HYDROGRAPHIC SURVEYS OFF THE LYBIAN COAST FOR AN OIL TERMINAL

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IHB Note. — Kelvin & Hughes (Marine) Limited sent to the IHB the following article which we thought would be of interest to States Members.

On 12 December 1957 oil was first discovered in Libya. The country was divided into about 80 concessions which were then leased to several oil companies from many nations; of these companies, Esso Standard was fortunate in locating the richest field at Zelten, about 100 miles south of El Brega. The successful location of rich oil deposits in concessions owned by Esso led to the Company's decision, midway through 1959, to investigate the possibilities of building a terminal at Marsa el Brega in the centre of the Gulf of Sirte. This stretch of water is renowned for its bad weather, even in Greek mythology, and in the Admiralty Sailing Directions such comments as " these winds are much feared by local seamen " appear. From the chart, Marsa el Brega seems to be the only part of the coast offering any shelter, and presumably this was the reason why the Italian Navy carried out a survey of the area to a scale of 1/30 000 in 1931. It was also used as a supply base by the Germans during the last war. It is not surprising, therefore, that this should be the place selected for a terminal, especially being so close to the oilfields. There was, however, one disadvantage in selecting this site. During the last war El Brega became the centre of a vast minefield laid by both sides. Large numbers of German, Italian, French and British mines had been planted and very few records kept of their positions. This was obviously the major problem before any work could be carried out and a large mine clearance team had to begin clearance work in the late summer of 1959.

In October 1959 the Kelvin & Hughes Survey Team of 5 men, later reduced to 4, arrived in Benghazi and the first task was to select the camp site and anchorage for the boat, a small 22 ft launch with outboard oscillator. Brega Point had by this time been cleared of mines and it was possible to visit the site with Mr. T. P. MODINE, the Esso Fields Engineer. Thereafer it was decided to anchor the boat in the Southwest corner of the bay and to have the camp close to it. A landing strip was marked out a few hundred yards from the camp so that Company aircraft could visit the area at any time.

It may be of interest to mention at this stage, the main differences that I have noticed between surveying in the Royal Navy and surveying for a commercial company when tackling a job of this size in a remote part of the world. The actual methods of surveying are exactly the same but in commercial life the big advantage is that the camp and staff are normally provided by the client. This means that there are far less administrative worries and one can concentrate fully on the survey. One of the biggest problems of any camp party landed by a survey ship is the supply

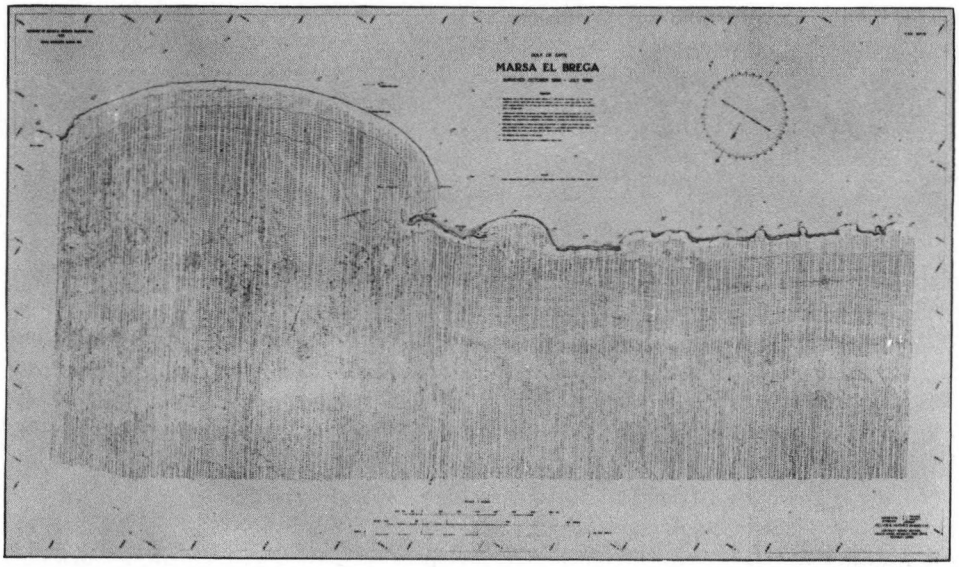

FIG. 1. — Main sounding plan.

