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SCIENTIFIC CONFERENCE OF THE INSTITUTE OF INDUSTRIAL HYGIENE AND OCCUPATIONAL DISEASES, ACADEMY OF MEDICAL SCIENCES USSR, ON HEAT EXCHANGE PHYSIOLOGY AND INDUSTRIAL MICROCLIMATE HYGIENE

/Translation/

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SCIENTIFIC CONFERENCE OF THE INSTITUTE OF INDUSTRIAL HYGIENE AND OCCUPATIONAL DISEASES, ACADEMY OF MEDICAL SCIENCES USSR, ON HEAT EXCHANGE PHYSIOLOGY AND INDUSTRIAL MICROCLIMATE HYGIENE

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A. Ye. Malysheva,
Doctor of Medical Sciences

A Scientific Conference of the Institute of Industrial Hygiene and Occupational Diseases, Academy of Medical Sciences USSR, on Heat Exchange Physiology and Industrial Microclimate Hygiene was held 6-8 July 1959 in Moscow. More than 260 scientific workers from 18 cities in the USSR took part.

Forty papers dealt with the principal problems of heat exchange physiology and industrial microclimate hygiene.

In opening the conference Professor A. A. Letavet, director of the Institute of Industrial Hygiene and Occupational Diseases of the Academy of Medical Sciences USSR, and member of the academy, stressed the significance of the problems being considered in the light of the decisions of the Twenty-first Congress of the CPSU regarding the seven-year plan for developing the national economy. The plan for 1959-1965 calls for the substantial growth of heavy industry and enlargement of the climatic zones where major groups of the population may live and work. New technological processes, newly-built shops, mechanization and automation of industrial processes are changing the conditions affecting the industrial work of man. Work at control panels is becoming a major occupation. New possibilities are emerging for the creation of an artificial microclimate. "Hot shops," for example, will gradually lose the designation of "hot."

Hygienists and physiologists are facing major new problems as they study the relations between the macroclimate, microclimate, and the organism in the effort to determine the most favorable conditions bearing on health and work capacity.

The solution of practical hygienic problems is impossible until many aspects of theoretical physiology are elucidated, e.g., the biochemical processes involved in the creation of animal heat under various environmental conditions and human activity, the physiological mechanisms of heat exchange and heat regulation in various bodily states and muscular activity.

A study of adaptation and acclimatization of the population to the newly-developed climatic regions is of exceptional importance. The vast adaptive faculties of man are surprising and, perhaps, peculiarly human. They play a large part in enabling him to subdue nature. An investigation of the subject is a fascinating scientific problem. However, even more important from the standpoint of acclimatization of large groups of people is the elaboration of physiologically sound hygienic recommendations aimed at ensuring the necessary level of comfort under unfavorable natural conditions.

Problems in the physiology of heat exchange were always central in the work of Russian schools of physiology. Unfortunately, interest has dwindled in recent years. Institutes of industrial hygiene are conducting an inadequate amount of research on hygienic problems.

Professor A. A. Letavet concluded by pointing out that the conference was to proceed under the flag of scientific cooperation between physiologists and hygienists.

A symposium on coordination and planning in the field of physiology and pathology of heat exchange held in February 1959 in the Institute of Experimental Medicine, Academy of Medical Sciences USSR, was the first joint endeavor of physiologists and hygienists.

Prof. P. N. Veselkin, corresponding member of the Academy of Medical Sciences USSR, presented a general report on "Heat Exchange and Thermoregulation in Fever, Overheating, and Muscular Activity." He used extensive experimental material to show that heat exchange in fever, muscular activity, and overheating regardless of origin is characterized physiologically by the accumulation of heat in the body. However, the physiologocal mechanisms and biological significance of hyperthermy in such states differ markedly from one other. Retention of heat in fever occurs as a result of the stereotyped "extreme" reaction of the thermoregulatory centers to a broad group of pathological irritants. Elevation of body temperature is caused by the active reconstruction of thermoregulation on a new level and within wide limits is not related to external temperature. Overheating is usually associated with exhaustion of the existent adaptive possibilities of thermoregulation and with total inability to release into the environment the heat formed in the body.

