals ΔT_r was proportional to T_m except at high (41-43 C) or low (34-37 C) T_m levels. Shivering occurred when T_m was lowered to 34-37 C. The T_r and shivering responses were unchanged after destruction of the PO/AH region. In behavioral experiments the time spent pressing a pedal to lower ambient temperature was proportional to T_m. The influence of T_m on this behavior was enhanced by PO/AH destruction. Similarities between effects of altering T_m and $T_{po/ah}$ together with the lack of dependence of the ΔT_r response on PO/AH mediation, enhancement of T_m control over behavioral thermoregulation after PO/AH destruction, and differences in precision of control exerted by the two brain temperatures, suggest that medullary thermosensitivity can mediate a separate secondary control of physiological and behavioral thermoregulatory activities. (Author's abstract)

738.

LIPTON, J.M., J.R. Glyn and J.A. Zimmer.
ACTH and α-melanotropin in central temperature control.
Fed. Proc. 40(13): 2760-2764; Nov. 1981.

Adrenocorticotropin (ACTH) and α-melanotropin (α-MSH) occur in brain tissue known to be important to temperature control. These peptides cause hypothermia if they are injected centrally in sufficient doses, but they do not act on the central set point of temperature control. Instead they appear to inhibit central pathways for heat conservation and production. In addition to their hypothermic capability, these peptides are antipyretic when given centrally in doses that have no effect on normal body temperature. ACTH has previously been associated with fever reduction in both clinical and experimental studies, and it may be that endogenous central ACTH is important for limitation of maximal fever. The hypothermic and antipyretic effects of ACTH do not depend on stimulation of the adrenal cortex because they are also observed in adrenalectomized rabbits. Nor is the antipyretic effect limited to the rabbit inasmuch as a comparable effect has been demonstrated in the squirrel monkey. The two peptides may be involved in central mediation of normal thermoregulation and fever, perhaps limiting the febrile response and other rises in body temperature by acting as neurotransmitters or neuromodulators in central thermoregulatory pathways. (Authors' abstract)

738a.

LIVINGSTONE SD, Kuehn LA, Limmer RE, Weatherson B.

The effect of alcohol on body heat loss.

Aviat. Space Environ. Med. 51(9):961-964; Sept. 1980.

The effect of the ingestion of alcohol on cooling in semi-nude human subjects was examined at 25 and 30°C in air; in heavily clothed individuals at −23°C in air; and nude subjects in a water calorimeter at 25°C. It was observed that consumption of the equivalent of five bar whiskey drinks did not affect the cooling rate of subjects as measured by infrared techniques or by thermistors. Total heat loss, measured in the calorimeter, was also not affected by drinking alcohol. It is concluded that the ingestion of alcohol does not cause an increase in cooling rate in humans. (Authors' abstract)

739.

LLOYD EL (letter).

Treatment after exposure to cold.

Lancet 2 :1376; 1971.

Pronouncing a victim dead from cold exposure at the site of the incident is not sufficient in light of successful attempts to revive hypothermia victims with absent vital signs. A method of actively rewarming hypothermic pateints with heated gases is being investigated. Oxygen for respiration is heated by passage through soda lime that has been heated by interaction with carbon dioxide. The results have been encouraging, with no after-drop of core temperature and early improvement of cardiac function. This method is designed to be portable for first aid at the site of exposure. As movement of the patient may be unsafe at certain temperatures, core temperature should be measured before deciding whether to move the patient to the hospital or attempt resuscitation on the spot. (RW/UMS)

740.

LLOYD EL.

Treatment after exposure to cold.

Lancet 1 :491-492; Feb 26, 1972.

Immersion therapy for hypothermic patients is evaluated. Though immersion of a hypothermic patient in a bath at 45°C is undoubtedly the most rapid method of rewarming, it has the disadvantage of being unsuitable in the presence of major injuries. Also, there is the problem of maintaining the airway of an unconscious patient while in the bath. This latter problem can be surmounted by endotracheal intubation. Though rapid rewarming after prolonged hypothermia may cause severe arterial hypotension in the spontaneously ventilating patient, the reason is still in doubt. It has been suggested that sudden vasodilatation was responsible for the cardiovascular breakdown. This theory is speculative and it is suggested that cardiac failure during rewarming could be due to a reversal of the fluid shifts during the induction of hypothermia, resulting in a relative hydraemia. (RW/UMS)

741.

LLOYD EL, Mitchell B.

Factors affecting the onset of ventricular fibrillation in hypothermia.

Lancet 2 :1294-1295; 1974.

A hypothesis is advanced that ventricular fibrillation supervenes when it becomes more efficient for intracardiac electrical conduction to occur through the muscle tissue rather than by the normal neuromuscular mechanism. In hypothermia neuromuscular conduction is impaired and evidence suggests that selective cooling of the endocardium and subendocardial conducting system in relation to the myocardium increases the risk of ventricular fibrillation, and vice versa. (Authors' summary)

742.

LLOYD EL, Croxton D.

Equipment for the provision of airway warming (insulation) in the treatment of accidental hypothermia in patients.

Resuscitation 9(1) :61-65; 1981.

Equipment is described which will provide airway warming (insulation) for the treatment of accidental hypo-

thermia. The equipment is light, compact and self contained and is therefore suitable for carriage by the rescue services. Equipment is also described which could be carried by groups as part of their first aid equipment. (Authors' summary)

743.
LLOYD OC.
Cavers dying of cold.
Briston Med Chir J 79:5; 1964.

Two fatal incidents caused by exposure to the cold during cave exploration are described and principles of prevention and treatment are outlined. One incident involved a 23-year-old man who was exposed to cold water of about 40°F while involved in a cave diving trip. He had a weak constitution and died from exposure with a post mortem indicating that the death was due to acute heart failure. The second incident involved a 17-year-old female who entered a cave after becoming soaked from the rain. It was estimated that she was exposed to 43°F water for a period of three and one-half hours. Only one hour after her condition first gave rise to alarm she died, and post mortem indicated that the death was due to acute heart failure. Both subjects were inexperienced cavers and were improperly clad. It is noted that slow rewarming of a dangerously cold subject may result in death due to the after drop of the inside temperature. Rapid rewarming in a bath of hot water is recommended. (RW/UMS)

744.
LOBOVA IV.
Assessment of adaptive powers of the cardiovascular system during selection of candidates for drilling work in the far north.
Hum Physiol (Engl Trans Fiziol Chel) 5(4) :492-497; Jul-Aug 1979.

A functional test for clinically heathly persons exposed to extreme Arctic conditions was developed. Not only were the functional reserves of the cardiovascular system (CV) determined, but also its lability. Physical workloads for 5 min with a power of 700 (high intensity) and 1400 kg • m/min (submaximal) were performed separated by an interval of 3 min under lab conditions. The increase in cardiac output (CO) after the second loading test compared with the resting state was chosen as the principal adaptive result of function of the CV system. Variations in response of CO ranged from 1.5 to 6 or more times. Subjects were divided into 3 groups on the basis of final increase in CO after the loading tests: group 1, increase was less than twice (inadequate, inappropirately weak); group 2, from 2 to 4 (adequate, normal); and group 3, more than 4 times (inappropriately strong). In addition individuals were categorized on the basis of 3 types of responses: I) an equal increase in CO to the 2 loading tests (plastic); II) a very small increase in CO after the first exertion followed by an increase to the maximum after the second (inert, hyporeactive "stayer"); and III) maximal increase in CO immediately after the first physical exertion, remaining unchanged after the second (hyperreactive, "sprinter"). In the selection process, work under conditions of the Far North is absolutely contraindicated for subjects at functional level 1. Subjects at functional level 3 have poor prognosis. Subjects with type I and II responses can be recommended for prolonged work under conditions of the Far North, whereas subjects with type III responses can only be recommended only for brief work schedules. (EP/UMS)

745.
LÖFSTRÖM B.
Induced hypothermia and intravascular aggregation.
Acta Anaesthesiol Scand (Suppl III) :3-19; 1959.

Six studies dealing with various aspects of the relationship between hypothermia and wound healing are summarized. The studies considered the occurrence of intravascular aggregation in induced hypothermia, its possible causes, prevention, and the significance of intravascular aggregation. The intravascular aggregation of erythrocytes observed during induced hypothermia was found to be a temporary event restricted to the actual phase of hypothermia. This indicates a difference between the intravascular aggregation occurring in induced hypothermia and the aggregation produced by trauma or infusion of high molecular weight dextran. In induced hypothermia the following hematological changes have been observed: a reduction in the amount of circulating hemoglobin, a decrease in the number of platelets and white blood cells, and a decrease in the plasma concentration of fibrinogen. Evidence indicates that intravascular aggregation produces an impaired nutritive blood flow in animals with a normal or slightly depressed metabolic rate. In induced hypothermia the effect of intravascular aggregation on oxygen consumption and on wound healing was restricted to the rewarming phase. It is concluded that

the effects of intravascular aggregation should be considered in studies on the pathophysiology of induced hypothermia and in studies on nutritive blood flow. (RW/UMS)

746.

LOMAX P, Bajorek JG, Chesarek WA, Chaffee RR.
Ethanol-induced hypothermia in the rat.
Pharmacology 21(4):288-294; 1980.

Ethanol (0.5-3.26 x kg^{-1} I.P.) caused a dose-dependent fall in body temperature in rats. A dose of 1.5g x kg^{-1} I.P. led to a fall of 1.6 ± 0.20°C over 60 min at an environmental temperature of 18 ± 1°C. There was no evidence of acute tolerance when the hypothermic response was elicited by the same dose of ethanol (0.7-20.0g x kg ± I.P.) 24 h later; indeed the second response was consistently, although not significantly, greater than the first. Behavioral thermoregulatory studies indicated that the fall in temperature after ethanol is due, at least in part, to a downward setting in the thermoregulatory set point. These results suggest that the rat may be a suitable animal model for a study of accidental hypothermia following ethanol ingestion and exposure to low environmental temperatures.(Authors' abstract)

747.

LOMAX P, Bajorek JG, Bajorek TA, Chaffee RR.
Thermoregularoty mechanisms and ethanol hypothermia.
Eur J Pharmocol 71(4):483-487; 1981.

The mechanisms underlying the hypothermic effect of ethanol have been investigated in rats. At an ambient temperature of 26°C, at which tail skin blood flow will normally be expected to play a role in regulating core temperature, no change in tail cutaneous temperature occurred during the period in which the core temperature was falling after administration of ethanol. As the drug effect waned tail skin temperature fell below the initial temperature as the hypothermia was corrected. This last observation confirms earlier results indicating a shift in the thermoregularoty set point after administration of ethanol. There was no significant change in oxygen consumption related to the ethanol induced fall in core temperature so decreased heat production would not appear to be a factor in the thermal imbalance. Neither was there any change in respiratory rate nor minute volume to account for an increase in convective or evaporative heat loss via the lungs. From these results it is not clear by what mechanism the ethanol induced lowering of the set point leads to a fall in core temperature. Other avenues of heat loss, for example from other cutaneous surfaces, and further detailed thermal balance studies will be needed to resolve this problem.(Aurhor's abstract)

748.

LOW A, Goethe H.
Vergleich zwischen warmeabgabe und warmezufuhr uber die lunge and korperoberflache bei der hypothermie bzw. bei deren behandlung.
[Comparison between heat loss and heat gain through the lungs and the surface of the body during hypothermia and its treatment].
Int Arch Occup Environ Health 45(3) :231-249; 1980.

Treatment of hypothermic patients by means of so-called central body rewarming (CBRW), i.e., through inhalation of warm and humidified air or oxygen, has been performed in Canada, England, and America for six years. As this new method seems superior to the classical warm bath treatment in certain aspects, both methods were compared in this paper. Heat uptake via the lungs is greater when the inspired air (maximally 45°C) is saturated with water vapor. This heat is transferred totally to the thoracic blood and then to the heart and brain. There, respiratory and vasomotor centers are rapidly stimulated. During warm bath therapy, rectal temperature increases faster but esophageal and tympanic temperatures and thus brain temperature rise slower than during CBRW. In CBRW the dangerous "after-drop" either does not occur or its effect is minimized, and the danger of a rewarming collapse is nonexistent. Assisted ventilation in CBRW leads to an even more rapid rise in critical core temperature. (Authors' summary)

749.

LOW A, Goethe H.

[Treatment of hypothermia in a crew member following sinking of a coastal motor boat]. Med Welt 32(21): 828-835; May 22, 1981.

This is a detailed account of a unique case of complete recovery of a shipwrecked patient after extreme hypothermia and near-drowning. A German sea captain had to abandon his sinking ship and was the only survivor. By his own account, certain aspects of the case would normally indicate that drowning would be inevitable. The captain spent 3 h in extremely cold water, with temperature below 10°C. Two rescue attempts failed; meanwhile he was swept against the ship, sustained injuries and brain concussion which rendered him unconscious for most of the time he spent in the near freezing water. All four limbs became paralyzed due to severe hypothermia. He was finally rescued by helicopter and transported to a Netherlands hospital where he remained in deep coma for 10 days. Hypothermia was so severe that it took 14 days of intensive care to bring his body temperature up to 37°C. Therapy began inside the helicopter where attempts at resuscitation by means of artificial respiration were unsuccessful. Later, at hospital, his consciousness returned (after 10 days), his paralyzed limbs were treated by physical therapy, and cardiopulmonary and metabolic functions returned to near normal. After 24 days of intensive care he received ambulatory neurological examination and treatment for the still partially paralyzed limbs. Two years after the accident the patient was pronounced fully recovered. The authors speculate that the survival and near-miraculous recovery of this patient were due to an unusual coincidence of factors: 1) his sturdy body constitution (body weight 105 kg); 2) warm clothing worn; 3) a strong will to survive; 4) successful last-minute rescue; 5) availability of a hypothermia specialist at the hospital; and 6) outstanding care at the ICU. The case demonstrates the vital importance of well equipped and efficient rescue systems at sea. (English abstract OLC/UMS)

750.

LUCAS, A., A. Therminarias and M. Tanche.

Maximum oxygen consumption in dogs during muscular exercise and cold exposure. Pfluegers Arch. 388(1):83-87; Oct. 1980.

Maximum oxygen consumption for a short exhaustive work (Ex $\dot{V}o_2$ max) and for a severe cold stress (C $\dot{V}o_2$ max) were investigated in 8 dogs. Heart rate, plasma catecholamines and substrate concentrations were measured under both conditions. Mean C $\dot{V}o_2$ max was lower than mean Ex $\dot{V}o_2$ max. Heart rate and plasma lactate were also lower during cold exposure than during exercise. Average plasma epinephrine concentrations were not significantly different and average plasma norepinephrine concentrations were similar under C $\dot{V}o_2$ max and EX $\dot{V}o_2$ max conditions. A positive correlation was found between plasma lactate and epinephrine concentrations measured under both conditions. It may be assumed that maximum oxygen consumption during muscular exercise is higher than during shivering thermogenesis. This difference does not seem to be due to differences in the involvement of the sympathico-adreno-medullary system. (Authors' abstract)

751.

LURIA SM, Neri DF, Kinney JAS, Paulson HM.

Cold weather goggles: 1. Optical evaluation. Groton CT, Nav Submar Med Res Lab, Rep No 970; 27 p, 19 Jan 1982.

To compare the utility of a dozen protective goggles for the cold, their transmittance of harmful radiation, optical quality, resistance to fogging, and comfort were measured. The transmittances were discussed in terms of thresholds for damage to the eye from various bands of light radiation. The optical characteristics were evaluated against military specifications for aviators' visors. All the goggles except one screened out enough UV at sea level, and all but two screened out enough of the visible and infrared radiation. There were wide variations in optical quality, resistance to fogging, and comfort. A set of specifications was drawn up to meet the various requirements, but it was concluded that one set of goggles was unlikely to be satisfactory for the wide range of conditions which would be encountered. (Authors' abstract)

752.

LURIA SM.

Cold weather goggles: 2. Performance evaluation.
Groton CT, Nav Submar Med Res Lab, Rep No 978, 12 p; 23 Mar 1982.

The performance of various tasks of importance to the Marines was compared when the subjects were wearing different goggles designed to protect the eyes from the cold. Color perception through yellow goggles and riflery through the most distorted goggles were degraded, but there were no significant impairments in acuity, depth perception, or vision through binoculars. The optical standards adhered to in the manufacture of commercial goggles appears to permit the satisfactory performance of practical tasks. (Author's abstract)

753.

LURIA SM, Neri DF.

Cold weather goggles: 3. Resistance to fogging.
Groton CT, Nav Submar Med Res Lab, Rep No 982, 5 p; 17 May 1982.

Twelve pairs of goggles designed to protect the eyes from conditions in the cold were tested for their tendency to fog while being worn during strenuous exercise in very low temperatures. Subjects reported the visibility of targets of various contrasts during 15-minute periods of exercise. The times at which the different targets became invisible were recorded. There were wide differences between the goggles in their resistance to fogging as revealed by the ability of the subjects to detect the lowest contrast target; these differences declined as target contrast increased. In general, goggles advertised by the manufacturers to be resistant to fogging performed well and were better than goggles by the same manufacturer not so advertised. (Authors' abstract)

754.

McCANCE RA, Ungley CC, Crosfill JWL, Widdowson EM.

The hazards to men in ships lost at sea, 1940-44.
London, HMSO, Medical Research Council, Special Rep No 291, 34 p, 1956.

The depositions made by men who survived the loss of their ships between 1940 and 1944 have been analysed. Records of 448 sinkings, almost entirely merchant ships, involving 27,000 persons, have been available. About 68 per cent of the men were rescued. Some 26 per cent were lost before they reached one or other form of lifecraft, but relatively few of these men were killed or trapped by damage to the parent ship. A further 6 per cent of all those at risk died after reaching lifeboats or rafts. Relatively few of the lifecraft at risk were never picked up, and a man's chances of rescue were good once he had reached one of these vessels. Only 2 per cent of all the men at risk were lost in lifecraft which disappeared without trace. More frequent and more realistic drill, better means of launching and boarding lifecraft and better protection against the elements would have saved thousands of lives. Cold, intensified by exposure, was a most important cause of death before and after boarding the lifecraft. On short voyages at temperatures below 5°C the death-rate was 20 to 30 per cent whereas it was less than 1 per cent on short voyages at temperatures over 20°C. There was a high mortality on long voyages. Only 2 per cent of the men who reached lifecraft were lost if they were picked up by the second day, but 26 per cent died when they were adrift for more than 15 days. On lifecraft voyages of over 3 days in length, the drinking of sea-water was accompanied by a rise in the death-rate from less than 4 per cent to a figure of the order of 40 per cent. The provision of enough fresh water would have prevented this. Better conspicuity and signalling devices would have shortened a number of the lifecraft voyages and so materially reduced the loss of life. (Authors' summary)

755.

McGINNIS JM, Lockhart JM, Bensel CK.

A human factors evaluation of cold-wet handwear.
US Army Natick Labs, Rep USA-NLABS-TR-73-23-PR, 77 p, Apr 1972. (AD 756 417)

Subjects performed a battery of manual performance tasks (torque test, Minnesota two-hand turning test, O'Connor fine finger dexterity test, Cord manipulation and Cylinder stringing test, Bennett hand tool dexterity test) under six handwear conditions; bare-handed, standard leather glove, impermeable glove, leather glove with wool inserts, impermeable glove with wool inserts, and impermeable glove with built-in insulation. Each subject performed the tests under each handwear condition for 14 days at 35°F ambient temperature and this comprised the dry glove investigation. An additional wet glove investigation involved the same tests and handwear conditions and was of four days' duration. For the remaining tests, the bare hand condition resulted in superior performance

and the impermeable gloves with built-in insulation resulted in inferior performance compared to the other handwear conditions. Performance level on all tasks decreased on the first day of water immersion, but performance on the Minnesota two-hand turning test only was adversely affected on both water immersion days. (Authors' abstract)

756.

McINNIS J.

The icy facts on how cold water kills.
Quest Magazine: 3 p; June 1979.

The dangers of contracting hypothermia due to exposure to cold water are examined. A hypothetical boating accident leading to immersion in a cold lake is presented to illustrate hypothermia. The onset of shivering, reflex heart and lung impulses, and loss of physical coordination are described. It is noted that the hypothermia sequence is extremely fast and most people are unprepared and ignorant about its dangers. Physically, sudden immersion causes a rapid and complex readjustment inside the body as it tries to protect itself. Mentally, the overwhelming pain can bring on confusion and anxiety. The physical and mental stress of coldwater immersion occur simultaneously and with devastating convergence, depending on such factors as wave height, water temperature, and time of rescue. It is suggested that people who are going to be exposed to cold water wear a special neoprene jacket that provides head and torso protection. (RW/UMS)

757.

McMILLAN, M.and R.S. Pozos.

The warning signs of hypothermia.
Offshore 41(14): 150; Dec. 1981.

The condition of hypothermia is defined briefly and a recent conference on the subject, held at the University of Minnesota in the summer of 1981, is described. Among the conclusions of the conference: wet suits offer protection underwater only if the person is able to shiver; the more dehydration a person undergoes, the greater the likelihood he will be unable to regulate body temperature – hot or cold; a person with hypothermia can survive for hours, unconscious or not; if biological sleep-wake rhythms are upset, temperature control is impaired; persons older than 55 do not regulate body temperatures as well as younger ones; personality changes can signal the onset of hypothermia; and use of marijuana will heighten sensitivity to cold. Areas requiring future research were suggested. (LET/UMS)

758.

McNICOL MW.

Respiratory failure and acid-base status in hypothermia.
Postgrad Med J 43: 674-676; 1967.

The patient with accidental hypothermia may show under-ventilation, hypoxemia or acidosis. The methods of diagnosis have been discussed and the information on the effects of hypothermia on lung function summarized. (Author's summary)

759.

MacINNIS JB.

Arctic diving and the problems of performance.
In: The working diver, 1972. Symposium Proceedings, Feb 1972, Columbus, Ohio, p 159-174. Washington, DC, Marine Technology Society, 1972.

In 1970 and 1971, the author led two expeditions for underwater studies in the Canadian high Arctic. The objectives were to begin focusing on the performance problems of scientists working in this extreme environment and to make preliminary surveys of local marine biology and geology. Sixty-three shallow scuba dives were made during winter and summer conditions in water at a temperature of 28.9°F. In order to improve understanding of the problems of performance almost half the dives were carried out by doctorate level scientists attempting meaningful work. At times the ice was six feet thick and air temperatures reached 50 below zero. Standard scuba equipment as well as the General Electric Mk X, the Poseidon Unisuit, and a portable communications station were evaluated. From these two expeditions and others in near-arctic conditions the author has begun to clarify the factors which enhance and degrade shallow diving performance beneath polar seas. (Author's abstract)

760.

MACLEAN D, Griffiths PD, Browning MCK, Murison J.

Metabolic aspects of spontaneous rewarming in accidental hypothermia and hypothermic myxoedema.

Quart J Med, New Series 43(171) :371-387; 1974.

The metabolic background to spontaneous rewarming has been studied in 70 euthyroid patients with accidental hypothermia and in 18 patients with hypothermic myxoedema by correlating their rates of rewarming with their initial serum protein bound iodine (PBI), blood glucose, plasma free fatty acid (FFA), plasma 11-hydroxycorticosteroid (11-OHCS), and arterial PO_2 levels. In the hypothyroid group the rates of spontaneous rewarming correlated significantly with only the PBI levels ($P < 0.05$). In the euthyroid group, there may be an inverse correlation between the rate of spontaneous rewarming and age ($P < 0.10$). The roles played in the rewarming process by the other parameters measured are discussed, particularly in relation to individual clinical situations. (Authors' summary)

761.

MACLEAN D, Murison J, Griffiths PD.

Serum enzyme activities in accidental hypothermia and hypothermic myxoedema.

