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REPORT FOR THE PERIOD JANUARY 1979 TO JULY 1981.(U)
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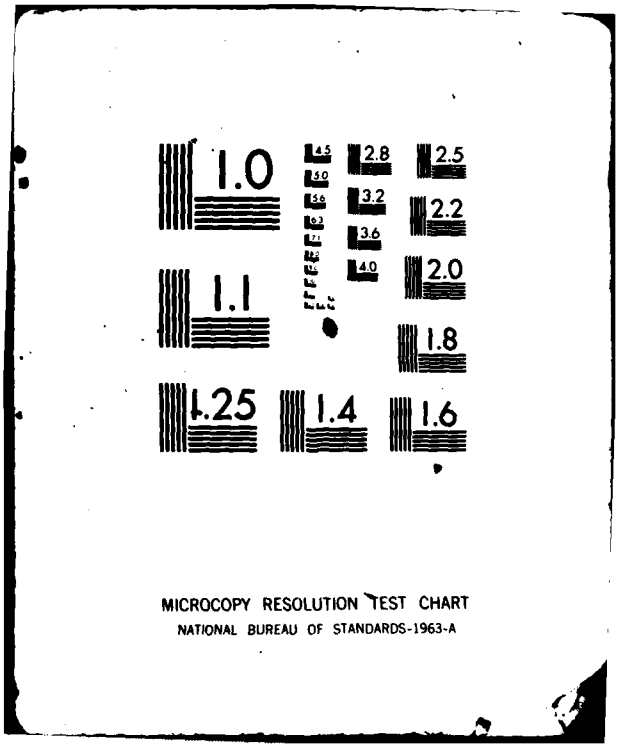
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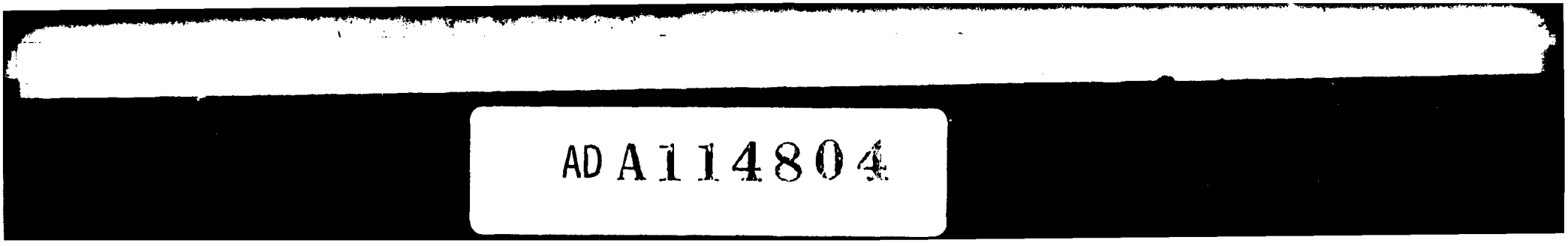
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ROYAL NAVAL PERSONNEL RESEARCH COMMITTEE
(R N P R C)

MEMBERSHIP - JULY 1981

Chairman

A D Baddeley MA PhD

Professor G R Hervey MA MB

Professor R J Linden MB ChB PhD DSc FRCP

Medical Director General (Naval)

- Surgeon Rear-Admiral/Institute of Naval Medicine

- Director of Medical Organisation (Naval)

Chief Scientist (Royal Navy)

- Senior Psychologist (Naval)

Flag Office Submarines

Deputy Director of Naval Warfare

Secretary

Assistant Secretary

Professor K W Donald DSC QP MA MD DSc FRCP FRSE

MRC Applied Psychology Unit

Professor of Physiology, University of Leeds

Professor of Cardiovascular Studies, University of Leeds

Surgeon Vice-Admiral J A B Harrison QHP MRCS LRCP DMRD FRCR

Surgeon Rear-Admiral R J W Lambert QHP MA MRCS LRCP MB BChir DPH DIH MFCM MFOM

Surgeon Captain L C Banks OBE MB BCh BAO MFCM

F A Johnson MSc PhD FInstP

K G G Corkindale BSc FBPsS *

Vice-Admiral R R Squires

Captain J W F Briggs RN

H W Bunjé MD FRCP
MRC Headquarters Office Staff

C A S Robinson MC
MRC Headquarters Office Staff

* SP(N) designate with effect from September 1980

CONTENTS

INTRODUCTION

Changes in Membership

1. MDG(N) - Surgeon Vice-Admiral J A B Harrison QHP MRCS LRCP DMRD FRCR — vice Surgeon Vice-Admiral Sir John Rawlins

   SRA/INM - Surgeon Rear-Admiral R J W Lambert QHP MA MRCS LRCP MB BChir DPH DIH MFCM MFOM — vice Surgeon Rear-Admiral J A B Harrison

