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ROYAL NAVAL PERSONNEL RESEARCH COMMITTEE LONDON (ENGLAND)  
REPORT FOR THE PERIOD JANUARY 1977 TO DECEMBER 1978.(U)

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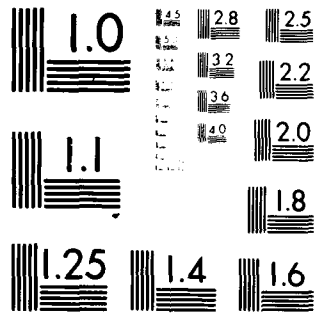
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ROYAL NAVAL PERSONNEL RESEARCH COMMITTEE  
(RNPRC)

MEMBERSHIP - December, 1978

Chairman	Professor K W Donald DSC QP MA MD DSc FRCP FRSE
Medical Director General (Naval)	Surgeon Vice-Admiral Sir John Rawlins KBE QHP FRCP FFCM FRAeS
- The Medical Officer-in-Charge Institute of Naval Medicine	Surgeon Rear-Admiral J A B Harrison QHP MRCS LRCP FRCR DMRD
- Director of Health and Research (Naval)	Surgeon Captain P F Toal MB BCh MFCM DPH DIH
Chief Scientist (Royal Navy)	Mr C C Fielding MA
- Deputy Chief Scientist (Navy)	Mr P R Wallis
- Senior Psychologist (Naval)	Mr E Elliott BSc FBPsS
Director of Naval Warfare	Captain D G Armytage
Flag Officer Submarines	Rear-Admiral R R Squires
Dr A D Baddeley MA PhD	MRC Applied Psychology Unit
Professor W Burns CBE MB ChB DSc FRCP	Emeritus Professor of Physiology, University of London
Professor G R Hervey MA MB	Professor of Physiology, University of Leeds
Professor R J Linden MB ChB PhD DSc FRCP	Professor of Cardiovascular Studies, University of Leeds
Secretary	Dr H W Bunje MD FRCP MRC Headquarters Office Staff
Assistant Secretary	Mr J A Brown MM MRC Headquarters Office Staff

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## INTRODUCTION

### Changes in RNPRC Membership

1. Surgeon Vice-Admiral Sir John Rawlins vice Surgeon Vice-Admiral Sir James Watt  
(MDG(N))  
Surgeon Rear-Admiral J A B Harrison vice Surgeon Rear-Admiral J S P Rawlins(INM)  
Surgeon Captain P F Toal vice Surgeon Captain R J W Lambert  
(DHR(N))  
Mr C C Fielding vice Mr B W Lythall (CS(RN))  
Mr P R Wallis vice Dr J Tunstead (DCS(N))  
Rear-Admiral R R Squires vice Rear-Admiral J D E Fieldhouse (FOSM)  
Captain D G Armytage vice Captain D R Reffell (DNW)

2. The previous report recorded that Dr A D Baddeley had consented to take over Chairmanship of the Operational Efficiency Subcommittee. In the event, however, it was decided, after consultation with Chief Scientist (Royal Navy) and the Senior Psychologist (Naval), to wind up the Operational Efficiency Subcommittee as then constituted and to establish in its place a new Psychology Subcommittee, with a broader academic base, and Dr Baddeley assumed Chairmanship of the new Subcommittee.

3. In the early part of 1978, Professor O G Edholm indicated his wish to resign the Chairmanship of the Environment Subcommittee and to withdraw from further participation in the work of the RNPRC. Professor Edholm had been associated with the work of the RNPRC for many years and the Committee noted with great regret that his services would now be lost to the Committee. Enquiries to seek a new Chairman for the Environment Subcommittee are continuing.

4. Difficulties facing the setting up of a tri-Service body to deal with problems of Physical Fitness have led to agreement by the Committee, at the request of the Royal Navy, to the setting up of a Subcommittee on Physical Fitness. Professor R J Linden has consented to chair the new Subcommittee and arrangements have been made for the inaugural meeting to be held in the early part of 1979.

### Current Work

5. The work of the Committee is summarised below in individual reports by the Chairmen of the various Subcommittees and working groups. These sub-groups provide a forum for discussion of the various projects, of the conduct of experimental work and of the final results. Recommendations in the light of the work are prepared by sub-groups and, if endorsed by the RNPRC, communicated to the appropriate Service department.