of water and food and, on many occasions, drums of water would have to be landed. At Brega, this problem was solved as nearly every day a truck would bring water from a well at Agedabir about 80 miles away. Food would also come in by truck each week so we never went hungry. A landrover was provided for our use and this definitely speeded up operations. Later a generator was installed which provided electric light, a provision one could never expect in a naval camp and we certainly looked upon this as a luxury. It made plotting and inking in much easier. Mail was flown in about once a week, so on the whole we were very well looked after. There were disadvantages, however : not having the facilities of workshops and trained staff on board ship, any breakdowns of the boat caused concern. Difficulties were experienced in obtaining various types of cordage and other stores, whereas in a ship they would always be available.

On the 12 October 1959, the team moved into camp and the survey commenced. Two members of the survey team sailed the boat from Benghazi and fortunately had a reasonably good passage.

Although a survey had been carried out in 1931, the only station recoverable was an astro position on the point and the whole survey was based on this station. Not only was the terrain very rough but also heavily mined. It was decided, therefore, that the quickest way of setting up a control would be with a tellurometer traverse along the coast and back close to the main road that runs from Tripoli to Benghazi. This would

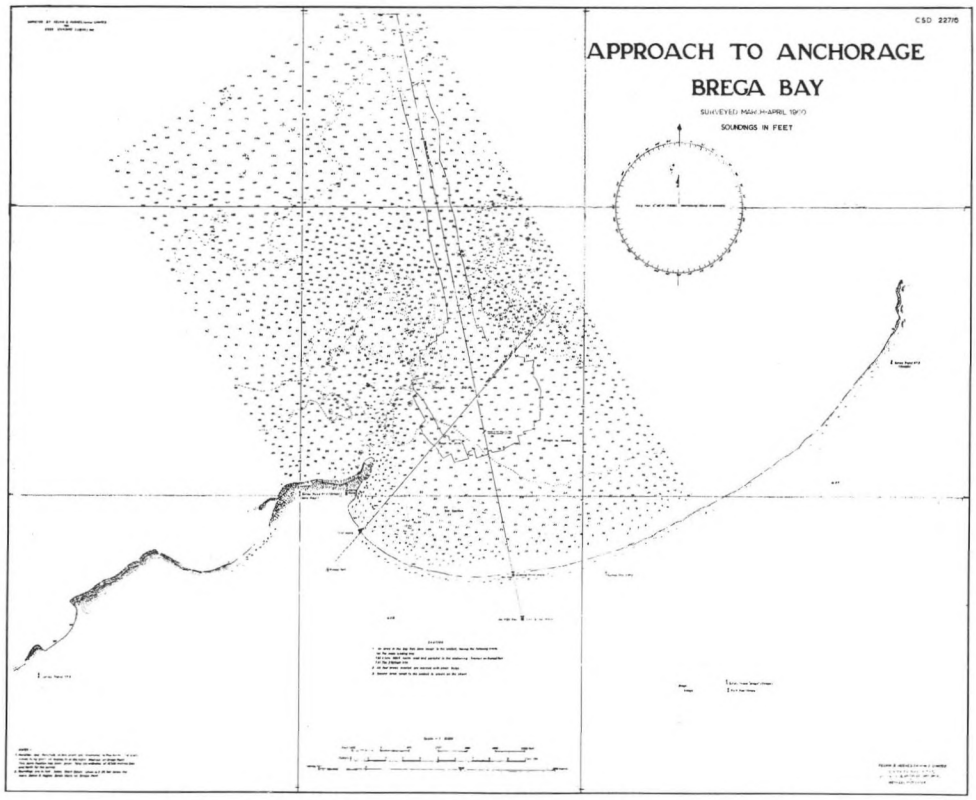

FIG. 2. — Preliminary navigation chart for supply ships.

reduce the time required for minesweeping as only a narrow lane need be swept along the coast and the remaining stations could be reached easily from the road. After a reconnaissance of the area with the leader of the mine clearance team, a start was made on setting up permanent traverse stations. Six to eight foot lengths of piping were driven into the sand and well cemented in position. The pipes were fixed to project 2 ft above the ground and small cairns were built around each one. These formed individual stations and 15 foot high tripods were then erected above them. The centre of each tripod was filled with camel scrub, the result making a most effective sounding or navigational mark. Not one station was disturbed by local bedouins, but good relations were established by handing out cigarettes when on the reconnaissance trip and this may have helped. All material that was used on smaller marks was slashed, however, as a precaution.