   DMedOrg (N) - Surgeon Captain L C Banks OBE MB BCh BAO MFCM — vice Surgeon Captain P F Toal (DHR(N))

   CS(RN) - Dr F A Johnson MSc PhD FInstP — vice Mr C C Fielding

   SP(N) - Mr K G G Corkindale BSc FBPsS — vice Mr E Elliott

   DDNW - Captain J W F Briggs RN — vice Captain D G Armytage

   The post of DCS(N) was abolished in May 1980.

2. In response to an invitation, DGRM, Mr I J Campbell, accepted ex-offico membership in June 1979.*

3. At the 62nd meeting on 16 October 1980 Professor W Burns CBE formally announced his retirement from the RNPRC. He had been a member since 1952 and Chairman of the Hearing Panel (later Hearing Subcommittee) since 1954. The Committee regretted that Professor Burns' services would be lost to the RNPRC and expressed deep appreciation of his help and advice during the many years of his membership. Professor Burns continues as Emeritus Civil Consultant to the Navy for audiology.

THE ROLE OF THE RNPRC

Terms of Reference

4. The terms of reference of the RNPRC are:

a. to advise the MRC on such investigations as the Council may be asked to undertake on biological, medical, physiological and psychological problems affecting the health and fighting efficiency of Naval personnel and to suggest investigations with a view to increasing or improving the health, fighting fitness and environment of Naval personnel, and to aid and supervise such investigations as expedient.

b. to advise the Navy Department through or on behalf of the MRC on the Navy Department Personnel Research Programme, including biological, medical, physiological and psychological aspects affecting the health and efficiency of Naval personnel.

* Mr Campbell retired in June 1981, and the post of DGRM was abolished.

5. The changing organisation within the MOD for personnel research and the enhanced facilities that have come about since the RNPRC was last reconstituted in 1958 point to a review of the RNPRC. Accordingly at the 62nd meeting it was decided to set up a small joint MRC/MOD Working Party to review the functions and the future role of the RNPRC.

SUMMARY OF WORK

HEARING SUBCOMMITTEE (HeS) - Chairman: Professor W Burns (until October 1980)

6. In response to a request from the Institute of Naval Medicine to investigate a problem raised by Director Underwater Weapon Projects (Naval) (DUWP(N)) in connection with diver safety during the operation of new generation sonar sets a Working Group of the HeS was set up. DUWP was worried about possible auditory hazards to divers particularly in shallow diving operations during such tasks as underwater repairs on ships. The Working Group's investigations, reported in HeS 1/80, advised that the criteria adopted should limit exposure of non-hooded divers to 175 dB* exposure and of hooded divers to 185 dB*. Using these figures, it was possible to calculate the nearest safe distance for divers operating in the vicinity of sonar sources of various types.

* The decibel levels refer to the rms sound pressure level in water related to 20μPa.

PHYSICAL FITNESS SUBCOMMITTEE (PFS) - Chairman: Professor R J Linden

7. Following a request from MDG(N) the Physical Fitness Subcommittee was set up in April 1978. Its main tasks were to define a safe and simple test of physical fitness and to recommend what research was needed in order to establish physical fitness standards for different types of Naval tasks. After a series of meetings, during which attention was drawn to the Canadian 5BX system, the Subcommittee came to the following conclusions: that a degree of physical exercise was beneficial and that those who took regular exercise were better able to perform physically demanding tasks; a regular training programme during working hours was necessary to maintain physical fitness in a fighting force; the step-up-to-fitness test should be discontinued, there being no evidence that it was an effective test; there was, at present, no safe and simple test to assess the physical fitness of an individual on a single occasion. It was however possible to measure changes in the fitness of an individual.

The Subcommittee discounted tests which attempted to relate fitness of one individual to another or of one group to another.