Clinica Chemica Acta 52: 197-201; 1974.

The high serum activities of the enzymes creatine kinase, "α-hydroxybutyrate dehydrogenase" and aspartate aminotransferase found in 75 patients with accidental hypothermia and 18 with hypothermic myxedema have been shown to be unrelated to either the severity or the duration of the hypothermia, but to be directly related to disturbances of acid-base equilibrium, hypoxia and hypotension. An inverse relationship also exists between the "α-hydroxybutyrate dehydrogenase" and the serum protein bound iodine levels, suggesting that a thyroid hormone-lack cardiomyopathy may be contributing to the exceptionally poor prognosis of those with hypothermic myxedema. These findings have important implications for the rational management of patients with accidental hypothermia or hypothermic myxedema. (Authors' summary)

762.

MACLEAN D, Emslie-Smith D.

Accidental hypothermia.

Oxford, UK Blackwell Scientific Publications, 1977, 467 p.

The book is designed as a comprehensive and lucid text for all doctors who are concerned with the problems and management of accidental hypothermia, in hospital, in family practice, in the services, in community care and in industry, especially those industries that are involved with the sea. An account of the various situations in which people may become hypothermic, and the ways in which hypothermia may endanger the health and modify the course of those who are ill is provided. It does not deal with "induced" hypothermia, i.e., that hypothermia induced before surgical operations or in the management of neoplastic disease. Included among various topics covered are the following: regulation of body temperature, abnormal physiology of hypothermia, hypothermia in infants and children, disorders predisposing to hypothermia, hypothermia in the elderly, clinical investigation of hypothermia patients, management of accidental hypothermia, pathology and appendices. (EP/UMS)

763.

MAHAJAN, S.L., T. Myers and M.G. Baldini.

Disseminated intravascular coagulation during rewarming following hypothermia.

JAMA 254(24): 2517-2518; June 26, 1981.

Accidental hypothermia is now being recognized increasingly, especially in the elderly on fixed incomes. This article points out a complication that has occurred in several instances during rewarming after hypothermia, disseminated intravascular coagulation (DIC). The syndrome is characterized by hemorrhage, thrombo-cytopenia, consumption of clotting factors, secondary fibrinolysis with elevated levels of fibrinogen-fibrin degradation products, microanglopathic hemolytic anemia, and fibrin thrombi in blood vessels. DIC may be initiated by the liberation of tissue thromboplastin into the circulation, by vascular endothelial damage, by abnormalities of blood flow, or by all of these. First recognized in experimental animals, the syndrome as a complication of hypothermia is on record in two groups of neonates and one case of a 65-yr-old man. The present report concerns a 13-yr-old boy who drank heavily and then fell unconscious outdoors on a cold winter night. When he

was taken to the hospital the following morning, his rectal temperature was 22°C. He was rewarmed very aggressively; fulminant coagulopathy developed 4 h after rewarming was initiated. He was then treated with heparin because it was thought that his peripheral ischemic changes were due to thrombosis associated with DIC. The use of heparin in DIC therapy is controversial as it may aggravate the bleeding diathesis of the condition, especially in patients with possible hemorrhagic pancreatitis owing to hypothermia. Further investigations on the possible influence of the rewarming rate and method (surface vs core) in treating hypothermic patients and on the role of heparin, are called for (LFT/UMS)

764.

MALI SL, Singhvi DR.

Effect of hypothermia on serum cholesterol & protein bound iodine in dogs.

Indian J Exp Biol 19 :582; 1981.

Significant fall in both serum cholesterol and protein bound iodine was noticed by lowering the normal body temperature of the dogs and maintained for 1 hr. (Authors' abstract)

765.

MALKINSON TJ, Martin S, Simper P, Cooper KE.

Expired air volumes of males and females during cold water immersion.

Can J Physiol Pharmacol 59(8): 843-846; Aug 1981.

Expired air volumes were measured from a random population of adult male and female human volunteers before and during short-term immersion in either cold (13.53 ± 0.13°C) or warm (33.18 ± 0.11°C) water. A statistically significant difference was found in the pulmonary ventilation over the first 4 min of immersion between males and females when immersed in cold water. The swim suits worn could not account for the differences observed. No statistically significant difference in pulmonary ventilation was found between males and females during warm water immersion. A numerically smaller group of volunteers was preheated in a sauna before immersion in cold or warm water and this resulted in an attenuated ventilatory response. In this instance there is no statistically significant difference in ventilation between males and females. Also, in another small group of volunteers, surface and deep skin temperatures were continuously measured before and during immersion in cold water. The rates of change of deep skin temperature between males and females were found to be similar. (Authors' abstract)

766.

MANALAYSAY AR, Langworthy HC, Layton RP.

Catecholamine levels in resting divers exposed to the stresses of cold water immersion and hyperbaria.

In: Program and abstracts, Undersea Medical Society annual scientific meeting, May 25-29, 1981. Undersea Biomed Res 8(1-Suppl): A 97; Mar 1981.

Abstract only. Entire item quoted: This study was undertaken to determine the changes in plasma catecholamine levels in response to the combined stresses of cold water immersion and hyperbaric exposure. Plasma catecholamines were measured in eight thermally unprotected U.S. Navy trained male divers immersed in water at 25°C and 35°C at both 1 ATA and 4 ATA. All measurements were made before any decompression procedures. Plasma norepinephrine levels were elevated with cold exposure (25°C vs. 35°C). The increases seen were 110% at 4 ATA and 70% at 1 ATA. Hyperbaric exposure at cold temperatures (1 ATA vs. 4 ATA) caused a 43% increase in norepinephrine levels; however, the corresponding increase in norepinephrine levels at warm temperatures was only 2%. Plasma norepinephrine levels can be used to assess general overall stress imposed on an individual. This study indicates that plasma norepinephrine levels may also be used to monitor the degree of stress imposed by hyperbaric exposure.

767.

MARCUS P.

The treatment of acute accidental hypothermia: Proceedings of a symposium held at the RAF Institute of Aviation Medicine.

Aviat Space Environ Med 50 :834-843; 1979.

A symposium was held at the RAF Institute of Aviation Medicine, Farnborough, Hampshire, on Feb. 28, 1978. The purpose of the meeting was to distil up-to-date expert opinion to provide advice for those faced with the

treatment of victims of exposure or cold water immersion. In particular, it was intended to recommend practical measures which could be employed in the field. However, it soon became apparent that there are large gaps in our knowledge of the physiology of hypothermia. These made the formulation of definitive advice extremely difficult. (Author's abstract)

768.

MARCUS P, Redman P.

Effect of exercise on thermal comfort during hypothermia.

Physiol Behav 22(5) :831-835; May 1979.

Subjective measures of thermal comfort were made in 12 male subjects who exercised intermittently during reduction of core temperature. Cold discomfort was found to be inversely proportional to work rate in the range studied of up to 65% aerobic capacity. This relationship was independent of the effect of the exercise on body temperatures. It occurred while core temperature fell and mean skin temperature either fell, remained steady at low levels or rose again towards normal. Possible mechanisms are reviewed and it is concluded that this effect of voluntary exercise, like that of shivering, is psychological. (Authors' abstract)

769.

MARTIN S, Cooper KE.

Alcohol and respiratory and body temperature changes during tepid water immersion.

J Appl Physiol 44(5):683-689; 1978.

Resting subjects were immersed for 30 min in water at 22° and 30°C after drinking alcohol. Total ventilation, end-tidal Pco_2, rectal temperature, aural temperature, mean skin temperature, heart rate, and oxygen consumption were recorded during the experiments. Blood samples taken before the immersion period were analyzed by gas-liquid chromatography. The mean blood alcohol levels were 82.50 ± 9.93 mg $(100\ ml)^{-1}$ and 100.6 ± 12.64 mg $(100\ ml)^{-1}$ for the immersions at 22° and 30°C, respectively. There was no significant change in body temperature measured aurally or rectally, mean surface skin temperature, or heart rate at either water temperature tested. Total expired ventilation was significantly attenuated for the last 15 min of the immersion at 22°C, after alcohol consumption as compared to the ventilation change in water at 22°C without ethanol. This response was not consistently significantly altered during immersion in water at 30°C. It is evident that during a 30 min immersion in tepid water with a high blood alcohol level, body heat loss is not affected but some changes in ventilation do occur. (Authors' summary)

770.

MARTIN, S.M., L. Bauce and K.E. Cooper.

Continuous sampling of plasma catecholamines in man during cold water immersion and rewarming.

Fed. Proc. 40(3):580; Mar. 1981.

Abstract only. Entire item quoted: The pressor response elicited during cold water immersion may be due to circulating catecholamines or increased sympathetic nervous system activity. The intense vasoconstriction noted during cold water immersion has made collection of blood samples by the usual catheter-syringe method difficult and uncertain. Experiments were undertaken to measure circulating catecholamine levels using a new technique. Six subjects were immersed for 20 min in water at 14.74 ± 0.04°C. Blood samples were continuously withdrawn from the subjects at a rate of 250 μl/min using a pre-calibrated catheter-peristaltic pump combination. Clotting of blood was prevented by introduction of sterile heparin at a rate of 5.5 μl/min approximately 10 mm (<1 sec) after blood left the vein. Heart rate (HR), blood pressure (BP), aural temperature and shivering were measured during the experiment. Subject rewarming was accomplished using a heat cradle or by immersion in a jacuzzi. Plasma levels (fmole range) or epinephrine (E), norephinephrine (NE) and dopamine (DA) were ascertained using the procedure of Bauce et al. (Life Sci. 27: 1921; 1980). The plasma levels of NE during immersion and rewarming by either method were significantly higher ($p < 0.05$) than control values. There also appears to be a linear relationship between the time lag and the plasma levels of NE during immersion. An earlier finding (Martin et al. Proc. Can. Fed. Biol. Soc. 23: 85; 1980) of a difference in the peak activity of HR, BP and NE was confirmed. No significant change occurred in the plasma levels of E and DA. The more sensitive assay and continuous blood sampling have permitted a better analysis of plasma catecholamines during cold water immersion and the rewarming period.

771.

MARTIN, S. and K.E. Cooper.
Factors which affect shivering in man during cold water immersion.
Pfluegers Arch. 391(1): 81-83; July 1981.

Six subjects were immersed in cold water (15.15 ± 0.42°C) and were asked to perform two tasks. Shivering elicited by the cold water immersion was attenuated and/or abolished by the mental arithmetic task and in some instances by a voluntary isometric contraction of forearm muscles. The physiological mechanisms of shivering are explained and possible reasons why cortical activity was seen to inhibit shivering are advanced. Electromyograms showing changes in shivering are reproduced. (Authors' abstract modified by LET/UMS)

772.

MARTYN JW.
Diagnosing and treating hypothermia.
Can Med Assoc J 125(10):1089-1096; Nov 1981.

Mild or moderate hypothermia may be underdiagnosed in Canada. This paper presents five cases of treated hypothermia, describes the pathophysiologic aspects of cold injuries and discusses the rationale and techniques of rewarming. An orderly series of specific clinical and laboratory observations is proposed to ensure prompt and accurate diagnosis and treatment, and to improve the management of hypothermia.(Author's abstract)

773.

MATHEWS JA.
Accidental hypothermia.
Postgrad Med J 43 :662-667; Oct 1967.

Accidental hypothermia is a common condition in certain groups of patients especially in cold weather. As it is potentially lethal its early recognition and treatment is vital. (Author's summary)

774.

MEARS G (letter).
Treatment after exposure to cold.
Lancet 1:38; Jan 1972.

Sir—The recent letters of Dr. Hillman and Dr. Leathart (Dec. 4, p. 1257) and Dr. Lloyd (Dec. 18, p. 1376) are interesting and disturbing. I feel sure I am not alone in being somewhat perplexed by the apparently contradictory advice we are given on how to treat exposure to cold. Those of us practising in remote places would welcome some authoritative advice on how to deal with exposure to cold. We have few facilities, apart from a resuscitator, oxygen, and our own bath.

775.

MEDVEDEV, L.N., S.A. Khramenko, N.P. Larionov and T. N. Zamai.
[Effect of cold adaptation on ouabain-sensitive respiration component of the rat kidney].
Biull. Eksp. Biol. Med. 92(8): 20-22; Aug. 1981.

In the course of intermittent cold adaptation (0°C, for 16 weeks), laboratory rats demonstrated an increase in the rate of oxygen consumption by a suspension of kidney sections. The increase in oxygen consumption by 60% was ouabain-sensitive. Together with the data on Na, K-ATPase activation, this indicates the main role of the Na pump in the increased respiration of the kidneys in cold adaptation. (English abstract)

776.

MERRICK SH, Hessel EA II, Dillard DH.
Determination of cardiac output by thermodilution during hypothermia.
Am J Cardiol 46:419-422; 1980.

The thermodilution method for estimating cardiac output was compared with the electromagnetic flowmeter technique in 10 mongrel dogs at normothermia and during surface-induced deep hypothermia. Thermodilution

curves obtained during cooling or rewarming must be corrected for the baseline draft caused by changing core temperature. At normothermia, the correlation coefficient between the two methods was 0.96 and the reproducibility of the thermodilution technique was 5 percent. Comparable correlation was present during hypothermia. Curves corrected for baseline drift resulted in significantly different output values from those derived from uncorrected curves ($p < 0.05$). The thermodilution method is valid at low body temperatures. Clinical confirmation of these results, particularly during open heart surgery in infants, is warranted. (Authors' abstract)

777.

MILLER BJ, Chasmar LR.

Frostbite in Saskatoon: a review of 10 winters.

Can J Surg 23(5):423-426; Sep 1980.

In review of 101 patients suffering from frostbite who were admitted to hospitals in Saskatoon during 10 winters, it was found that alcohol consumption was a contributing factor in 39 patients and a motor vehicle accident or breakdown in 33 others. Sixty-six patients underwent primary treatment in Saskatoon, the other 35 were referred for management of demarcated gangrene. Two hospitalized patients died, both of causes unrelated to the frostbite. The preliminary results of bone scanning with radioactive technetium methylene diphosphonate in frostbitten patients suggest that this is not a good prognostic indicator of the ultimate extent of tissue loss until 5 days have elapsed from the time of exposure. The lesion appeared to decrease in extent and increase in depth of a 3-week period. The mainstays of treatment remain rapid rewarming and adequate delay before conservative débridement or amputation. Tl e delay allows healing of partial-thickness injuries and demarcation of full-thickness injuries. One third of patients receiving primary care in Saskatoon required amputation.(Authors' abstract)

778.

MILLER JW.

Psychophysiological aspects of deep saturation exposures in the sea.

In: Lambertsen CJ, ed, Underwater physiology. Proceedings of the third symposium on underwater physiology, 23-25 March 1966, Washington, DC, p 122-127. Baltimore, Williams and Wilkins Co, 1967.

Performance is measured on men working in an underwater environment during a saturation dive for the following reasons: to determine whether man should be included as a free swimmer; to increase the probability of survival; to better estimate the probability of man performing successfully; to establish safety practices and medical limitations; to properly select and plan specific tasks; to decide on equipment requirements; to assist in the selection of performance aids in the form of equipment, drugs, or training; and for scientific curiosity. The studies of performance must take into consideration such environmental problems as the effects of cold air and cold water; limited underwater visibility with its associated lack of communication, difficulty in bodily orientation; pressure effects and the biological hazards associated with it; and marine hazards of the local environment. (CWS/BSCP)

779.

MILLER JW, Danzl DF, Thomas DM.

Urban accidental hypothermia: 135 cases.

Ann Emerg Med 9:456-461; 1980.

We retrospectively reviewed 135 presentations (114 patients) of urban hypothermia treated at the discretion of the emergency department staff over a nine-year period from February 1971 to March 1980. Rewarming treatment options included passive external, active external, and heated oxygen aerosol administered by mask or intubation. The rates of rewarming were statistically similar for passive external (0.71°C/hr) and heated aerosol via mask (0.74°C/hr). The rate of rewarming for active external methods was 0.90°C/hr. Heated oxygen aerosol using intubation rewarmed the patient at a significantly greater rate than the passive external method (1.22°C/hr) ($P < 0.01$). The overall mortality rate for the series was 11.9%, but 47.9% when serious underlying disease was present. Individual mortality rates were 64.3% for active external (9/14), 7.67% for active core with a mask (1/13), 5.2% for passive external (4/68), and 5.0% for active core with a nasotracheal tube (2/40). Active core rewarming using intubation was selected more frequently with moderate and severe hypothermia ($P < 0.001$). The group of survivors had a higher mean arrival temperature (31.33°C) than did the non-survivors (27.55°C) ($P = 0.01$). Active core rewarming with heated aerosolized oxygen via nasotracheal tube is a safe technique for the rapid rewarming of selected hypothermic patients. The arrival temperature and the presence of serious underlying disease, in addition to the method of rewarming, appear to be major determinants of prognosis. (Authors' summary)

780.

MILLER JW, Danzl DF, Thomas DM (letter).
Authors' reply.
Ann Emerg Med 10(7) :396-397; 1981.

The authors refer to the inclusion of 56 cases from O'Keeffe's series in the passive external rewarming (PER) group on the basis of personal correspondence with him. Since the rate of rewarming was not provided in O'Keeffe's series for PER, comparison with their rate (0.71°C/h) was not possible. They state that his series is important because it documented that what amounts to PER is a safe technique in selected patients. In addition, their literature review yielded cases in which airway securement was temporarily related to cardiovascular collapse. They attempt to resolve the confusion relative to the use of endotracheal intubation and fibrillation and cite a study which concluded that invasive monitoring and treatment maneuvers are not in themselves harmful. In their series of 138 cases, 40 were nosotracheally intubated without complication. (EP/UMS)

781.

MILLS WJ Jr.
Summary of treatment of the cold injured patient.
Reprint: Alaska Med 15 :56-59; Mar 1973.

A basic program for treatment of hypothermia and cold injuries is outlined. When hypothermia is present, rapid warming with warm packs or blankets, in a warm tub, with warming fluids, or by dialysis are recommended. However, in rapid warming, acidosis and the accompanying danger of ventricular fibrillation must be avoided. For cold injury, thawing methods, from best to worst prognosis, include rapid rewarming in water, gradual thawing at room temperature, delayed thawing or thawing with ice and snow techniques, and thawing by excessive heat of 120°F or higher. Treatment before thawing involves protection of the frozen part to avoid trauma and thawing in a whirlpool or tub. Treatment after thawing may involve hospitalization if the injury is severe. Aspects of treatment including daily whirlpool baths, escharotomy, fasciotomy, exercises, pain medication, diet, amputation, and fracture management are described. (RW/UMS)

782.

MILLS WJ Jr.
Out in the cold.
Emerg Med 8:134-147; 1976.

I was considerably bemused to read in an article published this past year that "a satisfactory treatment for cold injury has never been devised and few therapeutic advances have been made." It is a good place to start any discussion of the management of cold injury because I think the record is better than that. Today, with proper treatment, morbidity is slight and mortality is rare. Our amputations, if necessary at all, involve fingers and toes, not hands and feet or levels above or below the knee. Deep infection is no longer encountered in most patients. Over the long haul, the restoration of anatomy is much more complete. Where once we worried about life and limb, now we concern ourselves with nerve dysfunction, volar fat pad loss, intrinsic muscle atrophy, and function of the extremities. I think you will agree that we have com a long way since the Grand Army retreated from Moscow. The treatment of cold is not cold but warmth – rapid rewarming in a tub at 90 to 106°F until the hypothermic patient responds or the frostbitten part is flushed to the distal-most tip. Then, for the hypothermic victim, bed rest until he's ready to get up and around. For the victim of frostbite, a hands-off approach in an absolutely sterile environment until healing is well underway, with twice-daily whirlpool baths, and strict and adequate physiotherapy. Plus, of course, the cheeriest atmosphere you can provide. It all sounds so simple – and it is. (From author's introduction and summary)

783.

MILLS WJ Jr.
Accidental hypothermia: management approach.
Alaska Med 22(1) :9-11; Jan-Feb 1980.

A step by step management approach was developed from over fifty Alaskan case histories to acquaint the physician with the treatment of accidental hypothermia. The physician is encouraged to outline "the problem: A cold patient in a metabolic icebox: Alive? The purpose of care: Bring patient to a physiological responsive state, under homeothermic control-living. Consider: The higher the temperature of the warming methods, or thawing methods, the less time you have to direct, control, obtain and maintain the normal physiological state." And, "The

method: Rewarm under total patient control." This paper discusses the physiologic and metabolic complications that may accompany the hypothermic patient before and during rewarming. Both passive and active rewarming techniques are reviewed. Controversy over the effectiveness of peripheral versus core rewarming and the etiology of rewarming complications, such as afterdrop and cardiac irregularities still remains. However, regardless of the technique employed, familiarity with the procedure is the key to management of accidental hypothermia. (CDR/UMS)

784.
MILNE PH.
Seabed surveying by divers.
Underwater J 5:120-122; June 1973.

Most of the survey work was carried out in relatively shallow water, 0 to 9m, where divers could work all day without risk of decompression. However, it will be noted that the King's Knowe dives average one hour and that of Stave Geo, one hour 20 min. The limitation on time was due to the coldness of the water temperatures in Shetland, 11-12°C, in which, after one hour, a wet suit diver was very cold. Divers involved in underwater surveying, especially the table operator and staff man, are often motionless, so good protection against the cold is essential. The author combatted the cold with a dry Unisuit and nylon-fur underwear, using twin 60 ft^3 (3.3 m^3) cylinders encased in a Sceptre backpack. This equipment gave the author effective control of the survey work during which, on one occasion, the diving time approached two hours without discomfort. In addition to providing extra warmth the Unisuit also gave very effective buoyancy control which simplified the lifting and movement of the plane table underwater.

785.
MOLNAR GW.
An evaluation of wind chill.
In: Cold Injury. New York, Josiah Macy Jr Foundation, 1960, p 175-221.

The significance of wind chill, expressed in terms of heat transfer by convection and residual radiation, is assessed. In a panel discussion the following topics are addressed: modification of wind chill formulas to take into account heat diminution, surface to air temperature difference during freezing of unstirred water, relation of the heat transfer coefficient to wind velocity, wind tunnel experiments to measure wind chill, formulas for the calculation of the equivalent still air temperature, relation of the rate of heat transfer by radiation and convection from the nude man, and the relation between wind chill and susceptibility to frostbite. (RW/UMS)

786.
MOLNAR GW, Read RC.
Hypoglycemia and body temperature.
JAMA 227(8): 916-921; 1974.

Among 36 recumbent nude men exposed for 2 hrs in a thermoneutral environment, insulin-induced hypoglycemia reduced rectal and tympanic temperatures by 0 to 2°C (3.60°F). Twelve patients experienced rectal cooling below 36°C (96.2°F) (lowest, 34.9°C [94.8°F]); 17 experienced tympanic membrane cooling below this limit of normothermia. Cooling was due to reduction in heat production and to secretion of sweat, peripheral vasodilatation, and hyperventilation. Temperatures below 36°C (96.2°F) neither inhibited sweating nor stimulated shivering. Seven patients showed negligible cooling; they and three others did not sweat. Hypoglycemia was the same in those who cooled as in those who did not. Sweating and hyperventilation ceased while hypoglycemia persisted. Cooling may be greater during summer than during winter, perhaps because heat-acclimatized sweat glands discharge more sweat. Published evidence establishes that hyperthermia occurs when hypoglycemia is complicated by infection, dehydration, or cerebral edema. (Authors' abstract)

787.
MORRISON JB, Conn ML, Hayward JS.
Thermal increment provided by inhalation rewarming from hypothermia.
J Appl Physiol 46(6):1061-1065; June, 1979.