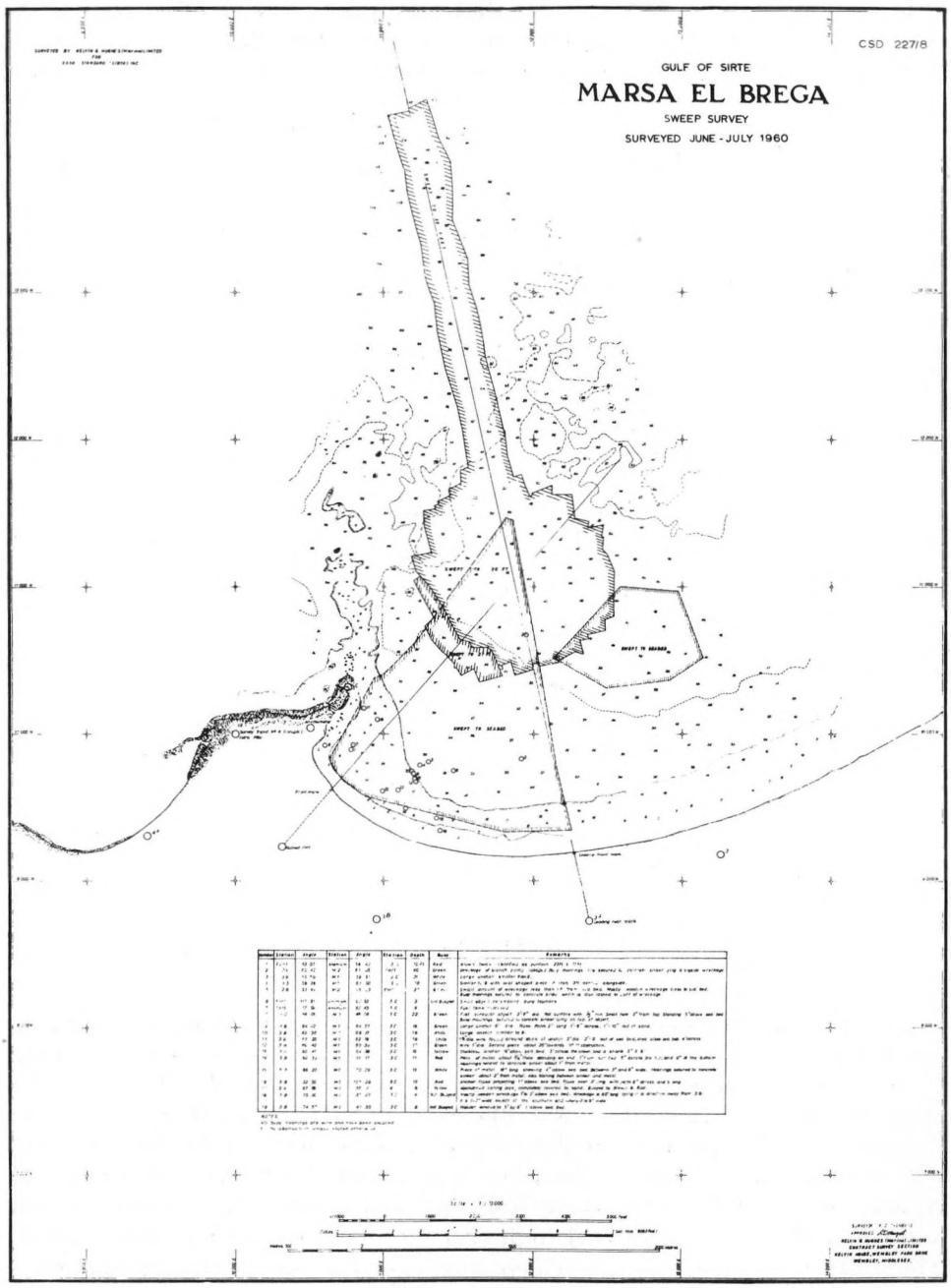

FIG. 3. — Chart of sweep clearance survey.