8. The recommendations of the Subcommittee fall into two categories: those relating to training for and testing of physical fitness, and those relating to research associated with such a programme.

a. Testing and training A fitness test should be carried out on entry to the Service and on completion of initial training. Periodic tests subsequently, taking into account ageing, would allow an assessment to be made of the individual's fitness relative to his earlier performance. Such a test could be adjusted to take account of the different activity levels for different tasks and could be used to validate a progressive training programme to improve physical fitness.

b. Research Two fitness tests should be used and evaluated in parallel: one test which would relate the heart rate produced during exercise to a previously measured work load causing an increased rate (this test could be used in a limited initial programme for observing and testing fitness in groups of men); and another test, simple, practical, capable of being used at sea, which would relate body weight and step height to the heart rate achieved while stepping at a prescribed rate.

Other recommendations were that the oxygen cost of tasks involving sedentary, moderate and heavy Naval activities should be estimated in order to establish suitable training levels for Naval personnel in these 3 broad categories; that an investigation of the shortest time in which physical fitness may be obtained and of the minimum time which must be spent in maintaining physical fitness should be undertaken; and that an investigation should be carried out to determine whether performance of sedentary tasks, particularly skilled ones, is improved by a higher level of physical fitness.

9. The Subcommittee's recommendations have been endorsed by the RNPRC and passed to MDG(N).

PSYCHOLOGY SUBCOMMITTEE (PS) - Chairman: Dr A D Baddeley

10. The Psychology Subcommittee has met about three times a year during the period covered by this report. Its main concern has been to explore possible ways of increasing the psychology input for Defence research for the Navy. The principle of visiting Royal Navy or MOD establishments has continued and several meetings have been held at the AMTE Applied Psychology Unit, Teddington, and at the Institute of Naval Medicine, Alverstoke. These visits together with earlier presentations by psychologists at the MOD, Admiralty Arch, have assisted the Subcommittee in formulating its views on areas of research where psychological input needs increasing. In the opinion of the Subcommittee the main areas are:

Performance testing

Recruit retention/wastage

Decision aiding

Computer-aided learning

Man-computer symbiosis

Considerable concern has been expressed by the Subcommittee that although the case for the importance of human factors advice is accepted by the Service, manpower available for this aspect of equipment development has fallen far short of that needed. This has resulted in crucial failures due to the inability of current Naval operators to cope with some systems designed. The obvious answer to this problem would be to increase dramatically the number of MOD psychologists. Whilst this should be the long-term aim, though it appears impracticable in the present economic climate, the Subcommittee has recommended that a scheme should be introduced which would make use of two sources of expertise, namely, university and polytechnic teaching staff, and postdoctoral research staff. The administration and financing of such a scheme will need careful examination; the problem cannot be solved without spending money, but the proposed scheme would not involve the creation of more Civil Service posts.

11. Cognitive performance, sleep quality and mood during deep oxy-helium diving

This study, undertaken by Vivien J Lewis and A D Baddeley of the MRC Applied Psychology Unit on divers at the AMTE Physiological Laboratory, Alverstoke, is reported in RNP 1/81 and forms part of a series of simulated saturation oxy-helium dives to examine the physiological and psychological changes in man in high pressure conditions. A series of five dives (ten man-dives) lasting between 18 and 26 days, and reaching maximum simulated depths of between 300 metres sea water (msw) and 540 msw, were studied. Tests of cognitive functioning, including associative and short term memory, arithmetic ability, perceptual speed, spatial manipulation, grammatical reasoning, and semantic processing were administered to well-practiced subjects prior to each dive, at maximum depth and again during decompression. Sets of questions for self-report measures of sleep and mood were issued for a period extending from one week before each dive commenced until at least one week after the dive was completed. The results suggest that though a diver is able to function at the depths studied, and tests of short term memory and grammatical reasoning showed no decrement, his cognitive efficiency is likely to be impaired on a wide range of tasks. He is also likely to suffer from partial sleep depreviation and a possible drop in alertness. It seemed highly unlikely that either of these was responsible for the observed performance decrements however, since sleep was no better during decompression that it was at depth while performance recovered to pre-dive level. The observed decrement in cognitive performance is likely to have important implications for both a diver's efficiency and safety under open sea conditions.

