Printed by Coasby & Co. Ltd., Festing Buildings, Highland Road, Southsea

ROYAL NAVAL DIVING magazine

Scilly Isles Expedition (*see page 31*)

Vol. 14 No. 3

2/-

Since 1949 TYPHOON DIVING EQUIPMENT has been manufactured for the Sports Diver in the United Kingdom. Today the most comprehensible range comprises equipment of our own manufacture, such as Typhoon Suits, Fins, Masks, Snorkels, etc., as well as selected imported products, Diver's Watches, Underwater Cameras, Harpoon Guns and two-stage, single hose compressed air Demand Valves.

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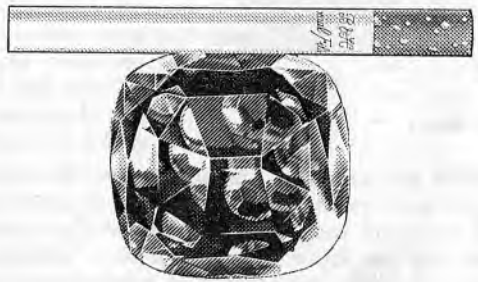


THE BOX IS GOLD—THE PLEASURE PRICELESS
Imported from England

Contents

R.N. Diving Magazine

VOL. 14 WINTER, 1967 No. 3

EDITOR'S NOTES

ONCE more the wheel has turned and a new Editor has appeared to try his luck and persuasive powers in keeping the Magazine rolling off the press at frequent intervals. Our thanks go to P.O. Harrison for all his good work in the past, and our best wishes for the future in the civilian field of commercial diving. The highlight of the Divers year, the Divers Reunion Dinner is past us and went off with a bang, as the saying goes and was well attended. Being earlier in the year, some 230 persons were persuaded to a run ashore between their summer holidays and Christmas. Some well known faces were missing this time, perhaps because I didn't have their current address. There must be a moral there somewhere. Being only a few days after the new drinking and driving laws came into effect, the large car park was just about empty and taxi firms in the city reported an increase in turnover comparable to New Year's Eve.

Now to the plea for more material, as is usual on taking over as Editor! Without your assistance, it just isn't possible to produce the magazine without the article's to print, so how about it! We need lots more short stories about teams, ship's expeditions — in fact anything which will help towards making our next issue 15/1 a special edition as it is the 50th since the magazine was started in 1951.

We also rely on you — the subscriber — to keep us financially solvent by sending us the fruits of your salesmanship in cash and increased sales. Please don't hesitate to ask for more copies if you can sell them. Remember it is your magazine produced for, by, and on your behalf.

The Far East Fleet Clearance Diving Team

WHEN writing articles for the 'Mag.' it is always difficult to know where to start or what to say, as everyone appears to get the same sort of job. I could start by saying something of our latest acquisition to the team—boat-wise that is. The older hands of the branch will remember H.M.T. *Diver*. Well, she's back again in the diving world as F.C.D.T.'s tender.

A crew was detailed to get her clean and shipshape, after the dockyard workers had left. Incidently, one of the first jobs was to clean the wooden 'Patch' aft. Many ways were tried, bleach, repeated scrubbings, scrapers and even glass scrapers. In the end our Lt. Q.D.D. who had been watching with interest, took his pipe out of his mouth and said that 'Holy Stone was the only way,' and that he would get some! However, hands knees and Holy Stone did not appeal to the crew, and before the latter arrived, an electric sander was found and $\frac{1}{8}$" of wood was promptly sanded off!

Eventually she was brought up to scratch and her first job came along. This was in support of one attack on the Fleet at Pulau Tioman. The trip up was in a very uncomfortable sea, but apart from a very erratic course (due to push button steering)—was uneventful. On this particular trip we were backed up by a contingent from K.D. *Malaya*. They carried off a very successful series of attacks by manning one of the local dugouts and acting as bumboatmen, 'selling' fresh fruit and coconuts.

One of the more recent exercises was to clear a channel for landing craft to get ashore, the only snag being that the gemini engines could not be used as these could be heard from the beach. Not to be beaten, the team commenced to lay 1,000yd. jackstays from canoes, which proved very successful even when the canoes passed within yards of the beach.

Aircraft jobs? Yes! We get our share of those, too. The latest was an R.A.F. *Canberra* that crashed off the south-west coast of Singapore. Some alarm was caused amongst the team when it was learned that a large shark had been caught the day before in the area and when it was cut open, part of a man was found inside! Never-the-less, after 5 days the R.A.F. investigation team decided we had recovered enough wreckage, and diving was called off. We returned to base congratulating ourselves on a job well done, and looking forward to a well earned rest. However this was not to be, for two days later a helicopter crashed off Changi Point, and the wheels were once again put into motion, with the Boss shouting last minute instructions to *Diver* on sailing.

We frequently supply our one man pot, for treating serious hospital cases who are suffering from gas gangrene. Obviously more and more use will be made of this form of treatment.

In the athletics, Ted clipped 16 seconds off the record in the steeplechase. The team we had entered for the swimming had to be scrubbed at the last moment, as part of the team was called to Hong Kong to assist the Army in dealing with home made bombs. Our other outstanding achievement in the sporting field was Cass, when he boxed his way through several bouts, to win the Far East Inter-Services Boxing Championships, in no mean fashion!

That just about concludes our write up this time, and all that remains is to say who the members of the team are.

Lt.-Cdr. Shaw, M.C.D., T.A.S.
Lt. Coggins, M.C.D.
Lt. Walker, Q.D.D.

C.P.O. Soper, D.1.
C.P.O. Bray, C.D.1.
P.O. Charlwood, C.D.1.
P.O. Setchell, C.D.2.
L.Sea. Cassidy, C.D.2.
L.Sea. Chapman, C.D.2.
L.Sea. Barker, C.D.2.
L.Sea. Trotter, C.D.2.
A.B. Williams, C.D.2.
A.B. Lee, C.D.2.
A.B. Clutton, C.D.2.
A.B. Lougher, C.D.2.
A.B. Porter, C.D.2.
A.B. Revels, C.D.2.
A.B. Russell, C.D.2.
A.B. Pert, C.D.2.
A.B. Cockayne, C.D.2.

Yours TROTS.

The Commander Far East Fleet, Vice-Admiral W. D. O'Brien, C.B., D.S.C., having just completed a Compression Chamber dive during his visit to the Far East Fleet Clearance Diving Team in September this year.

Historic Wrecks in the Solent Area

by ALEXANDER MCKEE

THE Solent Area has been used by seafarers for at least 4,000 years, but there are many gaps in the chain of historical knowledge. The Roman period is a complete blank, although there were important maritime and naval bases. For instance, the great Roman 'palace' recently uncovered at Fishbourne, at the head of Chichester Harbour, with quays of Bembridge limestone buried many feet deep in marine silt, was constructed of stone brought from the Isle of Wight, Portland, Italy and Greece. Of the ships which carried this cargo material, and also ordinary general cargoes, no trace has been discovered. Similarly, the Romans based a naval squadron alongside Portchester Castle, which was a fortified barracks for a mobile brigade group of mixed infantry and cavalry, but we do not know even what these ships looked like. In all England only three Roman vessels have so far been found — two Thames barges and what may be a small cargo ship (or yet another river barge). The single relic of Roman seaborne trade in the Solent is a vase dredged up on Spit Sand. Their ships used these waters in numbers, some must have been wrecked — but, where are they now?

The next period, that of the Saxon and Viking raiders, traders and occupiers, is well known. Ceremonial warships in which chiefs were buried have been discovered on the Continent, and there is one example in East Anglia. Recently, five merchant ships have been found in Roskilde Fiord, Denmark. They proved what some of us had already suspected, that the establishment and supply of the Greenland colonies, plus the discovery of North America, had not necessarily been carried out in the highly unsuitable 'longships', which were really short-ranged war galleys, packed with oarsmen and warriors. Their range with full war-load, was probably no more than that of an M.T.B.

The last major campaign in which 'longships' were used was that led by William Duke of Normandy, when in 1066 he ordered his assault craft to beach near Pevensey. As depicted in the Bayeux Tapestry they were not ships at all but open boats — long, narrow and clinker-built, with a single mast and square sail for cruising and oars for speed and manoeuvrability when necessary. This is hardly surprising, as the Nornands — the 'Northmen' — were Vikings settled in France, and not French at all.

What is surprising is the gap in our knowledge following the Norman Conquest. From roughly 1100 to 1400 we know virtually nothing of the development of the ship; and from 1400 to 1600 very little. Yet, during this period, the typical European warships changed dramatically from the small clinker-built open boat of 1100 to the giant clinker-built battleship of 1400, which became the large, four-masted carrack, carvel-built, of 1500, followed by the same type modified to take really heavy artillery by 1509, and by the time of the Armada Campaign of 1588 had been fined down to a much faster and more seaworthy type of warship called the galleon. The galleon in turn led to the typical ship-of-the-line, of which the *Victory* is a good example. How did the Viking 'longship' turn into the *Victory*? We don't know.

Until recently, we could say that the gap in the chain of evidence covered the enormous period 1100—1700, by which

time builder's plans, builder's ship models, artist's pictures, and some surviving examples of actual ships, had given us a very clear picture of the technical development of ships and armament. (Although not of the way their crews lived). The importance of the raising intact of the *Vasa* was that she took us back into the unknown period, for the *Vasa* was a galleon built in 1628 by the Swedish Navy to Dutch designs. We should still like an example of the English galleon, however these, unlike the Dutch and Italian types, did not capsize on their first trip out of the dockyard, but circumnavigated the globe on raiding voyages without incident; they were not in peril from the sea!

One point must be made now. The *Vasa* was important, not merely as evidence, but because she was raised intact and then carefully examined and preserved. The evidence was not destroyed in order to give newspaper editors a cheap thrill. Under current British Salvage laws, however, it is likely that some salvage company would have bought her from the Admiralty in order to salvage untold riches in brass cannon (in fact, only three remained), would have blown her to pieces in order to get at them quickly, and such wooden and iron objects as were recovered would have been handed to the Receiver of Wrecks who, knowing nothing of conservation, would have put them in a bicyle shed where, after a short time, they would have totally disintegrated. As it was, the Swedes were able to reconstruct not merely the ship, but the life of her crew, and the bodies of a number of them. The information obtained from the bodies was of such detail that it indicated whether or not the man had V.D., what personal possessions he took to sea with him, what clothes he wore, the colour of his hair, and whether he was a Swede or a Finn. This was true also of the two women found aboard. The *Vasa* was a typical Baltic wreck, and so preserved to the upper deck. In most seas, the remains will be less impressive, but not — I repeat NOT — in the Solent Area. The object of my own research programme launched in 1965 under the project name SOLENT SHIPS was designed to find out how much was likely to remain, in favourable circumstances, and the results show clearly that the Solent Area, although inferior to the Baltic in some respects, nevertheless preserves ships remains for a surprisingly long time. An untouched ship in deepish water will probably remain reasonably intact for 150 years or more; any part which is buried below the seabed will last indefinitely in good condition. In some respects the Solent is unique for its preservative properties and, by a fortunate chance, has far, far more than its fair share of important historic wrecks. By yet another fortunate chance, some of these wrecks are 'key' ships in the story of the development of the warship.

"GRACE DIEU"

The *Grace Dieu* was the largest warship in the world when laid down at Southampton for Henry V in 1416, more than 550 years ago. Launched in 1418, she was 'moth-balled" in the Hamble River in 1434, and later moved to a mud-berth up stream from Bursledon where in 1439 she was struck by lightning and burnt to the waterline. According to various lists she was either of 400 tons or 1,400 tons. When properly surveyed in 1933, the remains proved to be those of a monster battleship with a keel length of 175—200 feet overall, beam about 50 feet. This would fit the figure of 1,400 tons. The odd thing was that she was clinker-built, like a rowing boat, but with multiple planking. This strange clinker construction — strange in so large a ship — was probably one reason why for so many years she was believed by the locals to be a Viking 'longship'. Additionally as she had burnt to the waterline, the hull section which remained was double-ended. Also, it showed in part only at low water of exceptionally high spring tides and was hard to get to because of the wide expanse of soft mud between ship and shore.

The first man to try to solve the mystery of the mud-embedded ribs was an enthusiastic antiquarian named Crawshay who investigated the wreck in 1879 by liberal use of explosives and piecemeal removal of the resulting wreckage. The Admiralty stepped in to recover some of the remains which were placed for safekeeping with the Coastguard, from where they vanished without trace as effectively as if they had been left to Crawshay. Until very recently, this combination of amateur enthusiasm and Admiralty ineptitude has held the historians 'First Prize for Foolery'. A great deal was destroyed, and nothing whatever was learned. The wreck was still thought to be that of Swayns 'longship'.