The traverse observations commenced on 16 October and took four days to complete. As the going along this part of the desert was so rough, it was decided to use camels for transporting the tellurometer in preference to the landrover. This method worked well in spite of one temperamental camel that decided to rid itself of its load when things became difficult. Later on, when we became more confident of the tellurometer's robustness, we carried it in the landrover, well padded with mattresses. The only trouble that was ever encountered was a faulty plug connection to the tellurometer power pack. One peculiarity with the crystal tuning, however,

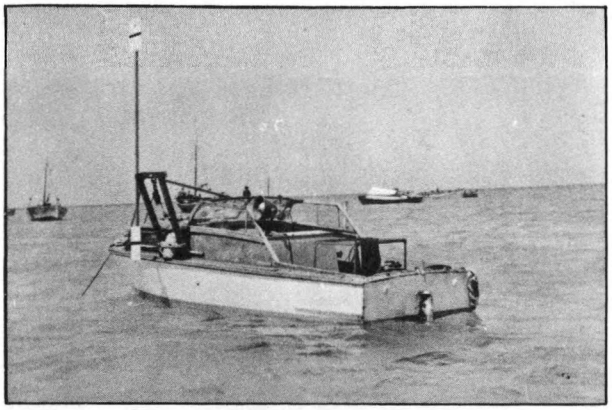

FIG. 4. — 22 *foot* sounding launch rigged for sweeping.

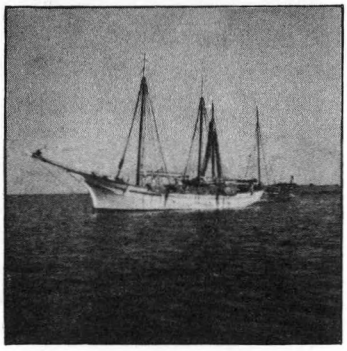

FIG. 5. — Sponge boat used
for sounding
for reconnaissance surveys.

was that the master, although being half a turn behind the remote up to position 8, then jumped to 2 turns ahead from positions 9 to 20. Checks were always made that the lower of the two frequencies was being used, and later the manufacturers assured us that there was nothing to worry about and no accuracy would be lost through this peculiarity. The traverse was carried over a distance of 35 000 metres, a misclosure of 0.3 metres in eastings and 0.4 metres in northings, which appeared reasonable. Secondary stations for fixing close inshore were then erected along the

coast and all semi-graphically intersected with a theodolite from the main traverse stations.

A tide pole was erected by the rocks to the north of the camp and levelled into a permanent bench mark, which was later used for all other surveys and construction work. The range of the tide, each day, was only about six inches but the mean level was governed by the wind and, with a northerly wind could be as much as 1.2 ft higher than the mean level with a southerly wind. Chart datum was determined after two weeks continuous observations taking the wind directions into consideration.

An azimuth was observed on the night of 21 October from the astro position to the first traverse station and a satisfactory mean was obtained from eight stars.

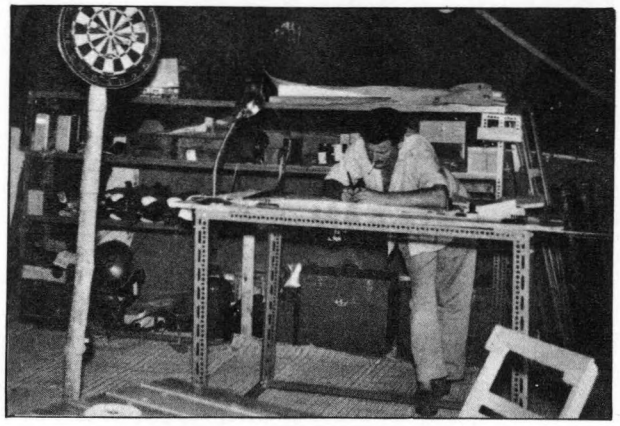

FIG. 6. — The main plotting table and instrument rack.

After all computations were completed, the survey team commenced sounding to a scale of 1/10 000 with lines 170 ft apart. All shoal areas were interlined and investigated in the normal manner.

On the 8 November, a brand new tanker, the *Esso Liverpool* anchored off Brega for anchor holding trials. A chart had been specially prepared so that she could navigate safely in the area that had been sounded. Captain BAPTIST, the Marine Consultant of Esso Petroleum Company, stationed himself on the forecastle to supervise the letting go of the anchor and watch the cable. The survey team was on the bridge recording the engine movements and fixing the ship's position about every half minute. In this way, after plotting it was possible to have a clear picture of the situation and to determine at what stage dragging commenced.