Increased heat production attendant on muscular activity in a healthy organism is balanced by intensified heat transfer. Hyperthermy in muscular activity results from an active thermoregulatory reaction.

Prof. A. D. Slonim presented new data on the function of the muscular system in thermoregulation. The problem requires a study both of the role of the striated and (in part) of the unstriated muscles in changes affecting heat formation during cooling and of the significance of muscular activity in the development of functional relations (dynamic stereotype) between the physiological mechanisms regulating heat formation and heat transfer. It is now regarded as an established fact that no distinct boundaries can be drawn between the phenomena of chemical thermoregulation, muscular tremor, and involuntary muscular contraction due to cold because the so-called thermoregulatory tonus of the skeletal muscles is observed in the shift from temperatures near thermic neutrality to the lower temperatures of the environment.

Under industrial conditions with low environmental temperature skin temperature drops during actual work. Muscular effort here causes a depression of purely chemical thermoregulation and in part an impairment of vascular thermoregulation. The role of the individual components of muscular activity is important if we are to understand the physiology of thermoregulation in workingmen.

Prof. G. P. Konradi summarized the published data of Soviet and foreign authors on the mechanism of changes in blood circulation as effected by temperature factors. Up to now a good deal of attention was paid to summational changes in blood circulation in investigations of the effect of various environmental temperatures on the organism. However, the mechanisms involved in the circulatory changes have been studied much less. Thus, research on regulation of the blood supply of different areas in connection with thermic stimuli is highly important. Peripheral blood circulation is regulated under these circumstances by separate vasomotor mechanisms and by special redistribution of excitation and inhibition in the vasomotor center. A major task is to combine exact measurement of the blood flow with an investigation of the state of the central formations at the different levels involved in regulation of blood circulation. The report reviewed modern methods of investigating blood circulation.

Prof. S. A. Neyfakh's paper "Oxidative Phosphorylation and Formation of Animal Heat" set forth modern views on the chemism of energy exchange in man. It is now possible to study not only the methods of recovering and accumulating oxidation energy in macroergic contacts, but also the reverse process, i.e., dissipation of oxidations in the form of heat. Nontonic thermogenesis, in the author's opinion, can be elucidated only by data on energy exchange at the cell level.

The report cited the results of experiments on rabbits with dinitrophenol in calorimetry of short and long duration. There is a flare-up of heat production at the intermediate stage of metabolism, but the daily balance of heat exchange remains unchanged. "A prompt mobilization of heat" takes place. Neyfakh also discussed economical and uneconomical heat formation in the organism.

The report of Profs. P. G. Snyakin and L. M. Kurilova presented data on the functional state of the thermoreceptors that signal temperature changes of the external and internal environments in the central nervous system. This problem is particularly interesting for occupational hygiene since people in different jobs are subjected to different temperatures. The report included experimental material on the functional state of the thermoreceptors in man under the influence of various thermic stimuli.

A. M. Ugolev's paper "Homeostasis and the Regulation of Thirst and Salt Appetite" presented new experimental data regarding the effect of an environmental factor on salt appetite and thirst (water appetite). The data indicate that there is a possibility of fine analysis of the internal environment and that modification of the water and salt appetite ensure not only osmotic homeostasis, but also a balance in the total mineral content of the blood. While investigating the reflexes regulating water and salt appetite, the author discovered that the salt appetite decreased without subsequent thirst if hypertonic solutions acted only on the gastric receptors. Thirst is caused only after salt enters the intestines and is absorbed into the blood. Ugolev also presented data indicating that the appetite is an important, but not unique, mechanism for regulating hemeostasis. Two effector mechanisms - behavioral and vegetative - also seem to participate in the process of adaptation to repeated salt loads.