When a properly equipped survey team descended on her in 1933, they were therefore able to produce only a shadowy picture of this medieval monster. She certainly had one mainmast amidships and probably a small aftermast at a point deep in the river which they could not probe. Almost certainly there was no foremast. Instead, there was an enormous high fighting-platform jutting far out over the water beyond and on both sides of the bows. This conception makes sense, because her main armament was infantry, using short range missile weapons. Victory at sea then depended on poking this towerlng platform over the deck of a lower-sized opponent and raining down stones, arrows and bolts onto her deck prior to jumping down onto her for close-range, hand-to-hand combat. Victory would inevitably go to the biggest ship carrying the biggest battalion. As heavy guns were not then in use at sea, the vessel would not need to be strongly built and the old clinker style, suitably modified, would suffice.

The surveyors of 1933 examined the wreck and plotted it, taking away only a few important samples; they did not destroy it. So it is still possible to see the actual *Grace Dieu* of Henry V. She lies with her bows pointing into a creek near a solitary houseboat, on the eastern side of the Hamble River and one mile upstream from Bursledon Bridge. On the equinoctal spring tides a beam breaks the surface — this is the stem — following by a row of blackened posts — these are the ribs. The area is intermingled salt and freshwater which has probably helped to preserve her, plus the peculiar chemical qualities of the mud which would tend to offput any of the ordinary ship-eating organisms. They certainly offput me when I tried to wade out over the mud to her in May 1967. Being in a river, the wreck is regarded as an Ancient Monument and it is illegal to remove anything from it. A further survey of the underwater part would, however, be useful, as the 1933 party did not have the use of divers.

TWO FRENCH CARRACKS

When the *Grace Dieu* burned, there was aboard her only a maintenance crew of eight men, who escaped, and she cannot tell us very much about the seafaring community of the 15th Century. It is otherwise with two French losses in the Battle of Southampton Water in 1419. The English took three Carracks, one Halke and four Ballingers. But they also sank two carracks. One was wrecked on a sandbank, but the other went down in deep water off Southampton, 'in which there perished

eight hundred in light Harneys', that is, 800 infantrymen in light armour, apart from the mariners. Clearly, this ship must have been as large as the *Grace Dieu* and of much the same design. Morever she was not an empty hulk. If she has sunk into a soft sea-bed, sufficient may remain to provide a cross-section of French military and naval society of the time, as well as adding greatly to knowledge of shipbuilding. But it is possible that dredgers have damaged or destroyed her, and certainly there are reports of signficant artifacts being recovered in that fashion recently in that area. The dredgermen are unlikely to realise the historical importance of their finds and there is as yet no law of the sea comparable to that which protects the land, structures ranging from Stonehenge to Westminster Abbey.

To be Continued in the Next Edition.

A Report from Cuba

A dramatic call crosses the ether: S.O.S.! S.O.S.! S.O.S.! It is heard by coastal stations who request the ship in danger to give her position. Minutes later in the peaceful port of Camaguey, the alarm bell sounds in the ship salvage section. The coastal station broadcasts the position of the ship in distress whilst the salvage ships are putting to sea. The salvage ships have all the necessary resources, experienced diving crews, suits, aqua-lungs, wires, dynamite and decompression chambers.

In 1960 the Cuban Navy created a small group of divers who were to help vessels which had gone aground and to carry out other underwater tasks. Underwater fishermen, treasure hunters and young revolutionaries were recruited. At that time they had only three worn-out American aqua-lungs. In 1961 they adapted an old wooden boat as diving tender with a decompression chamber and two old diving suits. It was then that a Russian Military Mission taught them underwater work and how to use the new suits that were arriving.

In 1962 the small group of divers became an elaborate military organisation with brand new equipment and high speed, steel hulled boats. The section also received its official name, Ship Salvage Section.

Leading the section was 1st-Lt. Jimenez Lero, an underwater worker. He was the first man in Cuba to use an aqua-lung and with his vast experience, 'down there where the keels are not seen', good progress was soon made.

The duties of the Ship Salvage Section were defined: Recovery of stranded and sunken vessels, hull repair, underwater demolition, propeller changes and rudder changes.

The diving organisation was also laid down:—

Diving Station —
Three Divers (Chief, First Diver, Diver 1);
Diving Brigade —
Two Diving Stations: a Brigade Chief;
Diving Specialist —
Heading a group of Brigades.

The diving unit is ready to attend any vessel in danger, be they warships, or cargo and passenger vessels, the instant an S.O.S. is heard.

Divers' Dinner 1967

I had never been to a Divers' Dinner before, as with, I suppose lots of other members of the Branch. Having heard a lot about them, I decided more out of curiosity than anything else to go this year. It was being held at the Rock Gardens Pavilion at a charge of 30/- a head.

I arrived just after 7 o'clock to find the foyer crowded with people, some I knew, many I had never seen before, and all trying to get a drink at the same time. I made my way through the crowd, speaking to people I knew, on my way. I eventually came to the main entrance of the hall. Tables were laid out in neat rows and at the far end of the hall, another bar as crowded as the first. The time was now 7.30, time for a quick pint. The dinner started just after 8 o'clock and the Menu read like this:

Oxtail Soup

Poached Fillet of Plaice in White Wine Sauce
Garnished with Prawns and Mushrooms

Roast Turkey and Braised Ham
Bread Sauce Minted Garden Peas
Brussels Sprouts Roast Potatoes

Ice Gateau

Coffee

After the dinner had finished, I think we all felt still a little peckish, although the quality of the food was good, the quantity was insufficient, and anyway ice cream never did go down very well on top of four or five pints of beer.

We were called to order by Lt.-Cdr. D. B. Burstall, who was 'hitting hell' out of the table top with a little wooden hammer. After the toasts to 'HerMajesty The Queen' and 'The President of the United States', he went on to introduce himself as I Diving, and then present the first Guest of the evening, Captain W. P. B. Barber D.S.C., the Captain of H.M.S. *Vernon*, who after correcting Lt.-Cdr. Burstall on a small diving matter went on to speak about the importance of Diving and Divers in the Navy, and a little on T.A.S.

The second Guest was Commander A. C. W. Jones, D.S.C., Cdr. (S) in *Vernon* who during the past few months had been blamed for the stopping of divers extra issues but he soon explained that they had been stopped by someone higher up, and that he was fighting to get them back. He also gave a short history on our rum ration in which Mrs. 'M.O.T.' Castle got a mention.

The last Guest speaker was Cdr. P. A. White, M.B.E., Superintendent of Diving. He gave us a very good speech on Diving, a few jokes and yet another mention for Mrs. 'M.O.T.' Castle. He welcomed a lot of older people back and a lot of new people from overseas to the dinner.

After Commander White's speech, the tables were cleared and the serious drinking began, and everyone really enjoyed themselves (impression!) The bars closed at 12.30 a.m. and by 1 o'clock the crowd began to disperse.

I think the organisers did a great job and helped to make it a good night. If C.N.D. will let me, I know that I will be there next year. R.S.

R.N.—U.S.N. Diving Officer Exchange

THE first R.N.—U.S.N. Diving Officer Exchange has just been implemented. Lieutenant J. C. Bladh, U.S.N., is now firmly established as the Officer in Charge, Admiralty Experimental Diving Team in H.M.S. *Vernon*, Portsmouth, U.K. Lieutenant Commander J. Majendie, R.N. is about to take up his appointment at the E.O.D. Facility, Indian Head, U.S.A.

Lieutenant Bladh, who enlisted in 1943 and was commissioned in 1959 has recently filled assignments as Ordnance Gunner, U.S.S. *Canberra*

1959—1961, Executive Officer E.O.D.U. 2, Charleston S.C. 1961—1964 and Diving Officer, U.S. Navy Mine Defense Laboratory 1964—1967. He has worked extensively with Sea Labs I and II and was Project Officer for the operational evaluation of the Mk.VI Mixed Gas Breathing Apparatus.

Lieut.-Cdr. Majendie joined the Royal Navy in 1952 and Commissioned as a General List Sub-Lieutenant in 1956. He served in H.M.S. *Orwell* and *Chaplet* until 1959 when he commenced the R.N. Clearance Diving Course, on completion of which he was employed as Bomb and Mine Disposal Officer, Singapore until 1963. From 1963 until 1965 he commanded the R.N. Emergency Deep Diving Team. He then qualified as the first R.N. Mine Clearance Diving Officer, followed by a year in the Persian Gulf as Staff Mine Clearance Diving Officer.

I am sure that it is the aim of both officers concerned in the exchange and the wish of all Explosive Ordnance Disposal and Diving Officers that this will be only the beginning of a long and continued liaison which can produce nothing but good.

News from *Nubian*

AS can be appreciated, opportunities for diving in an operational ship are not as frequent as one would like and this explains why some ships are reluctant to commit their scant activities to paper. '*Nubian*, is no exception and with an average of two thirds of any month underway, we have only a little to write about. We will write it anyway, in the hope that it may be of some use to other ships following in our wake.

It all seemed so simple before we left U.K. We eagerly looked forward to diving in the warm, clear tropical waters. In particular, we had hoped to make our own small contribution to the scant knowledge of shark behaviour. The line, we hoped to take, was by conducting various experiments with different sonar frequencies as a deterrent. Unfortunately, this has not yet been achieved as the only sharks encountered had already closed the range to almost touching distance in low visibility, negating the detached sort of study we had envisaged. We suspect, however, that they have considerable potential if trained in the field of ship husbandry, one having been surprised (Diver or Shark, take your pick) coming round the sonar dome. A few minutes later, during an examination of the rudders, he appeared once more, but showed little enthusiasm. The diver on this occasion was a Royal Marine, a human shark repellant if ever there was one, which perhaps explains it.

One interesting dive took place off Massawa, Ethiopia, on the wreck of an Italian floating crane sunk, by the R.A.F., during the war. This was carried out in conjunction with divers from the Ethiopian Navy who were trained by the French on the lines of the R.M. Swimmer Canoeists. For ships visiting Massawa, which is an annual event to attend the Naval Academy passing out parade, it is well worth getting in touch with this team. We were very impressed by their ability and they showed us some very interesting wrecks that abounded in fish and rested in water that had a temperature of 82° at 85 feet.

Diving in Mauritius was excellent value more so because of the help from H.M.S. *Mauritius*'s sub-aqua club who acted as our guides.

Apart from an appalling lack of space, Type 81 Frigates are quite reasonable as Diving Tenders. They carry in addition to the standard boats, 3 Gemini and a Dell Quay Dory. Perhaps the most versatile tender, however, is our *Wasp* helicopter. We enjoyed great moments when leaping from it into Gibraltar Harbour. Because of the layout of the *Wasp* it is extremely difficult to enter the water without pain, a C.D. Instructors dream. The situation was reversed in Mombasa when the helicopter suddenly got the diving bug. The team spent a happy time driving whilst submerged—after extracting the mail!

The majority of our diving has taken place in the harbour at Mombasa, the only difference between there and Vernon creek being the temperature. On our last visit there we were asked to survey the bottom of a slipway to determine the limits of a coral shelf, so that a dry dock could be built and sited on a solid foundation. This sounds easier than in actual fact it was. After several hours of floundering in deep mud and pushing probes down 12 feet into sometimes loose and sometimes hard coral or concrete, who could say which, we were only a little wiser. This was a prime example of a job required by a non diving engineer who required ver-

tical and horizontal measurements to the nearest inch. We were able to gauge the effects of a handful of sea-egg spines however, found by a diver who scorned the use of gloves.

Ships employed on the Beira Patrol normally operate from Mombasa and will find therefore that the coral reef along the coast well worth exploring. The best sport is about twenty miles south of Mombasa in the vicinity of the Tradewinds or Twiga Lodge Hotel where the reef is closer inshore. A word of advice however—there is very little well informed local knowledge available —and such as there is is discouraging, except that from those who have actually been on the reef. After testing the water with two Royal Marines we can testify to the fact that is is completely safe (unless you happen to meet a spear toting marine, which is highly dangerous as they all have 00 numbers). There are shells to be found which are quite valuable. Some fetch £60 on the local market (a fact which we found out too late) and the area is rich in piscatorial life. This is a very good place to spend station leave especially if the divers leave is co-ordinated so that they all have it at the same time and in the same place. If unco-ordinated, the divers scatter to the four winds and tend to carry out all manner of non-diving activities which produce 'ears, dog or stoppage.' As a result of which, the Diving Officer, who has permitted this to happen, bears the brunt of the diving tasks thereafter. Strange how I did all my diving in the mud and sewerage of Killindini Harbour!

