I.O.S.

I.O.S. DIVING TEAM

by

S K WILLIS AND N C FLEMMING

A SUMMARY OF WORK DONE BY I.O.S. DIVERS FROM 1969 – 1975, AND THE DIVING SERVICES AVAILABLE TO I.O.S.

REPORT NO 18

1975

NATURAL ENVIRONMENT RESEARCH COUNCIL

INSTITUTE OF OCEANOGRAPHIC SCIENCES

INSTITUTE OF OCEANOGRAPHIC SCIENCES

Wormley, Godalming,
Surrey, GU8 5UB.
(0428-79-2122)

(Director: Professor H. Charnock)

Bidston Observatory,
Birkenhead,
Merseyside, L43 7RA.
(051-652-2396)
(Assistant Director: Dr. D. E. Cartwright)

Crossway,
Taunton,
Somerset, TA1 2DW.
(0823-86211)
(Assistant Director: M.J. Tucker)

INSTITUTE OF OCEANOGRAPHIC SCIENCES

I.O.S. DIVING TEAM

by

S.K. WILLIS and N.C. FLEMMING

A summary of work done by I.O.S. divers from 1969-1975, and the diving services available to I.O.S.

REPORT NO. 18

1975

Institute of Oceanographic Sciences,
Wormley, Godalming,
Surrey, GU8 5UB

CONTENTS

I.O.S. DIVING TEAM

ABSTRACT

In April, 1975 there were six active trained divers available for work in I.O.S. Wormley, and three in training. Trained I.O.S. divers at Taunton, Bidston, Barry, Blacknest and UKMBA Plymouth bring the total up to fifteen. This report is principally concerned with the services which can be provided by the team at I.O.S. Wormley, but includes some reference to work done in conjunction with divers from the other I.O.S. establishments.

Work done by divers is primarily a service to other departments, whether scientific or engineering. From 1969 - 1975 the capability of divers in I.O.S. has steadily improved, and a wide variety of tasks can now be carried out efficiently and safely. Scientific project leaders may, however, not be aware of the techniques available which could be of use to them. This report describes typical work tasks accomplished to illustrate the service provided. I.O.S. divers are trained to work on compressed air to a depth of 55m. In the last six years 100 jobs have been carried out involving 950 man-hours in the water. Jobs include clearing debris from ships' hulls; observing behaviour of towed equipment at speed; rigging hauling gear; search for lost equipment; laying moorings; installation of sonar gear; experiments in diver navigation; sediment sampling; rock sampling; and launch and recovery of GLORIA.

Underwater skills available within the diving team include photography, use of hydraulic and pneumatic tools, oxy-arc cutting, etc.

INTRODUCTION

The Wormley diving group was formed of necessity in 1969 to assist in the first GLORIA Trials in Loch Fyne. Diving began on an unofficial basis. By the end of 1969 it had become obvious that it would be necessary to have divers on a regular basis to help with the launch and recovery of GLORIA, and so a team was trained and equipped to work to a depth of 10m. During 1970 a certain amount of diving work was done which was in no way connected with GLORIA, and so it was decided to expand the team to eight, and to increase the working depth of the more experienced divers to 30m. By 1972, six of the eight were capable of working to 55m., which is the maximum safe working depth whilst breathing compressed air.

Before the amalgamation of the Unit of Coastal Sedimentation and the Institute of Coastal Oceanography and Tides with N.I.O. to form I.O.S., diving had been conducted at all establishments for several years. Nigel Kelland was Diving Officer at U.C.S., and Ivor Chivers at I.C.O.T. With the formation of I.O.S. N.C. Flemming was appointed overall Diving Officer, and Stewart Willis was appointed overall chief Diver. A common budget was set up for joint training exercises. The Diving Officer in each establishment has absolute responsibility to ensure that diving is carried out safely. In early 1975 John Moore became Diving Officer at Taunton, and in May 1975 Ivor Chivers, then at Bidston, was appointed Chief Diver for the whole of I.O.S., in succession to Stewart Willis. At I.O.S. Wormley, Stewart Willis will continue to support the diving team by conducting trials of new equipment, and organising the training schedule.

The following sections of the Report describe the selection and training of personnel, the funding of the diving team, and work carried out to date.

