by fixing the ship on the points already laid down on the harbour surveys and shooting up prominent intermediate natural objects, assisted possibly by theodolite lines from the shore stations. Theodolite lines to the ship at any of her positions are particu­larly valuable, and floating beacons suitably placed materially increase the value of any such work. A sketch survey of a coast upon which it is impossible to land may be well carried out by dropping beacons at intervals of about 10 m., well out from the land and placed abreast prominent natural objects called the “ breastmarks,” which must be capable of recognition from the beacons anchored off the next “ breastmark ” on either side. The distance between the beacons is found by running a patent log both ways, noting the time occupied by each run; if the current has remained constant, a tolerably good result can be obtained. At the first beacon, angles are observed between the second beacon and the two “ breastmarks,” an “ intermediate ” mark, and any other natural object which will serve as “ points.” At the second beacon, angles are observed between the first beacon and the same objects as before. Hotting on the line of the two beacons as a base, all the points observed can be pricked in on two shots. At a position about midway between the beacons, simultaneous angles are observed to all the points and laid off on tracing-paper, which will afford the necessary check, and the foundation is thus laid for filling in the detail of coast-line, topography, and soundings off this particular stretch of coast in any detail desired. Each section of coast is complete in itself on its own base; the weak point lies in the junction of the different sections, as the patent log bases can hardly be expected to agree precisely, and the scales of adjacent sections may thus be slightly different. This is obviated, as far as possible, by fixing on the points of one section and shooting up those of another, which will check any great irregularity of scale creeping in. The bearing is preserved by getting occasional true bearing lines at the beacons of the most distant point visible. Space does not here permit of dwelling upon the details of the various pre­cautions that are necessary to secure the best results the method is capable of; it can only be stated generally that in all cases of using angles from the ship under weigh, several assistants are necessary, so that the principal angles may be taken simul­taneously, the remainder being connected immediately after­wards with zeros involving the smallest possible error due to the ship not being absolutely stationary, these zeros being included amongst the primary angles. When close to a beacon, if its bearing is noted and the distance in feet obtained from its elevation, the angles are readily reduced to the beacon itself. Astronomical positions by twilight stars keep a check upon thc work.

*Sketch Surveys by Compass Bearings and Vertical Angles.—*In the case of an island culminating in a high, well-defined summit visible from all directions, a useful and accurate method is to steam round it at a sufficient distance to obtain a true horizon, stopping to make as many stations as may be desirable, and fixing by compass bearing of the summit and its vertical angle. The height is roughly obtained by shooting in the summit, from two positions on a patent log base whilst approaching it. With this approximate height and Lecky's vertical danger angle tables, each station may be plotted on its bearing of the summit. From these stations the island is shot in by angles between its tangents and the summit, and angles to any other natural features, plotting the work as we go on any convenient scale which must be con­sidered only as provisional. On completing the circuit of the island, the true scale is found by measuring the total distance in inches on the plotting-sheet from the first to the last station, and dividing it by the distance in miles between them as shown by patent log. The final height of the summit bears to the rough height used in plotting the direct proportion of the provisional scale to the true scale. This method may be utilized for the sketch survey of a coast where there are well-defined peaks of sufficient height at convenient intervals, and would be superior to an ordinary running survey. From positions of the ship fixed by bearings and elevations of one peak, another farther along the coast is shot in and its height determined; this second peak is then used in its turn to fix a third, and so on. The smaller the vertical angle the more liability there is to error, but a glance at Lecky’s tables will show what effect an error of say 1' in altitude will produce for any given height and distance, and the limits of distance must depend upon this consideration.

*Surveys of Banks out of Sight of Land.*—On striking shoal soundings unexpectedly, the ship may either be anchored at once and the shoal sounded by boats starring round her, using prismatic com­pass and masthead angle; or if the shoal is of large extent and may be prudently crossed in the ship, it is a good plan to get two beacons laid down on a bearing from one another and patent log distance of 4 or 5 m. With another beacon (or mark-boat, carrying a large black flag on a bamboo 30 ft. high) fixed on this base, forming an equilateral triangle, and the ship anchored as a fourth point, soundings may be carried out by the boats fixing by station-pointer. The ship's position is determined by observations of twilight stars.

In a detailed survey the coast is sketched in by walking along it, fixing by theodolite or sextant angles, and plotting by tracing-paper or station-pointer. A sufficient number of fixed marks along the shore afford a constant check on the minor coast-line stations, which should be plotted on, or checked by, lines from one to the other wherever possible to do so. When impracticable to fix in the ordinary way, the ten-foot pole may be used to traverse from one fixed point to another. With a coast fronted by broad drying, coral reef or flats over which it is possible to walk, the distance between any two coast-line stations may be found by measuring at one of them the angle subtended by a known length placed at right angles to the line joining the stations. There is far less liability to error if the work is plotted at once on the spot on field board with the fixed points pricked through and circled in upon it; but if circumstances render it necessary, the angles being registered and sketches made of the bits of coast between the fixes on a scale larger than that of the chart, they may be plotted after­wards; to do this satisfactorily, however, requires the surveyor to appreciate instinctively exactly what angles are necessary at the time. It is with the high-water line that the coast-liner is concerned, delineating its character according to the admiralty symbols. The officer sounding off the coast is responsible for the position of the dry line at low-water, and on large scales this would be sketched in from a small boat at low-water springs. Heights of cliffs, rocks, islets, &c., must be inserted, either from measurement or from the formula, height in feet = angle of elevation in seconds × distance in miles/34,

and details of topography close to the coast, including roads, houses and enclosures, must be shown by the coast-liner. Rocks above water or breaking should be fixed on passing them. Coast­line may be sketched from a boat pulling along the shore, fixing and shooting up any natural objects on the beach from positions at anchor.

The most important feature of a chart is the completeness with which it is sounded. Small scale surveys on anything less than one inch to the mile are apt to be very misleading; such a survey may appear to have been closely sounded, but in reality the lines are so far apart that they often fail to disclose indications of shoal-water. The work of sounding may be proceeded with as soon as sufficient points for fixing are plotted; but off an intricate coast it is better to get the coast­line done first. The lines of soundings are run by the boats parallel to one another and perpendicular to the coast at a dis­tance apart which is governed by the scale; five lines to the inch is about as close as they can be run without overcrowding; if closer lines are required the scale must generally be increased. The distance apart will vary with the depth of water and the nature of the coast; a rocky coast with shallow water off it and projecting points will need much closer examination than a steep-to coast, for instance. The line of prolongation of a point under water will require special care to ensure the fathom lines being drawn correctly. If the soundings begin to decrease when pulling off-shore it is evidence of something suspicious, and intermediate lines of soundings or lines at right angles to those previously run should be obtained. Whenever possible lines of soundings should be run on transit lines; these may often be picked up by fixing when on the required line, noting the angle on the protractor between the. line and some fixed mark on the field board, and then placing the angle on the sextant, reflecting the mark and noting what objects are in line at that angle. On