In the meantime, mine sweeping continued ashore and large numbers of mines were located. In the first four months that the survey team was on site, it was estimated by one of the minesweeping team leaders that at least two thousand mines had been removed. Every few days heavy explosions could be heard as those detected were placed into deep pits and blown up. One tended to become less cautious after a time, and this natural reaction obviously added to the danger, but the survey team did not suffer any casualties.

In order to maintain morale as much as possible, one of the tents in the camp was turned into a replica of an English inn, complete with swinging sign outside. This proved to be very popular and at Christmas was almost a home from home ! It became quite well known, especially as it was the only bar for 150 miles.

Sounding progressed the whole time but rather slowly as high winds and heavy seas were frequent. With these conditions however, one usually continued with the coastlining which was all surveyed on the ground. One remarkable feature of this coast was the seaweed that was washed up onto the beach and packed so solidly as to have the appearance of rocks. Then, quite, suddenly, it would disappear overnight.

A further example of the usefulness of the tellurometer was yet to

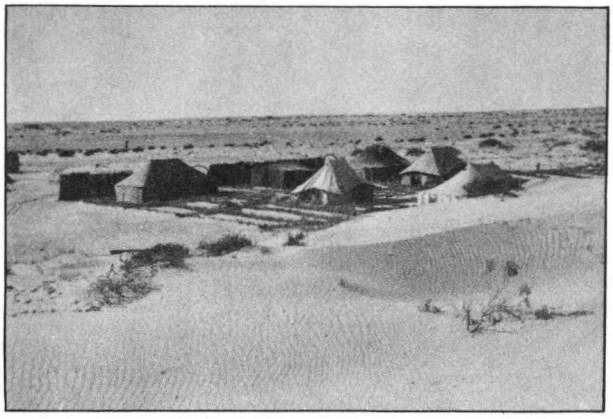

FIG. 7. — The camp after two months.

come. A few days before Christmas, instructions were received to carry out a reconnaissance survey a further 21 000 metres along the coast. This was to be on a scale of 1/15 000 with lines 500 ft apart in order to define the 10 fathom line. Results were required as soon as possible and a target date was given. The speed of running this traverse was restricted to the speed of the minesweeping team and, over a very rough terrain, was completed in four days. This time the tellurometer was transported in the landrover and came to no harm. The sounding of the areas has to be carried out in a much larger craft, as no shelter existed and it was not considered safe for the 22 ft launch to be so far from her anchorage in the weather conditions prevailing at the time. A sponge boat, therefore, had to be sailed round from Tripoli and with an outboard oscillator over her side proved to be satisfactory. On completion of the reconnaissance survey she was used for borings by the engineering consultants and then returned to Tripoli.

Work on the main survey of Brega Bay continued but the time was now approaching when vessels carrying pipes would have to anchor in the bay. The pipes were to be laid from the oilfields at Zelten to Brega and after much consideration, it was decided by Esso that the most economical method of getting them ashore would be to float them in, towed by small

fishing boats powered by outboard motors. A few beach gradients had been surveyed to investigate the possibility of beaching landing craft but the gradients did not appear to be very suitable. In spite of the bad weather, the anchorage area for these ships had been sounded and a navigational chart was prepared and forwarded to the master of each ship. Each chart was accompanied by Sailing Directions and a booklet giving views of the leading marks that had been erected and other conspicuous navigational objects.

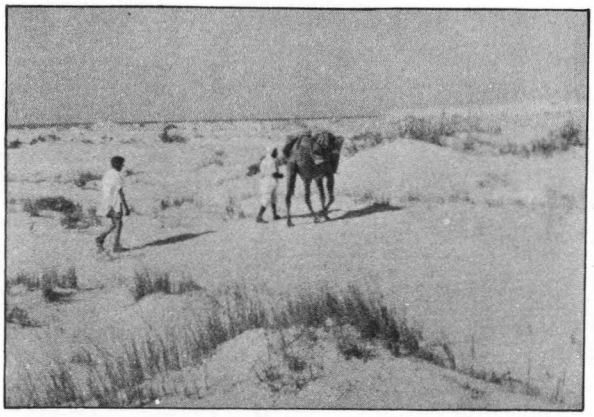

FIG. 8. — Transporting the tellurometer by camel.