To quantify the core temperature gain derived from inhalation rewarmings, 10 subjects were immersed in seawater (mean temperature 12°C) until a 2° drop in rectal temperature occurred, and were then rewarmed by breathing hot saturated air at 45°C for 30 min. Each subject was rewarmed once breathing air and once rebreathing a controlled fraction of expired air adjusted to produce a hyperventilation of 50 L/min. After 30 min of

rewarming mean rectal temperature had increased 0.39°C in subjects breathing air compared with 0.77°C in those hyperventilating (P less than 0.01). Corresponding gains in tympanic temperatures were 111 and 1.5°C, respectively. Calculations indicate that the additional heat input with hyperventilation yielded a core (rectal) temperature gain of 5.1×10^{-4} °C/L. It is concluded that each additional 10 L/min of ventilation of hot saturated air will increase the rate of core rewarming from hypothermia by approximately 0.3°C/H.(Authors' abstract)

788.

MORRISON JB, Conn ML, Hayward JS.

Accidental hypothermia: The effect of initial body temperatures and physique on the rate of rewarming.

Aviat Space Environ Med 51(10): 1095-1099; 1980.

After cooling in sea water, 14 subjects having varied core temperatures were rewarmed by inhalation of saturated air at 44°C. Multiple linear regression analyses were computed for best possible subsets relating rectal and tympanic rewarming rates, ϕ_i (i = R,T), to physiological and anthropometric measures. It was found that there was a good correlation between ϕ_i and metabolic or ventilatory rates ($0.61 < r < 0.74$). Rewarming rates ϕ_i could be more closely predicted by a combination of initial core temperatures and $(\text{height/weight})^{0.5}$ or by a combination of initial core temperatures and initial skin temperatures ($0.75 < r < 0.88$). The effectiveness of inhalation rewarming has been challenged and experimental studies appear contradictory. It is shown that the different inhalation rewarming rates measured are predictable and can be explained largely in physiological terms. (Authors' abstract)

789.

MORRISON, S.D.

Cold-specific feeding response of rats to cold exposure and energy density of body weight change.

J. Appl. Physiol. 51(2):327-334; Aug. 1981.

The increased food intake of rats exposed to cold is the result of increased intake due to cold (cold-specific compartment; *A*) and decreased intake due to simultaneously decreased body weight (weight-specific compartment; *B*). The two compartments are evaluated at 5, 13, and 17°C. *B* is evaluated as the food intake of a theoretical, isogravimetric control (identical to cold-exposed rats with respect to body weight and rate of change of body weight and identical to nonexposed rats in all other respects) that takes into account both the change in energy expenditure due to decreased body weight and the energy yield from tissue catabolism represented by change of body weight. *A* is the observed food intake minus *B*. A theoretical heat flow model, in which expected changes in heat flow during cold exposure drive food intake to maintain or restore preexposure body weight status, corroborated the partition derived from experimental data. However, both the experimental results and the heat flow model imply that the energy density of body weight change is negatively correlated with rate of body weight change. The energy density of weight change is high with high rates of weight loss and low with high rates of weight gain. (Author's abstract)

790.

MULLER-ESCHNER M, Djonlagic H, Brodersen HP, Diederich KW.

Charakteristische befunde bei unterkuhlung.

[Characteristic findings in hypothermia].

Dtsch Med Wochenschr 105(46) :1594-1595; 1980.

The definition of hypothermia is the lowering of the body temperature under 35°C. Etiologically, hypothermia can be classified into 2 basic forms: 1/ induced by exogenous cold 2/ manifestation or symptom of some acute disease causing imbalance in the body's thermoregulation. For effective treatment, early diagnosis and determination of the degree of severity are of utmost importance. The great variety of symptoms of hypothermia are discussed in detail in the present communication. Most important finding is the involvement of the heart conduction system which can be detected by abnormal ECG findings. In some cases of severe hypothermia arrhythmia can be life threatening. Liver and kidney involvement are also to be considered. Hypothermia lowers the detoxificating capacity of the liver as well as the excretory function of the kidney. The toxic substances remaining in the body as a consequence of impaired liver and kidney function may affect the myocardium. To avoid life-threatening myocardial impairment patients with severe hypothermia should be treated and observed in intensive care units for at least a 24 h period. (OLC/UMS)

791.

MURRAY BJ.

Severe lactic acidosis and hypothermia.

West J Med 134(2) :162-166; Feb 1981.

Survival of persons with severe lactic acidosis and a pH of less than 6.9 is unusual. In general, mortality approaches 100 percent for patients with a pH of less than 6.9 or a lactate level of greater than 13 mEq per liter. Although there are case reports of patients surviving with a pH of less than 6.9, there are no cases reporting survival with a lactate level of greater than 20 mEq per liter and a pH as low as 6.67, as occurred in this patient. Survival was more probable in this woman because of concordant hypothermia. Hypothermia is known to decrease the metabolic rate and, consequently, allows a patient to tolerate better inactivation of vital intracellular enzymes during acidosis. The patient's clinical features were well correlated to the hypothermia. (Author's abstract)

792.

MUSACCHIA XJ.

Heat and cold acclimation in helium-cold hypothermia in the hamster.

Amer J Physiol 222:495-498; Feb 1972.

A study was made of the effects of acclimation of hamsters to high, 34-35°C, and low 4-5°C, temperatures for periods up to 6 wk on the induction of hypothermia in hamsters. Hypothermia was achieved by exposing hamsters to a helox misture of 80% He and 20% O_2 at 0°C. Hypothermic induction to Tb [body temperature] 7°C was most rapid (2-3 hr) in heat-acclimated hamsters and slowest (6-12 hr) in cold-acclimated hamsters. The induction period was intermediate (5-8 hr) in room temperature non-acclimated animals (controls). Survival time in hypothermia was relatable to previous temperature acclimations. Heat-acclimated hamsters lived longest (2-2.5 days), cold-acclimated animals were short lived (12-18 hr), and nonacclimated control animals were intermediate (18-24 hr). The longevity of hypothermia in heat-acclimated hamsters compares favorably with the periods of hibernation experienced by this species. The hypothesis that thermogenesis in cold-acclimated hamsters would accentuate resistance to induction of hypothermia was substantiated. (© BA)

793.

MYERS RA, Britten JS, Cowley RA.

Hypothermia: quantitative aspects of therapy.

JACEP 8(12):523-527; Dec 1979.

Quantitative aspects of various methods of warming are presented comparing the peripheral method of warm bath immersion to the central method of ventilation with heated water-saturated air, infusion of warmed intravenous solutions, peritoneal lavage with warmed solutions, and hemodialysis or cardiopulmonary bypass. The need to convert arterial blood gas results for body temperature is emphasized. Two cases demonstrate combined use of peripheral warming using warming mattress and blankets and central warming with ventilation and infusion. (Authors' abstract)

794.

MYERS RD, Yaksh TL.

Control of body temperature in the unanaesthetized monkey by cholinergic and aminergic systems in the hypothalamus.

J Physiol (LOND) 202(2) :483-500; 1969.

In the unanaesthetized rhesus monkey, 5-hydroxytryptamine (5-HT), catecholamines, acetylcholine or carbachol were micro-injected in a volume of 1.0 µl or less through chronically implanted cannulae at eighty-six sites in the hypothalamus. 5-HT in doses of 2-10 µg caused a long-lasting elevation in temperature which was dose-dependent. An anatomical 'mapping' of the hypothalamus revealed that the hyperthermic action of 5-HT was localized to the anterior, pre-optic area directly ventral to the anterior commissure. Noradrenaline in doses of 1-12 µg produced a dose-dependent fall in temperature of short duration. An anatomical 'mapping' showed that the hypothermic action of this and other catecholamines was again localized to the anterior, pre-optic region. Acetylcholine, alone or in a mixture with eserine, or carbachol caused a dose-dependent hyperthermia which was characterized by an intense rise of short duration and vigorous shivering. A 'mapping' of this response

revealed a diffuse patterning of sites throughout the hypothalamus which were sensitive to the application of acetylcholine and carbachol. However, in one circumscribed region at the junction between the posterior hypothalamus and mesenchephalon, the two cholinomimetic substances caused a marked fall in temperature. We conclude that 5-HT activates a cholinergic heat production pathway which projects from the anterior to posterior hypothalamus. Noradrenaline, on the other hand, blocks the hyperthermic action of 5-HT rather than activates the heat loss system. A chemically mediated heat loss pathway apparently does not exist in the hypothalamus. (Authors' summary)

795.

NAKAYAMA T.

Temperature sensors in the brain.

Med J Osaka Univ 26(3-4) :157-158; 1976.

The preoptic area and anterior hypothalamus contain two kinds of thermally sensitive neurons. The discharge frequency rises for warm-sensitive and cold-sensitive neurons in response to a rise and a fall in local temperature. The characteristics of thermally sensitive neurons as true temperature sensors are described. A clarification of the mechanism of impulse generation needs to be made. Additional sites for thermally sensitive neurons are the brainstem and spinal cord. The action of bacterial pyrogen on warm-sensitive and cold-sensitive neurons is explained. These studies of the brain make an effective means in an analysis of drug action. (EP/UMS)

796.

NARAKI N, Imbert G.

Liberation d'energie, ventilation pulmonaire et equilibre thermique chez un mammifere en atmosphere hyperbare oxygene-helium.

[Discharge of energy, pulmonary ventilation and thermal balance in mammals in a hyperbaric heliox environment].

Med Aeronaut Spat Med Subaquatique Hyperbare 20(80): 338-343; 3rd quarter 1981.

During simulated deep dives on heliox, studies of gas exchange and thermal exchange in the cat were performed. Pulmonary ventilation and oxygen consumption were measured during exposures of 1-2 h at pressures of 3, 6, 9 and 10 MPa (corresponding to depths of 300, 600, 900 and 1000 msw). Temperatures were monitored as well; core temperature tended to drop at 900 or 1000 msw, in spite of the increase in the production of heat and an elevated ambient temperature. Causes are discussed and three hypotheses for the drop are presented: 1) an irregularity of nervous mechanisms involved in thermoregulation related to HPNS; 2) insufficient thermogenesis due to a limitation of respiratory gas exchange and/or a vigorous metabolism; and 3) excessive heat loss brought about by elevated thermal conductibility of heliox and aggravated by the increased pressure. (Authors' abstract translated by LET/UMS)

797.

NEWMAN RW, Cipriano LF.

Effect of hypoxia on temperature regulation of men exposed to 10°C air temperature.

Am J Phys Anthropol 40(1) :146; 1974.

Abstract only. Entire item quoted: A number of experiments on animals and a few on man have suggested that exposure to hypoxia produces a higher skin and lower rectal temperature during a cold challenge than would be found in normoxia. We suspected that it was not the oxygen but the CO_2 depletion which accompanies hypoxia which was the problem. Therefore, we exposed ten subjects to three 90-minute cold challenges on different gas mixtures: 21% O_2, 11% O_2, and 11% O_2 with 4% CO_2, properly randomized. Skin temperatures were consistently highest on 11% O_2, lowest on 21% O_2, and intermediate on 11% O_2, 4% CO_2. There were no differences in rectal temperature between the normoxic and hypoxic gas mixtures, but the addition of CO_2 with an accompanying massive increase in ventilation caused a continuing depression of rectal temperature. Shivering was least on 21% O_2 and greatest on CO_2 replacement, but there were no consistent differences in tissue conductance. A study did not establish the mechanism by which the hypoxic individual maintains a warmer skin, but it casts doubt on comparisons between high and low altitude populations which do not take into account this phenomenon.

798.

NIKIFOROV IN.

O reflektornoi sosudistoi reakstsii slizistoi nosa u vodolazov.
[Reflective vascular reactions of the nasal mucosa of divers].
Voenno-med Zh 1:70-73; 1968.

A study of the reactions of the nasal mucosa of military divers before and after training under normal and elevated pressure revealed that systematic athletic training reduces the response reaction of the nasal mucosa when the feet are chilled. The vascular reflex of the nasal mucosa does not disappear after training is terminated and remains on the level of reaction of physically developed persons. A reduction of the nasal mucosa temperature by 0.35°C should be considered a nonintensive vascular reaction. Well trained divers do not display a spastic vascular reflex when exposed to elevated (3 excess atm.) atmospheric pressure. The physical conditioning of the organism to elevated atmospheric pressure sharply reduces the intensity of the vascular reflex under normal pressure and has no essential effect on it under elevated pressure. (Author's summary translated) (© Biol. Abstr.)

799.

NORDREHAUG JE.

Sustained ventricular fibrillation in deep accidental hypothermia.
Br Med J 284:867-868; Mar 20, 1982.

Cardiac arrhythmia is an important cause of death in deep accidental hypothermia (temperature <30°C) in otherwise healthy patients. Superficial or core rewarming is the most important treatment. I report a case in which the patient had continuous ventricular fibrillation for three hours 40 minutes and was rewarmed with simple and inexpensive equipment that is generally available in any hospital. To my knowledge this is the longest period of ventricular fibrillation in deep hypothermia in which resuscitation has been successful. (Author's abstract)

800.

OKADA Y, Miyai K, Iwatsubo H, Kumahara Y.

Human growth hormone secretion in normal adult subjects during and after exposure to cold.
J Clin Endocr 30(3) :393-395; 1970.

Eight experiments on human growth hormone (HGH) secretion during and after 1- or 2-hr cold exposure (4°C) were undertaken in 2 male and 4 female normal adult subjects. Body temperatures decreased to less than 35°C at 60 to 90 min after cooling was commenced. NEFA increased to 113-267% of the initial value during or after cooling. Serum cortisol showed only a slight increment ranging from 2.4 to 9.7 μg/100 ml. No increase in serum HGH level was found during cold exposure for 1 or 2 hr, but a significant increment ranging from 3.1 to 13.5 ng/ml was observed on rewarming in any case with or without prior oral administration of 20 mg beta blockade (propranolol). (Authors' abstract)

801.

O'KEEFFE KM.

Accidental hypothermia: A review of 62 cases.
J Am Coll Emerg Phys 6: 491-496; 1977.

A retrospective review of all patients seen in an urban city-county emergency department over a 32-month period with a primary or associated diagnosis of hypothermia was performed using the emergency department encounter form and the inpatient chart of 62 cases (59 patients) with core temperatures of 35°C (95°F) or below. With this relatively large population, a general conclusion was reached about the presentation and natural history of this interesting entity. This permitted a defensible treatment regimen which is currently employed at this institution and which is offered for institutions in similar settings. The variance in clinical signs, laboratory values, electrocardiographic findings and complications encountered in this study are detailed against the background of a review of the findings of the current literature. (Author's abstract)

802.

O'KEEFFE KM (letter).

Hypothermia treatment.

Ann Emerg Med 10(7) :396; 1981.

The author corrects some of the reference information by Miller, Danzl, and Thomas (9:456-461, 1980). He states that it is not technically correct to say that they used "passive" rewarming in their series at Denver General since they did regularly use an available blanket warmer to supply frequently changed warmed blankets to their mildly hypothermic patients. His concern with more active measures, though they can be shown to be thermodynamically more effective, is that they are not of additional proven benefit to the patient with mild hypothermia and are inadequate for unstable and, certainly, for fibrillating patients. He agrees with Miller, et al, that one must individualize treatment methodology. (EP/UMS)

803.

OLSEN RG, David TD, Houk WM.

A potential treatment modality for severe hypothermia.

Paper presented at 53rd annual meeting of the Aerospace Medical Assoc, Bal Harbour, Fl; May 10-13, 1982.

Whole-body immersion in cold water, and hypothermia in general, are life threatening situations requiring immediate rescue and treatment by the best available means. The Navy mission demands that duties be performed in constant close proximity to this potentially lethal environment, and for many, the risks of accidental immersion and cold exposure are significant. Statistical tabulations in recent years show that a consistently high number of active duty Navy and Marine Corps personnel are lost each year from the effects of environmental exposure. Examination of the present state-of-art in the treatment of severe hypothermia shows that the resuscitation method of choice (peritoneal dialysis) can only be performed at a hospital or medical center using experienced personnel. There is an obvious need for a field-usable treatment modality in the rewarming of the severely hypothermic patient. Using such a modality, treatment could be accomplished aboard ship, in search and rescue vehicles, at the dispensary, or aid station level. With this need in mind, a project was recently initiated at the Naval Aerospace Medical Research Laboratory (NAMRL) to develop the use of electromagnetic (EM) energy for hypothermia treatment. This method would provide a practical means for meeting a very important therapeutic objective, on which most researchers agree; the myocardium should be warmed first while oxygen demands from the extremities are still reduced by hypothermia, then selectively or generally the rest of the patient could be rewarmed. The technique is similar in physical concept to another recent development in some cancer research laboratories in which EM energy is used to produce controlled hyperthermia in tumors. Results of the use of such a modality of rewarming would be noninvasive and under absolute control at all times. This rewarming technique then would be of significant value to the other military services and to the civilian population. Although progress in the NAMRL project is in an early phase, the generation and irradiation of radio frequency and microwave energy is a highly developed technology that has already been adapted to the rigors of the operational environment. (Authors' abstract)

804.

OLSEN W.

Cold water boating, the hazard and protection.

In: Proceedings of the Coast Guard's Boating Safety Seminar in Memphis, Tenn, Dec 1980.

The cold water hazard and protection methods for whitewater and quiet water boating were investigated. The safety practices and hypothermia experiences of a large northern whitewater club were surveyed, national accident statistics for cold water boating were reviewed, the insulating value of wet clothing was measured, and the maximum safe immersion time in cold still or whitewater was estimated. Based on the results, safety recommendations for cold water are offered. The key safety practice is the wearing of a life jacket at all times. In addition, each river trip should have a minimum of three boats, appropriate thermal protection for the water conditions should be worn, those not wearing wet suits should consciously resist gasping for air upon immersion, and those participants not thermally protected should be watched for symptons of hypothermia. Organized whitewater boaters did not account for a large number of boating deaths because of their awareness of dangers and safety measures. A high proportion of drowning victims were on quiet waters and were not wearing life jackets. Survey questions and results are appended. (RW/UMS)

805.

ORLOV GA.

Residual phenomena after exposure of the extremities to cold.

Khirurgiia (Mosk) 5:81-83; May 1980.

Fifty-two persons were examined in different periods after frostbite of the extremities. The method of infrared thermography with a scanning device was used in the examination. In the pre-reactive period infrared radiation is greatly inhibited. In the early reactive period the infrared thermograms are mozaic, the fields of inhibited radiation alternate with areas of intensive radiation. This structure is explained by the alternation of inflammatory zones and foci of developing necrosis. In late periods after exposure to frostbite infrared thermography provides evidence of circulatory disorders of the peripheral type. Neurovascular disorders consequent upon frostbite remain as residual phenomena for a long period of time. Cold neurovasculitis of the upper and lower extremities is the most frequent and stable complication. (Author's abstract)

806.

ORUC T, Terzioglu M.

The sensitivity to hypoxia of peripheral and central respiratory control mechanisms under normo- and hypothermic conditions.

Bull Eur Physiopathol Respir 15(6) :1117-1128; 1979.

The central and peripheral effects of hypothermia on respiratory control mechanisms were independently investigated under local cooling by means of appropriate cross circulation techniques. Two series of experiments were conducted. In the first series, the isolated carotid body area of a recipient dog, respiring atmospheric air, was perfused with normoxic of hypoxic blood from a normo- or a progesssively cooled hypothermic donor dog. When the carotid body was perfused with hypoxic blood, minute volume and tidal volume were increased at normal temperature, but this increase was reduced as the temperature of the donor dog was reduced down to a temperature level of 22°C, whilst respiratory frequency did not change significantly. Below this temperature, hypoxia had no effect on the respiratory parameters of the recipient animal. In the second series of experiments, the head of a recipient dog was cooled by perfusion with blood from a surface-cooled donor animal. The temperature of the carotid body region of the recipient was normal since it received blood from its own systemic circulation. Tidal volume and respiratory frequency of the recipient were recorded, while the animal was breathing air or the hypoxic gas mixture. The results of these experiments indicated that central respiratory mechanisms still respond to impulses from the chemoreceptors at brain temperature levels of 18-20°C. However, the diminution in the magnitude of response during progressive cooling of the brain suggested that there was depression of excitability of the central mechanisms. The results of the present study suggest that the diminution in or the loss of sensitivity of peripheral chemoreceptors may be mainly responsible for the failure of ventilatory control at temperatures below 22°C during general hypothermia. (Authors' abstract)

807.

OSTERTAG H, Hibler H.

General hypothermia. First aid and clinical treatment.

Fortschr Med 99(19):707-711; May 1981.

The general problematic of accidental hypothermia is pointed out. 12 patients have been treated with a new procedure of rewarming. This method is easy to apply, both at the site of accident and in the clinic without any risks. Considering the important principle of rewarming the core ("core first") our method is successfully applied with only a few means.(Author)

808.

OSTROVSKAYA RS, Belomytseva LA, Baikova IS, et al.

Health status of workers building pipelines in the north of the Tyumen region.

Gig Tr Prof Zabol 6:28-31; Jun 1980.

Effects of working conditions and a cold climate (circumpolar tundra) on the health of workers building long-distance trunk pipelines were studied. Alterations in various organs and systems and phasic changes in physiologic functions were recorded, the adaptation mechanisms of the body were found to be strained and the immune system to be highly sensitive to the environment of the Far North. (Authors' abstract)

809.

PACE N.

Physiological studies in the Antarctic.

In: Cold Injury, New York, Josiah Macy Jr Foundation, 1960, p 141-173.

The concept of physiological stress and techniques to assess it are examined. Changes in physiological functions were used to assess the degree of stress present in Arctic personnel at Operation Deepfreeze I. It is argued that this method of measuring stress is more appropriate than the use of performance tests. In a panel discussion, the following topics were considered: changes in performance measures as a function of stressor severity, the difference between physiological stress and physiological failure, mean blood and urinary constituents in stressed populations and controls, mean urinary constituents of men participating in a cold weather indoctrination course, and thyroid function changes due to cold stress. (RW/UMS)

810.

PANDOLF KB, Haisman MF, Goldman RF.

Metabolic energy expenditure and terrain coefficients for walking on snow.

Ergonomics 19(6) :683-690; 1976.

Ten male subjects each walked at two speeds, 0.67 and 1.12 m s^{-1} (1.5 and 2.5 mph) on a level treadmill, and on a variety of snow depths. Energy expenditure increased linearly with increasing depth of footprint depression and was expressed, considering clothed weight, by the regression equation: energy expenditure (W kg^{-1} hor km^{-1} h^{-1}) = 1.18 + 0.089 depression (cm). At 45 cm footprint depression as compared to a 0 cm depression, energy expenditure increased by a ratio of approximately 5:1. Although subjects were considered above average in terms of fitness [average $Vo_{2\ max}$ = 51.4 ml kg^{-1} min^{-1} (n = 6)], all terminated walking due to exhaustion at an average footprint depth of 35.0 cm at a walking speed of 1.12 m s^{-1}. Practical limits for prolonged snow walking not exceeding approximately 50% $Vo_{2\ max}$ were developed with 20 cm being the maximal depth at 0.67 m s^{-1}, and 10 cm at 1.12 m s^{-1} without snow shoes. At increased footprint depths, limiting factors for snow walking were the increasing lift work, inefficient stooping posture and balancing difficulty. (Authors' abstract)

811.

PAPANICOLAOU J, Fennessy MR.

The acute effect of ethanol on behavior, body temperature, and brain histamine in mice.

Psychopharmacology (Berlin) 72(1):73-77; 1980.

The possible relationships between ethanol-induced changes in behaviour, body temperature, and brain histamine were studied. Mice were injected intraperitoneally with various doses of ethanol in the range of 0.088-1.75 g/kg. There was a dose-dependent biphasic alteration in behaviour and body temperature, where a low dose of 0.175 g/kg produced excitation and hyperthermia. Doses of 0.875 and 1.75 g/kg caused an increasing state of depression and dose-dependent hypothermia. Behavioural changes induced by ethanol appear to reflect changes in body temperature. When hyperthermia was produced the animals were hyperactive, whereas with hypothermia they were sedated and huddled close together. These changes in behaviour and body temperature closely paralleled the ethanol-induced modifications in whole brain histamine levels, indicating that a relationship may exist between the ethanol-induced changes in these parameters.(Authors' abstract)

812.

PARK, Y.S., I.S. Lee, K.S. Paik, D.H. Kang, D.J. Suh, S.H. Lee, S.Y. Hong, D.W. Rennie and S.K. Hong.

Korean women divers revisited: current status of cold adaptation.

In: Program and abstracts, Undersea Medical Society annual scientific meeting, May 25-29, 1981. Undersea Biomed. Res. 8(1-Suppl.):A29; Mar. 1981.

Abstract only. Entire item quoted: Previous studies conducted during 1959-1969 documented various types of cold adaptation in Korean women divers (Hae-nyo) who had been diving daily in cold water (10°C in winter and 25°C in summer) wearing only a cotton bathing suit throughout the year. Since 1976 these divers have been wearing wet suits to avoid cold stress. The aim of the present study is to compare thermoregulatory functions of these protected modern divers with those obtained in earlier studies on unprotected divers. The results indicate that: 1) the reversible increase in basal metabolic rate observed during the cold season in early studies is absent in modern divers; 2) the shivering threshold is still higher (critical water temperature is lower) in divers as compared to the control (nondivers); 3) the divers still tolerate a lower rectal temperature in water of critical

temperature than the control; 4) the maximal tissue insulation for a given skinfold thickness is no longer higher but lower in divers than in the control; and 5) the finger blood flow measured during a hand immersion in 6°C water is still lower in divers than in the control. These findings suggest that use of wet suits for 3-4 years has differential effects on various types of cold adaptation; while it completely reversed the metabolic and insulative adaptation and partially reversed the hypothermic adaptation, it had no effect on the local vascular adaptation.

813.

PASCHE, A., S. Tønjum, B. Holand, A. Dyrseth and C. Olsen.
Deep Ex '80: Project II – Thermal studies in diving: thermal model.
Bergen, Norway, Norwegian Underwater Inst. Rep. 42-80, 15p. Dec. 29, 1980.

Cooling rates of three thermally unprotected subjects were studied at 31, 26 and 21 bar during 2 h exposures in cold helium-oxygen environments. Monitoring included deep body temperature, skin temperatures (on 12 sites), heat flow measurements (on 4 sites), inspiratory and expiratory gas temperatures and heart rate. In spite of the fact that the main heat loss avenue at the pressure levels tested was through respiration, significant differences were noted in the cooling rate between the three subjects. The differences are very likely results of differences in morphological characteristics. The results so far indicate that morphological factors should be included in mathematical models for heat loss in hyperbaric environments, even at pressures as high as 31 bar. The subjects in this study could rewarm until they felt thermally comfortable (usually not more than 2 h). At the time they decided to terminate the rewarming procedure, the rectal probe and the temperature radio pill showed a core temperature in the range of 36.2-36.6°C. (Authors' summary)

814.

PASCHE A, Tonjum S, Wissler EH.
Body cooling rate in hyperbaric heliox.
In: Report of Proceedings, European Undersea Biomedical Society 7th Annual Congress and Symposium on Decompression Sickness, July 21-24, 1981, Cambridge, UK, p 379-389.

Cooling rates of three thermally unprotected subjects were studied at 31, 26 and 21 ATA during 2 h exposures in cold helium-oxygen environments. The subjects differed in morphological characteristics. Average skinfold thickness was 19.5 mm for the fattest and 9.5 mm for the thinnest subject. Inspired gas temperature at 31 ATA was 23.7 ± 0.9°C (mean ± S.D.), relative humidity 90 ± 5%, while inspired gas temperature at 26 and 21 ATA was 21.5 ± 0.4°C and 18.2 ± 0.3°C, respectively. Relative humidity was 60 ± 8% at the two lower pressure levels. Linear regression analysis of the rectal temperatures from the 20th to the 120th min of the exposure times show body cooling rates for the three subjects in the range of 0.42 – 0.78°C/h at 31 ATA, 0.42 – 0.91°C/h at 26 ATA and 0.42 – 1.06°C/h at 21 ATA. The subject with the highest average skinfold thickness had the lowest cooling rate at all three pressure levels. In spite of the fact that the relative importance of heat loss through respiration increases with increasing pressure, and that this heat loss only to some extent depends on morphological factors, significant differences were found in cooling rates between the three subjects. The differences are most likely due to variations in morphological characteristics. The cooling rates obtained in the present study are compared to estimated cooling rates using a mathematical model for heat loss in hyperbaric environments. The results of the comparison are discussed. The subjects could rewarm until they felt thermally comfortable (usually not more than 2 h). The rewarming was performed at a comfortable temperature using high-quality sleeping bags. At the time the subjects decided to terminate the rewarming procedure, the rectal probe and the temperature radio pill showed a core temperature in the range of 36.2 – 36.6°C. The results indicate a slow rewarming, and that the subjects' own evaluation of their thermal status is faulty under these circumstances.

815.

PASCHE A, Tonjum S, Holand B.
Diver heating during cold water dives at 51 ATA.
In: Program and Abstracts, Undersea Med Soc, Inc, annual scientific meeting June 1-5, 1982, Undersea Biomed Res 8(1-Suppl) :A 18; Mar 1982.

Six divers performed standardized work in water of 4-6°C during a simulated 500 msw saturation dive, using conventional hot water suits and thinsolate underwear. A prototype hot water gas heating system was used to heat the divers' breathing gas. Hot water flow to the diver was kept constant at 14 l/min, supplying both the suit and the gas heating system. The divers performed a total of 17 dives with an average dive duration of 86 min. The longest dive was 182 min. In an attempt to produce a slowly progressive hypothermia, the temperature of

the hot water to the diver's umbilical was reduced by 2.5°C. As a result, mean skin temperature and breathing gas temperature dropped 0.8 and 1.5°C, respectively, from a temperature level considered by the diver to be comfortable. Thirty-five minutes after the reduction in hot water temperature the diver aborted the dive because he was cold and shivering. His rectal temperature had dropped 0.4°C. With the exception of this dive, none of the dives were stopped because the divers felt cold. Rectal temperatures did not show any incidence of undetected hypothermia. The results obtained confirm our earlier observations that divers are sensitive to breathing gas temperatures at high pressures. At 51 ATA breathing gas temperatures between 30 and 32°C were considered comfortable. The divers would complain that 28°C was cold, while inspired gas temperatures of 33.5-34.0°C were described as uncomfortably hot. In one dive the hot water hose to the gas heating system became disconnected. The breathing gas temperature dropped to 15°C within 15-20 sec, at which time the diver started shivering and had to return to the dry section of the experimental chamber. Even though the hot water flow was unchanged, the correlation between the divers' mean skin temperature and the temperature of the hot water to the suit showed considerable variations from dive to dive. The results presumably reflect variations in hot water mixing in the suit. As an indicator for a diver's heat supply during deep diving, monitoring of the hot water to the suit alone might therefore be insufficient. (Authors' abstract)

816.

PASCHE A, Tonjum S, Onarheim J.

Body cooling rate in heliox at 21, 31, 41 and 51 ATA.

In: Program and Abstracts, Undersea Med Soc, Inc, annual scientific meeting June 1-5, 1982, Undersea Biomed Res 8(1-Suppl) :A 16; Mar 1982.

Cooling rates of thermally unprotected subjects were studied at 51, 41, 31 and 21 ATA during two-hour exposures in cold helium-oxygen environments. The subjects differed in morphological characteristics. Average skinfold varied from 19.5 mm to 9.5 mm for the subjects. Chamber gas temperature at 51 ATA was 27.5 ± 0.4°C (mean ± S.D.), at 41 ATA 26.9 ± 0.4°C, at 31 ATA 20.5 ± 0.7°C and at 21 ATA 17.5 ± 0.4°C. Relative humidity was 88 ± 5% for the three highest pressure levels, while it was 60 ± 8% at 21 ATA. Linear regression analysis of the rectal temperatures from the 30th to the 120th min of the exposure time shows body cooling rates for the three subjects in the range of 0.30-1.21°C/h at 51 ATA, 0.30-0.57°C/h at 41 ATA, 0.42-0.78°C/h at 31 ATA and 0.42-1.06°C at 21 ATA. In spite of the increasing relative importance of heat loss through respiration with increasing pressure, the results show individual differences in cooling rate at all pressures, reflecting the difference in morphology of the subjects. However, other factors like individual differences in cold response and shivering rate may be equally important for cooling rate. The subjects could rewarm until they felt thermally comfortable. The rewarming was performed at comfortable chamber temperature using high quality sleeping bags. The rate of change in rectal temperature indicates a slow rewarming. At 51 ATA the subjects rewarmed for as much as 3 hrs, at which time their rectal temperature was not more than 0.2°C higher than at the termination of the cold exposure. Rectal temperatures were in the range of 36.2-36.9°C when the subjects decided they felt completely rewarmed. (Authors' abstract)

817.

PATTON JF, Doolittle WH.

Core rewarming by peritoneal dialysis following induced hypothermia in the dog.

J Appl Physiol 33:800-804; 1972.

Cardiovascular function was measured in anesthetized dogs prior to the induction of hypothermia, after 3 hr at a cardiac temperature of 25°C, and following external rewarming or core rewarming by peritoneal dialysis (PD). The rate of rise in cardiac temperature was greater with PD (4.5°C/hr) than with external rewarming (3.2°C/hr) and resulted in only a slight rise in skin temperature when compared to external rewarming. Typical electrocardiogram T-wave inversion during hypothermia became normal in the dialyzed group during rewarming, but in 7 of 10 animals rewarmed externally the T-wave failed to return to normal. Cardiac output, total peripheral resistance, and left ventricular work remained depressed in both groups immediately upon rewarming but significant improvement developed in the PD group by 12 hr posthypothermia. In addition, the mean arterial pressure was depressed in the externally rewarmed dogs 12 hr after hypothermia but not in those rewarmed by dialysis. Thus peritoneal dialysis appears to be an effective, practical method of rewarming and when compared to external rewarming, results in an earlier return toward prehypothermic cardiovascular function. (Authors' abstract)

818.

PELIZZO C, Franchi GL.

Frostbite.

Minerva Anestesiol 44(1):41-44; Jan-Feb 1978

After a brief account of the pathophysiological aspects of frostbite, and on the basis of a personal case, an interesting theory regarding a possible aetiopathogenetic identity between irreversible shock and serious intractable frostbite, is put forward.(Authors' summary)

819.

PENNER S, Nikitenko BN.

Blood gases in craniocerebral hypothermia.

Bull Eksp Biol Med 86(7):27-29; 1978.

Experiments were conducted on dogs; cranio-cerebral hypothermia (a reduction of body temperature from 38 to 28°C) led to increase of oxygen and to reduction of carbon dioxide tension in the blood. In case of marked hypothermia (24°C) the blood gaseous concentration became less than at 28°C, but remained above the initial level. This indicates prolonged preservation of adequate lung ventilation in the hypothermic organism.(Authors' abstract)

820.

PEPELKO WE.

Elimination of nonshivering thermogenesis by hypercapnia.

Tex Rep Biol Med 31: 115-116; Spring 1973.

Abstract only. Excerpts: The present experiment was designed to measure the effect of CO_2 upon non-shivering thermogenesis in 24 young adult rats previously acclimated for 30 days or longer at a temperature of 5°C. The animals were anesthetized, paralyzed with succinyl chlorine to prevent shivering, artifically respired with either room air, 5%, 10% or 20% CO_2 and cooled in double walled chamber with cold water. All three levels of CO_2 resulted in a significant depression of VO_2 at room temperature ($P < .001$). During cold exposure VO_2 increased 50% or more. This increase in non-shivering thermogenesis was partially inhibited by 5%, 10% or 20% CO_2 and cooled in a double walled chamber with cold water. All three levels of CO_2 resulted in a significant depression of VO_2 at room temperature ($P < .001$), although oxygen consumption remained above control levels. With 10% CO_2 inspiration, VO_2 was not significantly different from that of thermoneutral controls with 20% CO_2, VO_2 declined to a level significantly ($P < .001$) less than controls. The data clearly indicate that inspiration of 10% CO_2 or greater completely eliminates non-shivering thermogenesis in cold-adapted, cold-stressed rats.

821.

PEPELKO WE, Dixon GA.

Elimination of cold-induced nonshivering thermogenesis by hypercapnia.

Am J Physiol 227(2) :264-267; 1974.

Oxygen uptake VO_2 (in $ml.kg^{-1}.min^{-1}$ STPD) was used as an estimate of nonshivering thermogenesis in anesthetized paralyzed male rats, previously cold acclimated for 30 days at 5 ± 1°C. Plasma pH, $PaCO_2$, VO_2, and rectal temperature were first observed at an ambient 24°C and then at 0°C. Cold exposure resulted in a 50-60% increase in VO_2. Addition of 5%, 10% or 20% CO_2 to the breathing gas resulted in a progressive decrease in O_2 uptake at both 0°C and 24°C. The change in O_2 uptake with $PaCO_2$ at 24°C was described by the equation $\Delta VO_2 = 0.499 - 0.055 \Delta PCO_2$, and at 0°C by $\Delta VO_2 = 7.916 - 0.140 \Delta PCO_2$. The rate of decline in VO_2 with increasing PCO_2 was significantly greater ($P < .01$) during cold exposure. With inspiration of 10% CO_2 at 0°C, VO_2 decreased to a level not significantly different from air-breathing controls at 24°C. Nonshivering thermogenesis can be completely eliminated by adding 10% or more CO_2 to a breathing mixture.

822.

PETERSON G, Hugar DW.

Frostbite: its diagnosis and treatment.

J Foot Surg 18(1):32-36; 1979

The treatment, diagnosis, and outcome of frostbite victims is by no means an exact science. As this presentation

shows, most authors agree that the key to control and treatment of cold injury comes from a reversal of the damage to the micro-vasculature The methods of diagnosis of the extent of damage are all based on determination of vascular status whether it be tissue or bony structures. Treatment varies widely but rapid rewarming of the affected tissues is by far the most successful treatment to minimize tissue loss. As in the case study presented here, when surgical amputation is necessary, one must take mechanical function into account as well as the line of demarcation in order to give a functional limb for rehabilitation and to prevent the possibility of subjecting the patient to unnecessary repetative surgical procedures.(Authors' conclusion)

823.

PETROFSKY JS, Burse RL, Lind AR.

The effect of deep muscle temperature on the cardiovascular responses of man to static effort.
Eur J Appl Physiol Occup Physiol 47: 7-16; 1981.

Eight healthy male subjects (age range 24-38 years) were asked to exert a fatiguing isometric endurance contraction with their handgrip muscles at 40% of their maximum strength after immersion of their forearms in water at various temperatures ranging from 3-40°C. For each subject, isometric endurance was longest after immersion of his forearm in water at a particular characteristic bath temperature; endurance decreased markedly above or below this temperature. The increase in heart rate from the beginning to the end of the fatiguing contractions was the same irrespective of the bath temperature. In contrast, the increase in blood pressure (both systolic and diastolic) throughout the contractions was almost constant for contractions exerted after immersion of the forearm in water at 20-40°C, but was reduced progressively for contractions exerted in water below 20°C. (Authors' summary)

824.

PHILLIPSON EA, Herbert FA.

Accidental exposure to freezing: Clinical and laboratory observations during convalescence from near-fatal hypothermia.
Can Med Assoc J 97: 786-792; 1967.

A 50-year-old man was accidentally frozen. The patient's core temperature on admission to hospital was 25°C (77°F), and on superficial inspection he appeared to be near death. Cardiovascular, acid-base, electrolyte, respiratory, hematologic and neurologic studies were performed at 25°C, during a rapid rewarming phase and during the convalescent period. The principal cardiovascular findings at 25°C were bradycardia and hypotension. These were accompanied by the characteristic electrocardiographic changes seen in severe hypothermia including atrial fibrillation and prominent J-wave formation. Spontaneous conversion to sinus rhythm occurred with rewarming. A severe metabolic acidosis, attributable to excess lactic acid, was noted at 25°C. It is believed that impairment of the blood buffer capacity and the renal and respiratory compensatory mechanisms contributed to the severity of the acidosis. Following rewarming, a systemic alkalosis developed which was accompanied by greatly elevated levels of serum sodium and chloride, with decreased renal excretion of these electrolytes and increased excretion of potassium. It is possible that excess aldosteronism underlay these changes. The chief respiratory complication at 25°C was a lack of response to metabolic acidosis. Delivery of oxygen to the tissues was also probably impaired. After rewarming, bronchopneumonia developed, necessitating early tracheostomy and the maintenance of vigorous tracheobronchial toilet. Anemia, resulting from mild hemolysis and relative failure of the bone marrow, was present during the first 3 wk. The marrow depression was likely due to the effects of hypothermia and of chloramphenicol administration. Neurological studies at 25°C revealed profound central nervous system depression, muscular rigidity and electromyographic evidence of shivering. Subsequently the patient developed signs of memory loss, expressive dysphasia, swallowing difficulty, and peripheral neuropathy. A follow-up study 9 mo after admission demonstrated only neurological defects and partial loss of extremities due to the original cold injury. (Authors' abstract)

825.

PIANTADOSI CA.

Respiratory heat loss limits in helium-oxygen saturation diving.
US Navy Exp Diving Unit, Rep 10-80, 23 p, June 1980.

Convective respiratory heat transfer in divers breathing cold helium-oxygen is a major avenue of body heat loss for which there is no effective thermoregulatory compensation. Review of recent studies of hyperbaric respiratory heat loss provides a physiological data base for updating current minimum inspired gas temperatures for saturation diving. The new proposed inspired gas temperature-depth curve is based upon a maximum convective respiratory heat loss of 20 $W \cdot m^{-2}$ for a resting diver maintaining thermoneutral skin temperature in a hot

water suit. This level of respiratory heat loss is predicted to allow an average rectal temperature drop of 0.25°C per hour, and will support a four hour mission. The new limits are designed to allow divers with any ventilatory response to exercise or cold to gain heat from exercise, although it is expected that most of the exercise heat remaining after obligatory increases in respiratory heat loss from the ventilatory response to the exercise, will be dissipated though the diver's skin as he adjusts his hot water flow and temperature for comfort. (Author's abstract)

826.

PIANTADOSI, C.A., E.D. Thalmann and W.H. Spaur.
Metabolic response to respiratory heat loss-induced core cooling.
J. Appl. Physiol. 50(4):829-834; Apr. 1981.

To study the phenomenon of isolated core cooling, four resting men breathed cooled helium-oxygen (T_{in} = 14 ± 2°C, 40-60% relative humidity) in a warm hyperbaric chamber at pressures equivalent to 640, 1,000, 1,400, and 1,800 ft seawater (fsw). Rectal temperature (T_{re}) fell by 0.43 ± 0.13°C at 640 fsw to 0.98 ± 0.15°C at 1,800 fsw after 60 min. The rate at which T_{re} fell was linearly related to the product of inspired gas density times specific heat. The metabolic response ($\dot{V}O_2$) to this isolated core cooling was more closely related to the rate of fall in T_{re} than to the magnitude of this fall. A distinct threshold temperature, below which a rise in $\dot{V}O_2$ would occur, was not demonstrable. However, when the rate of fall of T_{re} exceeded 0.70°C·h^{-1}, $\dot{V}O_2$ increased above base line, in spite of high skin temperatures that may have blunted the $\dot{V}O_2$ response. When $\dot{V}O_2$ did increase, its net benefit on thermal homeostasis was negated by the associated rise in pulmonary ventilation and its attendant increase in respiratory heat loss. Breathing cool helium-oxygen under hyperbaric conditions can rapidly lower deep body temperature, even in the presence of a warm body surface. (Authors' abstract)

827.

PORTNOI VA (letter).
Hypothermia.
Ann Intern Med 90(2) :273-274; 1979.

To the Editor: In his article "Hypothermia: Pathophysiology, Clinical Settings, and Management" (Ann Intern Med 89 :519-527, 1978), Reuler discusses susceptibility of the elderly to accidental hypothermia. This subject is of great interest not only for clinicians but for the general public and politicians. Politicians are looking for scientific data on the need of the aged for adequate means of heating and cooling their homes and on the particular hazard that shortage of energy for such purposes poses to their health. There are studies supporting Reuler's view that the elderly are more prone to hypothermia due to several specific aging factors; however, one should be cautious with generalizations regarding the entire aged population. Studies have shown that there is a group of elderly persons at high risk of developing hypothermia, but most older persons have a capacity of normal temperature regulation. The study of Macmillan and colleagues showed that normal subjects aged 84 to 93 years had normal thermoregulatory responses on cooling as opposed to a group of survivors of accidental hypothermia aged 66 to 89. More investigations are needed to clarify the mysterious relation between hypothermia and the aging process. For practical reasons, conditions common to the elderly such as chronic diseases that limit their mobility, myxedema, and drug influences (phenothiazine, barbiturates) should be recognized as triggers for development of hypothermia.

828.

PUGH LG.
Deaths from exposure on Four Inns Walking Competition, March 14-15, 1964.
Lancet 1: 1210-1212; 1964.

The 8th Annual Four Inns Walking Competition (forty-five miles) took place in wet-cold conditions, the air temperatures on the moors being 2-3°C. There was heavy rain most of the day, and a strong wind. The official weather report was misleading. From the fifth h some competitors began to get into difficulties. Three Scouts lost their lives and at least four others had narrow escapes. The clothing of the dead men was not waterproof, and the trousers were not windproof. The cause of death was given as exposure to prolonged cold. In one of three cases a severe attack of influenza three weeks previously was thought to have been contributory. There were no significant necropsy findings other than terminal congestion. Symptoms of exposure, in order of development, were: (a) slowing of the rate of progress, clumsiness, and stumbling; (b) repeated falling; (c) inability to continue; (d) incoherence, impairment of consciousness; (e) unconsciousness, extreme pallor, and in one case

what appears to have been a convulsion. In these cases mental symptoms were late in appearance. Only about 2 h elapsed between first symptoms and collapse. Evacuation of one of the fatal cases took 5 h. Mild cases recovered with rest and warmth. The race was well organized and all recognized safety precautions were taken. (Author's abstract)

829.

PUGH LG.

Accidental hypothermia in walkers, climbers and campers; Report to the Medical Commission on Accident Prevention.

Brit Med J 1: 123-129; 1966.

Twenty-three exposure incidents in various parts of Britain are described. There were 25 deaths, 5 cases of unconsciousness with recovery, and 58 milder cases. Most cases occurred at temperatures near freezing point and in the presence of gales, wind, or snow, wet-cold conditions being more dangerous than dry-cold conditions. Wet clothing and walking to the point of collapse were the two principal factors in fatal cases. Symptoms began usually 5 to 6 h after setting out. The interval between onset of symptoms and collapse and between collapse and death was variable, but might be as little as 1 to 2 h respectively. Convulsions occurred in two unconscious patients being carried in the head-up position. Casualties could be prevented and lives saved by wider use of: (i) emergency dry clothing and waterproof overgarments, (ii) light-weight emergency camping equipment. It is suggested that the safest treatment of such casualties, whether by other members of the same party or by rescuers, is to camp and allow the patients to rewarm spontaneously before moving them, unless the distance is short. (Author's abstract)

830.

PURSHOTTAM T, Pahwa ML, Brahmachari HD.

Effects of 6 hours hypoxic and cold exposure on urinary electrolyte and catecholamine excretion.

Aviat Space Environ Med 49(1) :62-65; 1978.

