outer end on the tail of the rudder fits into the notches on the outer ring of the frame when the machine is locked and thus keeps the rudder fixed, but when the first messenger has started the machine by pressing down B and opening the levers AA, this small lever is raised and the rudder can revolve freely. EE arc four small cones which revolve on their axis in a vertical plane, similar to an anemometer; the axis is connected by a worm screw to geared wheels which register the number of revolutions up to 5000, corresponding to about 4 nautical miles. There is a small lever in connexion with AA which prevents the cones revolving when the machine is locked, but allows them to revolve freely when the machine is in action. Below the rudder-post is a compass-bowl F, which is hung in gimbals and capable of removal. The needle is so arranged that it can be lifted off the pivot by means of a lever in connexion with AA; when the meter is in action the needle swings freely on its pivot, but when the levers are locked it is raised off its pivot by the inverted cup-piece K placed inside the triple claws on the top of the compass and screwed to the lever, thus locking the needle without chance of moving. The compass bowl should be filled with fresh water before lowering the instrument into the sea, and the top screwed home tightly. The needle should be removed and carefully dried after use, to pre­vent corrosion. the long arm G is to keep the machine steady in one direction; it works up and down a jackstay which passes between two sheaves at the extremity of the long arm. This also assists to keep the machine in as upright a position as possible, and prevents it from being drifted astern with the current. A weight of as much as 8 or 10 cwt. is required at the bottom of the jackstay in a very strong current. An elongated weight of from 60 to 80 lb must be suspended from the eye at the bottom of the meter to help to keep it as vertical as possible. On the outer part of the horizontal notched ring forming the frame, and placed on the side of the machine opposite to the projecting arm G, it has been found necessary to bolt a short arm supported by stays from above, from which is sus­pended a leaden counterpoise weight to assist in keeping the appara­tus upright. This additional fitting is not shown in fig. 12. A 3/4-in. phosphor-bronze wire rope is used for lowering the machine; it is rove through a metal sheave H and india-rubber washer, and spliced round a heart which is attached to metal plate B. The messengers are fitted with a hinged joint to enable them to be placed round the wire rope, and secured with a screw bolt. To obtain the exact value of a revolution of the small cones it is necessary to make experiments when the actual speed of the current is known, by immersing the meter just below the surface and taking careful observations of the surface-current by means of a current log or weighted pole. From the number of revolutions registered by the meter in a certain number of minutes, and taking the mean of several observations, a very fair value for a revolution can be deduced. On every occasion of using the meter for under-current observations the value of a revolution should be re-determined, as it is apt to vary owing to small differences in the friction caused by want of oil or thc presence of dust or grit ; while the force of the current is probably another important factor in influencing the number of revolutions recorded.

The features of the country should generally be delineated as far back as the skyline viewed from seaward, in order to assist the navigator to recognize the land. The summits of hills and conspicuous spurs are fixed either by lines to or by angles at them; their heights are determined by theodolite elevations or depressions to or from stations whose height above high-water is known. As much of the ground as possible is walked over, and its shape is delineated by contour lines sketched by eye, assisted by an aneroid barometer. In wooded country much of the topography may have to be shot in from the ship; sketches made from different positions at anchor along the coast with angles to all prominent features, valleys, ravines, spurs of hills, &c., will give a very fair idea of the general lie of the country.

Circum-meridian altitudes of stars on opposite sides of the zenith observed by sextant in the artificial horizon is the method adopted wherever possible for observations for latitudes. Arranged in pairs of nearly the same altitude north and south of zenith, the mean of each pair should give a result from which instrumental and personal errors and errors due to atmospheric conditions are altogether eliminated. The mean of several such pairs should have a probable error of not more than ± 1*''*. As a rule the observations of each star should be confined to within 5 or 6 minutes on either side of the meridian, which will allow of from fifteen to twenty observa­tions. Two stars selected to “ pair ” should pass the meridian within an hour of each other, and should not differ in altitude more than 2° or 3°. Artificial horizon roof error is eliminated by always keeping the same end of the roof towards the observer; when observing a single object, as the sun, the roof must be reversed when half way through the observations. The observa­tions are reduced to the meridian by Raper’s method. When pairs of stars are not observed, circum-meridian altitudes of the sun alone must be resorted to, but being observed on one side of the zenith only, none of the errors to which all observa­tions are liable can be eliminated.

Sets of equal altitudes of sun or stars by sextant and artificial horizon are usually employed to discover chronometer errors. Six sets of eleven observations, a.m. and p.m., observing both limbs of the sun, should give a result which, under favourable conditions of latitude and declination, might be expected to vary less than two-tenths of a second from the normal personal equation of the observer. Stars give equally good results. In high latitudes sextant observations diminish in value owing to the slower movement in altitude. In the case of the sun all the chronometers are compared with the “ standard ” at apparent noon; the com­parisons with the chronometer used for the observations on each occasion of landing and returning to the ship are worked up to noon. In the case of stars, the chronometer compari­sons on leaving and again on returning are worked up to an intermediate time. A convenient system, which retains the advantage of the equal altitude method, whilst avoiding the necessity of waiting some hours for the p.m. observation, is to observe two stars at equal altitudes on opposite sides of the meridian, and, combining the observations, treat them as rela­ting to an imaginary star having the mean R.A. and mean declination of the two stars selected, which should have nearly the same declination and should differ from 4*h* to 8*h* in R.A.

The error of chronometer on mean time of place being obtained, the local time is transferred from one observation spot to another by the ship carrying usually eight box chronometers. The best results are found by using travelling rates, which are deduced from the difference of the errors found on leaving an observation spot and returning to it; from this difference is eliminated that portion which may have accumulated during an interval between two determinations of error at the other, or any intermediate, observation spot. A travelling rate may also be obtained from observations at two places, the meridian distance between which is known; this rate may then be used for the meridian distance between places observed at during the passage. Failing travelling rates, the mean of the harbour rates at either end must be used. The same observer, using the same instrument, must be employed throughout the observations of a meridian distance.

If the telegraph is available, it should of course be used. The error on local time at each end of the wire is obtained, and a number of telegraphic signals are exchanged between the