Prof. N. K. Vitte cited several examples of insufficient utilization of data on heat exchange in connection with standardizing meteorological conditions in various branches of industry. Modern methods can be used not only to determine the individual components of heat exchange, but also to study physiological changes in the organism. The author pointed out the need of investigating heat exchange clinically, using as an example the effect of aminazine chlorpromazine on heat exchange in man.

Prof. S. A. Kosilov's paper "Methods of Preparing and Introducing Effective Work and Rests Schedules in Hot Shops in Machine Building Plants" stressed the need of working out typical work and rest schedules for different kinds of jobs in hot shops, which should solve the problem of standardizing rest time in these production sections. Kosilov based his conclusions on his studies of the physiological functions of: (a) pulse rate during work and recovery; (b) expenditure of energy; (c) static and dynamic muscular exertions; (d) changes in the process of higher nervous activity.

Prof. M. V. Leynik discussed standardization of rest time in hot shops of metallurgical plants. Determination of the physiological criteria to be used in standardizing additional rest time for "hot" work is extremely important. One of the criteria is the difference in extent of decreased work capacity (for the same job) under the conditions of high and normal environmental temperatures.

A lively discussion followed presentation of the papers.

Prof. V. N. Chernigovskiy, member of the Academy of Sciences, USSR, made a detailed analysis of A. D. Slonim's views on the inhibiting effects of muscular activity on chemical thermoregulation under hypothermal conditions. He also discussed the regulation of peripheral vascular reactions associated with general changes taking place in the central apparatuses. He pointed out that this matter must be taken into account when investigating the regulation of blood circulation following thermic stimulation.

Prof. M. Ye. Marshak, corresponding member of the Academy of Medical Sciences USSR, stated that the influence of high temperatures on the organism is compelling many investigators to concentrate on changes in regional blood circulation. The blood supply of muscles generally increases during muscular work. However, regional blood circulation, it should be remembered, is related to vascular tonus. Central influence on the periphery is likewise determined by the state of the periphery proper, as demonstrated by experimental data. Studies of the thirst and salt appetite mechanisms should be applied to industrial conditions. Marshak concluded by directing attention to the fact that in recent years the physiology of heat exchange and regulation is not keeping up with modern science and the needs of medicine.

There was a discussion of chemical thermoregulation in muscular activity under hypothermal conditions and of methods of devising effective work and rest schedules in hot shops. The speakers stressed elevation of body temperature in various states of the organism and the biological significance of oxidative phosphorylation and production of animal heat.

Comments on the papers of Profs. M. G. Snyakin and A. M. Ugolev included the suggestion that their studies be applied to practical medical problems. The satisfaction of thirst, dehydration, and salt exchange are important problems in workers in hot shops and to inhabitants of the hot regions of the country. There was considerable discussion of heat exchange, thermoregulation, the vascular system, adaptation, and acclimatization.

A special session heard ten reports dealing with the effect of cold under various conditions of human activity.

In their paper "Acclimatization and Morbidity" in a Cold Climate," Profs. I. S. Kandror and Ye. I. Soltyskiy reported on their many years of observations in a northern region of the country. A comparison of the shifts in thermoregulatory functions (basal metabolism, gas exchange in muscular activity, vascular reaction in cooling of the skin) with the frequency of illnesses, in the etiology of which the cooling factor plays a certain part, shows that there is a connection between the beginning and development of these shifts and level of morbidity. Introduction of a set of measures designed to train the thermoregulatory function resulted in a substantial reduction of morbidity.

In a survey paper "Certain Functional Shifts in Work under Conditions of Cooling," A. Ye. Malysheva. Doctor of Medical Sciences, presented material on shifts in people working under these conditions (construction laborers, workers in refrigerators). The data permitted her to draw conclusions of acclimatization to cold of this group of men when working in the open during the winter. Analysis of the physiological shifts of refrigerator workers disclosed their effect on the sick rate. Thus, depression of chemical thermoregulation in loaders under conditions of cooling is evidently one of the reasons for their low resistance to respiratory diseases. This research led to the formulation of measures to improve working conditions for several occupational groups.