Despite being 'owned' by the Persian Gulf, we managed to evade its clutches for over five months, but having been netted, the problem of keeping amused is very real. To this end a sub-aqua course has been arranged and it is 18 strong. Our attempts to reduce it ro a manageable number have been thwarted by sheer enthusiasm and so two courses are running concurrently. In addition, the ships divers have been active in training the Army's sub-aqua club. The area used for initial training is adjacent to the sailing centre, where the ship is running sailing and water skiing courses. There is no lack of entertainment, when all the courses are training together and one comment that was heard was, 'Better than Billy Butlins'.

We will not offer the usual list of divers in case we are recognised.

DELTA BRAVO.

Monthly Dippers Section — Horsea

THIS section provides an important service for ships' divers, who are unable to obtain at their own ships or establishments the required 120 mins. per quarter to qualify for S.S.P. (Diving) and also deals with aptitude tests to determine the suitability of ratings for ships' diver courses.

From the beginning of January to the end of the quarter, ending on the 14th of October, we dived 1,160 qualified divers. This is little more than half of those who 'booked' to dive. Many divers are sent away without a 'dip', because they are out of date for X-ray, or Medical, or that they have failed to have these entered in their logbooks. Some even forget to bring their logbooks! Therefore, we would like to remind all those who book for Horsea to bring theirs with them, up-to-date with medical and X-ray entered and save themselves the hike across the bridge for nothing. Of those people who book and don't turn up, often without even letting us know, nothing more need be said except that it prevents others from attending who *are* keen!

How does one go about it? To book for Horsea, ring H.M.S. *Vernon* 2323, ask for P.O. Quinn, Horsea Bookings, and your troubles are over. When this is arranged — and provided the diver arrives by 8.30 a.m. or 1 o'clock (except in exceptional circumstances) with his logbook (in date), he will be dived. In some ships and establishments, the Diving Officer keeps the 'teams' logbooks. On this point, I must point out that a diver *cannot* be dived on a 'Cover note' saying that he is in date.

And now about aptitude tests. From the beginning of the year to the end of the period ending on October 14th, we tested 260 candidates of which 183 passed and 77 failed. Again, we had to send away, due to the causes mentioned above, some of these we may see again.

The Navy is short of divers, so if you have a chum who seems keen, give him the information necessary to get him an aptitude test at Horsea. We have all kinds of divers at Horsea from the indifferent to the keen, from the recommended to re-qualify to the recommended for C.D. We also have two official S.A.B.A. endurance records, one of 26 mins. and the other by A.B. Borer of 141 mins.! On both these occasions the sets were checked before the divers entered the water and when they left it.

For all 'monthly dippers' I would like to point out that it is worth over £20, to you to dive for only two hours every four months, so be 'in date' and 'on time', with your logbooks made 'up-to-date'. See you at Horsea. . . . M.S.

The Greatest Living Beings in the Sea

THERE are two kinds of 'warm-blooded' animals — the birds and the mammals. After 'exaustive research', zoologists have discovered a fool-proof way of telling the two types apart:— one has feathers whilst the other has hairs! Of course, to justify their research, they have included a few additional criteria, such as whether or not they lay eggs, and whether or not they suckle their young. Mammals of course, give birth to 'live and kicking' young which are weaned on mothers milk, (which, by the way, is just modified and enriched sweat!)

Now besides all the 'conventional' mammals such as rabbits, horses, lions, bears, man and the like, there are a few rather unique types — the marine mammals. Though by all outward signs they bear strong resemblances to fish, such as the elegant stream-lining and fin-like limbs, these individuals are essentially similar to all other mammals in their internal anatomy, complete with a full set of lungs, one diaphragm, one twin-pump heart . . . you name it . . . they've got it.

What are the marine mammals? Well, they include the *cetaceans* (whales, dolphins, porpoises), the *pinnipeds* (seals, sea lions and walruses), not to mention the dugongs and manatees. Undoubtedly the best adapted to life in the sea are the cetaceans — the whales, dolphins and porpoises. They never venture onto dry land and this means that they are obliged to eat, sleep, breathe, copulate and give birth all at sea. Needless to say, they are extremely good at it and must be the unchallenged experts of sea living.

The physiological problems which they encounter in their diving activities are exactly the same as those to which we humans are exposed; but who ever heard of dolphins having trouble clearing their ears or sinuses, or getting the 'squeeze', 'narks', or 'bends'. The visibility at 2,000 feet must be atrocious but the sperm whale (*Physiter*; the Moby-Dick type) seems to hunt giant squid successfully at such depths. And what about all that cold water? How can they survive in polar waters?

How do these highly intelligent animals manage to cope in such apparently adverse conditions! Read on.

First of all let us look at the middle ear and sinuses. These are foam filled and possess groups of blood vessels which can swell considerably during a dive and thus compensate for the reduction in gas volume. The ear drum is therefore never strained and can remain perfectly efficient as a sound receiver. This foam filling also serves the purpose of acoustically isolating the two ears underwater, facilitating directional hearing. Man unfortunately, loses the ability to detect the direction of a water-borne sound because it is conducted directly to both inner ears via the body tissues instead of simply along the outer ears as they do in air.

It is still a bit of a mystery how the chests of the cetaceans manage to avoid collapse during the deeper dives. The rib cage is very compressible, and so are the diaphragm and lungs, but cannot account entirely for the phenomenon. It has been suggested that the vast collections of blood vessels often found within the chest (called the *rete mirabille*) become engorged with blood and make up for the loss in gas volume.

Nitrogen narcosis and the 'bends' are dangers which never really present themselves since these animals only take down one lung-full of air. This hardly contains sufficient nitrogen to saturate the various tissues to an extent that might produce the 'narks' or the 'bends'. With regard to the lack of visibility at depth, these marine mammals have overcome that problem by developing an underwater detection system independent of light — underwater sonar. The sonar system of a bottle-nosed dolphin (*Tursiops*) is so sophisticated that it can not only home-in on and catch a small fast moving fish in 'zero' visability, but can probably tell what species it is by the quality of the 'echo'.

It seems paradoxical, but these warm-blooded animals living in very cold waters actually have a problem keeping cool especially during strenuous exercise. This is because they have relatively large amounts of muscle which produce much heat and only a small surface area (a concouritant of stream-lining) over which to dissipate it. The problem is minimised by a system of special blood vessels which can divert blood very close to the skin surface for cooling, especially the skin covering the fore-limbs and tail flukes.

One would think it would be pretty dangerous to drop off to sleep at sea when one needed air to breathe. Be that as it may, dolphins have been observed dozing happily some inches below the surface; periodically, with barely perceptible movement, they made slow excursions to the surface for air without even waking up. It's as simple as that.

Cetaceans display great sexual libido. One young ('calf') is born after a relatively long pregnancy. The process of birth is remarkably swift, after a nominal amount of labour, the calf being virtually shot out tail first. The umbilical cord snaps in the process and the calf is hastily nudged to the surface by the attending 'nurses'. As its nostrils break surface a nerve-reflex initiates its first breath.

The lack of hands with which to investigate the nature of objects by touch, would appear to limit the sensory versatility of the Cetaceans. However, it has been found that the male bottle-nosed dolphins (*Tursiops*) have even overcome this limitation by using the penis to investigate the shape and texture of novel objects. Indeed they have occasionally caused embarrassment to unsuspecting divers in the American Marineland Aquaria who were regarded as novel objects.

So it can be seen that the whales, dolphins and porpoises are extremely well adapted to their chosen way of life, even though their ancestors once roamed around on land on all-fours. Such near-perfection of adaptation and highly organised social life, coupled with their high intelligence, surely makes these animals the greatest living beings in the sea.

J. BEVAN, B.SC.

SOLDIER KILLED BY OCTOPUS

Sydney. A soldier was killed on his second day in the Army, by a tiny Octopus he found in Sydney Harbour. He was carrying the eight inch long octopus from the beach to his depot when it bit him.

He quickly fell into a coma and died in hospital within two hours. His attacker, purple with yellow rings, injects nerve poison through its beak.

H.M.S. *Delight*

SHETLAND EXPEDITION, 1967

ON 3rd November 1711, the Dutch East Indiaman *de Liefde* sailed from Texelon on her fourth voyage to Batavia. Under the command of Captain Barent Muykens she was manned by 300 seamen, measured 160ft. long and had a tonnage of 250 'lasten' (One lasten=1976 kg.) Her armament is thought to have consisted of 32 guns, viz. two metal 24 pounders, ten iron 18 pounders, four long-bore 12 pounders, twelve 8 pounders and four 4 pounders.

On her last and fateful voyage, she sailed in company with eight other ships including the *Cockenge* and *Mossel*. All appeared to go well until the 7th November 1711 when, in a fierce gale, she was driven onto a reef in the 'Out Skerries' group of the Shetland Islands and became a total loss. Of her fine crew, only one man survived. In a resolution of the Directors of the Amsterdam Chamber dated the 8th January 1712, the loss of the *de Liefde* is reported and by a further resolution dated the 18th January 1712, the Directors contracted Captain Wybe Wybrants from Makkun in Friesland to try to salvage the money and merchandise in the ship. On 28th April 1712, Captain Luytje Bontikoe of the galliots *Otter* and *Arent* reported that nothing had been found on the spot except for some pieces of rigging.

H.M.S. *Shoulton* during a routine exercise, discovered a cannon in the area in 1964 and this was recovered by a local yachtsman and the Skerries M.F.V. *Snowdrop* the same year. There are also stories of the discovery of coin by the inhabitants of the islands over the years. In August 1965, a preliminary expedition led by Lt.-Cdr. A. D. Bax, R.N. discovered coin and other artifacts and a second expedition in September 1966, which included nine divers and six others, visited, the site again. This time a magnetometer survey was carried out, but weather, shortage of time and sickness precluded an extended search.

A large number of items were recovered, however, which undoubtedly came from *de Liefde*. These included Dutch and Spanish silver and gold coins, cannon balls, spoons, knives, clay pipes, pistol-ball shots, iron nails, copper, etc.

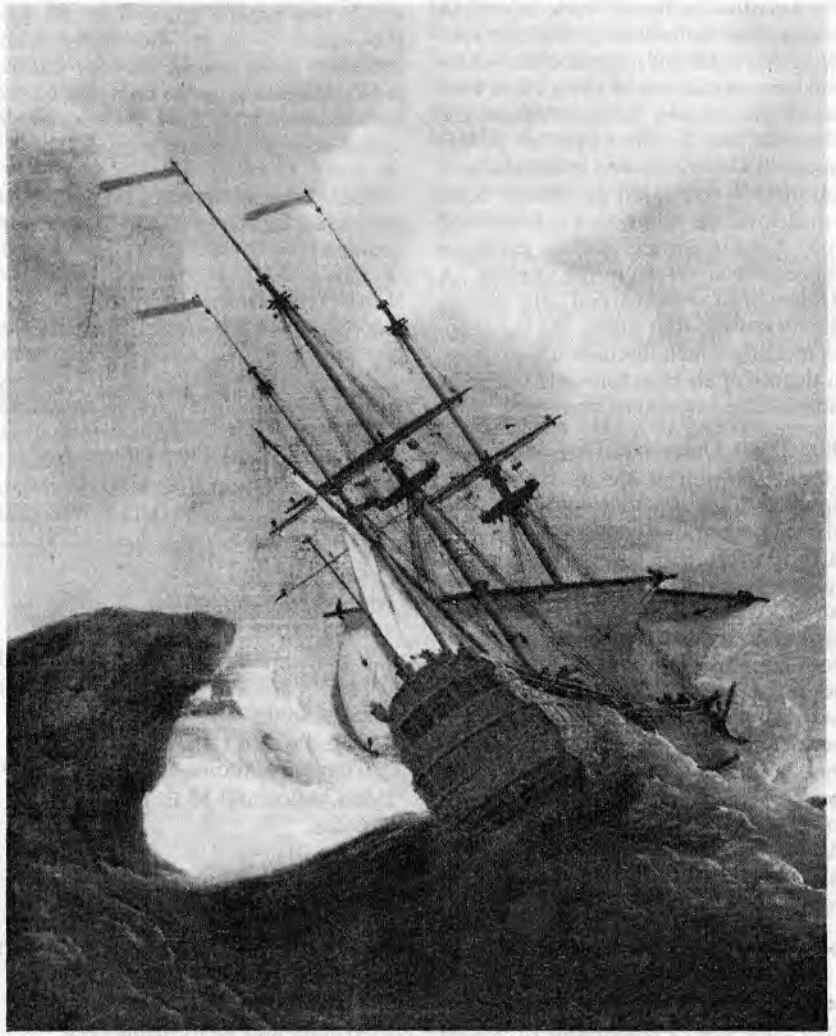
The third expedition to the wreck site took place during June 1967 and consisted of a party of 25 officers and men from H.M.S. *Delight* (Commander J. M. Child, M.V.O., R.N.) during a routine visit of the ship to Lerwick in the Shetland Islands. The party hired the Motor Fishing Vessel *Argo* of Vidlin from a local man, Captain Georgson. *Delight* effected a rendezvous with the *Argo* at 0500 on 31st May 1967 off the 'Out Skerries' Group. The whole party, including several tons of diving equipment, compressor, rations, radio equipment and explosives, were quickly landed and the *Delight* proceeded on her way to Lerwick. The base camp was set up in the village hall after contact had been made with the local schoolmaster, Mr. McKinnen, and a diving maintenance workshop was set up in the pier store-house.