Eleven young male Indian volunteers fasted overnight and were exposed to 6 h to cold at 8°C (I), hypoxia at 4267 m at 28°C (II), and cold plus hypoxia of 4267 m at 8°C (III), in a walk-in climatic chamber, and excretion of some urinary constituents was measured. Urine output was significantly decreased in (II) and increased in (I) and (III). Urine pH significantly increased only in (II). Catecholamine excretion significantly increased only in (I). Ca++ excretion was significantly raised in (I) and (III) and lowered in (II). Na+ excretion was significantly decreased and K+ excretion remained unchanged in all three stress conditions. Cold seemed to be a greater stressor than hypoxia, under stated experimental conditions. (Authors' abstract)

831.

RAE D.

Accidental hypothermia: emergency rewarming techniques.

Can Nurse 76(2) :28-30; Feb 1980.

Increased interest in outdoor activities in inclement weather has resulted in an increased number of accidental hypothermia cases. Victims of hypothermia are in danger of developing ventricular fibrillation due to a decreased supply of oxygen to the myocardium and its subsequent irritability. The central nervous system and renal responses are depressed and acidosis develops. Three main rewarming techniques now being used are as follows: central body rewarming by means of peritoneal dialysis, hemodialysis or cardiopulmonary by-pass; active surface rewarming through baths or heating pads; and passive surface rewarming through shivering thermogenesis in combination with insulating blankets to decrease heat loss. Clinical features for the moderately and profoundly hypothermic patient are listed. Death is defined as a failure to revive after one hour of attempted resuscitation and core body temperature has been raised to 30°C. (EP/UMS)

832.

RAHEJA R, Puri VK, Schaeffer RC Jr.

Shock due to profound hypothermia and alcohol ingestion: report of two cases.
Crit Care Med 9(9) :644-646; 1981.

Cardiovascular failure (shock) associated with acute alcohol ingestion and severe hypothermia (core temperature 23 and 21°C) was studied in 2 patients. In each case, perfusion failure was associated with lactacidemia, severe bradycardia, and agonal respirations. Infusion of fluids and mechanical ventilation reversed shock and prevented a fatal outcome. One case, complicated by renal failure and volume overload with pulmonary edema, was managed with peritoneal dialysis. These findings suggest that perfusion failure associated with severe accidental hypothermia after acute alcohol ingestion is due to a combination of hypovolemia, bradycardia, and respiratory depression. (Authors' abstract)

833.

RAMSTEAD KD, Hughes RG, Webb AJ.

Recent cases of trench foot.
Postgrad Med J 56(662) :879-883; Dec 1980.

Two cases of cold injury to the lower extremities, 'trench foot', are presented. The management is essentially conservative, but in cases of severe damage, particularly in elderly people, amputation must be advised. (Authors' summary)

834.

RAND PW, Lacombe E, Hunt HE, Austin WH.

Viscosity of normal human blood under normothermic and hypothermic conditions.
J Appl Physiol 19 :117-122; 1964.

Although blood viscosity varies in relation to shear rate, hematocrit, and temperature, equipment is now available with which it may be measured in respect to each of these variables. A simple, clinically practical technique for such measurement is presented. Blood from 60 normal subjects was adjusted to hematocrits 0, 20, 40, 60, and 80, and the viscosity shear rate rate relationships measured at 37.0, 32.0, 27.0, and 22.0°C. The data obtained are presented as a reference to future studies using this method. Technical details are discussed and some deserving areas of application considered. (Authors' abstract)

835.

RAVEN PB, Pape G, Taylor WF, Gaffney FA, Blomqvist CG.

Hemodynamic changes during whole body surface cooling and lower body negative pressure.
Aviat Space Environ Med 52(7) :387-391; 1981.

Six young healthy male subjects were studied to evaluate the use of whole body surface cooling (WBSC) as an antiorthostatic intervention. Previous studies in our laboratory have demonstrated that perfusion of an Apollo cooling garment with 16°C water produced a significant increase in stroke volume and decrease in heart rate at rest and during lower body negative pressure (LBNP). However, optimal perfusion temperatures have not been determined. The present study examined the effects of WBSC using perfusion of water at a temperature of 10°C. This perfusion temperature produced a greater decrease in mean skin temperature (T_{sk}) than water at 16°C, -4°C drop compared to -2°C respectively. The hemodynamic effects were also more prominent with 10°C water as shown by the increase in stroke volume of 11% at rest and of 35% during LBNP at -50 torr compared to control measurements at ambient temperature. Heart rates were lowered significantly (8 beats/min) and systolic arterial blood pressure was higher (8 torr). Cooling with 10°C water produced a slight increase in muscle tone, reflected by a small but significant increase (+84 ml/min) in oxygen uptake. These data suggest that WBSC is an effective nonpharmacologic means of controlling preload and deserves further investigation as an antiorthostatic intervention. (Authors' abstract)

836.

RAYMOND LW (letter).

Temperature regulation in helium-oxygen atmospheres.
Lancet 1 (7910) :807; Apr 5, 1975.

In this letter to the editor the author enlarges on the subject of thermal discomfort in a hyperbaric helium en-

vironment that had been mentioned in an editorial in an earlier issue. (See Anonymous, Lancet 1 (7910): 440; Feb. 22, 1975). Men at 50 ATA (1600 ft) require an ambient temperature of over 29°C to maintain thermal comfort. Quantitative data on exposures to HeO_2 at subcomfort temperatures is lacking, but anecdotal information indicates that (1) the diver may be rendered helpless by the fast onset of hypothermia, (2) muscular activity (including shivering) speeds up the rate of its development, (3) conventional protective devices such as Neoprene wet suits are ineffective. A table is given which indicates the minimum comfortable temperature at depths from 5 to 50 ATA. AT 50 ATA, the temperature must be 31.7°C. (MFW/UMS)

837.

REIF AE.

Protection against drowning: training and equipment.

In: Vinger PF, Hoerner EF, eds. Sports Injuries – The Unthwarted Epidemic, p 307-326. Littleton, MA, PSG Publishing Co, 1981.

The main thrust of this chapter is protection from drowning after boating accidents. However, much of the information on training in the necessary skills and in use of equipment, and on the hazards of the cold water environment, is relevant to diving as well. Hypothermia is discussed briefly. The safety equipment for various categories of boats is described in some detail, and the safety code of the American Whitewater Affiliation is presented in an appendix. (LET/UMS)

838.

REULER JB (letter).

Management of hypothermia.

Can Med Assoc J 117(12) :1372, 1375; 1977.

The author refers to Dr. V. Wood's communication (Can Med Assoc J 117:16, 1977) and cites a survivor of hypothermia with a core temperature of 18°C. The suggestion is made that for patients with core temperatures below 32°C the methods available in hospitals for core rewarming include peritoneal dialysis, partial cardiopulmonary bypass, inhalation of heated oxygen and colonic infusion. Disadvantages of active external rewarming by water immersion include, interference of pateint monitoring, and movement of patient which may precipitate ventricular fibrillation. In selecting a method for treatment of hypothermia, physicians should be aware of these considerations. (EP/UMS)

839.

REULER JB (letter).

Hypothermia.

Ann Intern Med 90(2) :273; 1979.

In comment: Dr. Rotman raises several excellent points on blood gas measurements in hypothermia. It is unrealistic due to technical and logistical limitations to recalibrate the blood gas analyzer to the patient's core temperature. The provided correction factors obviate the need for recalibration and should be applied to febrile as well as hypothermic patients, as is done routinely in some respiratory care units. Because mixed venous P_{O_2} and cardiac output measurements are difficult to obtain readily and may be altered due to regional changes in perfusion and the effect of the lowered core temperature on cardiac performance, the arterial blood gases remain an important variable in evaluating the hypothermic patient. Although oxygen requirements are decreased in hypothermia, inadequate tissue perfusion can more than offset the benefit derived from lowered tissue demands for oxygen. The adequacy of tissue perfusion during hypothermia depends on many factors, including cardiac output, peripheral resistance, and blood viscosity. The oxy-hemoglobin dissociation curve is also shifted to the left, causing increased affinity for oxygen. This, combined with problems with mucous plugging and ventilation-perfusion inequalities, makes it quite unlikely that oxygen administration carries with it the potential for harm. As well, the changes in pH during hypothermia, as reflected in the correction factors, interface with decisions on advisability of bicarbonate administration. For example, a patient with a core temperature of 27°C and a pH of 7.10 and P_{O_2} of 20 mm Hg would have, with correction for temperature, a tissue-level pH of 7.25 and a P_{O_2} of 20 mm Hg. Therefore, not to use correction factors for arterial blood gases in dealing with the hypothermic patient, as some authors have advocated, is to ignore major pathophysiologic changes that may have significant impact on management and lead to unnecessary and potentially dangerous therapy in a rapidly changing metabolic milieu.

840.

REULER JB (letter).

Hypothermia.

Ann Intern Med 90(4) :721; 1979.

In comment: Drs. Hamilton and Rosen raise several excellent points on the management of the hypothermic patient. Recent literature suggests that morbidity and mortality in hypothermia may be associated more with severity of underlying disorders than with the depth of temperature depression. The hypothermic state, however, may mask underlying disease as well as precipitate new abnormalities (for example, pancreatitis). The article by O'Keeffe to which the authors refer is a retrospective analysis and lacks a controlled population treated with other modalities. This, unfortunately, is the state of the art at present. There are no prospective, controlled studies in the literature comparing methods of rewarming and, as I stated in my review, "there is no unanimity of opinion regarding indications" for use of core rewarming techniques. This controversy was highlighted by vigorous argument by leading authorities at a recent symposium. Because of this lack of "hard data," one cannot be dogmatic in recommending a specific rewarming technique. As Drs. Hamilton and Rosen point out, management should be individualized. When core rewarming is chosen—and it should be strongly considered as the core temperature drops below 30°C—peritoneal dialysis is the therapy of choice.

841.

RICHARDSON, D.L. and N.F. Audet.

A 10-zone thermal manikin for evaluating personnel protective garments in cold air and water immersion environments.

Navy Clothing Textile Res. Facility, Tech. Rep. 142, 11p. Apr. 1981.

A thermal manikin with the dimensions and weight of a fiftieth percentile standing man simulates metabolic heat and will be used for evaluating the thermal protection capability of clothing and diving suits in cold air and/or water environments. The manikin has 10 independently heated and controlled sections made from aluminum castings. Power for each section is controlled by the temperature level of the torso and by temperature differences between adjacent sections. The manikin is water tight at a depth of 3m without internal pressurization. A pressure equalization system permits evaluation of protective clothing in water environments equivalent to submersion in 300 m of sea water. An automatic control and data acquisition system computes individual temperatures from thermistor sensors, average section temperatures, section and total power, and both section and total insulation (in units of clo) of the garment being tested. *(Authors' abstract)*

842.

RIGGS CE Jr, Johnson DJ, Konopka BJ, Kilgour RD.

Exercise heart rate response to facial cooling.

Eur J Appl Physiol 47(4):323-330; 1981.

The heart rate responses of physically untrained men to exercise with and without facial cooling were determined. Cold wind (10°C, 6.5 $m \cdot s^{-1}$) was directed at the faces of the subjects during a 16 min bout of progressively intense exercise. The 10°C wind resulted in a significant ($p < 0.05$) lowering of heart rate that appeared to be associated with a decline in forehead temperature at 4, 6 and 8 min of exercise. No differences were observed for blood pressure or rectal temperature. The significant ($p < 0.05$) reduction in the heart rate with the 2°C cold wind did not appear to be associated with changes in facial temperature. The 2°C wind also resulted in a persistent peripheral vasoconstriction ($p < 0.05$). The results suggest that the heart rate response to facial cooling during exercise is mediated not through a reflex associated with increased stroke volume but rather via a central thermoregulatory response.(Authors' summary)

843.

ROBERTS, D.E., J.F. Patton and D.W. Kerr.

The effects of airway rewarming on severe hypothermia.

Fed. Proc. 40(3):421; Mar. 1981.

Abstract only. Entire item quoted: The use of warmed, humidified air/O_2 has been widely accepted as a useful non-invasive method of rewarming hypothermic victims. Studies have shown this to be somewhat effective on mildly hypothermic (35°C) subjects, but no data exist on its use with severe hypothermia. This study utilizes dogs cooled to 27°C as the model. Airway rewarming is instituted in conjunction with external rewarming and certain physiological parameters are compared with dogs that were externally rewarmed only. Measurements compared include blood pressure, heart rate, blood gases, cardiac temperature, cardiac output, MWST, and ECG. Comparison of the cardiac temperature curves indicates that the addition of airway rewarming does not improve

either the rate of rewarming or the time to start warming. The only improvement is a faster return of blood oxygen levels to normal values. The dogs with airway rewarming had a greater tendency toward abnormal ECG's on rewarming. Our conclusions are that there is no data to support the use of airway rewarming for severe hypothermia, and the use of airway rewarming may not be in the best interest of the hypothermic victim.

844.

ROBSON MC, Heggers JP.

Evaluation of hand frostbite blister fluid as a clue to pathogenesis.

J Hand Surg 6(1) :43-47; Jan 1981.

Observations on early pathophysiology of burning suggests that the release of prostaglandins and thromboxanes plays a role in dermal ischemia. Because of the similarities of the early-phase frostbite wound, blister fluids were aspirated from 10 patients with frostbite, and routine biochemical analysis, immunoelectrophoresis, immunodiffusion, and evaluation of prostaglandins E_2, $F_{2\alpha}$, and thromboxane B_2 were performed. Potassium, serum glutamic-oxaloacetic transaminase (SGOT), creatine phosphokinase (CPK), and lactic dehydrogenase (LDH) levels exceeded normal serum values. All blisters were found to have IgM, IgG, IgA, C_3a, and opsonin. PgE_2 was present in levels less than normal, but $PgF_{2\alpha}$ and TxB_2 were markedly elevated. Since the vasoconstricting metabolites of arachidonic acid, $PgF_{2\alpha}$ and TxB_2, are known to mediate dermal ischemia in burns and pedicle flaps, it is suggested they may play a role in the pathogenesis of frostbite. (Authors' abstract)

845.

ROGERS, W.H., K. Laxar and G. Moeller.

Effects of cold experience and training on administration of emergency medical treatment in the cold.

U.S. Nav. Submar. Med. Res. Lab., Rep. 939, 29p. Aug. 14, 1980.

Performance of emergency medical treatment in the cold was assessed and three methods for reducing cold-induced decrements in performance investigated. Time to complete a realistic medical treatment task developed for this experiment, as well as a standard test of manual dexterity, was significantly longer in the cold (5°F) than at room temperature. This confirms that aspects of Navy corpsmen's duties in cold weather are seriously impaired by the cold. The substantial correlation between the medical task scores and manual dexterity scores, combined with other evidence, suggests that loss of gross arm and hand dexterity accounts for much of the decrement in cold weather emergency medical treatment. Performance of both tasks significantly improved between the first two training sessions with no further improvement with practice. This one-day practice effect occurred whether practice was in the cold or at room temperature. This suggests that personnel should practice the emergency medical treatment procedures they are likely to perform in the cold, and that one training session is as effective as two or three. Prior cold exposure and prior cold training seemed to have no significant effect on cold performance. These results, however, are tentative. (From authors' abstract)

846.

ROTMAN HH (letter).

Hypothermia.

Ann Intern Med 90(2) :273; 1979.

To the Editor: In the excellent review of hypothermia in the October issue (Ann Intern Med 89 :519-527, 1978), Dr. Reuler states that "arterial blood gases must be corrected for body temperature" and that "because these values are standardly measured at 37°C, direct communication to the laboratory is necessary in order to obtain results that can be rationally interpreted and applied to management." Does Dr. Reuler intend that the laboratory measure the sample at the patient's core temperature, or simply to supply an arbitrary correction retrievable from the literature? The first possibility presents an enormous logistical problem in a busy blood gas laboratory, for to bring one or more blood gas analyzer down to the patient's core temperature would take excessive time, and each succeeding sample would be similarly delayed in analysis if the patient's temperature is being riased (which presumably is the case). If the intent is simply to apply a correction, then I have to ask whether Dr. Reuler recommends that this correction be applied equally to hypothermic and febrile patients alike. I question the need for this because everything else we do is referred to 37°C, and if we apply this correction, this neglects the decreased oxygen requirements that the hypothermia engenders and might lead to unnecessary oxygen administration with potential harm to the patient. Surely if the mixed venous P_{O_2} is maintained, auxiliary oxygen is superfluous. To me, it seems more reasonable to have all of the relevant information–arterial blood gases, mixed venous blood gases, and cardiac output–than to insist on a correction for only one of the variables.

847.

RUSCH NJ, Shepherd JT, Vanhoutte PM.

Effect of stepwise rewarming on the response of canine cutaneous veins to sympathetic stimulation.

Fed Proc 38(3 Part 1) :1228; 1979.

Abstract only. Entire item quoted: In the isolated cutaneous vein, profound cooling increases the affinity of the alpha-adrenergic receptors, depresses the contractile process and abolishes the evoked release of norepinephrine. Thus, veins cooled to 5°C maintain a response to exogenous norepinephrine, but lose their responsiveness to sympathetic stimulation. The present experiments determine the effect of small increments of temperature during electric (sympathetic) stimulation of cooled preparations. Isolated rings of canine saphenous veins were mounted for isometric tension recording. At 5°C the rings did not respond to electric stimulation; increasing the temperature to 7°C had no effect. Warming from 7 to 9, from 9 to 11 and from 11 to 13°C caused marked increases in tension; warming from 13 to 15°C augmented the contractile response during electric stimulation to a lesser extent. Further warming (up to 37°C) caused decreases in tension. These experiments demonstrate that in cold blood vessels small increases in temperature may cause the resumption of norepinephrine release, which together with the increased affinity of the smooth muscle cells for the adrenergic transmitter causes immediate constriction. The alternation of inhibition and resumption of norepinephrine release could explain the "hunting reaction" occuring in human extremities submersed in ice-cold water.

848.

RYZHAVSKY, B.Y., A.A. Zhirnova, N.F. Semenova, N.B. Murzina, Z.M. Litonyan, M.K. Zakharov, N.N. Shirokova, L.M. Melnikova and N.M. Bachaldina.

Morphofunktsionalhye dannye ob obratimosti izmenenii, voznikayushchikh pri khronicheskom kholodovom stresse.

[Morphofunctional findings of reversible changes induced by chronic cold stress].

Byull. Eksp. Biol. Med. 91(6): 657-658; June 1981.

White rats exposed to low temperatures (5-7°C) over 80 days showed a slow increase in body weight and size of liver, a lowering of liver glycogen and cholesterol, an increase in the relative weight of the thyroid gland and in the nuclei size of adrenal medulla. Also noted were a drop in the 11-HOCS blood level, a change in the mitotic phase ratio in the epithelium of the tongue and cornea, and an increase in the number of pathological mitoses in the cornea. A number of changes did not appear fully reversible after the discontinuation of exposure to low temperatures. (English abstract)

849.

RYZHIKOV GV, Rakov GK.

Effect of intensity of cooling on some systems of the body in polar building workers.

Hum Physiol (Engl Transl Fiziol Chel) 4(6) :828-834; Nov-Dec 1978.

The heat state of building workers is directly dependent on the intensity of exposure to cold. A similar relationship is found also for the level of the hemodynamics. Its immediate cause in all probability is the level of the heat state of the body in different ranges of weather conditions. Exposure to the cold factor during work leads to distinctive restoration of the hemodynamics: 1-2 min after the end of work indices equal to the original values or even below them were recorded. The level of excitability and of working capacity of the CNS of building workers also changes in accordance with an increase in the intensity of exposure to cold (Authors' conclusions)

850.

SCHAEFER KE, Wünnenberg W.

Threshold temperatures for shivering in acute and chronic hypercapnia.

J Appl Physiol 41 :67-70; July 1976.

Threshold temperatures for shivering in acute and chronic hypercapnia were determined in guinea pigs by measuring the time course of cervical cord temperature, skin temperature, oxygen consumption (VO_2) and electrical muscle activity during cold exposure (14°C). Prior to acute exposure to CO_2, the shivering threshold was determined in each animal during control conditions breathing air. With increasing CO_2 concentrations, (5, 7.5, and 15% CO_2), the shivering thresholds fell to lower temperatures, decreasing by approximately 4°C at 15% CO_2.

The shift of the shivering threshold to lower values found during acute exposure to 15% CO_2 was reversed after chronic exposure to 15% CO_2 for 3 days, which marks the time of metabolic adaptation to CO_2. (Authors' abstract)

851.

SCHAEFER O, Eaton RDP, Timmermans FJW, Hildes JA.

Respiratory function impairment and cardiopulmonary consequences in long-time residents of the Canadian Arctic.

Can Med Assoc J 123(10):997-1004; Nov 1980.

Spirometry, roentgenography and electrocardiography were performed during community health surveys in 1976-1978 in 176 Inuit and other long-time residents of the northeastern (Arctic Bay) and western (Inuvik) Canadian Arctic, and the results were related to age, ethnic origin, occupation and history of climatic exposure, smoking and hospitalization for tuberculosis. In Arctic Bay the young men showed excellent respiratory function, normal-sized pulmonary arteries and normal electrocardiograms, but abnormalities of all three types were increasingly frequent and severe after age 25. The forced mid-expiratory flow (FMF) fell to less than 50% of the norm by age 40, and dilatation of the pulmonary artery, hypertrophy of the right ventricle, right bundle branch block and a pseudoinfarction pattern on the ECG were frequently associated. In contrast, the men in Inuvik, a urbanized centre, maintained above normal respiratory function until age 40, and the FMF and pulmonary artery diameter remained normal in the older men except for Inuit and white trappers over 60 years old who had run fox trap lines along the Arctic coast in the 1920s and 30x. These data suggest that inhalation of extremely cold air at miximum ventilation may be a prime factor in the chronic obstructive lung disease of Inuit hunters, whereas smoking has only a minor role and hospitalization for tuberculosis appears to protect from rather than contribute to this disorder.(Authors' abstract)

852.

SCHISSLER P, Parker MA, Scott SJ Jr.

Profound hypothermia: value of prolonged cardiopulmonary resuscitation.

South Med J 74(4):474-477; 1981.

A patient with severe hypothermia (core temperature of 22.2°C) and ventricular fibrillation had manual cardiopulmonary resuscitation for 3½ hours while various rewarming technics raised her temperature to a level permitting successful electrical cardioversion. Laboratory testing revealed disseminated intravascular coagulation and several endocrinologic abnormalities. The need for prolonged, aggressive resuscitative measures and the possible role of corticosteroids in the management of profound hypothermia are discussed.(Authors' abstract)

853.

SCHLARB K.

Kontinuierliche epiduralblockade bei erfrierung der unteren extremitäten.

[Continuous epidural blockade for frostbite of the lower extremities].

Anaesthesist 29(6):339-340; Jun 1980.

We describe the case of a patient suffering from freezing of the lower extremities, for which continuous epidural-blockade, over a period of four days, was conducted. By this means it was possible to relieve the vessel-spasm caused by the freezing and the patient was spared bilateral upper-thigh amputation. As the lower extremities are concerned in many case of freezing, a continuous epidural-blockade as described here, seems to be the therapy to choose.(Author's summary)

854.

SCHMID-SCHOENBEIN H, Klose HJ, Volger E, Weiss J.

Hypothermia and blood flow behavior.

Res Exp Med 161 :58-68; 1973.