The paper of Ye. F. Medvedeva, Candidate of Medical Sciences, set forth new data on the effect of hypothermia on changes in muscular endurance and tactile sensitivity in construction workers. It was shown that endurance is determined not only by the arduousness of work, but also by the hyperthermal factor. A rise in the threshhold of tactile sensitivity in individuals working in the cold is due to functional changes of adaptive character.

G. N. Repin read a paper entitled "Chemical Thermoregulation and Energy Consumption among Various Occupational Groups Working under Hypothermal Conditions." Energy consumption of bricklayers and similar workers was higher in the winter than in the summer with the same work load. No significant differences in basal metabolism were observed among construction workers in the winter and in the summer. Differences in gas exchange induced by cold were established in individuals performing control functions (controllers) or heavy physical labor.

In his paper "Physiological Mechanisms Involved in the Effect of Inhaling Cold Air," V. A. Bukov presented experimental data concerning the tonic and inhibitory effect of breathing cold air on the central nervous system of animals.

Candidate of Medical Sciences P. I. Gumener and M. N. Konovalov reported on the results of observations of physical thermoregulation among miners in the polar region.

K. M. Pogodina presented new data on the occupational pathology of cotton irrigators induced by prolonged cooling of the legs.

In his paper "Use of Local Radiant Heating in Work under Conditions of Cold," Candidate of Medical Sciences V. K. Kuz'min discussed investigations made on a building site. It was recommended that heating be used when the air temperature is below -15° and air motion is at the rate of 5 m/sec. Gas was suggested as a source of radiant heating.

Experimental data on adaptation and disadaptation to the weather factor was presented by B. B. Koyranskiy. Adaptation and disadaptation to cold, heat, and infrared radiation takes place in different ways. The author concludes that a knowledge of the relevant data will make it possible to devise a set of preventive measures.

New facts were offered in the report of Prof. G. Kh. Shakhbazyan, corresponding member of the Academy of Medical Sciences USSR, F. M. Shleyfman, and I. G. Veksler, "Hygienic Significance of Temperature Drops." They studied immunobiological reactivity and the state of exchange processes (reserve alkalinity, sugar) and of protein fractions in the blood serum. The data indicated that vascular shifts were restored more quickly than biochemical and immunobiological reactions. This phenomenon is considered a manifestation of the prolonged residual effect due to the influence of temperature drops.

Prof. B. B. Koyranskiy reported on problems of industrial hygiene in connection with research on industrial microclimate. The tremendous expansion of our industry, large-scale introduction of new technological processes, mechanization and automation of production are creating new and complex relations between certain meteorological conditions and the human organism. It is necessary to investigate adaptation and acclimatization, the effect of heat, cold, radiant energy (infrared and ultraviolet radiation), humidity, air motion, etc.

It is extremely important to work out meteorological standards, protective measures and individual devices as well as to study the effect of industrial microclimate on nonspecific diseases of the cardiovascular and nervous systems and of the respiratory tract.

In a paper entitled "The Role of Ultraviolet Radiation as a General Hygienic and Occupational Factor," Prof. N. F. Galanin, corresponding member of the Academy of Medical Sciences USSR, examined the effect of ultraviolet radiation with respect to spectral composition and dose. Ultraviolet radiation of workers occurs in

various branches of industry. The amount of radiation to which the workers are exposed often exceeds erythema doses. Galanin gave a detailed description of protective measures and instruction on how to use them.

Prof. Z. D. Gorkiy discussed "Problems in Industrial Hygiene created by the Use of Ultraviolet Irradiation in Production and in the Clinic of Occupational Diseases." Investigations conducted in the USSR and abroad have demonstrated that irradiation of industrial workers from artificial sources can be wisely used for purposes of sanitation and prophylaxis. Further research is needed on the effect of this irradiation on higher nervous activity, the endocrine apparatus, immunobiological state of the orgamism, etc. It is also necessary to establish hygienic irradiation doses for various occupational groups and for various regions of the country. The combined action of ultraviolet and infrared radiation is another important hygienic problem calling for study.