6. The arrangements for carrying out studies are agreed by the Subcommittee in discussion with the staff of those mainly concerned, principally the Medical Director-General (Naval) and Chief Scientist (Royal Navy). In broad terms the work is carried out in the following ways:

- (a) by Navy Department scientists and medical officers carrying out research within the Service with advice, when needed, from the RNPRC on the scientific aspects of the work;

- (b) in Navy Department establishments with assistance from the Medical Research Council (MRC) in terms of equipment and scientific or technical personnel;
- (c) by MRC staff working on projects in MRC laboratories.

### Reports

7. Reports covering the work are produced as MRC/RNPRC documents and distributed widely within the Ministry of Defence and also on an international basis in consultation with the Defence Research Information Centre. It has proved possible in almost every case to produce reports which are of 'unlimited' distribution and therefore freely available to whoever may need them. Scientists associated with the RNPRC, both inside and outside the Royal Navy, are encouraged to publish their findings in the open scientific press, subject to the customary MOD clearance.

8. With the increase of in-Service research, a number of establishments such as INM, AMTE(PL) and AMTE(APU) produce their own reports. Such reports are independent of, and do not contain reference to, RNPRC or MRC.

## THE ROLE OF THE RNPRC

### Terms of reference

9. 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.

### RNPRC/MOD liaison

10. The arrangements recorded in the last report have continued in operation and have continued, also, to work well. Representatives of the RNPRC now attend meetings of the Chief Scientist's Advisory Committee on Human Engineering Research and Chairmen of the Subcommittees have an opportunity of meeting with Navy Department staffs annually for discussion of the overall in-Service programme of personnel research. Discussions have been initiated between RNPRC and AMTE(PE) to concert improved liaison and co-operation in the field of physiological research.

## SUMMARY OF WORK

### ENVIRONMENT SUBCOMMITTEE (ES) - Chairman: Professor O G Edholm (up to January, 1978)

#### Protective Clothing

11. Following the experimental work reported upon in the last report, some improved clothing assemblies were tested in cold chamber conditions and, as a result, the Subcommittee has been able to recommend the adoption of clothing assemblies, from amongst items already available in the Services, which provide improved protection for men in exposed positions on HM Ships. The need for improved protection of hands, face and feet remains an outstanding requirement and this matter is being kept under review.

### HEARING SUBCOMMITTEE (HeS) - Chairman: Professor W Burns

12. There has been little activity on the part of the Hearing Subcommittee during the period under review but a number of on-going surveys, being carried out under the aegis of the Subcommittee, are continuing. These include a survey of deafness in divers, a study of noise levels in ships and an audiometric survey of engineering staff. These are long term investigations and it must be some time before sufficient results are available for assessment by the Subcommittee.

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

13. The Psychology Subcommittee was set up to continue the work of the former Operational Efficiency Subcommittee following the retirement of Professor Drew from the Chairmanship of that body but, as the moment seemed opportune, it was deemed expedient to review the composition and functions of the Subcommittee. In the event it was decided to widen the academic representation on the Subcommittee and to re-define the terms of reference as follows:

- (a) to advise on the application of psychological research to the solution of naval problems;
- (b) to set up working parties to investigate specific problems as required;
- (c) to monitor, as necessary, extra-mural research on naval problems.

14. The Subcommittee held its first meeting in April, 1978, and has since met on two further occasions during which it has devoted its first efforts to obtaining a general understanding of naval problems. During these meetings, visits have been undertaken to a naval vessel and to a number of shore-based training and research establishments.

15. As an outstanding item of business remaining from the Operational Efficiency Subcommittee, the Psychology Subcommittee reviewed a paper prepared by the late Dr A Carpenter on 'Speech Communication' for incorporation in the handbook 'Human Factors for Designers of Naval Equipment'. The paper was approved for publication.

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

16. The Submarine Subcommittee has been currently concerned with two particular problems, ie the effects of carbon dioxide and the effects of carbon monoxide.

(a) CO<sub>2</sub> investigations

In the early part of 1977 the Submarine Subcommittee convened an ad hoc group to consider a preliminary report on the work carried out up to that time and was able to advise on the pursuit of further investigations. Reports on this work were received at the end of 1978 and have not yet been fully studied. However, preliminary study would seem to indicate that levels of 0.5% or even 1.0% CO<sub>2</sub> would be acceptable. It proved possible in the later studies to show that urine acid-base changes seen in a previous study were probably artefactual due to imperfect urine collection methodology. This could not have been forecast. In addition, all changes proved to be reversible on return to fresh air. It has been established, also, that variation of Vitamin D levels in the presence of these concentrations of CO<sub>2</sub> does not affect levels of mineral excretion.