COMPOSITION OF THE TEAM

One of the major problems of forming a diving team from scientists is that of the proportion that are young and physically suited, only a small proportion would like to take up diving. Of those who would, most will either be involved in external day release training and are, therefore, unable to work on jobs taking more than one week, or will not be able to be released from their main project as they are overqualified, and their use would be inefficient unless their own project required diving. Having thus narrowed down the choice, a further 40% will drop out before completing open water training. There is, therefore, a continuous, but slowing, turnover of personnel (See Table 1). The hope is that eventually a team of eight extremely capable divers will crystalise from the present group and trainees. The versatility of the group has been increased by taking people from as many different departments as possible. This also helps to reduce the loss of manpower from any one department when diving teams are operating.

FUNDING

The group is funded as a service project. Where specialised equipment is needed for a particular job, the project using the diving team supplies that equipment

which may then be handed over to the diving group for general use. In this way money is not spent in a speculative way, but at the same time there is no need to turn a job down owing to lack of equipment, and a pool is gradually built up.

Where high capital expenditure is involved, such as in the purchase of the recompression chamber, this is paid for by N.E.R.C. and is available to N.E.R.C. component bodies and N.E.R.C. funded projects. There was no diving budget as such until 1972/73 when £1,800 was allowed. This rose to £2,080 in 1973/74 and £2,600 in 1974/75, with a further £1,000 allowed for training throughout I.O.S. The budget is now levelled off with expenditure only on replacement of existing equipment and routine training apart from actual project work.

TYPES OF DIVING WORK PERFORMED BY I.O.S. WORMLEY

Approximately 100 jobs involving 950 man-hours in the water have been done in six years. A brief summary of some typical types is given below. A log of every dive is maintained as a full record of work done.

1. Removing Debris from the Hull Fittings of 'Discovery'

On a number of occasions the 'Discovery's external hull sensors have become fouled by fishing lines or stay ropes. These have normally been cleared at sea, the job taking less than 10 minutes. On one occasion whilst entering Barry Dock the bow and main propellor had become badly fouled. They were successfully cleared in under two hours, the bow propellor being particularly difficult owing to guard bars preventing divers entering the tunnel. In 1975 a photographic inspection was made of the propellor of Discovery while at sea.

2. Observing the Behaviour of Equipment when Towed at Speed

On several occasions whilst divers have been aboard 'Discovery' to help with the handling of the GLORIA system there have been doubts as to the behaviour of the tow at speed, and so it has been observed and photographed at 5 knots as it was towed past stationary divers. A line Hydrophone has also been observed at 8 knots.

3. Rigging Hauling Gear in Muddy Water

The King George V dry dock at Southampton was hired during one weekend for buoyancy trials of the GLORIA float. A wire was reeved from a dock crane, through a block in the bottom of the dock, which was then flooded. The float was then attached to the free end of the wire so that as the crane hauled up the float would be pulled under. Unfortunately, the type of block used caused the wire to part. To save the considerable expense and time of draining and re-flooding the dock, divers were used to install a suitable block and to re-reeve the wire. This was accomplished in spite of having to work entirely by feel because of the extreme muddiness of the water.

4. Search for Gear Lost on the Sea Floor

Whilst in training in the torpedo test range at H.M.S. Phoenix divers were asked to recover parts of an experimental explosive mine-cable cutter. All the parts were recovered within half an hour. The job is normally done by diving bell, and takes three men many hours.

5. The Laying of Moorings

A waverider buoy was laid at a site, determined by diver survey, in 42m. of water. Anchors were placed in the optimum configuration by divers using a variable buoyancy lifting device.

6. Instalation of Sonar Array on Pier

A trainable sonar array weighing about 150 kg. has been installed on the end of Calshott pier, Southampton Water. It was floated out and sunk at the point at which it was required. It was then clamped to the pier pile and trained onto the required target by divers.

7. Diver Guidance by Sonar

Divers were involved in trials of a three dimensional sonar, developed by Birmingham University and Marconi Marine, carried out at Windemere and Plymouth. This system combined with voice communications allows a surface operator to

guide a diver onto a sonar target at distances up to 1 km. It is a valuable search tool that could be used for the recovery of lost equipment.

8. Sediment Sampling near the Coast

I.O.S. Wormley was asked to loan specialised equipment and an operator to Swansea University for a survey of sand/shell fragment boundaries in Whitesand Bay, Pembrokeshire. The survey was carried out by following the boundaries using the I.O.S. electric tug. Samples taken from either side of the boundary were stored in the tug's panniers, and observations were dictated onto the I.O.S. underwater tape recorder. The position of each station was plotted by releasing a float to the surface, and the cover dinghy alerted the shore theodolite stations to take a fix.