First Day's Operations (31st May).

On arrival at the wreck site in *Argo*, permanent moorings were laid and the first diver was down by 0830. We used SDDE extensively and with great success. On his first dive Lt.-Cdr. Bax returned with two silver coins. A series of numbered markers were then laid by Surgeon Cdr. Preston and P.O. Morly while other divers cut the thick kelp surrounding the site with machetes.

The water, though cold (47F.) was wonderfully clear horizontal visibility at 60ft. being 80—100ft. Marker No. 6 was found to be lying on top of a cache of coins deeply embedded in a mass of iron oxide.

The wreck site was littered with large boulders, the result of a cliff slide probably years or so ago and it was decided to disperse these using plastic explosives. 7 x ½lbs. of P.E. was placed in clefts in the largest rock with 1 x ½lb. P.E. and 3 sticks of Gelignite at other areas, the whole being detonated electrically from the surface. This, plus extensive photography of the site underwater, concluded the first days work and the diving party returned tired but happy at 1930 when the air charging party took



Peter Monarny — Detail from *East Indiaman* and *Royal Yacht* in a storm near rocky coast. *By courtesy British Maritime Museum.*

over the empty SDDE bottles and SABA.

Second Day's Operations (1st June).

Many of the markers had been damaged by the previous day's blast and had to be replaced. Preston and Lambert proceeded below and commenced clearing rubble from the explosion area using air-lifted kit-bags. This proved to be very hard work and divers were changed in pairs after an hours work below. A further blast before lunch did not split the largest rock but increased the rubble situation. A number of silver coins were picked up, cannon balls, complete and otherwise, and an almost perfect pewter spoon. S.D.D.E. proved invaluable and undoubtedly increased the divers duration below. In addition, Lt. Evans and App. Gittins carried out an extensive magnetometer search in the Gemini. A further blast was carried out before leaving the site that night. At the evening meeting, much discussion took place on the use of air bags for rubble clearing and possible improvements.

Third Day's Operations (2nd June).

On inspection, a lot of rubble was found from the previous day's blast and this was laboriously cleared away by pairs of divers using an air-lifted basket. Again a large number of coins, cannon balls and other artifacts were recovered. Further attempts at blasting the large rocks had mixed results. After mid-day the weather deteriorated and a large swell developed from the south which precluded any more diving for the day. The magnetometer search was continued, however, and a search technique slowly evolved. Only one reasonable 'magnetic anomaly' was found and time only permitted one quick dive on the spot with no result.

Fourth and Last Day (3rd June).

Argo proceeded to Vidlin with half the party and the heavy diving gear while Surg.-Cdr. Preston and Lt. Evans carried out a landward survey of the site. All other gear, including the compressor, was moved to the old jetty. At 1245 *Argo* returned to pick up the compressor and remainder of the party and finally set sail at 1300 arriving alongside *Delight* at Lerwick by 1800 with the whaler in tow and accompanied by the Gemini under her own power.

In summary, a most successful Exped. which was greatly enjoyed by all who took part. Every member worked extremely hard during the four days in the Out Skerries, the air charging parties working until 0300 each morning which, at this time of year is dawn!

The following took part and their particular functions in the Exped. are detailed.

*Lt.-Cdr. A. D. Bax, R.N.
In Command.

*Lt. D. Evans, R.N.
2nd I/C—Photo and survey records.

*Surg.-Cdr. F. S. Preston, R.N.R.
Diving and Medical Officer.

P.O.M.E. Ives and L.M.E. Stokes.
Air charging.

C.E.R.A. McCormack
Engines.

App. Gittins
Magnetometer.

L.E.M. Holmes, A.B. Rainsford, CK(s) Dean
Food and camp duties.

L.R.O. Pollard
Communications.

*L.Sea. Allen and M.E. Lambert
Boats.

*P.O. Morley
Explosives and firearms.

Midshipman S. Allen and A.B. Downey
Diving and all written records.

*P.O.M.E.'S Malam and Baldwin
Artifact and Kelp logging, etc.

*A.B. Hallahan, *M.E. Jackson, *A.B. Fisher, A.B. Lawson
Diving maintenance.

A.B. Lawson
Gemini driver.

*L.Sea. Bryan, *A.B. Swainston
Miscellaneous equipment.

*Denotes qualified Ships Divers.

The coins we found are silver ducatons of two distinct kinds. Unfortunately they are not particularly valuable but they make a good story. The first type are ducatons from the Spanish Netherlands of the Province of Brabant minted in Antwerp and on the obverse side have the Inscription 'phiLLLL D, G. Hisp et Indiar Rex' and then the date—say 1648—with a hand between the 16 and 48. Freely translated this means 'Philip IV by the Grace of God, King of Spain and the Indies' . The hand shows that the coin was minted in Antwerp. On the reverse side there is the inscription 'Burg. Brab. Archid.Avst. Dux' which means 'Archduke of Austria, Duke of Burgundy and Brabant'.

The other coins are also ducatons but come from the United Netherlands and are not Spanish at all. They were minted in Utrecht and known as silver riders. Specimens of these dated 1711—the year of the wreck—were obtained. The obverse side has the inscription 'Mo. No. Arg. Pro. Con. Foe. Belg. Trai' which means 'New Silver Money of the Provinces of the Belgian Federation, County of Utrecht'. On this side there is a rider on horseback with the arms of Utrecht below him. On the reverse side there is the inscription 'Concordia Res Parvae Crescunt 1711' which freely translated means 'By Concord small things increase'. There is also a crowned and supported Arms with a date in the cartouche.

Before you rush off to the Shetlands, however, remember the value of these coins is small—probably only 5/- each, and they are not particular collectors items.

Our thanks are due to Commander Child, whose help and encouragement made this successful venture possible.

F. S. PRESTON,
Surg.-Cdr., R.N.R.

PROMOTIONS AND ADVANCEMENTS

To Chief Petty Officer:

J. M. MacRea-Clifton, C.D.1.
F. Rose, C.D.1.
A. Wheeler, C.D.1.
W. S. A. Crane, D.1.

To Petty Officer:

G. France, C.D.1.

To C.D.1.:

P.O. Gardner
P.O. Wright
P.O. Vaughan
L.S. Humphrey
L.S. Coulson
L.S. Welch

To C.D.2.:

M(e) Sykes
A.B. Phillips
A.B. Murdoch
A.B. Hindmarsh
A.B. Barnett
L.S. Collins
L.S. Edge
L.S. Downey
M(e) Lawson
A.B. Yeats
A.B. Griffiths
M(e) Baily
R.E.M. Sharp
A.L.A. Powell

General Report on Project "Cold Finger"

by PETER WARREN

THE Fleet Air Arm of the Royal Navy has had for many years its own Sub-Aqua Organisation (N.A.C.-S.A.C.) which brings diving activities on various air stations under a Policy-controlling central organisation, This summer N.A.C.-S.A.C. organised a trip to the Scillies, and a search for the '*Association*' was started, plus the tagging of crawfish for the Ministry of 'Agg and Fish'.

The *Daedalus* Branch of N.A.C.-S.A.C. based at R.N.A.S., Lee-on-Solent decided on a winter project and this (with apologies to 007) would be locally known as project 'Cold Finger'. The Royal Air Medical School directed by E. B. Boyd-Morton, O.B.E., based at Seafield Park in Hampshire, were approached and readily agreed to supervise and conduct the trials under strict medical supervision. The R.N.A.M.S. carry out environmental experiments with regard to the survival of aircrew under extreme conditions, and have a 4,795 gallon tank which can be thermostatically controlled at selected temperatures. It was decided that because of the variations in the thermal insulation properties of wet suits with depth, project 'Cold Finger' should be split up into three phases. *Phase* 1—0-6ft. *Phase* 2.—30ft. *Phase* 3—60ft. and all at a temperature of 4·5°C.

Comparative work of this nature has been carried out by the U.S. Navy Department of Medicine, Philadelphia, and also by the U.S. Marine Corps.

It was decided to use five volunteers representing the five types of diver, i.e. Tall, Short, Thin, Average, and in order to give the trial added interest, it was suggested that each diver should undertake two dives, over a period of two days: one dive in a wet suit and the second in a dry suit, in order to give a comparison. Variations in the type of wet suit used would be permitted, in order to see if they were of advantage. Also variations in dry suit underclothing and head wear were permitted for the same reasons. The dry suits were standard Admiralty Pattern. Suit inflation was not considered practical at this depth, also a direct comparison without air insulation at this stage was required. Each diver was required to undergo a few medical tests 24 hours before diving. They were as follows:—

1. A check for fat calibration which is indicative of a diver's own natural insulative properties.
2. A check for cholesterol level in the blood: this is in fact a safety measure and in brief the higher the cholesterol level the more likely the danger of a heart attack, perhaps caused by shock and in this case the entering into cold water.
3. An Electric Cardiogram reading of the heart, again a safety measure in order to affirm that all is functioning normally.

In order to gain a satisfactory overall picture of temperature variation, each diver was monitored, and leads were taped to the following positions.

1. Left Finger. 2. Left Toe. 3. Left Heel. 4. Left Thigh. 5. Left Buttock. 6. Left Shoulder. 7. Back of Neck. 8. Chest.

In addition heartbeat was monitored by an E.C.G. machine. This meant that at least an hour was spent in dressing and this in itself was a delicate operation.

The monitoring was controlled by C.P.O. Williams, who showed an unnatural patience towards our pre-dive periods. The final result was a strange looking creature attired in a rubber suit with an umbilical cord made up of ten wires following wherever he went.

The most significant temperature (and indeed the most dangerous) is Deep Body Temperature. Normal body temperature is 98·6°F (37°C). During initial cooling heat production is increased. This is caused by involuntary shivering; shivering stops at between 91·4°F (33°C) and 86°F (30°C); at 86° muscles are stiff and conciousness is lost. Very broadly speaking therefore there is only a span of 7°C between life and death and only 5° between normal conditions and that where heat production ceases. The limiting factor for this kind of trial has been set by the Medical Research Council; that is when the index finger temperature falls to 8°C and this is recognised as the physiological lower limit. The method used to record Deep Body Temperature was by a miniature radio set which together with its battery encased in a rubber finger stall were swallowed by the diver one hour prior to diving. Signal pitch was directly proportional to Deep Body Temperature and on an aerial carried by the diver next to his stomach added to the trailing 'gangle' of wires. (Swallowing the pill provided quite an amusing diversion; recovering the pill is unmentionable).

The five volunteers were:

1. Lt.-Cdr. J. Gayton. 2. Lt. R. Graham. 3. Lt. T. Montgomery. 4. C.A.M. P. Warren. 5. A.A.2. B. Furlong.

In spite of adequate supervision and monitoring, each diver was instructed to terminate the dive if he felt at all distressed due to the cold and as an added precaution, a safety line was attached to his middle.

A standard S.A.B.A. apparatus was used as the breathing set for all divers with a full facemask. Temperature and Deep Body Temperature were noted at five minute intervals. E.C.G. recordings were taken over the period of $\frac{1}{4}$ minute every five minutes. The diver was also signalled 'are you okay' every five minutes.

On average each diver spent one hour eight minutes in the tank in both wet and dry suits and each diver rendered his own report based on his own reactions to the low temperature. A typical report submitted by Brian Furlong is as follows:—

From P.O. B. Furlong.

WET SUIT

(No Zip, Attached Hood)

On submerging felt slight resistance to breathing from set. Tightening and ache around jaws, this disappeared after about twelve minutes. All through the submersion a feeling of warmth was felt around buttocks and lower stomach. Hands were first affected by cold, the right hand holding the safety rope felt that slight amount colder than the left. Breathing was controllable all through test. Feet and top of chest, after approximately half an hour, were next affected by cold and towards the last ten minutes, shivering occured on exhalation, stopping on inhalation and the pause before exhaling again.

Not affected by boredom at all through test and when brought to the side of bath only thought quarter of an hour had elapsed; no undue discomfort felt at any period of the test. On moving towards edge of bath I felt quite active and after about three minutes in hot bath felt restored and normal.

