

that the observed position is in remarkably good agreement with the true position and that the comparison between observers shows a high degree of consistency.

The sights numbered 1 to 6 are to me even more remarkable in their consistency, as they were taken under very poor conditions. Before proceeding to Malta the ship was required to survey the area of the Little Sole Bank for reported shallow water. On arrival at the site two beacons were laid under very poor conditions, and the only means of fixing their positions was by astronomical sights. The captain and navigator obtained the results shown as sights 1 and 2 on the morning of February 24 when a very heavy sea was running, and a gale blowing. On the evening of February 24 and at both twilights on February 25, the captain and navigator obtained the results shown as sights 3 to 6 for fixing the second beacon. Here again conditions were very poor until the evening of February 25.

We found that the main aid to good fixing at sea was to obtain the sights with the brightest possible horizon, by means of good precomputation of altitudes and azimuths for presetting of the sextant. From observations made during this voyage we reckoned that stars and horizon are normally visible when the Sun is at a depression of between about  $3^\circ$  and  $9^\circ$  below the horizon. Therefore, unless the twilight is excessively long, a star globe set up for the time of civil twilight will give altitudes and azimuths within a degree or two for the whole of the observing time; it should enable stars to be picked up some minutes before they are visible to the naked eye, and provide sights with good horizons. The aim should then be to obtain sights in the quickest possible time, consistent with accuracy—we aimed to observe five stars, taking the mean of five altitudes for each, in ten minutes. This meant that if the first star was picked up early the set of observations was complete before the time of civil twilight, when the horizon was still good.

The preparation of the tabulated results of these observations has been simplified by the encouragement and assistance given by Mr. D. H. Sadler.

These notes are not intended as, and I trust will not be taken as, a reflection on the standard of navigation of Commander Sharpey-Schafer and his shipmates, but merely as a report on the standard which I found in H.M.S. *Dalrymple*—a standard which still seems exceptionally high.

## Navigation and Oceanography

VICE-ADMIRAL SIR ARCHIBALD DAY, the Hydrographer of the Navy, who was chairman at the Institute discussion on 15 May 1953, has received the following comments from Rear-Admiral Robert W. Knox, Assistant Director of the U.S. Coast and Geodetic Survey.

I have just finished reading the discussion on navigation and oceanography appearing in the October 1953 *Journal of the Institute of Navigation*. This is of great interest to me, but I cannot agree with at least one statement, that by Captain Shaw (retired master mariner), regarding kelp in Alaskan waters. He states that when navigating in south-east Alaska, he always avoided the open channels and sailed through channels full of kelp. I have spent about 13 seasons in Alaska avoiding kelp except in small boat hydrography when we were engaged

in detail sounding. I believe that kelp can always be taken as an indication of rocky bottom although at times the lead will bring up sand which probably lies in a thin layer over the rock. As a rule, the degree of kelp present is an indication of approximate depth—the thicker the kelp the shallower the water. Incidentally I have seen wisps of kelp in 22 fathoms of water. I agree with Commander Ritchie's statement that he was somewhat shocked by Shaw's mention of kelp.

Commander Frankcom mentioned that he had a special problem of position fixing of weather ships and that he had been toying with the idea of making an extensive survey of the bottom topography of the British ocean weather stations so that he could fix the ship by soundings. This I believe is an entirely feasible method of position fixing; it was used rather extensively by this bureau in connection with buoy relocation in radio acoustic ranging. I quote the following from many such instances found in descriptive reports of our hydrographic sheets:

'The area around buoy DAN was sounded to locate the buoy and was done in the following manner. Buoy DAN was planted by dead reckoning in an area of fast changing bottom on sheet H-6542 (1939) (1:80,000). Then, using DAN as a control point, the area around the buoy was sounded using gyro bearings and bomb distances to DAN for the location of the positions on the sheet. Depth curves were drawn on this small survey and a tracing of these were matched to those of a tracing of sheet H-6542 (1939). After the curves were matched, the position of DAN was taken off by Latitude and Longitude and plotted on sheet 121 (1940).'

And on another sheet:

'Buoy BAT was located by superimposing the depth curves of this season's survey or the 1933 survey so as to coordinate the two surveys.'

This survey was made in 1937, and the hydrographer had no trouble in recovering and using the 1933 depth curves to determine the location of radio buoy BAT. It must be remembered that these radio buoys were used for control of rather comprehensive and detailed surveys and that other radio buoys located by conventional methods were involved in the control. The fact that line crossings were acceptable and no serious jumps developed when shifting from buoy to buoy indicates that buoys can be accurately relocated by depth curves.

Mr. Croney said that he shared your pessimism on the determination of an absolute position fix by depth sounding alone. I agree that in certain types of bottom the fathometer is of little or no help in position fixing; in fact, we constructed a chart off of Massachusetts showing continuous depth curves which proved to be a dud, as bottom features were duplicated over the entire area. On the other hand, we have all had experience before the days of radar of making a landfall then steaming through an entrance and coming to anchor all in pea soup fog. I could quote dozens of actual experiences along this line. To my mind there is no one single aid to navigation so satisfying in making a landfall from an uncertain position offshore in thick weather as a fathometer used with a modern nautical chart.