(b) CO investigations

Reports on this investigation were also received at the end of 1978 and, again, have yet to be subjected to detailed study. The CO level in submariners is commonly found to be about 15ppm, rising in the case of some smokers to 50ppm and at these levels there are indications of some ECG changes (Arrhythmic); postulated as being changes caused by a specific toxic effect of CO on atrial pacemaking or conducting tissues. These problems are being considered further. It was not possible to detect changes in mental performance due to increased CO levels but comment was made that one test, the LOGIT test, was probably insufficiently sensitive to be an indication of CO effects.

17. Arrangements are being made for detailed study of the reports touching on the foregoing matters by a meeting of the full Submarine Subcommittee with a view to determining what further investigations may be needed.

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

18. There has been no meeting of the Survival-at-Sea Subcommittee during the period under review. There has, however, been continuing work on problems of immersion hypothermia and the report on Surgeon Commander Golden's work (now nearing completion as a PhD thesis) at the University of Leeds is currently awaited by the Subcommittee. The Department of Survival Medicine, with Surgeon Commander Golden as Medical Officer in Charge, has been established at the Institute of Naval Medicine, and promises to form a point of forum for action in survival problems.

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

19. As in the past, the role of the UPS has been that of an advisory body covering the RN programmes in the Deep Diving and Submarine Escape fields. The experimental and laboratory work involved is carried out at the AMTE (Physiological Laboratory), the

Admiralty Experimental Diving Unit and HMS VERNON.

Work by AMTE (Physiological Laboratory)

20. During the period under review, the UPS has considered a number of reports prepared on the basis of work carried out at the Physiological Laboratory. These include:

(a) Some cardio pulmonary responses to exercise in an increased ambient pressure of oxy-helium - RNPL Report No 8/75

In these chamber experiments it was shown that divers were able to perform heavy work at 240m (800 ft). However certain findings suggested the possibility of decreased lung compliance and that, under such conditions, the tension of helium may facilitate the pulmonary irritant effect (Lorrain Smith) of oxygen. These effects, whatever their cause, appeared completely reversible but, nevertheless, they were being further investigated.

(b) A Method of measuring oxygen consumption and minute ventilation in semi-closed circuit underwater breathing apparatus - RNPL Report No 3/77

The technique described allows both the oxygen uptake and ventilation to be measured. The subject was in a tank of water with shoulders and head above water. A bicycle ergometer was used. Results were compared with direct expired gas collected at 1 Atm. Results appeared most promising and will allow oxygen uptake and ventilation to be measured under operational conditions.

(c) Pneumatically controlled mixed gas underwater breathing apparatus - RNPL Report No 5/77

The laboratory has produced a re-breathing semi-closed apparatus in which the gas mixture supplied contains a constant amount (mass) of oxygen no matter what the depth.

The critical breakthrough here is a laminar flow element across which the pressure gradient (which is directly proportional to the mass of oxygen flowing through it) is kept constant by a feed-back regulating mechanism.

Such a development has been required in mixture diving for some forty years, if not longer. The device has been patented.

(d) Observations on men at pressures up to 300 msw (31 bar) - AMTE(E) Report No 78401

The Subcommittee also received and discussed a report on 'Observations on men at pressures up to 300 msw (31 bar)'. This was in the nature of an introductory report on work in this area and the Subcommittee expect to receive more detailed reports on different aspects of the work in due course. One particularly interesting new finding after these saturation dives was a typical 'ball race' (cog-wheel) appearance of some red cells which decreased in number and disappeared some days after. Investigations are proceeding as to whether this change (if validated) is an indication of marginal D.C.S. or unsatisfactory decompression.

21. The Chairman of the Subcommittee has now been appointed Chairman of the Biomedical Working Party of the Standing Committee on Submarine Escape and Rescue. He also represents the RNPRC on the Ethical Committee of the Ministry of Defence (Personnel

research). A most useful new exercise has been the Chairman's attendance at the Review Meetings of the AMTE Engineering and Human Factors Department.

22. At its last meeting it was generally agreed that the UPS should recruit more academic members. Professor Walder (Newcastle) and Professor Norman (Aberdeen) have already joined the UPS and discussions with CS(RN), Mr Tupper (AMTE) and Dr Hempleman as to the remit and functioning of UPS are about to take place.

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

23. Following the closing down of the former Physical Fitness Working Party, and the subsequent retirement of Professor O G Edholm, the Royal Navy requested the RNPRC to set up a new Subcommittee to act as a source of advice on problems relating to physical fitness in the Navy and, particularly, relating to physical fitness for performance of specific tasks. The RNPRC has agreed to set up a new Subcommittee for this purpose and Professor Linden has consented to chair the Subcommittee. Arrangements are in hand for an inaugural meeting of the Subcommittee to be held early in 1979.

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

24. The first meeting of the Ship Motion Working Party was held early in 1977 and, altogether, the Working Party has met on six occasions during the period under review. The Working Party's remit divides into two areas:

##### (a) Motion Sickness

It seems clear that motion sickness, even in a mild form well short of vomiting, is both common and potentially liable to degrade performance, although the extent of this impairment is probably variable and not well investigated. In the special case of the life-raft situation motion sickness - through its effects on morale and behaviour, on fluid balance and on the likelihood of hypothermia - poses a substantial hazard to survival; and a fully practical treatment method is certainly not yet available.

##### (b) Biomechanical effects of motion

It appears likely that performance of some tasks is degraded by the motion of the ship but, here again, the extent of any impairment does not appear to have been well investigated.

25. In the course of discussions held over the series of meetings referred to above the Working Party has proposed a number of lines of investigation:

##### (a) A study of the incidence and severity of motion sickness among personnel serving in HM Ships

In collaboration with INM a form of questionnaire has been devised which, it is hoped will yield information on these points. Arrangements are being made for the questionnaire to be distributed among ships of the Fleet and it is hoped, also, to obtain some subjective information regarding task performance variation from supervising officers regarding men under their command. Opportunity was taken to carry out a pilot investigation of this type in two ships and the Working Party received a report on this study (SMWP 9/78) which

indicated clearly the value of the information which may be expected to derive from the full scale study.

(b) Laboratory studies of performance of 'tracking' type tasks

Studies in this area involve the use of a motion simulator capable of producing realistic simulation of ship motion and installations of this type are not currently available in the United Kingdom. Nevertheless, a small pilot study is to be arranged, under the auspices of the Senior Psychologist (Naval), using the motion simulator at the Warren Spring Laboratory, which it is hoped will yield useful results.

Because of the lack of suitable installations in the United Kingdom, the Chairman and Secretary of the Working Party visited the United States in June, 1978, to acquaint themselves at first hand with work being undertaken there on studies relative to ship motion. They were able to visit the US Naval Aerospace Medical Laboratory Detachment at Michoud, where there are large scale installations designed to assist investigations in this field, and to discuss with workers there the studies that are being undertaken. Both here, and in later discussions at the Office of Naval Research in Washington, assurances were received that the US authorities would welcome the secondment of a UK physiologist to participate in the investigations. Facilities would also be given for the conduct of special investigations which might be of interest to the UK authorities. Visits were also made to a number of leading scientific centres where the work was discussed with the scientists concerned.

A report on the visit to the United States (SMWP 7/78) was discussed by the Working Party at its sixth meeting, and the Working Party advocated that enquiries be made to see whether funds can be made available to support the collaborative work of a British physiologist at Michoud. This recommendation is currently being pursued.

(c) Pharmacological studies

The Working Party has strongly recommended the carrying out of a series of pharmacological studies in connection with the prevention and treatment of motion sickness and it has been agreed that a scientist and technician shall be recruited for this work which will be carried out at the Institute of Naval Medicine. The nature of the work to be undertaken is outlined in the paper SMWP 5/78, and action is currently in hand to recruit the staff required.

(d) Habituation studies

The Working Party has recommended that funds be provided to support a study of the feasibility of adapting men to ship motion, having in mind particularly the value of such a process in the case of highly trained key personnel who might otherwise be so incapacitated by motion sickness as to be unable to perform adequately at sea. Proposals have been submitted to the Working Party (SMWP 4/78) for a study of the usefulness, in the naval context, of a relatively simple, non-specific deconditioning procedure which has been used in the RAF by Dr Dobie, who is also a member of the current working party. Enquiries are proceeding on the possible funding of this investigation.

(e) Fundamental physiological studies

The Working Party has noted the possibility that any further substantial advance in understanding of the effects of ship motion may be dependant upon basic investigations, including the area of possible changes in brain stem neural transmitters as the result of motion. It has recommended that the possibilities for such fundamental investigations should be kept under review.



SHIP MOTION WORKING PARTY

Working Party Meeting

1st Meeting	January 1977	SMWP 3/77
2nd Meeting	May 1977	SMWP 6/77
3rd Meeting	August 1977	SMWP 12/77
4th Meeting	November 1977	SMWP 20/77
5th Meeting	March 1978	SMWP 6/78
6th Meeting	October 1978	SMWP 10/78

REPORTS AND PAPERS

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GENERAL

Committee Papers

RNP 1/77	Report for the period January 1975 - December 1976.
RNP 3/77	Working Party on hyperbaric systems for diving R & D.
RNP 3/78	RNPRC relations with MOD.

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ENVIRONMENT Subcommittee

Committee Papers

ES 2/77	Headaches associated with cold-exposure.
ES 3/77	Cold and foul weather clothing assemblies for RN personnel (INM Report 11/77)

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PSYCHOLOGY Subcommittee

Committee Papers

OES 20/74	Colours for sizes.
PS 2/78	Continuous intense noise masks auditory feedback and inner speech.
PS 3/78	Evaluation of auditory, visual and dual-mode displays for prolonged sonar monitoring in repeated sessions.
PS 4/78	A reappraisal of artificial signals as an aid to a visual monitoring task.
PS 5/78	Human Factors - Speech Communication.

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SUBMARINE Subcommittee

Committee Papers

SMS 1/77	Effects on man of continuous exposure to 0.5% CO <sub>2</sub> (INM Report 22/77).
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## UNDERWATER PHYSIOLOGY Subcommittee

### Committee Papers

RNPL Report 8/75	Some cardio-pulmonary responses to exercise in an increased ambient pressure of oxy-helium.
RNPL Report 9/75	A comparative analysis of the effects of gases of differing molecular weights and ambient pressures, but the same comparative gas density, upon some physiological parameters.
RNPL Report 3/77	A method of measuring oxygen consumption and minute ventilation in semi-closed circuit underwater breathing apparatus.
RNPL Report 5/77	Pneumatically controlled mixed-gas underwater breathing apparatus.
AMTE (E)78401	Observations on men at pressures of up to 300 msw (31 bar).
UPS 2/78	Analysis of Submarine Escape Training. Apr 77-78.
UPS 3/78	Submarine Escape Training Tank incidents Nos 134-139.
UPS 4/78	Submarine Escape Exercise.

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## SHIP MOTION Working Party

### Committee Papers

SMWP 2/77	Note by SP(N)
SMWP 5/77	Head movement induced by angular oscillation of the body in the pitch and roll axes (FPRC /1348).
SMWP 7/77	Incidence of motion sickness.
SMWP 9/77	Draft questionnaire on incidence of motion sickness.
SMWP 10/77	Case for an automated multi-stress induction device.
SMWP 11/77	Revised questionnaire on incidence and severity of seasickness.
SMWP 13/77	Visit to HMS APOLLO.
SMWP 15/77	Laboratory studies of the effects of motion at Santa Barbara.
SMWP 16/77	Proposals for study of drug treatment of motion sickness.

SHIP MOTION Working Party

Committee Papers

SMWP 17/77	Note of discussions with Dr Channing L Ewing, Director of the US Naval Aerospace Medical Research Laboratory, Michoud, New Orleans.
SMWP 18/77	Assistance by Professor Hammerton.
SMWP 19/77	Proposals for an adaptation study.
SMWP 2/78	Recommended limits for human tolerance to the vertical shock following a vertical vibration rig failure.
SMWP 3/78	Low frequency motion simulators.
SMWP 4/78	Motion sickness and its treatment.
SMWP 5/78	Proposals for pharmacological studies.
SMWP 7/78	Visit to the United States by the Chairman and Secretary.
SMWP 9/78	A pilot study on the incidence of seasickness in RN personnel on two ships.

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

RELATED PUBLICATIONS in scientific journals etc

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