All through test, I was concious of the pickups on finger and toe. I doubt very much whether I would have been able to use my hands effectively after the first half an hour had elapsed, and account for the coldness of the upper chest to a large fold in the material at this point. During the immersed period, cleared mask three times due to mask being over hood.

DRY SUIT (Normal)

Same restriction to breathing due to set, also similar ache around jaws probably due to biting too hard on mouthpiece. Slight headache for first five minutes, but have experienced this before when diving in Scotland and disappeared when water in hood warmed up.

Felt extremely warm and comfortable for first half hour, and hands again felt cold but not enough to affect dexterity as in similar dive with wet suit. Breathing controllable—no shivering at this stage. Within the next quarter of an hour forearms and feet began to feel cold, hands felt in a similar state to final period in wet suit, breathing controllable but slightly more concentration required. Slight body trembling nearly merging to shivering on exhalation. Became really concious of single pulls and started to count them right to the finish, interval between pulls seemed to take much longer during last twenty minutes.

For the next quarter of an hour cold intensified on forearms, hands and feet, shivering on exhalation and running into inhalation period, besides counting pulls started to count holes in grid over pipe in tank but gave up after half way. Breathing rate increasing; with concentration found it could be controlled but couldn't be bothered for long periods. For the last five minutes of this quarter and the next ten minutes I became conscious of a faint twitching under right breast. Breathing also came with an increased rate probably with a slight idea that the faster I breathed the quicker I would empty the bottles and then out. Also for the last quarter of an hour (the last three pulls) I was thinking that I would signal myself out on the next pull, until the final pull when I felt so cold I was going to signal myself out anyway.

On moving my movements were very tired and I was grateful for the help on the side of the pool. Shivering became extreme on leaving the water and entering the bath, for the first few minutes I couldn't bear the left hand in the water. Recovery time was much longer before I could control the shivering and feel that my hands were back to normal. More conscious of the finger pick up this immersion.

All dives were completed over a period of three weeks and it is significant that all divers stayed down until ordered out. This operation involved the interpretation of some 80 graphs and a mass of information, therefore the full Medical and Technical Report will be published later. However certain simple recommendations can be made.

HANDS

1. Because of the large amount of water exchange, mitts are inefficient.
2. They are not as inefficient as the three part mitt which isolates thumb and forefinger. The isolated finger gets colder far quicker on its own.
3. Separate finger neoprene gloves worn under mitts would give adequate protection.

FEET

1. Bootees worn inside the trousers give better insulation than those worn outside the trousers. Zips just act as their own little water channels.

TRUNK

A good tailored fit is essential. An attached hood gives no benefit if in manufacture it causes the jacket to be a loose fit across the chest, i.e. a zipped jacket stretches when both halves are drawn together giving a better fit. The difference in fit caused a difference in Deep Body Temperature of 1·10 degrees which to the layman would not appear much, but to the diver is leading him towards danger.

It was proved that the ideal Trunk Combination was an inner neoprene vest next to the skin with the jacket on top; an inner and outer hood would also be of great advantage. There is no difference in insulative properties between lined and unlined suits. Ankles and wrists are therefore better off without zips.

DRY SUIT CONCLUSIONS

The dry suits used were standard Admiralty pattern with a double wool 'inner'. On the first dive of the series C.P.O. P. Warren used a 'C' type hood without any insulation underneath it, but by using exhaled air, temperature drop was arrested.

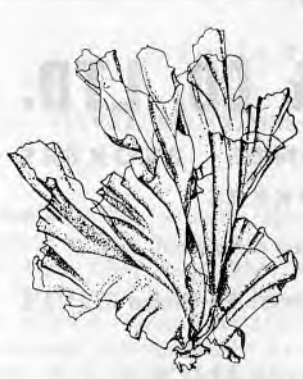
A direct comparison with a neoprene hood was spoiled however by water pouring down the gap caused by the join between the collar of the jacket and the neoprene hood on the wet suit. If the graph (not shown) is studied however, it can be seen that a 'C' type rubber hood *without* warm air blown into it would intercept the line of the wet neoprene hood at about the 40 minute mark. It is standard practice for Service divers however to wear a neck seal with a dry suit with a neoprene hood on the top. The following general conclusions were reached.

1. A neck seal and neoprene hood are more efficient than a plain rubber hood.
2. The looser the fit of a dry suit, the greater the air space—the warmer it becomes. This means a big man in a well made wet suit is warmer than if he is in a stretched 'off the peg' dry suit.
3. Divers using separate finger gloves under neoprene mitts were far better off than those wearing mitts.
4. The diver's feet all appeared warmer in wet suits than in dry. It would appear that a $\frac{1}{8}$ inch double skin neoprene sock would be ideal for wearing under a dry suit.
5. A diver wearing an Acrilan pile fur inner suit was much warmer than a diver wearing a double wool inner suit.

A detailed report will be published in *Underwater Technology* and will give all graphs comparisons and data obtained on these trials. It is hoped to continue these trials and investigate all practical combinations of wet and dry suits—underclothes, gloves, etc. Perhaps manufacturers and industry can help by giving us their requirements plus temperatures, depths and conditions, under which divers on specialist jobs would be required to work.

Address:—

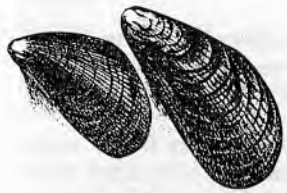
C.P.O. Warren, C.P.O's Mess,
H.M.S. *Daedalus*,
Lee-on-Solent, Hants.



SEA LETTUCE
Tastes good with sea salt

SEAWEED
Must be taken out of the sea garden

SEAGRASS
Difficult to cut with a lawnmower



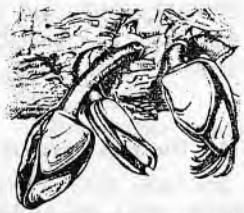
MUSSELS
What develops on divers from hard work

BARNACLES
What divers grow

HYDROIDS
To decorate the wife's hat

TUBEWORMS
Results of eating sea lettuce

TUNICATES
Decoration for a diver's regulator



GOOSE BARNACLES
What divers grow when frightened

Association

By ENG.-LT. R. H. GRAHAM, H.M.S. *Daedalus*

NAVAL AIR COMMAND SUB-AQUA CLUB EXPEDITIONS ISLES OF SCILLY — 1967

Preamble. The seventh annual expedition of the Naval Air Command Sub-Aqua Club sailed from Penzance for the Isles of Scilly on Saturday 1st July in the R.N. Auxiliary Minesweeper *Puttenham*, commanded by Lt.-Cdr. E. Barter, R.N. (Retd.). This was a combined operation. NACSAC supplied divers and the RNXS an experienced crew. The aims of the expedition were to:—

1. Provide advanced sport diving experience for the leaders in this pastime.
2. Search for the remains of the *Association*, Sir Cloudesley Shovel's Flagship sunk on October 22nd 1707.
3. Assist in Crawfish research in collaboration with Scientific Officers of the Ministry of Agriculture, Fisheries and Food.

The Team. The following divers took part. Each person was allocated a special duty. Some exchange of duties took place during the three trips and not everybody took part in all three Expeditions but basically the organisation was unchanged and worked well throughout.

R.A.E., Farnborough:
Lt.-Cdr. Jack Gayton—Officer-in-Charge.
Sqdrn.-Ldr. David Denison—Medical Officer.

H.M.S. Daedalus:
Lt. Roy Graham—Diving Officer.
Lt. Terry Montgomery—Expedition Planning.
Lt. Andrew Linsley—Equipment Officer
C.A.M. Pete Warren—Underwater Photography.
P.O. Brian Furlong—Boats.

R.N.A.S. Brawdy:
Lt. Paddy Minchin—Boats Officer.
P.O.A.F. Keith Warner—Equipment Boats.
P.O. EL. George Cooper—Boats.
N.A. 'Henry' Ford—Equipment.

R.N.A.S. Culdrose:
C./Air Ron Crocker—Quartermaster.
C.A.F. Bert Trise—Caterer.
P.O. EL Brian Lewis—Records/Equipment.
R.E.M. Dick Voisey—Supply/Boats.
N.A. (O) Phil Plevy—Boats.
Mr. Bob Hale—(Ex-Ships Diver), R.N.X.S.

R.N.A.S. Lossiemouth:
C.P.O. 'Chippy' Pearce—Equipment.
A.A.1 Dzus Hollomby—Equipment/Records.

R.N.A.S. Yeovilton:
EL. Mech. 'Bomber' Brown—Boats Officer.
C.P.O. John Conyard—Boats/Equipment.

H.M.S. Vernon:
L.S. C.D.1. 'Pablo 'Welch—Professional Adviser.

All the divers were qualified to NACSAC (BSAC) 2nd Class standard and most were also experienced Ships Divers including nine Expedition Leaders, plus our imperturbable C.D.1. 'Pablo', who joined us for the final week.

Diving Times:	*Total Diving Times:*	*Times on Gilstone:*
1st to 14th July ..	120 hrs. 47 mins. ..	84 hrs. 32 mins.
19th to 25 August ..	88 hrs. 39 mins. ..	83 hrs. 28 mins.
9th to 16th Sept. ..	98 hrs. 7 mins. ..	74 hrs. 24 mins.
TOTAL	307 hrs. 32 mins. ..	242 hrs. 24 mins.

Equipment. Over the years, club equipment has been built up, largely from Lord Nuffield Trust Grants. Inflatable boats, outboard engines, two compressors and Underwater cameras were borrowed. Wet suits, aqua-lungs, lifejackets and much ancillary gear were largely privately owned.

Research. Three years of research into Naval Records in the Public Records Office, the National Maritime Museum, the Guildhall library and other sources had confirmed our Expedition Officer, Lt. Montgomery and the Club Diving Officer, C.P.O. Dick Larn, in their belief that the *Association* had gone down on the Outer Gilstone Ledges. We were well supplied with evidence, down to lists of the numbers, sizes and weights of the cannon carried in each of the vessels sunk on the night of October 22nd 1707. The *Association* was 165 feet long, 45 feet 4 inches width and 18 feet 3 inches deep. She weighed 1,459 tons, carried between 600 and 900 men and was built in 1696 at Portsmouth.

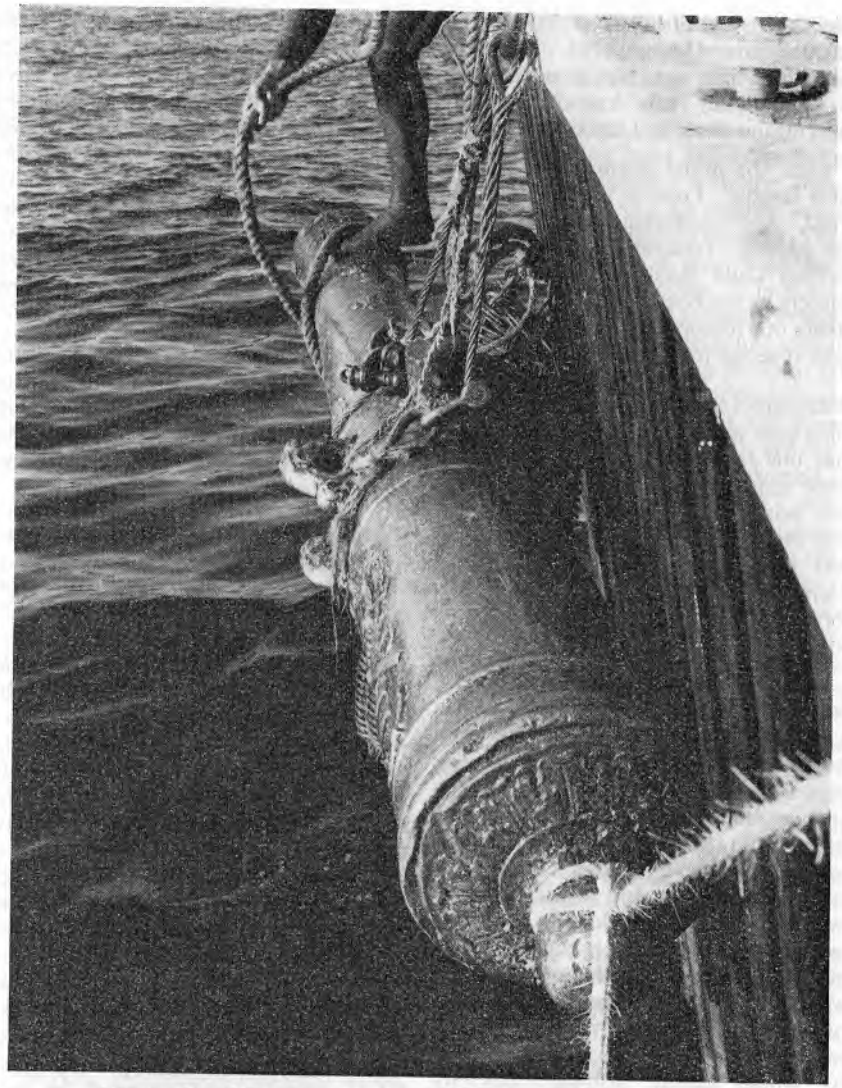
1965 and 1966. In 1965 and 1966 diving by NACSAC on the Outer Gilstones had been limited by wind and swell to 100 minutes in marginal conditions. Local Fishermen said that diving on the Gilstones might be possible for five days every year. So far, we had no reason to think their estimate anything but optimistic.