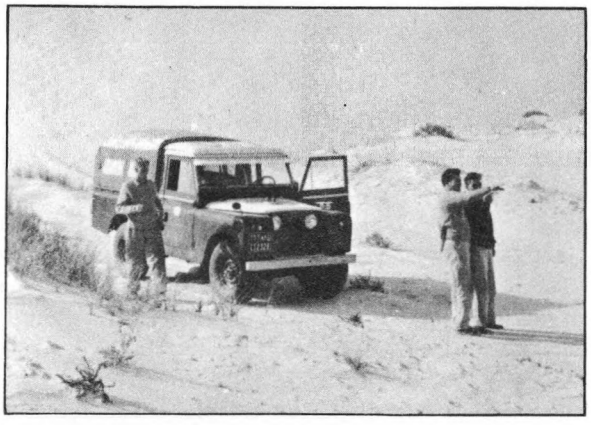

FIG. 9. — Later we used the Landrover.

The approach route into the anchorage area had also been swept using the normal Admiralty method with gallows built over the side of each boat and sinkers slung from them. Each sinker weighed about 1½ cwt and a fine wire was run between them and up into the boats. The sinkers were on the end of a marked wire which was hoisted and lowered with a Tirfor machine. These machines were found to be very useful and although only 2 ft long and 1 ft high, they had a horizontal pull of 1½ tons and a safe working load for lifting of 1 ton. They were often used for getting

landrovers out of soft sand and were twice used for hauling the boat up the beach for cleaning and painting.

While sweeping the area, the wire fouled on one obstruction which had to be investigated by divers. Most of the Kelvin & Hughes surveyors are trained aqualung divers and we have found this to be a great asset. During this survey about thirty dives were made, the majority on wrecks and other objects but twice to check the boat's moorings. This particular

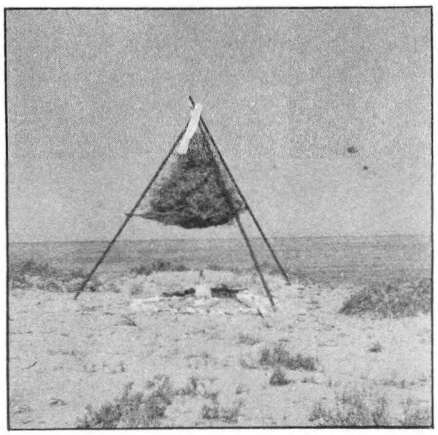

FIG. 10. — One of the main traverse stations.

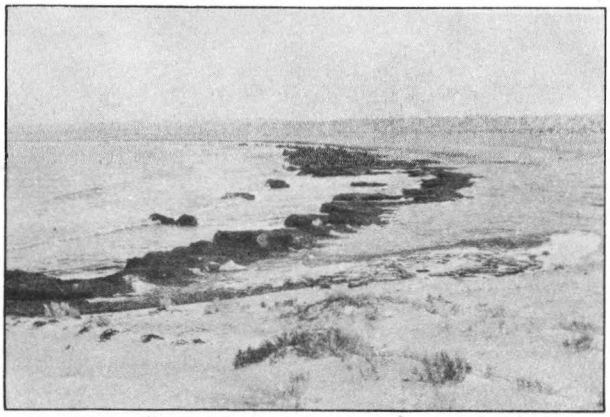

FIG. 11. — Rocky like appearance of Brega Bay after weed had been washed ashore.

wreck happened to be an aircraft that must have been shot down during the war, as bullet holes could be seen through the blades of the propellor. Part of this aircraft was salvaged later.

Having ascertained that it was safe to bring ships into Brega Bay and buoyed the channel, the next task was to sweep the western half of the bay to the seabed. For this sweep a 5/16″ diameter wire was used, each end being secured to sinkers towed along the bottom by each boat. To ensure full

coverage a 50 % overlap was carried out. This sweep took seven working days to complete and in this time a further 18 obstructions were located, some of these only an inch or two off the seabed. The sweep proved to be a great success although it would have been useless on a rocky or stony bottom. Fortunately for us, Brega Bay was practically all sand. Having located these obstructions, they were all investigated by divers. Where possible a wire moored buoy was secured to each piece of wreckage in case they should disappear under the sand over a period of time. This was important in areas that might have to be dredged sometime in the future. One wreck, thought to be an ammunition barge, was twice blown with underwater explosives but diving operations identified it as only a pontoon with empty tanks.