SUBMARINE SUBCOMMITTEE (SMS) - Chairman: Professor R J Linden

12. The Submarine Subcommittee at a meeting in October 1979 reviewed the results of research at INM on mineral excretion on long submarine patrols and on continuous exposure to carbon dioxide and carbon monoxide, and discussed work that was planned.

13. Exposure to levels of carbon dioxide It was established that there were no long term adverse effects from breathing air with CO_2 level of 0.5%. For technical reasons it was difficult in a submarine to maintain levels of CO_2 below about 1.0%. Although a 72 hour pilot trial to study the effects of breathing air with 1.0% CO_2 had shown no adverse effects, the Committee recommended that a further long duration chamber trial at INM, using a CO_2 concentration of 1.5% should be undertaken. This would be higher than the current permissible level on submarines but effects at lower concentrations could be interpolated from the trial results.

14. Exposure to levels of carbon monoxide There was firm evidence that 15 ppm of CO in air was a safe level. Any effects on task performance were not known but the Subcommittee felt that research in this area was important particularly in relation to the man/machine interface with sophisticated equipment where high degrees of concentration and accuracy of reaction were essential, and also in relation to officers' decision making. Long exposure to CO has produced small effects on the myocardium and minor P-wave changes were visible on ECG, but all subjects reverted to their normal state after terminating their exposures to CO. The Subcommittee strongly supported INM plans for a further study with CO.

15. The extensive research accomplished by INM into the effects of CO_2 and CO were commended by the Subcommittee and regarded as a bank of very useful information with which to compare future trials.

SURVIVAL-AT-SEA SUBCOMMITTEE (SS) - Chairman: Professor G R Hervey

16. Although there has been no formal meeting of the Survival-at-Sea Subcommittee during the period of this report, frequent informal meetings and consultations between the Chairman Professor G R Hervey and Surgeon Commander F Golden, SMO Survival Medicine at the Institute of Naval Medicine, has ensured that work in this field has progressed satisfactorily.

The major research effort continued to be concerned with some of the many physiological aspects associated with survival in cold water. The period saw the culmination of the research into determining the cause of the 'afterdrop' in deep body temperature following cold water immersion. The results, which showed that the 'afterdrop' may be accounted for largely by a physical mechanism and not by cold blood returning from the periphery as had been considered previously, leaves the question of the cause of immediate post rescue death open to question.

Excluding those deaths obviously due to drowning or the complications thereof, it would appear that post immersion death may result from 'Rewarming Collapse' or, in those who collapse and die before rewarming commences, from vasomotor collapse. The hypothetical mechanism of the latter being the sudden withdrawal of the external hydrostatic pressure provided by the surrounding water, which during immersion supports the circulation and helps to maintain a viable cardiac output in individuals whose vasomotor reflexes may be impaired and in whom blood volume may be depleted.

An initial pilot study was performed to test the hypothesis in which arterial and central venous pressures were monitored in a human volunteer immersed in cold water and on helicopter winching. On being lifted from the water the CVP fell by 12 mmHg; there was an associated fall in systemic pressure with a moderate increase in heart rate. The change in systemic pressure was not sufficient to produce any noticeable effects in level of consciousness in this instance, but this was not surprising as the condition of the subject was not comparable to those described in the many anecdotal accounts of this phenomenon. Nevertheless, the evidence of this pilot study suggests that the hypothesis is viable and should be pursued. Further animal experimentation is currently being considered.

During the period of this report, experiments were also conducted in an effort to determine the cause of swimming failure in cold water; the results of which are still being analysed. A pilot study of some current long distance swimmers has shown that modern distance swimmers are relatively lean and that their response to static immersion in cold water is different from a control group. The work suggests some form of acclimatisation which is worthy of further study.

Evaluation of liferafts and other items of survival equipment continued throughout the period. It was shown that when a 25-man liferaft, with a full complement aboard, was "closed down", toxic levels (3%) of CO_2 were reached within 25 minutes. A series of experiments with a fully manned liferaft in a wave motion showed that satisfactory ventilation could be achieved by opening a lookout port for 10 mins. in every 30. It remains to be determined whether such a ventilation procedure will compromise the thermal habitability in a cold environment with high air movement. The availability of a suitable climatic chamber is awaited to complete this study.

UNDERWATER PHYSIOLOGY SUBCOMMITTEE (UPS) - Chairman: Professor K W Donald

17. As requested by RNPRC this Subcommittee now has a larger representation from the universities. New members are:-

Professor W R Keatinge (London Hospital, Ch'man Ethical Committee)

Professor M de Burgh Daly (St Bartholomew's Hospital)

Professor D N Walder (Newcastle University)

Professor J Nelson Norman (Inst of Environmental North Sea Medicine, Aberdeen University)

Professors Keatinge and Norman are also experts on heat balance and hypothermia.

The Chairman (as Consultant to the Royal Navy not RNPRC) has also chaired the Biomedical Subcommittee of SCOSER for the last four years. However this has now been disbanded and AMTE(PL) has also dropped research on problems of submarine escape training. It is likely that UPS will become more involved in submarine escape and particularly escape training.

18. A meeting of UPS was held in March 1981 at AMTE(PL) to review the establishment's 1981/82 research programme and to discuss work carried out during the past year. Particularly interesting discussions took place on Oxygen poisoning in Mine Counter Measure (MCM) trimix diving trials, thermal protection of divers and personnel in diving bells and progressively deeper simulated dives on oxy-helium and trimix up to 660m.

The new submarine escape chambers and facilities will be completed in 1982. Discussion took place as to what information will be required before simulated deep submarine escapes by men on oxygen or super-oxygenated air could be agreed by the Ethical Committee. It was agreed that animals (rats) should be tested for performance (maze behaviour, solution of feeding problems etc) after such escapes, breathing high tensions of oxygen.

Progress in surface decompression procedure was also discussed.

SHIP MOTION WORKING PARTY (SMWP) - Chairman: Professor G R Hervey

19. Excellent collaboration has been established between Leeds University and the Institute of Naval Medicine particularly in the pharmacological work, and also with the Royal Aircraft Establishment and the MRC Applied Psychology Unit, who in collaboration with the previous SP(N) have conducted research using the motion generator at the Warren Spring Laboratory, and the Institute of Sound and Vibration Research of Southampton University. The last is also engaged in applied research into the effects of ship motion, and close liaison has been established through ISVR representation in the Subcommittee membership and a day spent by members of SMWP at ISVR.

Under the terms of a contract between the MRC and Leeds University a substantial proportion of the time of the Chairman SMWP, together with secretarial support, has been made available; and a pharmacologist, Dr Carol Muir, assisted by a technician, has been engaged by the University on behalf of the SMWP for research at INM.

20. The main activities have been as follows:

a. Therapy of motion illness by drugs The longest known and most effective anti-motion illness drug is hyoscine, but as currently administered it produces side effects which, although fairly well known and may often be preferable to severe motion illness, cause decrement in the performance of many operational tasks in a warship. As hyoscine is inexpensive and readily available the Subcommittee decided that, as a priority, rather than searching for a new drug, efforts would be directed towards identifying the best ways of administering the drug in different operational situations - having in mind the practicalities of the situation, speed and duration of action needed, and achieving the best balance between protection and side effects. To proceed with such an investigation it is essential to follow the time course of concentrations of the drug in the blood. Surprisingly it was found that no satisfactory assay for hyoscine in blood currently existed; Dr Muir is therefore developing an assay. An enzyme-linked immunoabsorbant assay had initially been tried but without success. Next a high performance liquid chromatography method was investigated; this has been developed to the point where it provided excellent specificity and it was now necessary to increase the sensitivity to that appropriate to blood concentrations after pharmacologically effective doses. This depended upon derivatisation of hyoscine: ie attaching another compound to the hyoscine molecule to make it more readily detected, by ultra-violet absorption or by fluorescence. Hyoscine is a difficult molecule with which to do this and valuable help is being obtained from several authorities, in particular the Department of Analytical Chemistry of Salford University.

A specially designed rotating chair which can be tilted while being rotated on a turntable, is being installed at INM. Capable of inducing motion illness this chair will enable comparative tests of effectiveness of different methods of administering hyoscine to proceed. It could also at a later stage be used to compare the effectiveness of different drugs and possibly for research into the feasability of adaptation to ship motion.