1967.

SUNDAY 2ND JULY. In a heavy swell and at a cost of much broken crockery, we launched one inflatable boat with four divers. They searched an area N.W. of the Gilstones, 110 minutes in all, at a depth of about 80 feet but soon the wind increased to Force 5 and the area within the ledges became a maelstrom of white water as Atlantic swell, wind and a meeting of currents did their work.

MONDAY 3RD JULY. A pilgrimage to the Outer Gilstones was made but conditions assessed as too risky. We went to Menawetthan to show the 'new' boys some iron cannon which we had found in 1966. 'So you will know what to look for' we said. Troubles never come singly. The delivery tube in the petrol driven compressor fractured and the electric compressor became temperamental. A Fleet Air Arm knot caused a flutter when a Gemini drifted away and we shed a prop from the 25 h.p. Gale. The sun came out, we sighted our iron cannon, nine grey seals and two basking sharks. The Diving Officers heard assurances that there had been no authenticated cases of sharks 'chomping' divers in Home Waters, but became the target for the kind of repartee with which some readers will be only too familiar. They dived all the same and the theory was upheld, although later on, Bert Trise did get nudged by a seal.

TUESDAY 4TH JULY, The wind had dropped and the swell subsided. Ted Barter produced 'The Little Divers Guide to Currents on the Gilstone'. Our first sortie, two teams of four, dived and returned to *Puttenham* with crawfish for tagging but no news of *Association*. Our second sortie was back inside twenty minutes, the divers yelling and waving excitedly. Jack Gayton and



16-pounder of French origin 9′ 7″ in length, nearly 3 tons weight.

'Bomber' Brown had found and marked a large iron cannon. The third sorties reported another twenty cannons. Swimming past a large rock shaped like the prow of a ship and peering over a ledge we found a large anchor 19 feet 6 inches in length and 12 feet across the flukes. Suppressing our rising excitement we prepared to tag each cannon in order to carry out an accurate count. Four ships had been lost on the 22nd October 1707 with a loss of 2,000 men, the *Association* 96 guns, the *Eagle* 70 guns, the *Romney* 50 guns and the Fireship, *Firebrand*. Then Dick Voisey found a gold coin just lying beside a cannon. It

was later identified as a Portuguese 4,000 Reis and dated 1704. Both the date and origin were significant because Sir Cloudesley was known to have banking interests in Lisbon.

After the initial elation we began to have doubts. Gold is a very evocative word. We could visualise headlines in the papers, 'Treasure ship found' and 'Scillies Gold Rush' bringing fortune hunters by the boatload. Events were to justify our forebodings but we could not keep it secret for long.

WEDNESDAY 5TH JULY. Whilst swimming over a line of cannon, we realised that one looked different, cleaner and more sharply defined. Our knives cut into bright yellow metal. This was a find of great importance. Serial numbers were sometimes marked on the trunnions of English ordnance of that period and would not have rusted away on a brass cannon.

Our first attempt to lift the cannon was not a success. John Ivals of the R.N.X.S. had worked hard making up the strops for the oil drums and these were shackled via a boat ring to a wire strop around the cannon. We filled the drums from our spare air cylinders and eight oil drums soon floated above the cannon strops clanging together in the swell but the gun would not lift. We gathered every kind of kit-bag or canvas specimen bag and tied these on as well. When this cluster of assorted bags was inflated our cannon came clear of the bottom. Delighted, we started to tow the whole untidy lash-up back to *Puttenham*. The many fangs of rock along the Gilstone ledges forbade close support by *Puttenham* and our three Geminis made slow headway towards the deep water South of the ledges. A towing rope became tangled in a screw and we drifted above the shallow southern end of the ledge. Our improvised lifting bags were spilling and leaking air and the cannon sank gently down to rest at a depth of 30 feet. This was a disguised blessing because 20 yards further south and it would have been lost in 30 fathoms. Operations were suspended as wind and tide turned nasty. Back in Hughtown the reporters and photographers really wanted to know. B.B.C. T.V. were on their way but we were almost out of time and weather. We requested and were granted an extension of one more week by FONAC and C.-in-C., Plymouth.

SUNDAY 9TH JULY. By Sunday 9th July the wind and sea had dropped but most of our oil drums were damaged. We salvaged what we could and signalled R.N.A.S. *Culdrose* for lifting bags.

MONDAY 10TH JULY. Our wreck plan now showed the approximate position of about 50 cannon and three anchors. A helicopter arrived at 1230 with six lifting bags, and a cargo net. These bags measured about 4 feet square and give approximately 4,000lb. of lift each. They were not designed for underwater work but for raising or supporting aircraft wings or fuselages during repair work when hydraulic jacks would not be suitable. Nevertheless, they are thoroughly recommended, inside a a cargo net, in the cannon lifting role. After the polishing of the brass by the movement of the strop during the storm and in the better light of the shallow water we could read the inscription 'Le Duc de Beaufort' on the cannon. The work of attaching the lifting bag now went smoothly. Filmed by underwater I.T.V. cameras and observed by two boatloads of pressmen and holiday-makers, it would have been ungallant to fail.

All afternoon the N.W. flank of the Atlantic rollers has been obligingly breaking precisely 5 feet to our S.E. foaming over the Southernmost fang of the Gilstone Ledges. Suddenly the inflation bag shot prematurely to the

surface pushing the support boat under a breaking roller and swamping us. Dzus expressed mild surprise and started bailing. Chippy Pearce and Bob Hale deflated the bag and we started again. By 1900 up she came cannon attached. Assisted by the current and the Press launch, *Sea King* we came to *Puttenham's* stern with our prize. The winch wire was attached and 'Le Duc de Beaufort' soon saw the light of day again after 260 years.

The cannon was later indentified as a 16 pounder of French origin, made in Le Harve around 1652 for Francois de Vendome (The Duke of Beaufort). De Beaufort was the last holder of the office of Grand Maitre de Navigation and commanded the French Fleet for Louis XIV until he died in 1669. It weighs nearly 3 tons and is 6 feet 7 inches in lenth from breech base to the muzzle.

The Tower of London were pleased to call it 'a find of international importance' but as a clue to identification of the wreck a 'Pussers Standard Issue' would have been better. It does seem as if this cannon and its brothers, found later, were prizes of war and as such, not listed in the tables of ordnance in our possession.

TUESDAY 11TH JULY. The forenoon was occupied with offloading 'Le Duc' onto the jetty, with press and T.V. interviews, and repairs to our gear.

During the afternoon it was decided to fill in an idle hour by searching further to the N.E. No timbers had been found and it was possible that the hull floated on, after being lightened by the loss of most of its heavy armament. No evidence in support of this theory was found during this and other searches later in the summer. The fury of the winter storms pounding away for 260 years would be enough to explain the absence of any wooden remains and also for the lack of any lighter debris or artifacts other than those trapped in crevices or buried under cannon and boulders.

WEDNESDAY 12TH JULY. Further finds included cannon balls and brass Pulley Wheels both stamped with the Broad Arrow and proving it an English wreck. A bronze breech loading cannon, 3 feet 4 inches long bore a crest with three Fleur de Lis and another 20 inch long bronze saluting gun was badly eroded. A second coin found was a five shilling piece dated 1696 showing William III. Musket balls and lead pistol shot littered one part of the wreck and the divers called this 'the magazine'. We also found some wooden discs assumed to be cannon wheels. A French T.V. team arrived to make an underwater sequence. Their needs proved more exacting than 'phone calls from Paris had led us to expect. One Gemini, Jack Gayton and myself were lost to the main task all day as we provided safety cover and guides and acted as film extras. The visibility in the Scillies was about 45 feet in 1966. This year the average had been about 25 feet due to more plankton in the water. Photographic conditions were therefore only moderate by Scilly standards. Nevertheless we later heard that the French team had handed in some very good film.

THURSDAY 13TH JULY. We dived to tidy up the site and recover markers and cordage. Two more brass cannon were reported — one, underneath iron cannon —but the tides were now ill-timed for Gilstone work.

FRIDAY 14TH JULY. We returned to Penzance tired and with gear in need of repair. The water is quite cold in the Scillies even in Summer.

The Site. The wreck appears to have struck the middle rocks of the Gilstone ledges and cannon are strewn to the N.E. and S.W. of this point over an

blowing up of *De Verguld Draak*, an area about 250 feet by 50 feet. The deepest part of the wreck, the large bow anchor, lay just off the N.E. edge of the Gilstone ledge in 90 feet. The shallowest part is an iron cannon at about 35 feet in the centre of the wreck. The bottom is very rugged with peaks of rock and deep crevices. The S.W. extremity of the site, presumably the stern section, has an average depth of 70 feet and consists of a craggy floor littered with enormous boulders. There is some weed down to about 55 feet, but this is not much of a hindrance. It is possible to work down in the gullies quite comfortably even when the surface current is too strong to swim against.

Other Teams. Even as we were leaving the Press were looking for our successors. A Mr. Roland Morris from Penzance announced that he would finance an expedition and use explosives if necessary. He had taken out a contract with the M.O.D. in August 1966 for 50% of salvage from *Association*.

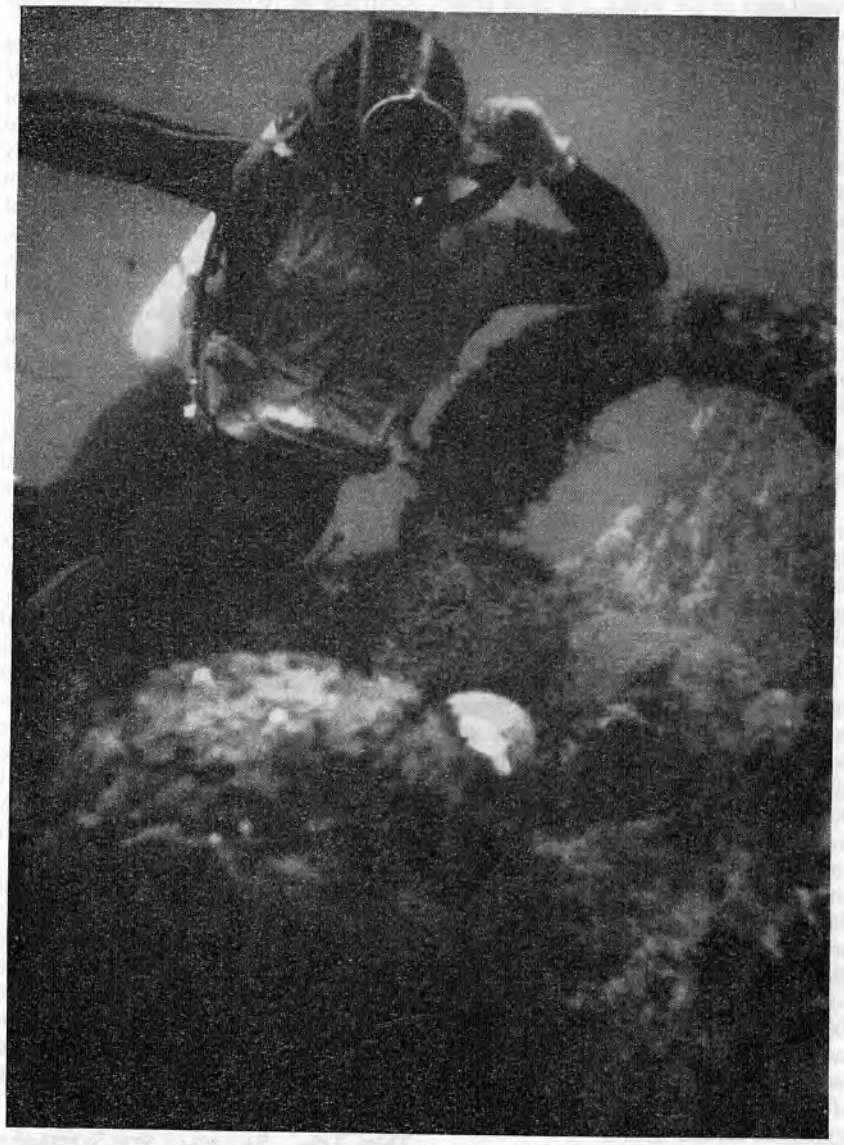
When we returned for another attempt, the Morris team were on site and we were in time to witness the recovery of three more brass cannons, one of which we had not seen before. One trapped underneath some iron cannon was recovered by blowing up the iron cannon on top of it. This was done with precision using small amounts of plastic explosive, but what had been a large depression in the rocky sea-bed filled with a picturesque litter of canon —waiting for the underwater tourists of 2000 A.D.—now looked like Steptoe's backyard. Dead fish floated around and the divers named this spot Death Gulch. After this, the M.O.D. banned the use of explosives on the wreck.