A. Yu. Tilis presented experimental data on the respiratory function of the blood at various times of solar overheating of Uzbekistan. The experiments were performed on dogs. Under the conditions of overheating the author determined that there were phases in the reactions of gas exchange and blood circulation and in the composition of the blood.

A group of papers followed on establishment of standards for industrial microclimate.

In his introductory report on the problem, Prof. G. Kh. Shakhabazyan, corresponding member of the Academy of Medical Sciences USSR, pointed out that the decisions of the Twenty-First Congress of the CPSU "to provide further improvements in working conditions, industrial sanitation, and safety measures in enterprises and construction work during 1959-1965" require the hygienists to solve in the shortest possible time the problems involved in hygienic standardizing of industrial environmental factors, including the industrial initiation of scientific research to refine and supplement present-day standards.

Profs. Ya. I. Trumpayts and B. B. Koyranskiy noted that existing norms of meteorological conditions for industrial locations are too general and do not meet modern sanitary and hygienic requirements. They offered for discussion a new plan of norms in which an attempt was made to take climatic zones into account.

In a report on the hygienic classification of the industrial microclimate, Doctor of Medical Sciences I. M. Erman advanced a plan setting up three basic types depending on physical features in the technological process.

Candidates of Medical Sciences M. Ye. Kurashvili (Georgia), A. A. Shaptala (Stalino), and T. D. Simonovich (Uzbekistan) then presented papers dealing with standardization of the industrial microclimate for several oblasts of the Soviet Union.

A number of reports dealt with a physiologicohygienic appraisal of the effect of microclimate on the organism of the worker: Candidate of Biological Sciences S. I. Gorshkov and Candidate of Medical Sciences S. S. Vishnevskaya presented data on thermoregulation in weavers; post graduate student Chzhai Fu-zhuy discussed the physiological reactions of workers and sanitary-hygienic conditions in a hot rod-rolling shop.

Candidate of Medical Sciences L. Ya. Ukvol'berg cited new data on the effect of prolonged high temperatures on the cardiovascular system. Electrocardiograms were taken directly under industrial conditions while a measured load of work was being performed. Functional shifts discovered in the cardiovascular system may be regarded as symptoms of a prepathological condition.

In a paper entitled "Diet with High Air Temperature," Candidate of Medical Sciences V. S. Dmitriyev expressed doubt as to the advisability of using a water-salt diet.

S. P. Raykhman demonstrated an original air suit for washers in steaming railroad tank cars.

Most of the papers were commented on in the ensuing discussion by Prof. L. K. Khotsyanov, corresponding member of the Academy of Medical Sciences USSR, Prof. G. P. Konradi, Prof. A. D. Slonim, Prof. N. K. Vitte, I. M. Erman, I. A. Zaydshnur, B. A. Khakhtman, B. G. Bagirov, Ye. F. Medvedeva, N. F. Stozhkova, and others.

The remarks centered largely on the industrial hygiene problems involved in industrial microclimate and the need to devise new means of combatting the unfavorable effects of heat, cold, infrared and ultraviolet radiation. There was a lively discussion of microclimate standards and diet for workers in hot plants.

The resolutions of the conference laid heavy emphasis on increased research on industrial microclimate and the physiology of heat exchange and thermoregulation to carry out the tasks assigned by the Twenty-first Congress of the CPSU for expansion of the national economy.

Meteorological laboratories and laboratories for ultraviolet radiation must be organized in institutes of industrial hygiene and occupational diseases to enlarge the scope of research. The resolution mentioned submitting a petition to the Presidium of the Academy of Medical Sciences USSR to set up a special physiological laboratory of heat exchange and thermoregulation in one of the physiology institutes of the Academy of Medical Sciences USSR.

A resolution was passed on the need to hold regular symposia on special problems in the physiology of heat exchange and thermoregulation.

The participants in the conference noted with satisfaction the friendly cooperation of physiologists and hygienists and suggested several specific ways to expand and strengthen the contacts.

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