An annotated bibliography of the literature forming the background to the research on drug therapy is in course of preparation.

b. The influence of ship motion on manual control skills Under the auspices of the Senior Psychologist (Naval) some collaborative experiments by MRC Applied Psychology Unit with the assistance of the RAE and staff of the Warren Spring Laboratory, Stevenage, were conducted using the Warren Spring ship motion simulator with a specially constructed cabin mounted on it. Effects of motion on a range of typical manual control skills (a tracking task, a tracing task and a digit keying task) were examined on the simulator driven in heave, pitch and roll by signals taken from motion records of the frigate HMS AVENGER whilst travelling at 13 m/s (25 knots) into a force 4 wind. The motion produced a vertical rms acceleration of 0.024g, mostly between 0.1 and 0.3Hz with comparatively little pitch or roll. It was found that a task involving unsupported arm movements was seriously affected by the motion; a pursuit tracking task showed a reliable decrement although it was still performed reasonably well (pressure and free-moving tracking controls were affected equally by motion); and a digit keying task requiring ballistic hand movements was unaffected. There was no evidence that these effects were caused by motion sickness. The differing response to motion of the different tasks, from virtual destruction to no effect, suggests that major benefits could come from an attempt to design the man/control interfaces on board ship around motion resistant actions.

c. Epidemiological studies by INM In 1979 CINCFLEET gave approval for a motion sickness survey to be carried out at sea. Crews of 14 ships had taken part by answering sets of questions, prepared by INM, which covered their individual histories of motion sickness whilst serving with the Royal Navy. The survey embraced 2000 men, 1750 (87%) of whom replied to the questions. The ships involved were 2 guided-missile destroyers, 4 general purpose frigates, 6 small vessels (eg off-shore patrol, mine-sweeper, mine-hunter vessels), 1 survey ship and 1 hydrofoil.

Early findings show that motion sickness at sea affected approximately 75% of sailors sometime during their Service career and some 24% were affected by motion sickness in motor cars, funfair machines etc. In the worst conditions studied the proportion of a ship's company affected by seasickness approached 50%; 5-10% had to stop work when seasick, and some were sick every day. It seems clear that seasickness must cause significant reduction of the total capabilities of a ship's crew. A report on the full analysis of the survey and the findings is being written.

d. Collaboration with US Naval Biodynamics Laboratory, Michoud Following the visit by the Chairman and Secretary SMWP to Michoud in June 1978 (described in the RNPRC report for the period January 1977 to December 1978, RNP 2/79) the recommendation to attach a UK scientist to join the US team at Michoud working on ship motion has been welcomed by the US authorities and by the MOD. The Biodynamics Laboratory has also been visited by a senior representative of AMTE. A contract between the MOD and Leeds University to fulfil the recommendation to attach a UK scientist to Michoud for 3 years has just been agreed, and steps are being taken toward making an appointment.

3. Instrumentation SMWP has drawn attention to a need for instrumentation to measure exposure to motion, particularly of a simple, portable kind. Collaboration between AMTE, RAE and ISVR has led to examination of the requirements, and development of hardware is progressing actively.

ANNEX A
to RNP 3/81

MEETINGS of the RNPRC and its sub-groups have been held as follows. Copies of the minutes can be made available to RNPRC members on request.

MAIN Committee		
61st Meeting	October 1979	RNP 5/79
62nd Meeting	October 1980	RNP 7/80
CHAIRMEN's MEETING		
8th Meeting	January 1980	RNP 6/80
HEARING Subcommittee		
Meeting of an ad hoc group on sonar transmissions/ diving activities	November 1979	HeS 2/79
PHYSICAL FITNESS Subcommittee		
1st Meeting	February 1979	PFS 1/79
2nd Meeting	April 1979	PFS 18/79
3rd Meeting	May 1979	PFS 20/79
4th Meeting	December 1979	PFS 25/79
5th Meeting	May 1980	PFS 2/80
PSYCHOLOGY Subcommittee		
4th Meeting	March 1979	PS 5/79
5th Meeting	December 1979	PS 10/79
6th Meeting	April 1980	PS 3/80
7th Meeting	June 1980	PS 7/80
8th Meeting	September 1980	PS 11/80
9th Meeting	December 1980	PS 1/81
10th Meeting	February 1981	PS 4/81
11th Meeting	April 1981	PS 8/81
SUBMARINE Subcommittee		
21st Meeting	October 1979	SMS 2/79