The microrheology and bulk viscosity of whole blood, erythrocytes and erythrocyte aggregates was examined at temperatures between 37 and 4°C. Beside the well established increases of blood and plasma viscosity at high rates of shear, a specific increase of blood (not plasma) viscosity at low rates of shear is seen below 20°C. This increase is not seen in non-aggregating blood samples (red cells in isotonic albumin solution). At the same temperature and shear rate range, a strong increase in the tendency to aggregation is regularly observed. The shear stresses necessary to keep red cell aggregates dispersed in flow increase from 3 (at 37°) to 10 dynes/cm^2 (at 4°C). The deformability of the cells as tested by their ability to pass 5 μm pores is, however, not abolished by lowering

temperatures. These in vitro results give strong support to the notion that the microcirculatory disturbances seen in response to hypothermia in vivo are indeed related in part to increased tendency to red cell aggregation. (Authors' summary)

855.

SCHMIDT, V. and K. Brück.

Effect of a precooling maneuver on body temperature and exercise performance.
J. Appl. Physiol. 50(4):772-778; April 1981.

Twelve subjects exercised to exhaustion at an ambient temperature of 18°C on a bicycle ergometer with the load being stepwise increased. On one day, exercise was preceded by a precooling maneuver. In the precooling tests, deep body temperature attained values of about 1°C lower than in the control tests. There was no indication of metabolic cold defense reactions being evoked throughout the exercise period. In the precooling tests, heart rate was significantly lower than in the controls, but the mean maximum work rate, peak oxygen uptake ($\dot{V}O_2$), time to exhaustion, and total work were not reduced, i.e., work rate and $\dot{V}O_2$ were increased for a given heart rate. In the three subjects with the lowest maximum work rates, total work and exhaustion time and, in two cases, maximum work rate were increased after precooling. The onset of sweating occurred at higher work rates but at lower core, mean skin, and mean body temperature after precooling. However, the accumulated sweat secretion was considerably smaller after precooling, indicating less thermoregulatory effort. (Authors' abstract)

856.

SCHNEIDER V, Klug E.

Death by hypothermia. Are there any new diagnostic aspects?
Z Rechtsmed 86(1):59-69; 1980.

The report concerns seven cases of death by undercooling which have been investigated this year. The hemorrhaging of muscles in the core of the body (*M. Iliopsoas*) as described by Dirnhofer and Sigrist was found once, this supposedly being a "relatively specific vital sign." In every case it was possible to detect punctiform hemorrhaging of the gastric mucous membrane which according to Unterhofer is decisive when diagnosing death by hypothermia. Furthermore, it was always possible to detect higher acetone values, especially in the urine. This finding could possibly be significant for the diagnosis (death by undercooling). The acetone value is simply a secondary finding when the amount of alcohol is determined by gas chromatography.(Authors' translation)

857.

SCIDA EE, Arredondo MT, Armayor MR, Clavin OE, Valentinuzzi ME.

Body hypothermia decreases transventricular simple capacitor discharge defibrillatory thresholds.
Fed Proc 38(3 Part 1) :1228; 1979.

Abstract only. Entire item quoted: Each mongrel dog was surrounded with ice while monitoring rectal temperature with a thermometer and venous blood temperature with a thermistor inserted in a jugular vein and connected to a Physiograph recording channel (Narco Bio-Systems). Blood temperature reached values as low as 22-23°C. The rest of the procedure was similar to that described in a previous study (Armayor et al., Digest ISWEME, Delhi, India, Febr 1978, p. 146). Over a total of 20 dogs and 260 successful defibrillations, the average peak current threshold was 0.64 A/kg (SD = 0.25). Instead, the value obtained under euthermic conditions in the above-mentioned study (Armayor et al., 1978) over a group of 20 dogs (346 defibrillations) was 0.82 (SD = 0.30). The unpaired t-test gave a significant difference ($p < 0.1\%$) between means. Linear regressions of I(A/kg) on T(°C) were calculated for each hypothermic dog along with the analysis of variance. The levels of significance for the f-test were distributed as follows: 16 dogs, $p < 1\%$; 2 dogs, $p < 5\%$; 1 dog, $p < 10\%$; 1 dog, $p < 25\%$. The overall regression equation was I = 51.4 + 39.9T, in mA/kg, SEE = 19.3, r = 0.642. Individual correlations were: .473/.511/.529/.614/.645/.675/.700/.720/.749/.79./.823/.836/.839/.875/.902/.911/.913/.934/.953/.990/. In conclusion: peak current defibrillatory threshold was significantly reduced.

858.

SEITZ HJ, Krone W, Wilke H, Tarnowski W.

Rapid rise in plasma glucagon induced by acute cold exposure in man and rat.
Pfluegers Arch 389(2) :115-120; Jan 1981.

The effect of acute cold exposure on the concentration of glucagon in the blood was investigated in man and in intact and adrenalectomized rats. In man fasted overnight acute cold exposure, which caused a twofold increase

in O_2-consumption resulted in a rapid rise in plasma glucagon. The levels of insulin and blood glucose remained unaltered, while the concentration of serum free fatty acids and β-hydroxybutyrate increased. In fasted intact rats acute cold exposure lead to similar effects. A close parallelism between the rise in plasma glucagon and the concentration of hepatic cycloAMP was observed. Adrenalectomy did not impair the cold induced rise in plasma glucagon and hepatic cycloAMP. It is concluded that acute cold exposure caused a rapid rise in the concentration of plasma glucagon leading to an increase in the concentration of hepatic cycloAMP, thus enhancing the rate of hepatic gluconeogenesis and ketogenesis. As these alterations were similar in the absence of glucocorticoids and medulla-derived catecholamines, it is suggested that glucagon may play a role in the metabolic adaptation to acute cold exposure. (Authors' abstract)

859.

SHEA ML, DeBell RM, Bondi KR, Margulies RA.

Drugs exposed to extreme cold: the military perspective.

Nav Submar Med Res Lab Rep NSMRL 963, 13p. Nov 1981.

By identifying the changes in the pharmaceutical properties of drugs exposed to extreme cold, valuable information can be learned about the requirements for storing drugs properly in cold environments to maximize the effectiveness of medical support. A list of drugs identified as being damaged by freezing (68 of 153 items) was excerpted from the 668 Authorized Medical Allowance List (AMAL). Freeze/thaw stability data was obtained from both the literature and innovator drug companies for over one half (45 of 68) of these items. A summary of recommendations for use in cold operations of these 68 items was prepared. Recommendations ranged from conservative (in those cases where no information was available) to liberal (where drug companies were concerned with efficacy). Recommendations also included the substitution of some items on the list with drugs of similar action but not needing freeze protection. (Authors' abstract and summary)

860.

SHEEHAN ME, Brauer RW.

Implications of changes in temperature perception and temperature regulation in high pressure heliox oxygen environments.

In: Cox B, Lomax P, Milton AS, Schoenbaum E, eds. Thermoregulatory mechanisms and their therapeutic implications: Fourth international symposium on pharmacology of thermoregulation, Oxford, England, July 30 - Aug 3, 1979, p 232-237. Basel, etc., S. Karger, 1980.

The problems of temperature regulation in high pressure environments, and of changes in thermal perception in these environments, for the mouse, the squirrel monkey, and man are examined. Data from various experiments indicate that in the euthermal interval, temperature distribution within the animal is very different at high pressures than in low temperature environments. Hypothalamic responsiveness was measured and found to increase sharply as pressure increased. Skin temperatures did not vary with pressure. Changes in ambient pressure also seemed to be related to changes in oxygen consumption – at low to moderate pressure, metabolic rate increases virtually linearly, whereas at high pressure, the correlation breaks down and oxygen consumption even shows a decrease when pressure is sufficiently high to cause convulsions. The authors inferred that the compression-induced increase in metabolic rate reflects some basic effect of pressure, rather than being secondary to responses to the environment as such, and further that one reason for the changes might be the large energy requirements of sodium ion transport between the cells and the surrounding fluid. Various hypotheses for the likelihood of the sodium ion are advanced. (LET/UMS)

861.

SHILLING CW (ed).

Hypothermia – research planning meeting.

Bethesda, MD, Undersea Medical Society report to Office of Naval Research (Grant No. N00014-82-G-0023), 35p. Mar. 25, 1982.

This is a report of a research planning meeting held at UMS headquarters on Dec. 3, 1981, to develop a protocol for studying the treatment of hypothermia. The main groups at risk were identified: the three U.S. military services and the Coast Guard; the U.K. and Canadian military; the elderly in inadequately heated homes; the inebriated exposed to cold, and accident victims in the cold. Attendees at the meeting, who represented the military, government agencies and university and industrial laboratories, agreed on these terms to differentiate the types of hypothermia – acute, chronic and urban. To gather data on hypothermia victims, two questionnaires will be developed and circulated to Emergency Medical Technicians and emergency room physicians; patients in "profound" hypothermia will be reported on further by hospital staff. A plan of action for the

research effort consists of five parts, the planning conference covered in this report, a literature review that will update the UMS bibliography "Man in the Cold," data gathering using the questionnaires mentioned above, data analysis, and final publication of the results. (LET/UMS)

862.
SIPLE PA.

Living on the south polar ice cap.
In: Cold Injury. New York, Josiah Macy Jr Foundation, 1960, p 89-115.

Living conditions at the Amundsen-Scott IGY South Pole Station are described. In a panel discussion, the following topics are addressed: buildings and inside temperatures, clothing, endurance of cold exposure, acclimatization, medical problems, the utility of various clothing items, effects of hard work under cold conditions, and experiments in cold endurance. Among the health problems occurring under Antarctic conditions were weight loss, aching joints, and continuous upper respiratory infections. Respiratory infections were highly contagious and symptoms were aggravated by cold exposure. (RW/UMS)

863.
SMITH RM.

Cardiovascular functions during saturation diving.
In: Hong, SK, ed, International symposium on man in the sea, Honolulu, July 1975, p IV-122 - IV-126, Bethesda, MD, Undersea Medical Society, Inc, 1976.

A literature review of cardiovascular functions during saturation diving suggested that the often reported hyperbaric bradycardia is complex, with possible 1) hyperoxic, 2) pressure (or inert gas), 3) gas density, and possibly, 4) cold effects. Preliminary data from 580 ft dry saturation dive relevant to the gas density and cold effects are discussed. It appears that cold is not a major contributor to bradycardia at depth. However, a literature survey of the effects of altered respiration due to increased gas density at pressure suggested two mechanisms by which increased gas density may contribute to hyperbaric bradycardia: 1) slightly prolonged expiration may augment the normal sinus arrhythmia and 2) larger lung volumes at depth may lead to a more negative intrathoracic pressure with increased venous return. Esophageal pressure (P_{es}) measurements in one subject during decompression from 580 ft confirmed that P_{es} is more negative at depth. Thoracic impedance plethysmography in four subjects undergoing compression to 580 ft confirmed an increase in thoracic blood volume at depth, which was associated with an increased stroke volume, bradycardia, an increased urine flow, and a mild dehydration. It is suggested that these cardiovascular and body fluid alterations at pressure are primarily the result of the altered respiratory pattern due to breathing a dense gas. (Author's summary)

864.
SOCKS, J.F.

Use of contact lenses for cold weather activities.
U.S. Nav. Submar. Med. Res. Lab., Rep. 969, 7p. Dec. 1981.

Military personnel are stationed in a wide range of geographical locations, many having adverse climates. Little is known about the effects of extreme cold on the cornea and on the ability to wear contact lenses. A survey was taken of contact lens wearers who commonly wear their contacts while engaged in outdoor activities. No serious problems were reported. Redness of the eyes was the most common complaint of hard lens wearers, and soft lens wearers most frequently complained about decreased vision. Contact lenses were generally comfortable in the cold, but lens care is difficult. Contact lenses offer an important advantage over spectacles in that they do not fog. (Of the 105 sportsmen and women surveyed, no divers were included. However, the conclusions as to comfort of contact lenses in the cold bear some relevance to their comfort in cold water. The special care required for contacts, however, would pose a problem to divers in undersea habitats.) (Author's abstract modified by LET/UMS)

865.
SOCKS JF.

Contact lenses in extreme cold environments: Response of rabbit corneas.
Am J Optom Physiol Opt 59(4):297-300; Apr 1982.

Contact lenses are worn by many individuals in military and civilian populations. Anecdotal reports have described contact lenses "sticking" and "freezing" to the eye during extreme cold conditions. However, some articles indicate the advantages of wearing contact lenses in cold environments. Military operations frequently

take place in cold regions; therefore, we need to know whether contact lenses can be worn safely in extreme cold. Rabbits were fitted with hard (polymethyl methacrylate) contact lenses and exposed to -28.9°C temperatures with winds up to 78 mph (125 km/hr) for 3-hour periods. The wind-chill factor in these conditions exceeded -68.8°C. No effects of the cold or contact lenses were seen in 85% of the eyes. A few of the eyes, both with contact lenses and without, showed mild superficial fluorescein staining of the cornea which cleared within a few hours after exposure. Histologic examination of the corneas revealed no abnormalities attributable to the cold. Inasmuch as this study showed that rabbits wearing contact lenses in extreme cold suffered no acute deleterious effects to the eyes, the research can be expanded to include human subjects.(Author's abstract)

866.

SOUNG LS, Swank L, Ing TS, et al.

Treatment of accidental hypothermia with peritoneal dialysis.
Can Med Assoc J 117 :1415-1416; 1977.

The successful treatment of an accidental hypothermia victim with peritoneal dialysis is reported. The patient was found sleeping in a neighbor's yard after consuming a large amount of alcohol. The outdoor temperature was -8°C. The patient had a rectal temperature of 28°C, was semicomatose, and had decreased reflexes, stiff muscles, shallow breathing, regular heartbeat, and a blood pressure of 110/70 mm Hg. The patient was wrapped in blankets but no active external means of rewarming were applied. Twenty minutes after admission the rectal temperature had failed to rise and the blood pressure had fallen. Peritoneal dialysis was begun with exchanges of 2 liters of dialysate warmed to 38°C every 30 minutes. One hour after initiation of dialysis, the patient became alert and rectal temperature increased to 33°C. Two hours later the temperature reached 37°C and dialysis was continued for another 5 hours. Rapid external rewarming and other internal methods such as hemodialysis may be too risky in the face of hypotension. The patient's prompt response to peritoneal dialysis indicates that it is the preferable treatment for patients with profound hypothermia and an unstable cardiovascular system. (RW/UMS)

867.

SOUNG LS, Ing TS (letter).

Treatment of accidental hypothermia with peritoneal dialysis.
Can Med Assoc J 118:764-769; 1978.

The authors thank Dr. Bristow (Can Med Assoc J 118:764, 1978) for bringing their attention to two excellent articles on the treatment of accidental hypothermia with peritoneal dialysis and agree that the availability of peritoneal dialysis, hemodialysis and partial cardiopulmonary bypass may have regional variation. They concede to modify their statement to read: "Peritoneal dialysis, hemodialysis and partial cardiopulmonary bypass are all relatively simple methods of internal rewarming that are readily available in most large hospitals." They suggest that where a number of core rewarming procedures are also available, the therapy of choice is at present unknown and studies should be conducted. For hemodialysis, they suggest a procedure that could be easily performed. (EP/UMS)

868.

SOUTHWICK FS, Dalglish PH Jr.

Recovery after prolonged asystolic cardiac arrest in profound hypothermia.
JAMA 243(12) :1250-1253; Mar 28, 1980.

Asystole can be the presenting ECG finding in accidental hypothermia when the core temperature is less than 28°C. Even two hours of persistent asystole does not represent irreversible cardiac compromise. With cardiopulmonary support and active rewarming, resuscitation and survival without serious sequelae can be achieved. Case reports and elctrophysiology studies suggest that asystole is a primary manifestation of hypothermia potentiated by carbon dioxide retention. However, ventricular fibrillation in this setting is probably a secondary complication of resuscitation efforts, being precipitated by hypocapnic alkalosis, physical manipulation of the heart, and rewarming. (Authors' abstract)

869.

STANG PR, Wiener EL.

Diver performance in cold water.
Hum Factors 12 :391-399; Aug 1970.

Twelve experienced divers repeatedly performed several representative underwater work tasks for 90-min. ses-

sions at water temperatures of 50° 60° and 70°F. Time to complete the task was the primary performance measure; choice reaction time, with mental arithmetic as loading task and four physiological measurements were also recorded. The subjects worked in 6½ ft of water wearing full 3/16 in. thick wet suits and SCUBA equipment. Performance on all tasks except mental arithmetic tended to decrease as water temperature decreased. Most performance measures also showed a significant decrement over time and a significant time-by-temperature interaction. The general trend in performance measures was also reflected in several of the physiological measurements. (Authors' abstract)

870.

STEINMAN AM.

Accidental hypothermia.

In: Proceedings of NASAR Conference, Sept 13-16, 1979, Baton Rouge, LA, 6 p, 1979.

Accidental hypothermia is a frequent complication of injuries occurring in wilderness environments. In the absence of a low-reading rectal thermometer, a rough estimate of core temperature can be made from assessments of shivering response, mental state, and vital signs. During rescue, the victim should be handled gently and avoid exertion. Emergency treatment of the hypothermia victim should begin as soon as possible because temperature can continue to drop after rescue. Resuscitation requirements include maintenance of adequate cellular respiration, minimizing additional heat loss, restoration of normal body temperature, restoration of normal body homeostasis, and treatment of other medical problems. (RW/UMS)

871.

STEWART S, Tainter S.

Hypothermia: What is is - what you can do.

Upwellings 3(4) :9-12; 1979.

(Michigan Sea Grant - Ann Arbor, MI)

The identification, prevention, and immediate treatment of accidental hypothermia are described. Hypothermia can be categorized into two types depending on length of exposure: chronic or long-onset hypothermia developes with exposures greater than 12 hours while acute hypothermia is usually the result of sudden immersion in cold water. Hypothermia may be recognized by violent shivering, muscle spasms, mental disorientation, and loss of consciousness. The victim should be rewarmed in a way that minimizes after-drop. If the victim must be rewarmed in the field, body heat should be supplied by the rescuers. Prevention of hypothermia depends upon proper dress and nutrition, the use of personal flotation devices, and knowledge of water safety practices. If a water accident does occur, victims can minimize heat loss by huddling or assuming the heat escape lessening posture. Swimming for shore is risky and should not be attempted unless there is no other chance for rescue. Many people rescued from cold water appear to be dead but can be revived without permanent damage. In such cases, cardiopulmonary resuscitation should be administered until the victim is under medical care. Apparent cold water drowning victims should not be rewarmed but further heat loss should be prevented. (RW/UMS)

872.

STONE EA.

Behavioral and neurochemical effects of acute swim stress are due to hypothermia.

Life Sciences 9(15, Pt. 1) :877-888; 1970.

Rapid rewarming of rats swum in 15°C water reverses the hypothermia, behavioral inactivity, shivering, and eye closure produced by the swim. Rewarming also reverses the reduction in brain NE concentration, the increased retention of H^3-NE and specific activity that have been observed after swim-stress. Forced swimming for comparable periods in 37°C water produces neither behavioral nor central noradrenergic changes similar to those seen after cold water swim. The behavioral and neurochemical effects of the stress are therefore produced by phenomena occurring during hypothermia. Swim-stress in cold water interferes with the depleting actions of both α-MT and reserpine on brain NE and DA, supporting a previous suggestion that this stress decreases the synthesis and utilization, while increasing the binding, of brain NE. The extent to which the neurochemical effects of the stress are the direct result of lowered brain temperature or a response to stimulation of cold receptors is not known but can be determined by methods discussed. The behavioral state seen during hypothermia in the naive rat may be similar to withdrawl reactions seen in primates and humans after severe psychological stress. (Author's summary)

873.

STRAUSS, M.B.

Survival in cold water.

In: International Society on Disaster Medicine. Third International Conference, Monaco, April 6-9, 1979, 3p. Published by the Society, 1980.

The body's heat conserving mechanisms, which can greatly prolong survival in cold water, are described. Tolerance to cold water is also enhanced by extrinsic factors such as exposure suits and rewarming devices. The author relates a recent study of the effectiveness of neoprene wet suits which exposed eight U.S. Navy divers wearing these garments to water temperatures of 6°C for four and six hour periods at depths of 3 to 5 msw. The suits were individually tailored neoprene nylon-one wet suits, thicker around the trunk than around the extremities, with similar mittens and booties. Mean core temperature declines were found to be surprisingly small and the divers' mean core temperature was .1°C warmer after the six than after the four hour dive, but this reflected a higher starting temperature. This suggested that body heat is stored, and that the neoprene wet suit effectively conserved heat. Further, psychological conditioning to cold water appeared to occur quite rapidly. The divers found that the resting state (sitting position termed HELP, or heat exchange lessening posture) promoted the body's own thermal conservation. (LET/UMS)

874.

STRAUSS, M.B. and W.S. Vaughan, Jr.

Rewarming experiences with hypothermic scuba divers.

In: Program and abstracts, Undersea Medical Society annual scientific meeting, May 25-29, 1981. Undersea Biomed. Res. 8 (1-Suppl.): A30; Mar. 1981.

Abstract only. Entire item quoted: Twenty U.S. Navy combat swimmers exposed to 4.5°C water at 2 to 5 meter depths in wet submersible operations of 4 to 6 hour durations were studied. Core temperatures were measured with temperature sensitive endoradiosonde pills. End exposure core temperature declines ranged from 0.3°C after 4 hour exposures to 1.4°C after six hour exposures. Rewarming was by immersion in 40°C water or exposures to 38°C air after wet suit removal, drying, and donning a cotton sweat suit and wool blanket. Mean temperature afterdrops during rewarming in water measured 0.1°C, 0.3°C, and 0.4°C after the 4, 5, and 6 hour exposures respectively. The nadir temperature afterdrop occurred ten minutes after rewarming commenced. Core temperatures returned to normal between 35 and 40 minutes after rewarming began. Mean core temperature decline after 5 hour exposures with an hour surface interval at hour 3 was 0.4°C. The mean core temperature afterdrop whether rewarmed in hot water or hot air in this scenario was 0.5°C. The nadir temperature occurred after 13.1 min in water and 14.6 min in air ($p > 0.01$). Time to reestablish normal body temperature averaged 31 min after rewarming in water and 52 min in air. These differences were highly significant ($p < 0.005$). Conclusions: 1) Core temperature afterdrops occur consistently during rewarming of immersion-induced hypothermic subjects. 2) The nadir afterdrop temperature occurs approximately 15 min after rewarming commences whether rewarmed in water or air. 3) Temperature afterdrop is no greater during rewarming in air than water. 4) Reestablishment of core temperatures to normal takes 1.67 times as long in air as water. 5) Subjectively, the subjects felt warm and comfortable shortly after the nadir temperature afterdrop occurred, but long before normothermia.

875.

STUART D, Ott K, Ishikawa K, Eldred E.

The rhythm of shivering: 1. General sensory contributions.

Am J Phys Med 45(2) :61-74; 1966.

The relationship between general sensory inflow and the shivering response was investigated. Human experiments involved immersion in waist-deep 5°C water while animal experiments involved feline exposure to brief immersions or to a cold room. The cats were administered various surgical operations to produce different kinds of sensory loss before participating in the experiments. Results indicate that local sensory inflow is not needed for shivering, for although deafferentation leads to marked deterioration of the regularity and vigor of the tremor, rhythmic activation of motor units in the deafferented musculature is still evident in favorable preparations. The presence during paralysis of some rhythmic activity in ventral root outflow of the cooled animal demonstrates that the neuraxis itself has some capability to oscillate independent of rhythmic sensory inflow. It is suggested that regional differences in the spinal cord itself in local sensory inflow, and in resonant properties of the body parts probably combine to determine the distinctive tremor at particular segment levels. (RW/UMS)

876.

STUART D, Ott K, Ishikawa K, Eldred E.

The rhythm of shivering: 2. Passive proprioceptive contributions.

Am J Phys Med 45(2) :75-90; 1966.