In the Mediterranean and in Australia, work on historic wrecks has become the subject of modern legislation. All historic wrecks off Australia are now the property of the state museums. There was a public outcry at the East Indiaman sunk off Western Australia in 1656, by treasure hunters.

The Gilstone wreck is not a complete wooden hull like the *Vasa* or *De Verguld Draak*. It is just a litter of cannon, anchors and artifacts and so explosives do not cause any really devastating damage. Nevertheless it does seem proper, if the maximum amount of historic information is to be extracted, to take it easy. *Association*, if such it be, has been there for 260 years. One could spend ten years just looking and another ten years probing and lifting. By that time underwater salvage techniques would be more advanced.

Second Trip. 21ST AUGUST TO 25TH AUGUST. For the second trip, we had the services of H.M.S. *Odiham* as accommodation vessel and H.M.X.S. *Shipham*, Lt.-Cdr. Tom Coombs, as Diving Vessel. This period was mostly good weather and we dived long hours. We raised the large bow anchor and placed it in 30 feet of water in St. Mary's Roads. Digging under boulders and cannon for small pieces, Dzus found a gold wedding ring inscribed 'God above increase our love'. There were also nine more gold coins, four Portuguese and five English. The dates on the coins ranged from 1669 to 1701 for the English and 1687 to 1706 for the Portuguese. Also raised were 52 circular coins and 44 pieces of silver, a lead inkwell, two pieces of bugle and a piece of bone which might be a human tibia. As we were about to return to Penzance we heard that the Prime Minister had been interested in our work and that we were to be given the opportunity of launching a third attempt.

Third Trip. SATURDAY 9TH SEPTEMBER TO 16TH SEPTEMBER. Two weeks later we were back, equipment repaired and well supplied with lifting tackle by courtesy of the Master Rigger at Portsmouth Dockyard. The Diving



Bar Anchor, 90 ft. *Photo by Paul Armiger, Daily Telegraph.*

Vessel was to be H.M.X.S. *Odiham*—Lt.-Cdr. John Payne.

Our aims were to further the survey and to lift some of the iron cannon to recover what might lie beneath them. This proved difficult since they had become welded to the rock by some chemical action and it was necessary to chip away this oxide cement. One cannon was lifted and we gathered a harvest of four bright gold coins. Pablo picked up two together whilst digging under a cannon. Other finds included 100 silver coins, a silver spoon with a family crest on the handle and a brass candlestick holder. The crest on the spoon is similar to that of Captain E. Loades, the Flag Captain of the *Association*.

WEDNESDAY 13TH SEPTEMBER. Attempts to raise the next iron cannon, weighing about 1½ tons, failed. It was so embedded in oxide concretion that 6½ tons of lift and a tug from *Odiham*'s stern winch wire would not budge it. Meanwhile Bomber Brown and Brian Furlong searching in the kelp to the N.E. found another French cannon (or culverine) similar to the others but with its dolphins (lifting eyes) broken off. An extract from 'London Letter' of 9th July 1710 contains the following reference to the Herbert Expedition of 1710.

> "We hear from Scilly that the gentlemen concerned in the wreck where Sir Cloudesley Shovel was cast away, have taken (from the bottom) several iron guns and seven brass guns, with a cable, and have found the *Association* in four fathoms at low water, the hull of the ship being whole, wherein there is a vast treasure . . . Had not the winds been westerly which occasioned the seas to be very high and boisterous, all the treasure before this had been finished out!"

After this we visited the Gilstones each day but the wind blew and the seas ran high. Even when the wind moderated, Atlantic swell and spring tides kept all of us, Morris, Regency and NACSAC teams from the Gilstones.

Conclusion. Despite enthusiastic press reports, the total treasure found by all the teams so far is about 1,500 silver coins and about 20 gold coins. The gold coins may fetch between £50 and £100 each.

There has certainly been a considerable re-distribution of wealth including a welcome post-*Torrey Canyon* boost to the Scillian tourist trade, but the main treasure of gold and plate has not yet been found.

The coins so far retrieved are fewer than are likely to have been held by the Paymaster or contained in the ships' Victualling chest.

Thanks. 'Thank You' to everybody who helped us, lent us gear, bent the rules a bit, gave us their time and sent us information. We are sorry we cornered the market in Gemini's for a while. A special thank you to those long suffering souls who worked beside us and took the extra weight when NACSAC divers went off for a five week 'jolly' this summer.

COMMENDATION

PETTY OFFICER Alfred Slingsby of the Mediterranean Clearance Diving Team, has won a Queen's Commendation for bravery in removing two live 500lb. German bombs, buried in thick mud in Bighi Bay, Malta.

Working in total darkness, P.O. Slingsby used bare hands to make a tunnel through the mud beneath the fused bombs for a lifting wire to be passed through. The bombs were towed into deep water and exploded.

Diver Ship Maintenance

CLEANING SHIPS' BOTTOMS AFLOAT USING DIVERS

(The following article is reproduced from the July issue of the Royal Naval Scientific Services Journal).

Introduction. Since 1961 various proposals have been considered by the A.E.D.U. for the underwater cleaning and painting of R.N. ship's hulls by divers. The requirement to be able to do this is not pressing, but as bases around the world become limited, the need for a full service is likely to arise.

The A.E.D.U. proposed in 1963 that a technique for hull cleaning should be developed but this was abandoned owing to the danger that the removal of marine fouling underwater would damage the anti-fouling paint and so leave the hull unprotected against the attachment of larvae and weed, and open to local corrosion.

It was proposed to use a team of underwater swimmers wearing a lightweight underwater breathing apparatus such as the R.N. Surface Demand Diving Equipment (S.D.D.E.), which enables a diver to swim with the minimum encumbrance and unlimited submerged duration. The S.D.D.E. is the recommended breathing apparatus for all Diver Ship Maintenance work.

Recent reports from various sources indicated that the hulls of merchant ships are being cleaned by divers as a matter of course, with no adverse effects. The technique is in use in Cardiff and Marseille.

Commercial Organisations. A visit was made by the author to Cardiff where the firm of 'Underwater Welders and Repairs Ltd.' has started a regular routine of cleaning ship's hulls underwater. The firm is trying to extend this service to other ports in the U.K.

The system at present involves a large lorry-mounted 600 cu./ft. min. compressor which can be driven to any port, complete with a team of four divers and their hull cleaning tools.

These tools include an 18in. diameter brush with nylon or wire bristles, which is fitted to a pneumatic rotary tool supplied with air by low pressure hose from the compressor. The exhaust is led away to the surface by a second hose. Operation of the tools by the divers is simply a matter of turning on the air and guiding the tool over the fouled area. The action of the brush in the water produces its own 'limpet/force' suction onto the hull. This 'limpet force' is due to the water moved by the bristles being radially displayed by centrifugal force and this creates an area of lower than ambient pressure in the centre of the brush. Little further information was gained at Cardiff except that all the ideas and tools originated from International Technique Services at Marseilles who have been doing this work for 6 years.

An expanded commercial organisation is proposed by International Technical Services which is to consist of two teams, each of four to six divers, based at all the major commercial ports throughout the world. Each pair of teams is to have its own launch and land based compressors with hull cleaning equipment as described later. At present divers are under training at Malta, Singapore, Newcastle (Australia), New Zealand and Cardiff. When sufficient divers are trained and established in their respective ports, the expanded service of hull cleaning will be available to merchant ships, enabling them to keep a regular underwater maintenance routine wherever they are.

Initially, the only service will be hull cleaning, but investigation is continuing into the difficulties of painting, propeller changing, tail shaft changing and rudder repairs underwater, with a view to adding these techniques to the existing service. At present a total of about 600 ships a year have their hulls cleaned underwater at Marseille, the majority before dry docking; either at anchor, when the divers operate from a launch, or in dry dock prior to pumping out the water. The divers then operate from the dockside.

One of the most remarkable facts about this system is the low number of diver-hours required. Four trained divers can remove roughly 70% of the total fouling on a tanker of 40,000 t.d.w. in four hours (16 diver hours). By comparison it takes a total time of one week for 24 unskilled men to clean the hull of an aircraft carrier in dry dock, which is 720 man-hours assuming a six hour working day five day week. (In dry dock the amount of fouling removed is naturally almost 100%).

Figs. 1 and 2 show the problem graphically. Fig. 1 shows three curves, power-speed, under identical loaded conditions, of a 35,000 t.d.w. tanker. Curve A is at acceptance trials, showing that at maximum s.h.p. the vessel achieved 16¼ knots. Speed and power steadily decreased and just prior to its sixth annual dry docking a sea trial was made which resulted in Curve B. The vessel was dry docked, cleaned, blasted down to bare metal and new protective coatings applied. Nine days later another sea trial was carried out which resulted in Curve C. (The same propeller was used on all trials, but it was cleaned only.) It can be seen that the difference in s.h.p. to obtain 15 knots is remarkable.

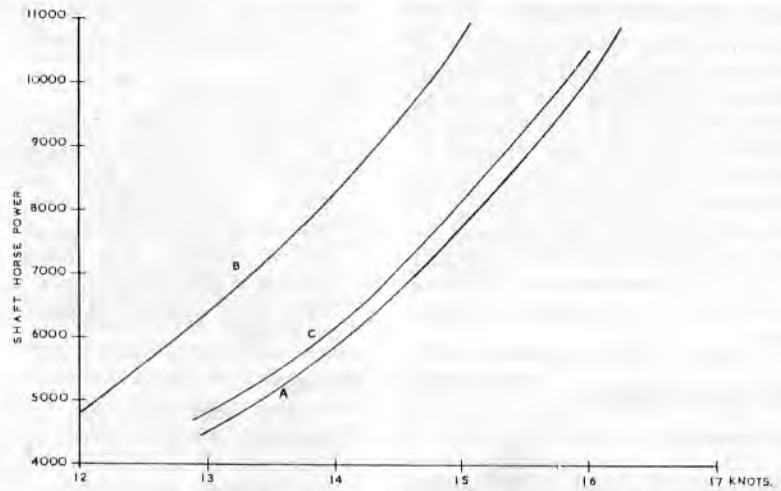


FIG. 1. Drop in performance of a 35,000 T.D.W. tanker (A. and B) and improvement after dry docking (C).

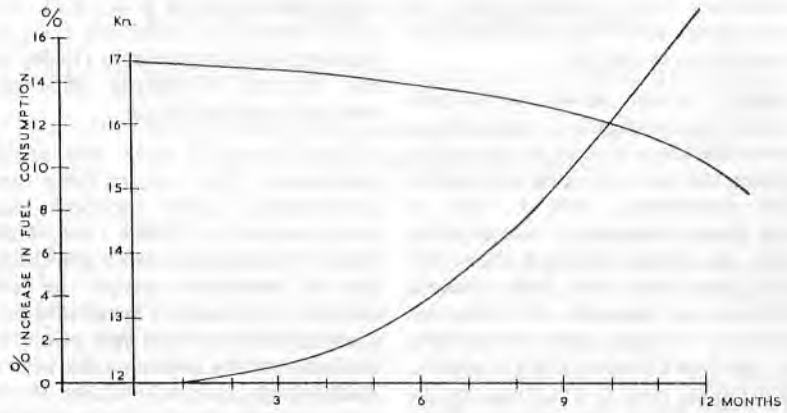


Fig. 2. Drop in speed and increase in fuel consumption of a 17 knot turbine driven tanker when run at service power between annual dry docking.

Fig. 2 shows the drop in speed when a typical 17 knot turbine tanker is run at its service power between annual dry docking, together with an estimated curve, transposed into percentage increase of fuel consumption should an attempt to maintain the service speed be made throughout the year.

As a test after the development of underwater cleaning and experimental underwater painting, a ship, similar to that described in Fig. 2 was kept out of dock for 26 months and cleaned at seven month intervals by divers. It was also painted after cleaning once at 14 months. The results are indicated by Fig. 3 When the ship was dry docked after 26 months she was in a condition equal to that of a ship docked 12 months previous.