UNDERWATER PHYSIOLOGY Subcommittee

54th Meeting	April 1979	UPS 2/79
55th Meeting	March 1981	UPS 5/81

SHIP MOTION WORKING PARTY

7th Meeting	March 1979	SMWP 4/79
8th Meeting	June 1979	SMWP 7/79
9th Meeting	October 1979	SMWP 11/79
10th Meeting	March 1980	SMWP 7/80
11th Meeting	September 1980	SMWP 11/80
12th Meeting	April 1981	SMWP 8/81

REPORTS AND PAPERS

GENERAL

Reports

RNP 2/79	Report for the period January 1977 - December 1978
RNP 1/81	Cognitive performance, sleep quality and mood during deep oxy-helium diving

HEARING Subcommittee

Committee paper

HeS 1/80	Sonar transmissions/diving activities - incompatability

PHYSICAL FITNESS Subcommittee

Committee paper

PFS 24/79	Recommendations of the Physical Fitness Subcommittee

PSYCHOLOGY Subcommittee

Committee papers

PS 2/80	Proposals for supplementing MOD Human Factors Expertise
PS 6/81	Statement on AMTE/APU research programme by the Psychology Subcommittee

UNDERWATER PHYSIOLOGY Subcommittee

Committee papers

UPS 4/81	AMTE/PL Submarine physiology research programme
UPS 6/81 (AMTE(E)R80401)	Cold water dives in deep trials unit to 250 and 300m. Report on the findings pertinent to respiratory heat transfer and the problems arising

SHIP MOTION WORKING PARTY

Committee report

SMWP 3/80	The influence of ship motion on manual control skills

Committee papers

SMWP 3/79	Effects of ship motions on personnel
SMWP 8/79	Rolling platforms in MOD (Naval Sector)
SMWP 10/79	Research on human factors problems arising from ship motion
SMWP 5/80	Recommendations for research on human factors problems of ship motion, May 1980
SMWP 10/80	Current status on motion sickness project, September 1980
SMWP 3/81	Visit by Mr E C Tupper to Naval Biodynamics Laboratory, New Orleans
SMWP 6/81	Therapy of motion illness by drugs. Position paper, March 1981
SMWP 9/81	Motion sickness incidence on sea-going passenger vessels: An interim report by ISVR to the Science Research Council

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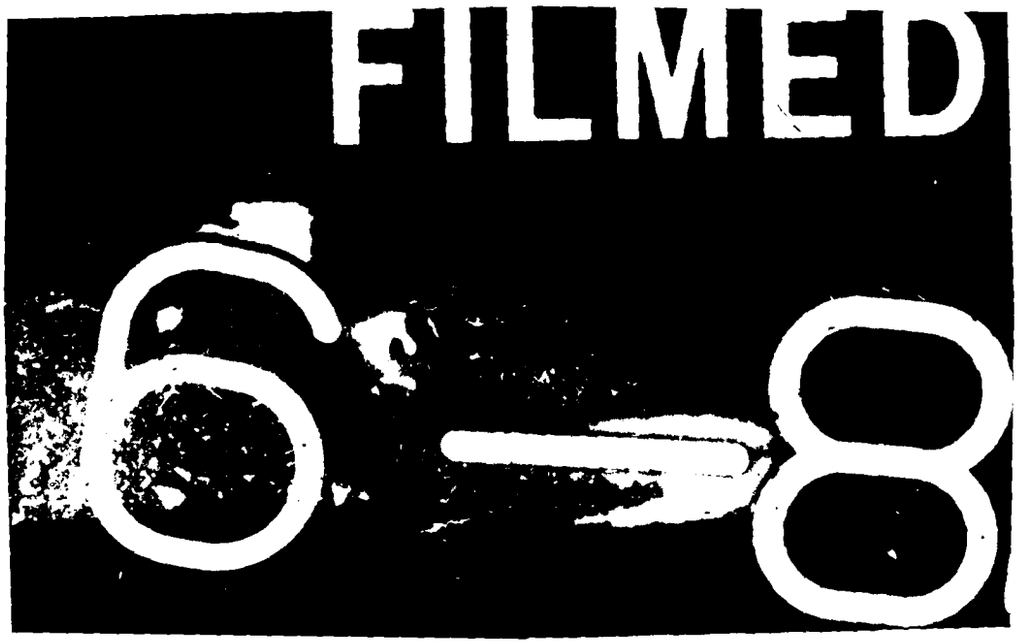
Note: Reports and papers are not necessarily available to the public or to commercial organisations.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