The contributions made by mechanical resonance and proprioceptive regulation to the shivering tremor were investigated. Human experiments involved immersion in waist deep 5°C water while animal experiments involved feline exposure to brief immersions or to a cold room. The cats were administered various surgical operations to produce different kinds of sensory loss before participating in the experiments. Results indicate that adding or subtracting weight from a limb or reducing resistance to its movement causes intimately related changes in the limb's resonant response to contractions and in its reflex responses to the altered sensory input. Mechanical factors such as elastic and viscous forces may greatly influence the frequency and amplitude of shivering. Change in tremor rate with simple loading gives direct evidence of reflex effect of the loading since the dominant tremor rhythm seemed always to be correlated with bursts of EMG activation in major muscles. It is suggested that activity over proprioceptive pathways may act centrally to affect in modest degree the threshold, frequency, and strength of shivering contractions. (RW/UMS)

877.

STUART D, Ott K, Ishikawa K, Eldred E.

The rhythm of shivering: 3. Central contributions.

Am J Phys Med 45(2) :91-104; 1966.

Neural and mechanical contributions to the rhythmicity of shivering have been studied in the cat and human. A variety of experimental approaches were employed and the results presented in three closely related papers. The importance of general sensory inflow was shown by deterioration in rhythmicity following deafferentation procedures. However, some residual rhythmicity of the hind limbs was detectable with unilateral or bilateral lumbosacral deafferentation and was even evident in peripheral nerve or ventral root activity of totally paralyzed and cooled animals. There was a suggestion that the spinal cord was reflexly more sensitive to rhythmic sensory influence when cooled. Experiments in which preferential deafferentiation of muscle or skin was made in cats revealed that proprioceptive inflow was particularly important in maintenance of the shivering tremor. Further influence of the proprioceptors was seen in the effects of loading on the shivering of limbs and isolated muscles. The related factor of resonance or mechanical translation of the tremor into limbs and soft tissues was also studied. Resonant frequencies capable of reinforcing the tremor were found. The presence of a rhythmic central influence descending from supraspinal levels to drive shivering at all levels was considered unlikely in view of variations in tremor rates in different parts of the body. Similar considerations implied that the stretch reflex loop could not be the primary determinant of tremor periodicity. Yet changes in rhythm rate induced locally by loading, and evidence of fusimotor contributions obtained from the effects of reinforcement maneuvers and procaine block of fusimotor axons in muscle nerves, showed that proprioceptors influence threshold and rate of shivering. Tonic fusimotor innervation was not essential since shivering persisted in cats at levels of barbiturate anesthesia sufficient to fully suppress fusimotor activity. It was concluded that under experimental conditions, the contributions to the shivering tremor of general sensory inflow, proprioceptive input, mechanical factors and central influences could be recognized and each even shown to be essential. In the intact animal and human the rhythmicity of shivering would appear to involve a complex yet smooth interaction between all these contributions. (Authors' summary)

878.

SU JY, Amory DW, Sands MP, Mohri H.

Effects of circulatory arrest and rewarming on regional blood flow during surface-induced hypothermia.

Am Heart J 100:332-340; 1980.

Regional blood flow and distribution of cardiac output (CO) were evaluated by the radioactive microsphere technique in rhesus monkeys during surface rewarming following the induction of deep hypothermia (20°C) under deep ether anesthesia. A comparison of animals subjected to 30 min of circulatory arrest and those not arrested revealed cerebral, coronary, and renal vascular resistance and flow patterns consistent with a hyperemic response to circulatory arrest at 20°C. Throughout rewarming cerebral and coronary absolute flows tended to be at or above the flows noted at comparable cooling temperatures in a previous study. Rental flow fraction (% Qt) were well preserved during rewarming to 30°C, but a decrease was observed thereafter. Carcass (muscle, skin, bone) %Qt was also reduced following rewarming, especially in arrested animals. CO appeared to be similar to

those noted at comparable cooling temperatures until 30°C during rewarming; thereafter, CO did not fully recover to awake control levels. These data suggest that regional flow is redistributed from the carcass and renal circulations to cerebral and coronary circulations in response to hemodynamic alterations during surface rewarming. It was concluded that autoregulative responses to both circulatory arrest and hemodynamic factors are elicited during surface rewarming from deep hypothermia to 20°C with the method described. (Authors' summary)

879.

SULLIVAN A.

Intraperitoneal lavage is mountain EP's standby for hypothermia.
Emergency Department News: 15; 1981.

The rescue procedures employed by an internist who specializes in treating hypothermia patients are described. The internist has developed an intraperitoneal dialysis approach that injects fluid heated to 110°F into patients suffering from hypothermia. This approach has been successfully used for 11 patients, all with body temperatures of between 78 and 90°F. In addition to the injection of heated fluid, the internist recommends gentle patient handling to prevent ventricular fibrillation. It is noted that most hypothermia deaths are caused by ventricular fibrillation. It is also recommended that if a patient's rectal temperature falls below 90°F, the patient should be considered hypothermic but rewarming therapy should not be attempted outside a hospital. (RW/UMS)

880.

SUTTON JR (letter).

Heat stroke or hypothermia?
Br Med J 1(6174) :1355-1356; May 1979.

Heat stroke from distance running is common in hot, humid weather, but just as common is hypothermia when races are held on cold, damp days. The author cautions that runners are very vulnerable to the environmental conditions of race day. Hypothermic incidents usually occur due to exhaustion and inadequate or wet clothing in a cold, windy environment. Appropriate emergency medical preparations should be taken for the conditions of the day and the medical staff should be aware of the differences in diagnosis between heatstroke and hypothermia. (CDR/UMS)

881.

SUZUTANI T, Ishibashi H, Endo M.

Studies on medico-legal diagnosis in cold district. 3. Autopsy findings of the victims of cold exposure.
Hokkaido Igaku Zasshi 54(4):335-339; July 1979.

The authors have investigated the autopsy findings of 8 bodies died from cold. The conclusions are as follows: pink color of the blood in the left ventricle or the pulmonary veins, pink color of the lungs and pink patches of the skin are fairly pathognomic findings of death from cold. Seven out of eight bodies presented at least one of these findings. Subserous or submucous hemorrhage is less pathognomic and has been presented less frequently. (Authors' translation)

882.

SWAN H, Zeavin I, Holmes JH, Montgomery V.

Cessation of circulation in general hypothermia. I. Physiologic changes and their control.
Ann Surg 138: 360-376; 1953.

Observations on the changes occurring in certain physiologic variables in many dogs and three humans undergoing general hypothermia with and without circulatory arrest are presented. These include data on pH, serum sodium, chloride, potassium and phosphorus, plasma protein and hematocrit levels. Total body water, extracellular fluid space and blood volume changes are recorded. Urinary output of some of these materials was also determined. Dogs were cooled in ice water to temperatures between 20° and 25°C. No cardio-circulatory drugs were used. Hypothermic dogs undergoing circulatory arrest by occlusion of cardiac inflow for 15 min were routinely subjected to auricular cardiotomy during this period. Serum sodium levels remain constant; serum chlorides show a consistent slight rise during the experiment. Blood volume tends to decrease, but the change is not excessive and is proportionate to a moderate overall loss of body water. Since ventricular fibrillation is the chief cause of death in the hypothermic dog, aberrations of physiology which might affect this complication were sought. Blood pH and potassium both appear to be of importance. Since adequate spontaneous respirations cease in hypothermia, a choice of rate and depth of artificial respiration must be made. Data are presented which suggest that ventri-

cular fibrillation may be initiated by sudden rises in pH from abnormally low levels, and that this stimulus to fibrillation may be avoided by vigorous hyperventilation throughout the cooling period. Contrary to observations by previous investigators, our studies consistently revealed a fall in the serum potassium during cooling. It appears there is a shift of this ion from the extracellular fluid space during this period, possibly into body cells. Although the significance of this change is not yet clearly understood, the use of a potassium solution as an agent to defibrillate the cold heart has proved successful, whereas previously all other methods have been unavailing in our hands. (Authors' abstract)

883.

TACKER WA Jr, Babbs CF, Abendschein DR, Geddes LA.

Transchest defibrillation under conditions of hypothermia.

Crit Care Med 9(5) :390-391; 1981.

The purpose of the study was to determine whether or not hypothermia changes ventricular defibrillation threshold. Ten dogs were anesthetized with intravenous pentabarbital and fir fibrillation was produced by a 5-sec burst of 60 Hx current of the right ventricle. Four temperatures were used at which defibrillation thresholds were measured, normal body temperature (37°C) and 3 hypothermic temperatures (32, 27, and 22°C). Threshold energy increased 2.5%/°C decrement of body temperature, while the current remained reasonably constant. The change in threshold energy with temperature with a constant current indicates a change in impedance. The study shows that the dose for defibrillation for hypothermic patients be the same as normothermic ones, since the energy threshold increase is slight as to have no practical effect on clinical defrbillation dose. (EP/UMS)

884.

TALBOTT JH, Consolazio WV, Pecora LJ.

Hypothermia. Report of a case in which the patient died during therapeutic reduction of body temperature, with metabolic and pathologic studies.

Arch Intern Med 68: 1120-1132; 1941.

Morphologic and metabolic data are reported for a patient who died during experimental hypothermia. The patient had suffered from schizophrenia for more than ten years but was physically sound. During hypothermia a minimum rectal temperature of 80°F was observed. The temperature remained below 98°F for fifty h. During restoration of temperature external heat was applied too rapidly. Cardiovascular collapse ensued, and death followed shortly. An autopsy was performed four h later. The significant anatomic findings included patchy bronchopneumonia, slight degeneration of the cortical cells of the brain and a small adenoma of the pituitary gland. It is believed that none of the morphologic changes was independently responsible for death. In retrospect it is thought that sudden vasodilatation was responsible for the cardiovascular breakdown. This change was aggravated by a combination of sluggish circulation, bronchopneumonia, impaired gas exchange in the lungs, acidosis and diminished glomerular filtration in the kidneys. Death, therefore, was produced by functional, rather than anatomic, disturbances. It is concluded that prolonged hypothermia is without serious morphologic effect on normal tissue. (Authors' abstract)

885.

TANCHE M.

The adrenal gland and thermoregulation.

Isr J Med Sci 12(9) :1019-1025; 1976.

The adrenal glands are involved in thermogenesis during acute cold exposure. There is a general interrelationship between corticoids, catecholamines and thyroid hormones. Normal thermogenesis requires the participation of the adrenal glands. Acute cold exposure is a special kind of stress, but the effects of adrenaline are different with respect to circulatory and cellular mechanisms in warm or cold environments. (Author's summary)

886.

TAYLOR IM.

Medical experiences at McMurdo Sound.

In: Cold Injury. New York, Josiah Macy Jr Foundation, 1960, p 117-139.

The 1955 experiences of the medical officer at an Operation Deep Freeze Antarctic camp at McMurdo Sound are recounted. Following a description of camp construction, and living conditions, and climatic conditions, a panel discussion was conducted on such topics as the effect of cold on injury healing, winterizing medical supplies, medical staff qualifications, water and supplies and sanitation, treatment of fractures, incidence of

injuries, insomnia and other psychiatric problems, the effectiveness of beards in protecting faces from frostbite and heat loss, acclimatization to altitude, upper respiratory problems, and the difficulty of administering first aid outdoors under Antarctic conditions (RW/UMS)

887.

THERMINARIAS A,, Chirpaz MF, Lucas A, Tanche M.

Calorigenic effect of insulin in hypothermic dogs.

J. Appl Physiol 47(20):342-346; Aug 1979.

In dogs acutely immersed in cold water (8-13°C), oxygen uptake increased approximately sevenfold and colonic temperature rapidly began to decrease. Fifteen minutes after the start of immersion a high level of hyperglycemia was found but no increase in immunoreactive plasma insulin level was observed. Under these conditions exogenous insulin (0.3 $U.kg^{-1}$) induced a further increase in oxygen uptake and in shivering intensity whereas a decrease in the fall of colonic temperature was observed. It can be concluded that insulin may have a calorigenic effect and improve the resistance to cold of dogs exposed to an acute cold stress.(Authors' abstract)

888.

THORNTON, A.G.

Potential of passive methods for protection of divers.

In: Society for Underwater Technology. Proceedings, International Conference "Divetech '81," Workshop A, London, Nov. 24-26, 1981, 6p. Published by the Society, 1981.

The provision of thermal protection to divers by passive means is particularly attractive, as the systems require no external energy supply to be carried or transmitted along an umbilical, and are inherently fail safe. The main routes for heat loss are from the body surface and through the respired gas; passive systems can help reduce losses by both routes. The paper presents a review of the typical thermal loads that divers would experience for several scenarios, assesses the degree of protection afforded by present protective clothing, and considers the improvements that could be made with new undersuit materials and respiratory heat exchangers. It appears possible to reduce losses through underclothing by at least 50% by the use of new materials, and to reduce respiratory losses by a similar factor. The ability of purely passive systems to provide adequate thermal protection for the earlier scenarios is considered. (Author's abstract)

889.

TIKHOMIROV II.

Acclimatization in the polar regions as a complex physiological-hygienic problem.

Vest Akad Med Nauk SSSR (8):72-77; 1978.

The problem of acclimatization has become very important in connection with intensive economic development of new scarcely populated regions of this country and migration of large masses of people. Acclimatization of man does not imply only a mere survival of the individuum and preservation of the species but it also includes the necessity of carrying out creative work. Hence, acclimatization of man is not only a physiological process of adaptation, but a sociohygienic one as well, in which a deliberate purposeful training of the body and active creation of favourable conditions are of importance. A proper degree of isolation from the effects of the external surrounding under extreme conditions is necessary in order to avoid, on the one hand, delicacy and detraining of the organism and on the other one—excessive noxious influences of the environment. Along with improvement of the systems of life support and solution of a number of hygienic problems (nutrition, clothes, housing, etc.) new problems have arisen. Some peculiarities of physiological reactions of the organism demonstrate that in the process of acclimatization of man the biological and sociohygienic aspects are closely intervened.(Author's summary)

890.

TOLMAN KG, Cohen A.

Accidental hypothermia.

Can Assoc J 103(13) :1357-1361; 1970.

Accidental hypothermia was studied in 11 patients, five of whom died. This condition occurs spontaneously, usually in a cold environment, and should be suspected in the comatose hypotensive patient. It is easily missed because regular clinical thermometers do not record extremely low body temperatures. It is distinguished from other forms of hypothermia by the very low body temperature and by the absence of recognized causes of hypothermia. Ten of the 11 patients were either alcoholic or diabetic. Intravascular thrombosis was the most common complication leading to death. (Authors' abstract)

891.

TOMIYASU, K., M. Nakamura, M. Yamada and T. Murai.

[Study of body heat loss and heat insulation or heating on a diver: effects on heat insulation of underwear for dry diving suit].

Tech. Rep. JAMSTEC 5:187-199; Aug. 1980.

Experiments were performed on heat effects of underwear for divers' dry suits. Three types of underwear (cotton, polyester, teviron) worn with a constant volume suit were tested in 10°, 7°, and 5°C water in a pool 3.6 m in diameter and 3 m deep. A wet suit was also tested for comparison. Measurements included rectal temperature, skin temperature at four locations, exhalation volume, and the change of body weight worn with each type of underwear. Teviron underwear provided the best heat insulation, and the wet suit the worst. The constant volume suit can probably be used in deep sea dives, instead of suits heated by hot water or electric power, by increasing the heat insulation with underwear and by maintaining the air space in the suit. (English abstract)

892.

TOMIYASU, K. and H. Nakayama.

Study on body heat loss and heat insulation, or heating on a diver. Report II: The change in rectal, skin and exhaled gas temperatures of saturation divers.

Tech. Rep. JAMSTEC 6:115-135; Feb. 1981.

Two simulated saturated dives, one to 200 msw and the other to 300 msw, were recently carried out at JAMSTEC. Heat stress was induced under pressure in the divers every 5 kg/cm^{2}G. Measurements of rectal, skin and exhaled gas temperatures were taken at comfortable environmental temperatures and points 3°C from these values. Two nude subjects resting on stools were tested. In addition, questionnaires on thermal sensation were sent to all the divers. The resulting data showed that rectal temperatures changed at a constant rate for 90 or 120 min during heat stress; the rise appears due to heat storage in high ambient temperatures. Forehead skin temperature, compared to other points, showed no clear correlation between changing environmental pressure and skin temperature. The changing rate of exhaled gas temperature versus inhaled gas temperature at 26 ATA and 31 ATA was roughly twice as great as at 1 ATA. Numerous charts illustrate the report. (English abstract)

893.

TOMIYASU, K. and H. Nakayama.

[Study on body heat loss and heat insulation or heating on divers; report 3: body heat loss under hyperbaric helium-rich environment].

Tech. Rep. JAMSTEC 7: 121-140; Aug. 1981.

From 1977 to 1979 JAMSTEC performed a series of saturation dive simulations to 300 msw, called the Seadragon project. Experiments were made on body heat loss of divers. The results and methods of measuring are described. Figures for heat loss both through the respiratory system and through the skin at 31 ATA are given. Heat loss from the skin was at a minimum at comfortable temperatures. Respiratory heat loss became greater than at 1 atm. Insensible water loss through respiration and perspiration was also measured at several depths. It was found that when pressure increased, insensible water loss through respiration decreased slightly but loss through the skin decreased very sharply. (Authors' abstract modified by LET/UMS)

894.

TONJUM, S., A. Pasche, D. Furevik, B. Holand, A. Brubakk and C. Olsen.

Test of survival systems for stranded bell divers at 31 bars.

In: Submitted Abstracts, European Undersea Biomedical Society 7th Annual Congress and Symposium on Decompression Sickness, July 21-24, 1981, Cambridge, U.K. Abstract no. 24.

Abstract only. Entire item quoted: Two different commercially available survival systems constructed for stranded diving bell situations were tested at 8-10°C in 96% helium atmosphere at 31 bars pressure for approximately 10 hours. Both systems were based on solely passive thermal protection and consist of thermal rebreather/scrubber, survival vest or parka and survival bag. The test divers had no respiratory heat loss during the test due to the capability of the thermal rebreather/scrubbers to keep the inspired gas temperatures above 37°C. The mean skin temperatures of the test divers stabilized above 31°C in both tested systems, and the rectal temperatures of the divers were 36.9°C and 36.8°C when the test ended. Both survival systems seem capable of keeping a diver alive during an extended period in the above mentioned conditions, but both thermal rebreathers/scrubbers ought to be evaluated for the same time period the survival systems are supposed to keep divers alive.

895.

TONJUM, S., A. Pasche, B. Holand, E. Svendsen and C. Olsen.

Thermal condition of divers using hot water suits at 300 msw.

In: Submitted Abstracts, European Undersea Biomedical Society 7th Annual Congress and Symposium on Decompression Sickness, July 21-24, 1981, Cambridge, U.K. Abstract no. 26.

Abstract only. Entire item quoted: Divers using hot water diving suits have been reported to produce progressive hypothermia without any serious sensation of cold. In the present study 6 divers performed standardized work in water of 4-6°C during a 300 msw saturation dive using conventional hot water suits and breathing gas heaters. With temperatures of the water entering the 6 m long umbilical in the range of 38-40°C the divers had to abort a scheduled 60 min dive because of shivering and a strong sensation of cold. Mean skin temperatures at the time of abortion were 29-31°C, while inspired gas temperatures were 11-14°C. In separate dives the temperature of the hot water supplied through the umbilical was increased to 42-43°C. The divers were able to complete the scheduled dive, but complained about being cold. Mean skin temperatures and inspired gas temperatures were 32-34°, and 16-19°C respectively. The water had to be heated to 47-48°C to reach what the divers described as comfortable temperatures. Skin temperatures and inspired gas temperatures were 35-37°, and 23-25°C in these dives. Work performance increased significantly with increasing temperatures. The results show a large drop in breathing gas temperature from the heater to the mask (90 cm long gas whip) and call attention to the need for improvement of this part of the divers' equipment. To reach acceptable breathing gas temperatures the hot water to the diver had to be heated to levels which increased skin temperatures above the thermo-neutral. In contrast to earlier observations our findings indicate that in spite of fairly high skin temperatures, the divers are able to sense cold when breathing insufficiently heated gas.

896.

TOWNE WD, Geiss WP, Yanes HO, Rahimtoola SH.

Intractable ventricular fibrillation associated with profound accidental hypothermia - successful treatment with partial cardiopulmonary bypass.

N Engl J Med 287(22) :1135-1136; Nov 30, 1972.

A case of profound accidental hypothermia is reported in which intractable ventricular fibrillation was reversed by rapid rewarming with partial cardiopulmonary bypass followed by electroversion. A 58-year old alcoholic man was admitted to the hospital comatose with a rectal temperature of 25°C, hypotension, and bradycardia. Following the institution of ventricular pacing, fibrillation occurred and did not respond to defibrillation attempts. The patient was put on partial cardiopulmonary bypass using the left femoral vein and artery. The extracorporeal blood was warmed to 37.8°C. Forty-five minutes after institution of bypass and two hours after onset of ventricular fibrillation, the temperature reached 34.4°C. At that point, defibrillation was accomplished. The patient's course was complicated by pneumonia, respiratory insufficiency, delirium tremens, and peripheral vascular insufficiency. Gangrene of the left lower extremity developed and the leg was amputated below the knee. Extensive arteriosclerosis was noted during surgery. The patient manifested slight disorientation, occasional confusion, and inappropriate affect. His higher intellectual functions may have been impaired by the prolonged period of circulatory arrest. He was discharged 57 days after admission. (RW/UMS)

897.

TREVINO A, Razi B, Beller BM.

The characteristic electrocardiogram of accidental hypothermia.

Arch Intern Med 127: 470-473; 1971.

The case findings in an elderly woman with accidental hypothermia are presented with reference to the diagnostic value of the ECG in this condition. Awareness of the electrocardiographic abnormalities characteristic of hypothermia will allow the prompt institution of appropriate therapy necessary for recovery. Although the electrocardiographic changes are distinctive, their electrophysiologic basis is not yet understood. (Authors' abstract)

898.

TROSHIKHIN GV, Isaakyan LA, Bekirova GG.

Oxygen exchange in the body during the replacement of atmospheric nitrogen with helium.

Kosm Biol Aviakosm Med 9(5) :10-14; 1975.

The total gas exchange, body temperature, content of free O_2 in the quadricepts muscle and its changes upon O_2 inhalation of a known dosage (O_2 test) were measured in the Wistar rats during their 1 h exposure to a He-

O_2 atmosphere (21%) at 25°C. The animals displayed a 1.8°C decline in the body temperature, a 20.5% increase in gas exchange and a 26% decrease of O_2 in the muscular tissue as compared with the respective parameters in the air. After the experiment during the 1st 10 min exposure to the normal atmosphere O_2 tests were 10-15% lower than before the experiment. These findings give evidence for an increase of O_2 exchange in the muscles of animals exposed to the He-O_2 atmosphere at a temperature below the comfortable level. (© BA)

899.

TURCHINSKY VI.

Cardiological aspects of human adaptation in the extreme north.
Vestn Akad Med Nauk SSSR (6):23-32; 1979.

Physiological mechanisms of the cardiovascular system adaptation and epidemiology of the ischemic heart disease were studied in the newcomer and aboriginal population of the Extreme North. A consecutive change of phases of rearrangements of the adaptive mechanisms in the cardiovascular system in the course of human adaptation in the Extreme North was found. The ischemic heart disease was shown to be unevenly distributed among the population of various medico-geographical zones of the Extreme North. One of the regular reactions of newcomers to the effect of a complex of the Extreme North factors was demonstrated to be a rise in the arterial blood pressure and the development of arterial hypertension in some people. It is stated that northern cardiology as a new scientific-practical aspect should be separated from general cardiology. Means of prevention of cardiovascular diseases under definite conditions of the Extreme North are recommended.(Author's summary)

900.

TURNER, B., J. Pennefather and C. Edmonds.