9. Rock Sampling in the Open Sea

In 1972, four divers from I.O.S. Wormley, and two from I.G.S. Edinburgh took rock samples from Hellen's Reef, two miles N.E. of Rockall Island, working from the R.A.F. Helicopter carrier Engadine. Fixes of dive sites were obtained using Decca trisponder system, a shore station being mounted on Rockall Island by a Royal Marine climbing team. On the one day on which weather permitted diving the reef was marked by a helicopter circling overhead. Five dives were made yielding valuable samples in spite of a swell which was felt down to a depth of 25m. Had weather permitted work would have been carried out down to 55m. and samples would have been obtained by blasting rather than sledge hammer and chisel.

This project was repeated in 1975 in co-operation with a team of five R.N. divers from H.M.S. Tiger

10. Handling of GLORIA

During the last six years there have been ten GLORIA cruises in the Mediterranean Atlantic and Sea of the Hebrides. These cruises have involved three or four divers for their duration. A lot of complicated rigging work has been done in seas up to sea state six whilst the ship was under way and unable to stop, generally at 1 to 2 knots but sometimes up to $3\frac{1}{2}$ knots. To do this safely

has taken considerable diving skill as well as a high degree of competence in rigging and boat handling. The engineering department have helped to ease many of the diving problems by careful and considerate design of fittings and connections that have to be operated by the divers.

The time taken for a launch or recovery has been reduced from ten hours to two and a half hours. This has been achieved mainly by simplification of the towing system and designing fittings specifically for diver operation. The whole operation has now become so routine as to verge on ritual as there is a high degree of teamwork and co-operation between ship's personnel, scientists and divers.

LIMITATIONS TO EFFICIENT WORKING

Diving conditions become less efficient with increasing sea state, although work has been done from small boats in wind force 7 and sea state 8. Diving, however, is not generally practiced in conditions worse than sea state 6, and 3m swell, and a 2 knot current or tidal stream. Explosives cannot safely be used in conditions worse than sea state 4, a 2m. swell and a 2 knot current owing to difficulties with firing lines and keeping station near the charge.

The time, backup, and organisation required for a particular job increases with depth as divers must work down to a maximum depth in increments before attempting any serious work. When working below 30m. it must be possible to get an injured diver to a recompression chamber within four hours. N.E.R.C. now has a two-man two compartment chamber that will fit on vessels of M.F.V. size and above.

SAFETY STANDARDS

The basic manuals of diving safety are the Royal Navy Diving Manual BR 2806, the British Sub-Aqua Club Diving Manual, and the Underwater Engineering Group's Principles of Safe Diving Practice. These refer respectively to military diving, sports diving, and commercial diving. In addition, there are a number of statutory regulations defining the responsibilities of employers of divers. These regulations are promulgated and enforced by the Department of Employment, the Department of Trade, and the Department of Energy. Since a wide variety of different types of

equipment are used by different organisations in different sea conditions there is no single body of rules or regulations which is generally applicable.

To assist Diving Officers and Directors of Establishments in maintaining safety, a Code of Practice of Scientific Diving has been drawn up by a group of experienced divers, and this has been published by N.E.R.C. The aim of this document is to maintain the highest possible standards of safety by selecting the most suitable and effective standards from the various existing manuals, with recommendations as to their use in different sea conditions.

PROJECT PLANNING INVOLVING DIVERS

In emergency the diving team is available at any time to salvage or recover equipment, etc. Even if there are not sufficient divers available in one I.O.S. establishment, divers may be borrowed from another laboratory. In the general case, however, scientists envisaging a project which may involve divers are requested to discuss their plans in detail with their Diving Officer or Chief Diver as early on as possible. This enables timetables to be arranged to suit other commitments, and gives time for the divers to practice any special techniques required, or to obtain special equipment. In addition, discussion of the project in advance may reveal simpler ways of tackling the problem.

