PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES

# Introductory Remarks to the Third Session

D. H. Elliott

*Phil. Trans. R. Soc. Lond. B* 1984 **304**, 103-104
doi: 10.1098/rstb.1984.0012

*Phil. Trans. R. Soc. Lond.* B **304**, 103–104 (1984) [ 103 ]
*Printed in Great Britain*

# Introductory remarks to the third session

By D. H. Elliott

*Shell U.K. Ltd, P.O. Box no.* 148, *Shell-Mex House, Strand, London WC2R 0DX*

This is a critical time in the history of diving and, in particular, a critical time for research into the effects of raised environmental pressure. Two principal reasons for the present situation are that diving appears to be approaching the natural limitations imposed by depth, and that diving has already exceeded the depths at which it can attract naval research funds. However, for selected tasks, and until the robots and one atmosphere alternatives become totally reliable, there will continue to be a task for man to the maximum depth of oil and gas production.

The ultimate depth limit to be imposed upon man's ability to work in the sea has not been defined and may not necessarily be one that is biological in nature. Possibly it will be a financial limit. One reason for this is the large cost of the resources that are required at sea to support a man more than 400 m below its surface.

Until the limit for diving has been safely explored and become relatively routine, research will continue to be needed into this special aspect of applied physiology. Another need for some research at deep depths is to facilitate by enhancement the study of physiological phenomena encountered at shallower depths. There is also a need for fundamental research into the effects of raised environmental pressure relevant to aspects of biology that are outside diving. The most important factor, common to most diving research programmes, including those at shallower depths, has been the financial support from the principal navies of the world.

The first steps were, however, made without naval involvement. The early history of diving in Britain is well recorded, from the diving bell patented in 1691 by the Secretary of this Society, a bell in which he spent some 90 min, 18 m below the river Thames (Halley 1716), to the formation of the Admiralty Deep Diving Committee in 1906, which provided the basis for present decompression theory (Boycott *et al.* 1908). Just 50 years later, the Royal Navy achieved a world deep diving record when Lieutenant Wookey reached 600 ft (182.8 m) for a few minutes. The history of early diving developments is beyond the scope of this introductory review. An account of the naval and civilian contributions to diving in Britain, the United States of America, France and other nations can be found elsewhere (Davis 1962; Bachrach 1982).

The present extension of man into yet greater depths began little more than twenty years ago, around the time of the first open-sea dive to 1000 ft (304.7 m) by Keller and Small, and the first saturation dives at sea. Since then, there have been many deep and prolonged dives and, besides acknowledging the work of Zurich Kantonsspital, Union Carbide, the University of Pennsylvania and several other laboratories, it is important to pay special tribute to the extensive work in France which lead in 1977 to the open-sea dive, JANUS IV, to 500 m. It is against this background of applied research that the next three papers must be considered, but it is relevant here to contrast the laboratory-supported achievements, in which man has been exposed to pressures equivalent to 685 m in a dry compression chamber, with commercial dives, which have been accomplished in less favourable circumstances at sea. Operational dives of outstanding achievement include: 14,000 man-hours in saturation with excursions down to

316 m during the installation of an oil platform, the recovery of seabed equipment at 326 m depth off Labrador, and particularly hard physical work recovering gold from H.M.S. Edinburgh at 240 m. These dives were all at significantly shallower depths than have been achieved under laboratory conditions. They have indicated that if man is to work safely at the deeper depths, it is further development of equipment in support of the diver that will be particuarly important.

Perhaps the most important factor in the future of diving in the last year or two has been the withdrawal of naval funds for developments below 300 m from even their own laboratories. At the same time the academic laboratories in the U.S. A. have learned that naval and N.I.H. funds are no longer available for diving-related researches at any depths. It is against this sombre background that the next three papers are introduced. The ATLANTIS series of dives at Duke University, to be described in the next paper, contained projects that are related to aspects of medicine and physiology that are important outside the specific interests of diving. For this reason a large measure of support came from the U.S. National Institutes of Health. Justification for the support given by the U.S. Navy and representatives of the oil and diving industry was more obvious and, with some Duke money too, the series has now finished – virtually in deficit. With the withdrawal of government funds from this field of research, there is little prospect of a direct continuation of this or any similar programme in the near future.

Diving research for the Royal Navy has a long and distinguished history, but with the completion of the recent series of deep dives at The Admiralty Marine Technology Establishment Physiological Laboratory to be described in the paper by Dr Hempleman *et al.*, there appears to be no immediate money to fund any continuation. Similarly, in the U.S.A., present naval objectives are focused upon diving to depths less than 300 m.

In Norway circumstances have been different. First, the Royal Norwegian Navy has no experience of deep diving but, second, the government has encouraged the oil industry to develop within Norway all that it might require offshore. The Norwegian Underwater Institute, now known as NUTEC, was created to help fill this need. Some four years ago, to add experience to the enthusiasm of this new research team, one major oil company sponsored two dives in the NUTEC wet chamber, the first to 300 m and the second to 500 m. These are to be summarized in the third paper by Dr Tønjum. NUTEC is now engaged in a programme of diving development to consolidate existing knowledge and, in particular, to develop the supporting equipment, for working dives to 350 m. No plans exist to develop diving at greater depths because, at present, no immediate application has been identified.

This is a disturbing situation for physiological research. Without major naval or government funding of civilian research into diving, there is a real danger that some university research teams will be disbanded. Once this is done their expertise will not be easily regenerated. If research is to be continued at a productive level, there needs to be a successful initiative to widen the necessary financial support.

## References


Bachrach, A. J. 1982 A short history of man in the sea. In *The physiology and medicine of diving* (3rd edn) (ed. P. B. Bennett & D. H. Elliott), pp. 1–14. London: Baillière Tindall.

Boycott, A. E., Damant, G. C. C. & Haldane, J. S. 1908 Prevention of compressed air illness. *J. Hyg., Lond.* **8**, 342–443.

Davis, R. W. 1962 *Deep diving and submarine operations* (7th edn). Chessington: Siebe Gorman.

Halley, E. 1716 The art of living underwater. *Phil. Trans. R. Soc. Lond.* **29**, 492–499.




PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES