The observations were made at eleven stations, viz. off the Een Vadembank (One Fathom Bank) and the Longbank, in Malacca Strait, Doerian Strait, Berhala Strait, Singapore Strait, Riouw Strait (northern part and south entrance), eastward of P. Djang (Lingga Archipelago), off P. Toedjoe (northward of Banka), in Banka Strait, off Amelia Bank and Nemesis Bank. The times of slack water and the times and strengths of the maximum current are given for these places, and for each day of the year, in eleven tables. The *constant current* to be expected is shown as " correction" at the top of each table. The direction of the current is indicated at the top of each page.

This publication merits attention and will doubtless be welcomed by shipping circles as a valuable addition to the *Zeemansgids voor Nederlandsch Oost-Indië* (Sailing Directions for the Netherlands East Indies). For this particular *Zeemansgids* is far from being complete as regards current data, owing to the fact that the opportunity had never before arisen of carrying out systematic observations at so many places in the straits over so long a period. In this connection homage must be rendered to both the Commanding Officer of the *Orion*, Mr. P.A.C.T. KNIJFF, Director of the Government Navy, who made the observations and worked them out in such a conscientious manner, and the *Hoofdkantoor van Scheepvaart* which lent its support to the undertaking and arranged for this publication.

On the route given, i. e. the busiest route of the Netherlands East Indies, the currents are not as a rule very strong ; it is but seldom (for instance in Riouw Strait) that the sum of tidal stream plus constant current exceeds three knots. The tidal stream is mixed at all stations, of prevailing semi-diurnal character in Malacca Strait and prevailing diurnal character in most of the other straits. Consequently the aspect of the current is very capricious ; all the more, for this reason, the current tables should be systematically consulted. This apparently capricious regime is evident on glancing at the tables. If the current is semi-diurnal, a notation is necessary every three hours, viz. slack water ; three hours later, maximum current ; three hours later, again slack water, and so on, so that each day is divided into 8 columns. During the period of prevailing diurnal tides, 4 to 5 columns only are filled in.

Mr. LUYMES, during his period of office, had already strongly advocated this type of tables (see *De Zee* of February 1934) and expressed his astonishment that the managers of shipping companies had apparently not yet completely realised the usefulness of such a publication. But opinions must be given time to evolve ; the introduction of novelties takes time.

If the *Hoofdkantoor van Scheepvaart* does not abandon the experiment too soon (for this publication is, as a matter of fact, provisionally considered merely as an experiment), it is certain that these Current Tables will be used by the captain of every ship as a most welcome and valuable addition to the Sailing Directions. The booklet is very concise and clear. Each station occupies 6 pages (the whole booklet consists thus of 70 pages) on which all the current data are collated. The price of this collection of tables is one florin and there *should* therefore be no obstacle in this respect in the way of purchase. The undersigned wishes to stress particularly that directors of shipping companies and captains should acquire this publication and use it ; they can but benefit therefrom. It may be procured, in Holland from Gebrs. van Cleef, Spui 28, 's-Gravenhage ; in the East Indies from the distributors and the sub-agencies for the sale of charts and Sailing Directions in the various ports, and at Palembang. Any criticism of these tables will be gladly received.

HOOYKAAS.

DIRECTIONAL RADIO AS AN AID TO MARINE NAVIGATION.

(Extract from "Notes from the U.S. Bureau of Standards",
published in the *Journal of the Franklin Institute*, Philadelphia, March 1935, page 365).

There are a number of applications of radio which make for safety in marine navigation. These include intercommunication among ships, the broadcasting of information such as weather reports, time signals, iceberg warnings, distress signals, and direction determination. The principal system for direction determination is the radio direction finder, used in conjunction with radiobeacons as installed on many lightvessels and lighthouses. The radiobeacon broadcasts a coded signal at timed intervals, while the direction finder, when used aboard ships, indicates the direction to the source of the signal, and enables the navigator to get an azimuth bearing with respect to the beacon. With cross bearings on two or more radiobeacons, or point bearings on a single radiobeacon, the ship's position may be obtained.

This system was developed in co-operative experiments by the Lighthouse Service and the Bureau in 1920. Radiobeacons were installed on Ambrose Channel and Fire Island lightships and at Sea Girt, N. J., lighthouse, and a radio direction finder was installed on the lighthouse tender *Tulip*. These early experiments showed the great value of the system. Up to the present time the Lighthouse Service has installed approximately 106 radiobeacons on our coasts, and there are a considerable number on foreign coasts. There are over 4,000 radio direction finders installed on ships throughout the world. Many instances are on record where the radio direction finder has been the means of locating a ship in distress and has thus made possible the saving of many lives.

There are three general classes of radiobeacons, known as *A*, *B*, and *C*. They differ principally in their power rating. The class *A* radiobeacon is rated at 200 watts or over, the class *B* from 100 to 200 watts, and the class *C* below 100 watts. The class *A* beacon is used for long range work, such as the one installed on Nantucket Shoals lightship. This is the first beacon to be picked up by vessels approaching New York from the east. The class *B* beacon is the more common type and is used on lightships such as the Ambrose Channel lightship, as well as on outside coast stations. The class *C* beacon is usually used on inland waterways as, for instance, Long Island Sound. The radiobeacon on Stratford Shoals lighthouse is an example of this type of beacon. Neighbouring beacons usually operate in groups of three. The stations of each group operate on the same radio frequency, and each radiobeacon in the group is timed so that one transmits for one minute, a second for the second minute, and the third for the third minute. Each has a different coded characteristic for identification. Charts issued for the use of mariners by the U.S. Lighthouse Service give full details as to each radiobeacon, its location, class, characteristic signal, etc.

Some of the radiobeacon installations operate simultaneously with a sound signal through the air, so that a navigator may determine distance as well as direction. The difference in time between the arrival of the radiobeacon signal and the sound signal makes possible this distance determination. One radiobeacon is similarly synchronized with a submarine oscillator.

Rough distance determination may also be made for the purpose of avoiding collision with a lightship by steering so as to pass to one side of it. Successive radio bearings are taken, and these, with the intervening distance run, are used to ascertain the distance off from time to time.

Most of the direction finders in use on ships of the United States are of the simple rotating-coil type, with which a bearing is taken by listening for the point of minimum signal from the beacon, as the coil is rotated. A somewhat more complex type of direction finder recently developed at the Bureau is one in which the bearing indication is given by a zero-centre pointer-type instrument. As the direction-finder coil is rotated the correct bearing is obtained when the pointer reads zero. This was developed primarily for airplanes, but would be useful also in marine service.

Tests have been made recently, with some degree of success, of a warning radiobeacon. This emits a low-power signal, with a continuous high-low or warble note, and is intended to have an average range of about 10 miles. The tests indicate the probable value of such a signal on certain lightships, both to guide vessels and to protect the lightships.

Tests made on the Great Lakes by the Lighthouse Service have indicated the feasibility of the use by navigators of low-power radiobeacons on shipboard to obtain radio bearings on neighbouring ships and thus avoid collisions.

Tests have been made in England of a system by which a ship can determine its position without the use of a direction finder. A transmitting coil antenna at the shore station is rotated at a known speed and a characteristic non-directional signal is sent when the minimum signal is being sent north. By the use of a stop-watch and the ship's radio receiver a pilot is able to determine his azimuth position with respect to this beacon.

The use of ultra-high radio frequencies is developing rapidly. It may soon be possible to direct a radio beam (approximately 1/2 metre in wave length) from the upper structure of a ship and orient it forward in such a fashion that a highly directive receiver, underneath the transmitter and oriented to receive forward, will receive the signal only when some reflecting object exists in front of the ship.

A NEW ROTATING RADIO BEACON.

(Extract from *Nature*, London, 6th April 1935, p. 539).

A new type of rotating radio beacon, likely to simplify navigation both by sea and air, was recently developed in Japan. It is common knowledge that taking bearings with the rotating radio beacon generally requires, at the receiving station, the aid of a stop-watch or chronometer. In the new type, however, the use of the chronometer becomes unnecessary. This new device is described in a paper by U. OKADA, published in the report of Radio Research in Japan, Vol. IV, October 1934, page 185; it makes use of a vertical loop transmitting aerial as previously, to give the usual "figure-of-eight" radiation characteristic. Instead of rotating this loop continuously, however, it is swung backwards and forwards about a vertical axis through an arc of 180°. During its movement the speed of rotation is uniform and equal to one revolution per minute. The movement in each direction starts from a north and south position alternately, at each of which a characteristic morse signal is emitted. This signal is then followed during the rotation of the loop by a succession of 90 dots, at the rate of 1 dot for every 2°. By counting the number of dots from the starting point to the signal minimum, the bearing of the receiver from the transmitter may be calculated. The additional observation taken with the loop moving in the reverse direction enables the midpoint of a broad minimum to be accurately determined. Tests carried out in Japan on land and at sea have shown that an accuracy of observation of $\pm 6^\circ$ was obtained at distances up to 46 km. with an experimental beacon operating on a wave-length of 950 m. It is considered that by attention to details of the apparatus the maximum error could be reduced to 2°, which it is suggested is sufficient for practical purposes.

EXPERIMENTS AT SEA WITH THE BUBBLE SEXTANT.

The following is a short summary extracted from the *Revue d'Optique Théorique et Instrumentale*, Paris, October 1934, of an article by E. O. HULBURT appearing in the *Journal of the Optical Society of America*, Volume 23, 1933, entitled *Experiments with the bubble sextant at sea.*

In the Bubble Sextant the bubble is used to provide an artificial horizon. Unfortunately the bubble is subject to two sorts of perturbations: the first, the period of which is less than one second, is due to the vibrations of the vessel and the second, the period of which reaches several seconds, is due to the rolling and pitching. If it be assumed that the rolling is represented by a sinusoidal function, the plane defined by the bubble at any moment lies, with reference to the horizontal plane, at an angle d such that $d = \tan f/g$, f being the acceleration of the rolling and g the acceleration of gravity. This relation, when applied to the case of a destroyer under average conditions, suggests an error of the order of 163' in sextant observations. As but few data are available as to the accuracy of observations in practice, the author examined the results given by existing bubble sextants under various conditions. Observations taken on land under good conditions showed errors of the order of 3'. At sea, in a vessel of 950 tons under average conditions, the error for an isolated observation may reach 60'; when the mean of 5 consecutive observations is taken, the error is usually less than 30'. On