DOCUMENTATION AND PUBLICATIONS

1. A log is kept of every dive carried out, and this contains details of the work, the water conditions, and any special equipment used. The total accumulation of dive-logs thus amounts to a very useful reference in order to see how jobs were done previously, and how long they took.
2. I.O.S. divers have been active in writing and publishing reports of their work, either in the form of scientific papers with passing reference to the employment of diving techniques, or in technical and methodological reports intended only to describe diving methods. (see bibliography).
3. I.O.S. divers were involved in all stages of drafting the Code of Practice for Scientific Diving. The drafting group for this publication was formed after the meeting at I.O.S. Wormley in December, 1971, to present papers on the applications of diving to marine science. The Diving Officers of I.O.S. Taunton, and

I.O.S. Bidston, - albeit under their previous titles - were members of the drafting group, as were the Diving Officer and Chief Diver at I.O.S. Wormley. The first edition of the Code was produced under the auspices of the Underwater Association after a meeting of forty diving scientists from most of the marine laboratories employing diving in Britain. A reprint was published late in 1973, which received world-wide distribution. The Code of Practice was subsequently approved by the Ministry of Agriculture Fisheries and Food, the Department of Agriculture and Fisheries for Scotland, and the Natural Environment Research Council. A second edition has been edited by N.C. Flemming and D. Miles of the Institute of Geological Sciences, and has been published by N.E.R.C.

4. I.O.S. divers have been involved in the organisation and presentation of papers at a number of meetings of the Society for Underwater Technology and the Underwater Association. In 1968 and 1969 some of these meetings were concerned with the preparation of Code of Practice for Commercial Diving, resulting in the Principles of Safe Diving Practice, published by the Underwater Engineering Group of the Construction Industry Research and Information Association.

BIBLIOGRAPHY

FLEMMING, N.C. 1970 Regulations for fin-swimmers and shallow water divers, NIO Internal Report 43.

FLEMMING, N.C. 1971 Underwater Geomorphology: in - Underwater Science eds. J.D. Woods and J.N. Lythgoe, Clarendon Press. pp. 265 - 290

FLEMMING, N.C. 1972 Diver selection and training: in - Diving Applications in Marine Science, ed. D.G. Roberts, NIO Seminar Series, No. 1 pp. 136 - 159

FLEMMING, N.C. 1973 Science Diving International (editor). Proceedings of the 3rd Symposium of the Scientific Committee of the Congres Mondiale des Activites Subaquatiques. Published by the British Sub-Aqua Club, pp. 282

FLEMMING, N.C. 1975 Code of Practice for Scientific Diving (editor). published and distributed by Natural Environment Research Council in conjunction with the Underwater Association. 86pp.

KELLAND, N.C. and HAILES, J.R. 1972 Bedrock morphology and structures within overlying sediments, Start Bay, Southwest England. Marine Geology. v.13. p. 19 - 26.

KELLAND, N.C. 1972 Geolgical diving: in - Diving Applications in Marine Science, ed. D.G. Roberts, NIO Seminar Series No. 1.

LAWFORD, V.A. 1975 The use of divers in laying and maintaining shallow water moorings. Society for Underwater Technology Symposium on "Technology of Buoy Mooring Systems".

PETERS, R.D. and WOOLDRIDGE, C.F. 1972 Divers' underwater electric tug, Underwater Association Symposium Report, p. 25 - 28.

WILLIS, S.K. 1974 Trials of equipment and instrumentation to improve the efficiency of scientific diving. Underwater Association Symposium, p. 160 - 165.

TABLE I

I.O.S. WORMLEY DIVING PERSONNEL 1969 - 1974

Initials	1969	1970	1971	1972	1973	1974
A.B.		------				
R.C.			------	------	------	------
R.K.						---
V.L.	------	------	------	------	------	------
D.M.			------	------		
G.M.		------	------	------	------	------
G.M.			------	------	------	O.Q.
M.McC.			------			
N.O.				------	------	---
R.P.		------	------	------	------	------
A.R.						O.Q.
S.W.	------	------	------	------	------	------

Out of a total intake of twenty, one is a trainee, seven have failed medical examinations, two are over-qualified (O.Q.) for general use, and four have dropped out for other reasons, leaving only six active divers, i.e., only 30% of the intake become successful general purpose divers.

TABLE II

The following skills are available:-

UNDERWATER	SURFACE
Rigging and Mooring	Boat Handling
Assembly and Dissembly engineering	Navigation
Lifting and Lowering	Marine engineering
Air Tools	Echo Sounder and Sidescan Surveys
Hydraulic Tools	Diver guidance by Sonar
Oxy Arc Cutting	Helicopter jumps and winching
Oxy Hydrogen Cutting	
Thermic Lance Cutting	
Explosives	
Cine and Still Photography	
Photo Mosaics	
Shear Current Measurements and Photography	
Seabed Surveys	
Sampling of rock, sediments, and epifauna,etc.	
Search techniques	
Underwater resin casting techniques	