Cardiovascular effects of hot water immersion (suicide soup).
Med. J. Aust. 67-2(1):39; 1980.

Deaths from thermal stress have been reported in saunas, diving environments and hot spa baths. While investigating the physiological effects of hyperthermic immersion and its application to the therapy of hypothermia, some disturbing physiological anomalies were noted in normal subjects. The effects of standing, cold water immersion and of exercise, each following hyperthermic immersion, were examined. This was only a pilot study but it now seems possible that the ectopic beats may be an effect of the hyperthermic environment rather than the return of cold blood to the extremities as previously assumed. (Authors' abstract)

901.

VANORE JV, Rosenthal DC, Mercado OA.

Frostbite: a review and case study.
J Am Podiatry Assoc 70(12) :619-627; Dec 1980.

Frostbite in the civilian population is not a common occurrence, but with the recent harsh winters, the physicians in such climates should be prepared to treat these cold injuries. The feet are by far the most frequently affected, although the hands, ears, and nose are also common sites of involvement. In first and second degree frostbite, rewarming and local measures of treatment will usually suffice. When a case of third or fourth degree frostbite is encountered, the authors recommend division of the disease process into acute, subacute, and chronic stages. Treatment then can be directed at the altered physiology; for example, the use of dextran to minimize circulatory stasis in the acute stage. Rapid rewarming is cited as the single most important aspect of treatment in the reduction of actual tissue loss. Poor therapeutic results are most commonly caused by premature surgery and would infection. Frostbite attacks the body parts from the superficial to the deeper tissues, and the necrosis of tissue may not extend very deep, forming the basis of its comparison to burns. A case study is given of an individual with third degree frostbite complicated by an overwhelming Proteus infection in a compromised host. The usual clinical course of frostbite was diverted and amputation became inevitable. (Authors' summary)

902.

VASILENKO AM.

Maximum oxygen consumption as a test of human resistance to hypoxia, hyper- and hypothermia.
Kosm Biol Aviakosm Med 14(6):3-10;Nov-Dec 1980.

Study of experimental results shows that physical work capacity is an adequate indicator of human tolerance to adverse environmental effects. Maximum oxygen uptake, being a measure of physical work capacity, can be used

as a prognostic indicator of human tolerance and adaptive capability in a hypoxic, high or low ambient temperature environment. Increase in maximum oxygen uptake under the influence of training or adaptation to hypoxia is accompanied by increase in heat and cold resistance.(Authors' abstract)

903.

VAUGHAN WS Jr, Mavor AS.

Diver performance in controlling a wet submersible during four-hour exposures to cold water.
Hum Factors 14(2) :173-180; Apr 1972.

Six 4-hr., open-sea test trials were conducted with a wet submersible. The purpose of these trials was to assess the effects of long exposure to cold (16.4°C) water on man's ability to perform basic submersible control tasks. The subjects were experienced submersible pilots who had a minimum of 20 hours training prior to the experimental trials. Skin and rectal temperatures were continuously recorded from both the pilot and rider of the submersible. A continuous record of vehicle depth and water temperature was also obtained. The pilot's task was to maintain a prescribed depth while performing a sequence of course changes for a 4-hr. period of submergence. Depth error variance was correlated with pilot core and skin temperature changes over time, and although pilot core temperature fell as much as 1.83°C, no degradation in depth control performance was apparent. (Authors' abstract)

904.

VEICSTEINAS, A.,G. Ferretti and D.W. Rennie.

Superficial shell insulation in cold water in resting and exercising man.
Fed. Proc. 40(3): 580; Mar. 1981.

Abstract only. Entire item quoted: From measurements of subcutaneous fat temperature (Tsf), skin surface temperature (Tsk) and direct skin heat flux (H), the superficial shell insulation (Iss) of in-series fat and skin was calculated as: Iss = (Tsf-Tsk)/H in nine men immersed head-out in a well-stirred water bath. At critical water temperature (CWT) subjects rested 3 hours or performed 2 hours mild exercise. Alternatively, water temperature (Tw) was increased by 1-2°C increments for resting subjects from 28 to 37°C over 4-5 hrs. CWT ranged from 28 to 33°C for mean fat thickness of 9.6 to 1.1 mm respectively. Iss became maximal after 30 min in CWT and remained constant from 28°C to 32-34°C then decreased sharply to 30% of maximal, consistent with observed increases in skin blood flow. During exercise to 200 $W \cdot m^{-2}$ in CWT, Iss remained maximal despite large increases in Tsf and H. Maximal Iss ($°C \cdot m^{-2} \cdot W^{-1}$) was linearly related to tissue thickness (mm): Iss = 0.0048 mm − 0.005; r = 0.95, n = 35. We conclude that, at CWT: (1) the thermal pathway in fat is homogeneous; (2) fat in vivo has the same insulation as in vitro ($0.0048°C \cdot m^{-2} \cdot W^{-1} \cdot mm^{-1}$) and hence is unperfused; and (3) during long-term mild exercise higher muscle perfusion is not accompanied by increased fat or skin perfusion. Implications for whole body insulation during exercise in water will be discussed.

905.

VEICSTEINAS A, Rennie DW.

Thermal insulation and shivering threshold in Greek sponge divers.
J Appl Physiol: Respirat Environ Exercise Physiol 52(4) :845-850; 1982.

Sublingual temperature (T_{or}), average skin temperature (T_{sk}), and skin heat flow (H_{sk}) were determined in a field study for six Greek sponge divers and seven nondiving controls during head-out immersions at water temperature of 21°C. Wetsuits kept T_{sk} at 22-28°C for 1-3 h until T_{or} fell to 36.5-35.5°C and violent shivering [metabolic rate (M) = 100-150 $W \cdot m^{-2}$] ended the test. At a steady T_{sk}, immediately before shivering, overall tissue insulation (I_t), calculated as $(T_{or} - T_{sk})/H_{sk}$, was linearly related to mean subcutaneous fat thickness (MFT) in both groups without statistical difference between them. The onset of shivering, as detected by a sharp increase of M, occurred at the same T_{or} for a T_{sk} of about 26°C, and the relationship of M vs. T_{or} (i.e., metabolic sensitivity) was the same for both groups. Contrary to other groups accustomed to diving in cold water, the use of a wetsuit for a long time has evidently prevented cold adaptation in these divers. (Authors' abstract)

906.

VIEILLEFOND, H. and H. Guenard.

Temperature des gaz expires en fonction de la temperature du corps et des caracteristiques de l'air inhale.
[Temperature of exhaled gas in relation to body temperature and properties of inhaled air].
S.S.A. 79 Trav. Scient. No. 1(9-12); 1979.

A linear relationship between temperature of exhaled air (Te) and temperature of inhaled air (Ti) has been

established earlier. The role of partial pressure of water vapors (pH_2O) in the inhaled air, as well as the effect of variations in central body temperature on respiratory heat loss, were also studied previously. In the present study the authors propose to establish an equation describing the relation between Tc, Ti and pH_2O on the one hand, and Te on the other. Two series of experiments were conducted on healthy volunteers. Esophageal temperature was considered to represent central body temperature (Tc). In the normothermic series, 5 adult volunteers took part; air and body temperature were at normal levels (20°C). In the hyperthermic experiment, which was very painful, 2 volunteers participated. The subjects were immersed in 40°C water. When esophageal temperature (Tc) reached 38.5°C, the water in the tub was also lowered to 38.5°C in order to maintain constant central body temperature (Tc). A complex measuring device capable of measuring temperature and water-vapor saturation of the air, as well as inspiratory and expiratory volume of the subjects, was used. Pulmonary ventilation was not measured because earlier experiments showed that it does not affect Te or Ti, either during exertion or rest. The linear relation between Te and Ti established by the authors agrees with earlier research. Respiratory heat and water loss were found to increase with age. The authors suggest that in the aging process the thermal exchange mechanism of the bronchi loses its efficacy, probably because of gradual thickening and loss of vascularization of the mucous lining of the bronchi. (OLC/UMS)

907.

VIKHRIEV BS, Burmistrov VM.

On certain principles of modern treatment of frostbites.

Vestn Khir 124(4) :92-96; Apr 1980.

Actual questions of the treatment of frostbites are considered on the basis of an experience of the treatment of 397 patients. The experience shows that superficial frostbites are healing well when treated by any method of local treatment. High degrees of frostbites are to be operated upon not earlier than the third week after injury, when the injury degree is established and acute inflammation has subsided. It has been established that the use of free and non-free skin plasty for closure of finger stumps and extremity segments improves functional outcomes and shortens the time of the treatment. (Authors' abstract)

908.

VIRR, L.E., A.G. Thornton, P.A. Hayes, R.R. Pearson and F.S.C. Golden.

Review of thermal protection.

In: Society for Underwater Technology. Proceedings, International Conference "Divetech '81," Workshop A, London, Nov. 24-26, 1981, 15p. Published by the Society, 1981.

This is a review of both passive and active means for thermal protection of divers, with emphasis on developing improved equipment and techniques. In pursuing such development it is important to identify the roles of the specialist scientists who are involved, and the areas in which cooperation is necessary. Protective clothing and techniques, developed by materials scientists and engineers, must be assessed under realistic conditions, and it is here that cooperation between the engineer and the physiologist is essential. Another aspect of thermal protection in which close collaboration is vital is that of temperature monitoring on the operational diver, and, indeed, environmental monitoring in general; in hyperbaric chambers, for example, environmental control is very important. It is the engineer who must provide the solution to the problem of thermal protection in diving, while the physiologist must specify the data on which engineering designs can be based. (Authors' conclusions)

909.

WADE CE, Dacanay S, Smith RM.

Regional heat loss in resting man during immersion in 25.2°C water.

Avia Space Environ Med 49:590-593; 1979.

Five male subjects having a wide range of relative body fat, 9.2-20.2%, were studied during total body immersion in water at 25.2°C. The regional surface area of each subject was calculated from anthropometric data utilizing a segmental geometric model. Skin temperatures (T_{sk}) and regional skin heat loss were measured prior to and during 30 min immersion at 13 sites. During immersion, mean T_{sk} was 25.9°C and remained significantly higher than the water temperature. A measurable temperature gradient for heat flow was observed from all body segments. Segmental temperature in water ranged from 26.7-25.4°C, being warmest at the neck and coolest at the foot. Heat flow per regional area was highest in the neck, 187 W/m^2, and least at the foot, 14 W/m^2. Heat flow from each body region was dependent on regional T_{sk}. Skinfold thickness was a minor factor in altering regional heat flow in the foot, hand, lower arm, upper arm, thigh, and calf; in the torso, neck, and head regions it was of major importance in detering heat loss. (Authors' abstract)

910.
WAYBURN E.
Immersion hypothermia.
Arch Intern Med 79: 77-87; 1947.

Immersion hypothermia is a progressive clinical syndrome which may follow immersion in cold water. It is related to experimental hypothermia and to clinical shock. The clinical picture is the resultant of the coldness of the water, the length of the exposure, the emotional factors affecting the patient before and during exposure and the specific response of the person to cold. The chief effects are those on (a) the cardiovascular system (among the transient conditions observed were auricular fibrillation and flutter, ventricular extrasystoles, slight prolongation on the P-R interval and falling arterial blood pressure, with narrowing of the pulse pressure), (b) the nervous system (partial to complete loss of consciousness and irrational behavior were observed) and (c) the blood (hemoconcentration and notable hyperglycemia were found in 1 case). Treatment consists in rapid restoration of normal body temperature by external heat, minimal activity, administration of warm fluids by mouth and, in severe conditions, use of blood plasma. No drugs were used in this series. Use of epinephrine is contraindicted. (Author's abstract)

911.
WELCH B (letter).
Oxyhemoglobin dissociation.
JACEP 8(1) :48; Jan 1979.

Concerning Dr. Johnson's paper, "Accidental Hypothermia: Peritoneal Dialysis," (6:556-561, 1977), I must take exception with his statement, "As cooling commences, the oxyhemoglobin dissociation curve shifts to the left representing a marked decrease in the hemoglobin-oxygen carrying a capacity (p 559)." It is true that the oxyhemoglobin dissociation curve shifts to the left with a decrease in temperature. However, there is increased oxygen affinity or higher oxygen content at any given partial pressure of oxygen. This is the transport side of the picture, however. At the tissue level, there is less movement of oxygen from the blood into the tissues. In other words, the strong affinity for oxygen makes the hemoglobin less able to release oxygen at the tissue level.

912.
WESTENSKOW DR, Wong KC, Johnson CC, Wilde CS.
Physiologic effects of deep hypothermia and microwave rewarming: possible application for neonatal cardiac surgery.
Anesth Analg 58(4) 297-301; 1979.

Deep hypothermia (20°C) without cardiopulmonary bypass is a valuable technique during cardiac surgery in infants but rewarming of the heart following circulatory arrest and cardiac repair has traditionally been a lengthy and difficult process. In experimental animals rewarming the heart with microwave energy, as reported in this work, warms the heart before warming the periphery. In 18 mongrel dogs that were surface cooled to 20°C, we found that during microwave rewarming the core temperature rose 4.7°C per hour. Whole body oxygen consumption, heart rate, and cardiac output returned to normal at rates equal to the rates at which they decreased during surface cooling. Blood pressure and arterial gases remained adequate. Microwave rewarming appears to be a useful method for reestablishment of cardiac function and normothermia following deep hypothermia.

913.
WHAYNE TF, Debakey ME.
Cold injury, ground type.
Washington, DC, US Government Printing Office, 1958.

Cold injury as it affects large numbers of men is primarily a form of wartime trauma. The history of all military campaigns conducted in winter, both in temperate and in cold climates, reveals crippling losses from this cause. Between wars, the staggering c of cold trauma in time of war is almost entirely forgotten. This volume has three purposes: 1. To record the history of cold injury, ground type, in World War II. 2. To summarize what has been learned of the nature of this form of trauma, including its pathologic physiology, its epidemiology, its military cost, and its management, including the rehabilitation of casualties from this cause. 3. To formulate, from the materials of the past history of cold injury, the principles of a sound program for its prevention and control in future military operations in cold regions and in temperate regions during cold weather. It is hoped that by concentration on the broad scope of the problem and on its multiple phases, including its epidemiology,

research may be stimulated which will result in more positive and more effective methods and practices for preventing, controlling, and treating this important variety of environmental injury. (Excerpts from authors' preface)

914.

WHITBY JD (letter).
Dangers of cold immersion.
Br Med J 1:1441; May 1964.

Sir—Surely to suggest in your leading article ("Dangers of Cold Immersion," 9 May, p. 1202) that Lapchinsky initiated the study of hypothermia in 1880 is to ignore the observations and work of Hunter, Kite, Boerhaave, Edwards, and others in the eighteenth and early nineteenth centuries. The general opinion at the time seems to have been against applying excessive heat to cases that had been severely chilled by prolonged immersion or other causes. In 1781 an anonymous but apparently eminent Exeter physician stated that if initial surface friction with snow and ice had been carried out in the case of Adam Thompson, of Piccadilly, who was frozen on his way from Banbury to Chipping Norton in 1762, his life might have been preserved, "whereas putting him in a warm bed was certain destruction."

915.

WHITE, M., D. Allan, I. Light and J.N. Norman.
Thermal balance in divers.
Lancet 1(8182):1362; June 21, 1980.

A group of 47 British Antarctic Survey divers were monitored to see to what degree actual rectal temperature decrease corresponded to the subjective sensation of comfort or discomfort. The divers were 10 to 65 minutes at 6-36 meters in water of +0.7°C to −1.9°C. For the most part, but not invariably, thermal comfort was related to the fall in core temperature. In these short dives, the divers do not appear to be at risk from hypothermia, but in the deeper and longer North Sea dives, continued reliance on subjective assessment of thermal status is questionable. (MFW/UMS)

916.

WICKSTROM P, Ruiz E, Lilja GP, Hinterkopf JP, Haglin JJ.
Accidental hypothermia: Core rewarming with partial bypass.
Am J Surg 131: 622-625; 1976.

Three patients with profound hypothermia were treated by rewarming on partial bypass. Two survived and have normal mental and metabolic functions. The resuscitation of the hypothermic patient should be approached with enthusiasm since the outcome is often much better than expected from initial vital signs and neurologic examination. To avoid ventricular fibrillation the patient should be handled gently and an effort should be made to keep the patient well oxygenated and the pH normal. Blood gases should be measured often and corrected for temperature. The potassium concentration and hydration status of the patient should also be monitored closely. The rewarming of profoundly hypothermic patients can readily be accomplished with a pump oxygenator and heat exchanger. The indications for this method are not established from our small experience and the few cases reported in the literature. Certainly ventricular fibrillation is a compelling indication. Patients with frozen extremities might also benefit from this method since theoretically tissue salvage would be increased. Finally, those patients who do not respond rapidly to external rewarming may be at less risk of ventricular fibrillation if rewarmed on bypass. (Authors' abstract)

917.

WOODCOCK AH, Goldman RF.
A technique for measuring clothing insulation under dynamic conditions.
Natick, MA, Quartermaster Res & Eng Cen, Tech Rep EP-137, 7 p, July 1960.

The use of a Beckman & Whitley Heat-Flow Transducer for measuring fluctuations in heat loss from the human skin through clothing to the environment has been examined using two different types of clothing. The method has been found satisfactory as a technique for obtaining local effects due to ventilation caused by body movement. Of the two hot weather uniforms examined, the experimental seemed to have little or no advantage with regard to coolness. (Authors' abstract)

918.

YAKIMENKO MA, Tkachenko EY, Livert VE, Fil'ko OA.

Indices of the temperature regulating system during adaptation to cold under arctic conditions.
Hum Physiol (Engl Transl Fiziol Chel) 5(5) :701-703; Sep-Oct 1979.

Prolonged exposure of the human to cold leads to a decrease in its mean weighted skin temperature, the level of thermoregulatory contractile activity of the skeletal muscles, and the thermoregulatory increase in oxygen consumption. Human adaptation to cold is thus aimed at reducing energy expenditure responsible for maintaining temperature homeostasis. Even small increases in oxygen consumption (9-10%) in persons adapted to cold in response to cooling are accompanied by increased thermoregulatory contractile activity of the muscles. (Authors' conclusions)

919.

YAKIMENKO MA, Zhdanova FG.

Engery expenditure in humans during exercise after adaptation to cold.
Fiziol Zh SSSR 65(11) :1626-1630; Oct 1979.

Oxygen consumption was measured in builders working at 26° and 13°C prior to, during, and in 10 min after a standard exercise. Prolonged and repetitious cooling increased oxygen consumption during and after the standard exercise. At 13°C this increase reached 28%. Cold adaptation seems to change the energizing of contractile skeletal muscles and thus to increase the exercise energy expenditure. (Authors' abstract)

920.

YAMADA, M., Y. Kadomoto, N. Inagaki, S. Kanda and T. Murai.

[Operational study on the diver heating system].
Tech. Rep. JAMSTEC 4:215-238; Feb. 1980.

Evaluations were made of diver heating systems, including the hot water diver's suit system, hot water personnel transfer capsule (PTC) heater, and watertight insulation on the PTC. Experiments were conducted on the hot water diver suit system in a diving simulation facility at depths to 300 m and temperatures to 5°C. Pressure loss and heat loss of the hot water supply hose were measured. The system worked well, with heat distributed rapidly and uniformly through the suit. The hot water PTC heater and watertight heat insulation material were assessed in tests made at sea in depths to 60 m. The PTC heater functioned efficiently and the insulation remained watertight under pressure. Also obtained were heat transfer coefficient data under operating conditions. (English abstract modified by LET/UMS)

921.

YATES DW, Little RA.

Accidental hypothermia.
Resuscitation 7(1) :59-67; 1979.

Most patients admitted with core temperatures below 35°C are at the extremes of the age scale, but young and middle aged persons who are physically fit, and involved in cold weather activities are susceptable to hypothermia as well. Initial treatment should begin with baseline monitoring of core temperature (via aural thermometer) and the unstable heart (via ECG) to determine the therapeutic course. In addition, arterial blood gas (with temperature corrections) and a hematologic study are helpful in monitoring recovery. Rewarming by the following methods depends upon the individual case. Passive spontaneous rewarming by insulating the patient retains endogenously produced heat. Active external techniques extend passive techniques by providing a radiant heat source or warm-water bath. Active core rewarming methods include: peritoneal and gastric lavage, warm intravenous fluids, warm inspired air, direct mediastinal rewarming, and exchange transfusion. Dehydration is a common problem in hypothermia management. Included in this paper are ten illustrative cases and a comprehensive discussion of the relative merits of various techniques employed in rewarming hypothermic adult patients. (CDR/UMS)

922.

ZINGG W.

The management of accidental hypothermia.
Can Med Assoc J 96: 214-218; 1967.

Accidental general hypothermia is defined as an unintentional lowering of the body temperature in a previously conscious patient due to exposure. Even mild degrees of hypothermia may be followed by death if treatment is not instituted promptly. Hypothermic patients who are still conscious may rewarm spontaneously. They should not be left unattended and, if the facilities are available, rapid rewarming appears to be the treatment of choice. Unconscious patients who are presumed to have a lower temperature of prolonged duration may not benefit from rapid rewarming. All hypothermia victims showing signs of life are potential survivors, but even with good facilities the mortality rate may be high. (Author's abstract)

923.

ZINGG W.

Fast and slow rewarming after acute and prolonged hypothermia in rabbits.
J Trauma 9: 250-256; 1969.

Accidental general hypothermia, defined as an unintentional fall in body temperature due to exposure, usually occurs in cold climates; but similar accidents have been observed in areas with relatively moderate climates. The very young and the very old appear to be particularly prone to this type of accident. This paper includes neither local hypothermia nor general hypothermia observed in patients suffering from endocrinological and neurological disorders. I have previously reviewed the literature related to the topic and outlined the problems. I had suggested some methods of treatment for accidental general hypothermia, though some of the principles on which that treatment was based are yet to be established. The purpose of this study was to provide data on one controversial aspect; what speed of rewarming leads to the best recovery. (Author's abstract)

924.

ZUMRICK JL, Jaeger MJ, Piantadosi CA.

Effects of cold gas breathing on forced expiratory flow to 1800 fsw.
In: Program and abstracts, Undersea Medical Society annual scientific meeting, May 25-29, 1981.
Undersea Biomed Res 8(1-Suppl): A 98; Mar 1981.

Abstract only. Entire item quoted: Breathing cold helium-oxygen mixtures at depth has been shown to produce both hypothermic and asthma-like effects in divers. Various pulmonary functions including expiratory forced vital capacity, one second forced expiratory volume (FEV1), maximal mid-expiratory flow rate (MMFR), peak expiratory flow (Vpk), maximum expiratory flows at 75%, 50%, and 25% of forced vital capacity (V75, V50, V25) were measured in 4 divers both before and after breathing cold helium-oxygen mixtures (14 ± 2°C), at 198, 304, 427, and 549 msw. The respiratory heat losses during the one hour cold gas breathing periods averaged 64, 91, 156, and 231 watts while the mean losses in rectal temperature were 0.43 ± 13°C, 0.55 ± .12°C, 0.93 ± .08°C, and 0.98 ± .15°C at the four depths respectively. The decrease in pulmonary functions with increasing gas density occurred as expected with FEV1, MMFR, Vpk, V75, V50, and V25 being 71%, 50%, 49%, 40%, 42%, and 57% of their surface controls at 549 msw. In three of the subjects, pulmonary functions did not change significantly with cold gas breathing. In one subject, however, both V50 and FEV1 showed a reduction which averaged 18.5 ± 3.3 and 11 ± 5.4% respectively over their controls. This corresponds to a reduction in expiratory flow rates at lower levels of respiratory heat loss than have been previously observed. The subject had no previous history of asthma or other pulmonary disease and does not smoke.

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