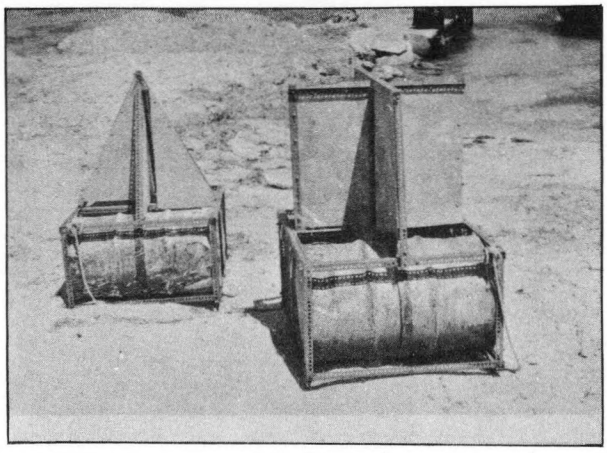

FIG. 12. — Channel buoys constructed from 40 gallon oil drums, Dexion and thin sheet metal.

On 23 June, the first pipe carrying ship, the *World Jonquil,* 10 500 tons, steamed into the bay and anchored less than half a mile from the shore. Her cargo consisted of 2 000 30 inch diameter pipes each 40 ft long. This pipe was the first of its size ever to be unloaded from a ship anchored in the open sea and towed inshore. After a few initial headaches the pipes were towed successfully onto the beach by fishing boats brought round from Tripoli. They were hoisted out of the water by crane and transported by truck to a pipe stacking area about a mile away. The *World Jonquil* was followed by two other ships and in all about nine shiploads were received at approximately fortnightly intervals.

Lights were placed on the two main leading marks to assist a ship having to leave the anchorage in bad weather. A third light was erected on one of the survey marks to enable anchor bearings to be taken at night. All these lights were visible over a distance of 8 miles and operated by batteries with a life of 14 to 30 months depending on the characteristics of the light.

While the pipes were being floated ashore, the last area of sounding was being carried out to the east of the bay. Finally on 21 July, the survey was completed and the team returned to England to draw the fair charts.

FIG. 13. — One of the aqualung divers.

CONCLUSIONS

This proved to be an extremely interesting survey, starting from a barren coast with no control but a considerable number of landmines and ending with an area surveyed eight miles long and 2-3 miles out to sea. Through these waters ships carrying pipes were directed into an anchorage area where their cargoes could be offloaded and this was made possible by drawing navigational charts on site and issuing them to the ships masters. In addition, a reconnaissance survey was carried out off a further 8 miles of coastline.

The usefulness of the tellurometer was certainly appreciated especially during work over difficult ground, when results were required in a hurry.

Anchor trials were carried out with detailed information and these were of great value in assessing the holding ground for future moorings.

Two types of sweep were used and both proved successful especially as the area was known to have been littered with wreckage during the war.

The fact that a surveyor can dive is a great advantage in hydrographic work and I believe that the idea of training divers is now spreading.

Finally it is hoped that in a few years time El Brega will be a thriving port rich in oil from the oilfields to the south.

APPENDIX

LIST OF MAJOR EQUIPMENT USED ON THE SURVEY

2 Kelvin Hughes MS. 26 A/O recording echo sounders
1 tellurometer outfit
6 Challenger type surveying sextants
2 micrometer station pointers
4 Stone Chance long-life flashing lights used as navigational marks
1 Kelvin Hughes direct reading current meter

1 Watts No. 2 microptic theodolite reading to 1 second
1 Landrover
Siebe Gorman's aqualung diving equipment
2 Tirfor machines (for heavy lifting or beaching of craft)
Beaufort 10 man life-raft for safety purposes
Walther calculating machine for computations
Watts level (microptic), staff & tripod
2 grid steering compasses
Hand bearing compass
Supplies of Dexion for construction of leading marks, sweeping gallows, stowage racks and furniture
Mercer chronograph and chronometer
Binkley water sampler
Snapper leads
Admiralty pattern valve leads
Aldis lamp
Loud hailer
Taut wire sweeping gear
Sundry survey items such as ranging poles, survey umbrellas, steel measuring bands, etc.