Hull Cleaning Equipment.

COMPRESSORS.

(a) Ingersoll Rand 600cu.ft./min. —Land based.

(b) 600 cu.ft./min. compressor fitted into the launch and powered by the launch engine.

AIR SUPPLY.

For the tools, high pressure air reduced to 65 p.s.i. and supplied via a reservoir directly.

For the divers, reduced and supplied via the same reservoir to two filters and a separator and then to the divers demand valves through ½in. bore hose coiled on reels.

PNEUMATIC TOOL.

Four vane air motor consuming up to 70 cu.ft./min.—underwater speed after gearing down and loss due to water drag about 500 r.p.m. depending on how far the air control is opened. The motor and gearing is enclosed within a watertight alloy casing. Approximate cost £140.

BRUSHES.

Various sizes from 9in. to 18in. diameter, wood or plastic backed, with tufts of wire, nylon or bristle for different states of the hull. These were also used on propellors, the interiors of inlets and outlets and in other restricted spaces. Approximate cost £3—£4 each.

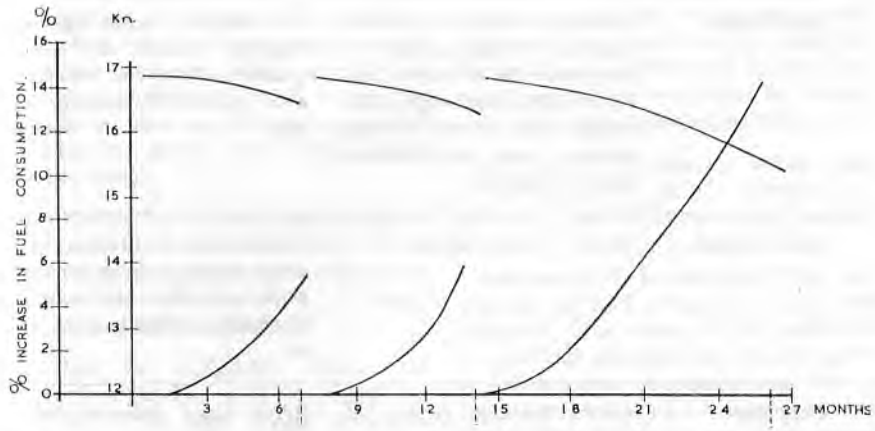


Fig. 3. A tanker similar to Fig. 2 kept out of dock for 26 months with hull cleaning and painting by divers.

Underwater Painting. At Marseille, the application of paint underwater has progressed to the stage where paint can be applied to a large area, provided that the surface to be coated is in good condition. The method of application is by rotary brush, using a power unit similar to the underwater cleaning tool but with a drive geared down so that the spindle revolves at about 50 r.p.m. Paint is supplied to the brush from a standard pressure paint pot, through a pressure tube into a spindle housing on the tool and then through the spindle to four nozzles embedded in the brush bristles. This system is considered efficient and a demonstration arranged on a steel plate at a depth of 7 feet gave a good even coverage of anti-corrosion/anti-fouling paint over an area of 50 sq.ft. in five minutes. Painting can only be done on a good surface. The latter point means that ship owners will have to be convinced of the necessity for regular cleaning and painting in order to preserve a good surface for coating (i.e. no severe break-down of the anti-corrosion paint.) Many commercial ships have hulls which are very badly neglected, and in this state the owner cannot expect to have the hull cleaned by divers and then painted effectively. At the present time it is not possible for hulls to be cleaned down to bare metal and painted underwater.

The Submerged Hull—Commercial v Military Ships. The object of observing demonstrations of these techniques was to evaluate this type of system for use on R.N. ships and to determine the main difference between the operation on commercial ships and naval vessels.

Differences in	*Commercial Ships (Tankers in Particular)*	*R.N. Ships (General)*
Hull Shape	Vertical sides to which marine fouling clings — the fairly flat bottom does not receive much light and unless laid up for a long period does not become heavily fouled.	'V' section, hence marine fouling occurs in larger quantities near the waterline and tapers off toward the keel.
Hull Fittings	None of Importance.	Certain hull fittings, i.e. sonar domes, transducer windows and others will need to be cleared carefully or avoided.
Propellers	Minor damage is not of major importance.	Some have delicate blade edges and proiles; careless use of tools must be avoided.
Seagoing Time	Almost continuous	Intermittent.
Waterline	Regularly varies.	Varies only occasionally within small limits.

Due to the above differences it will be seen that the R.N. ship is likely to have fouling over a larger percentage of submerged hull area than a commercial ship for a given length of time in similar conditions. This statement requires qualification due to many other factors; notably, the increased likelihood of docking an R.N. ship for other work and the superior anti-fouling paint used in H.M. Dockyards, but it does however give a comparison.

Considerations for the Fleet. From the above it can be seen that the value in terms of increased speed, lower fuel consumption and extended docking periods could be obtained for operational R.N. ships by cleaning the submerged hull from waterline to a depth of about 10ft. at regular intervals. Under normal peacetime conditions the requirements to do this regularly between dockings may not exist, but if the events imposed any restriction on docking then this system would be invaluable.

Using swimmers to clean the hulls of R.N. ships as a routine before they dry dock would be a valuable labour saving operation. The following advantages could be obtained :—

(a) A reduction in time for hull cleaning.

(b) A reduction in man power.

(c) No mess on the dock floor as all waste would be floated away.

(d) A dock which is almost immediately clear, allowing access to the hull for maintenance as soon as pumping out is completed.

(e) Shorter time in dock giving more dock availability.

The technique of painting the whole submerged hull underwater is not considered to be sufficiently advanced at

present for routine application on R.N. ships, but it has great potential. However, in limited application, benefit may be obtained by painting the waterline to a depth of about 5ft., at regular intervals between dockings. This would give continuous protection to the vulnerable splash-line area against corrosion and fouling by green weed which often occurs there.

A device for painting small areas of hull underwater after Diver Ship Maintenance work is at present under development at the A.E.D.U. to meet an existing staff requirement.

Trials by A.E.D.U. Since the methods described were witnessed, the A.E.D.U. has been loaned a simple apparatus, which was recently produced in Holland, and which works on the same principle as that developed by International Technical Services. This tool was introduced to us independently by another firm interested in the technique.

One week of diving trials have been completed on a destroyer while she was de-equipping. The successful operation of this tool depends very much on the skill of the individual diver, but the overall results were good and tend to confirm the view expressed in this article.

The search for an underwater painting technique which started in A.E.D.U. three or four years ago, originally met with little success, and enquiries were made as far afield as Liechtenstein for suitable painting media. However, a number of firms, French and British, are offering underwater paints. It was noticed at the Boat Show this year that one firm was featuring a gimmick for Yachtsmen—Underwater anti-fouling paint—apply it yourself and save docking costs. It is true, it can be done, but the mechanics of the task have a little way to go before *Ark Royal* or *Hermes* can be totally treated whilst afloat.

The A.E.D.U. expects, before long, to contribute a divers painting instrument that will bring the day nearer.

Summary. It is concluded that this method of hull cleaning is fast and effective. The value of the system to commercial shipping is obvious, since it satisfies the economic need for a minimum time in port between voyages and it gives the advantages of increased speed or reduced fuel consumption. Should an underwater hull cleaning system be developed for use on naval vessels, it would be most usefully employed in the first instance in cleaning ships hulls prior to docking, so allowing a shorter time in dock. This would result in increased dock availability and the saving of a considerable number of man hours.

The experimental application of anti-fouling paint is also described as it is the logical following project.

The author does not intend that the article should distract the attention from advanced work being done in the R.N.S.S. on hull protective coatings and anti-fouling paints, but rather that it should point a way to a possible integration of the technique with a slightly modified line of paint research.

M. KETTLE, R.N.S.S., A.E.D.U.

Letters to the Editor

Dear Sir,

With reference to the article on Marine Biology in your Summer edition of the magazine, in the description of the Portuguese Man-of-war, the Latin name stated is incorrect, and no description of the method by which it can be recognised is given. Also, it should be mentioned that the sting of this animal can be sufficiently dangerous as to be fatal, since if a first contact with the stings of this animal should produce a sensitivity, a second contact could be fatal.

The Portuguese Man-of-war belongs to the *phylum Coelenterata*, class *Siphonophora*, and the order is *Physalia physalis*. It is a Hydrozoan colony in which the individual polyps (many tentacles) are closely knit into a complex organism, similar in manner to the various organs in the body of man.

The colony is comprised of several kinds of specialized polyps and clusters of attached medusae (jellyfish form). The polyps perform the functions of feeding, protection, reproduction and sense. The protective polyps have tentacles which may reach a length of 60 feet, and are armed with thousands of very powerful stinging capsules, which, at the very least, can be painful.

The Physalia is incapable of swimming, unlike the majority of 'jellyfish', but instead has a gas filled float. It is thought to be a single transformed medusa which has lost the power to swim. Propulsion is by means of wind action on the float. As an inhabitant of the open Atlantic, it only appears on our coasts after prolonged S.W. winds, and is usually restricted to Southern coasts. When it appears, it may be abundant and then entirely absent for several years.

It may be recognised by the following features: an elongated—oval, thin gas filled bladder up to 12ins. long and 4ins. wide, silvery or pale blue in colour, with a pinkish-red longitudinal comb. The tentacles are blue. B. A. MAISEY.

BACK ISSUES

For those who keep up a Library of the Magazines, and of interest to new readers, we have in the office various Back Numbers. They go back to 1962 and have some interesting articles in them. Good Value for 6d. each. Volumes available are:—9–1, 9–2, 10–1, 10–2, 11–1, 11–3, 12–2, 12–3, 13–1, 13–2, 14–1. Post Free.

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The Editorial office holds stocks of R.N. Diving Association Badges at 30/- each. Ties in maroon and blue at 15/-.

All qualified R.N. Divers may purchase these. They will be sent post free to addresses in the U.K. and Commonwealth, on receipt of the money. Please make cheques and money orders payable to the Diving Magazine Fund.

Stop Press

IT is now common knowledge that the operational life of H.M.S. *Reclaim* has been extended until 1975 for the purpose of continuing the R.N. research into Deep Diving. It is proposed to proceed with our research and trials, aiming at producing an operational potential, to the point of saturation diving, to cover the European Continental Shelf. There is no doubt that, in spite of the delays and the frustration, the decision to proceed is very welcome and, providing we are allowed to plan ahead, without political and penny pinching interference, there is no reason why Britain should not regain her position as the leading 'Diving' Nation. The future, undoubtedly, can hold tremendous progress and advantages. The horizons are almost limitless. However, unless we start planning and designing the 1975 operational vessel now, we shall have failed.

In *my* opinion, there is no *choice* of basic design. The vessel must be a submarine or submersible. All the advantages of deep diving, saturation diving, living in the sea, plus mobility, and probably most of all, the ability to operate clear of the surface elements, can only be incorporated in a submarine type vessel. There is no doubt in my mind, that Captain George Bond, U.S.N., of Sea Lab fame, is almost 'about to re-invent the submarine'.

Volunteers for deep diving will be required in the near future. Any C.D. can request to have his name considered.

Finally, one is always hearing through the grape vine that the 'Ministry of Technology' and fairly senior R.N. Scientific Officers are taking an interest in deep diving. This is heartening and the more we can sell ourselves — and there is no doubt that we could offer much to British Industry — the better.

A word of warning is necessary however. Diving is not an armchair science, neither is it a medical or engineering science, it is basically a seamanship problem supported by physiology and engineering. Let us keep it so. J.W.

Note. The ideas mentioned in this article do not necessarily represent the feelings of the Instructional Diving Staff of H.M.S. *Vernon* nor those of the M.O.D. It is almost certain they don't represent the ideas of the armchair divers! EDITOR.

WANTED! WANTED! WANTED!

NATIONAL MARITIME MUSEUM

To make it possible for a complete history of Diving from the early days to be compiled by our Museum Library, and to assist researchers into underwater progress, we would like to obtain a complete set of R.N. Diving Magazines from its inception in 1951. H.M.S. *Vernon* has kindly assisted us by sending copies of back issues as far back as Volume 9. If anyone has any previous copies which they would like to donate to the Library, they may be sent to either the Editor, or direct to the Librarian, National Maritime Museum.

FOR SALE. Pye deep sea image orthicon Television Camera. In excellent condition. Now surplus to requirements in Western Canada. Videospection Engineering Ltd., 1,661 West 8th Avenue, Vancouver 9, B.C., Canada.

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WANTED. Divers (English)—Please send resume to International Underwater Contractors, Inc., P.O. Box 82, College Point, N.Y. 11356, U.S.A.