

BY AN OLD HYDROGRAPHER

The Dutch Way of Measuring Depths

Once upon a time there was no satnav, multibeam sonar or a computer to handle a survey system. Hydrographic surveying was done 'by hand' with instruments long forgotten, instruments which boasted accuracy which would nowadays make your hair stand on end. Which instruments? There is no general answer to this question, because the Hydrographic Services of different countries had their own specific ways and means. There follows an example of what was used by the Dutch around 1955 in the former Netherlands New Guinea.

When beginning a triangulation supported by a baseline, the position of one of the ends of this line should be known in latitude and longitude. In the case of a local (re)survey, such a position was simply taken from the largest scale chart. Later on, in the office, the cartographer took care of the transformation.

For a survey of larger dimensions and, after 1955, for establishing the position of a Decca transmitting mast, star observations often were the only solution. Two methods were in use. For the first, the theodolite was equipped with an astrolabe including a 60-degree prism and an artificial horizon (a small trough filled with mercury). This enabled the surveyor to measure his selected 24 stars at a height of exactly 60 degrees. A star was observed directly through the prism and via the artificial horizon. The observer found in the field of his telescope two images that moved towards one another. The moment the images were superimposed, the height of the star was 60 degrees. The observer then pressed a little button to mark the time on the chronograph, which could be read in tenths of seconds.

For the second method, four stars were selected under strict conditions of azimuth. Each was measured six times in fast sequence near a height of 60 degrees. This kind of observation was possible only with a 'broken' eyepiece, a small tube with a prism fixed at a 90-degree angle to the eyepiece of the theodolite. Thus the observer was able to place his telescope at a height of 60 degrees and still observe the stars.

Nearby, the assistant in his tent had the role of stage manager. He took care of the star programme; this included the necessary stars of a magnitude four to five at a height of around 60 degrees. He was to alert the observer as to what bearing and when he should expect the next star in the field of his telescope. Furthermore, he watched the chronometer and chronograph, took time signals from Hawaii at regular intervals and read a barometer and hygrometer. From an article by Steve Ritchie, I understand that our British colleagues had whisky and rum to hand; we simple souls had only coffee and sandwiches.

Triangulation must sound familiar: measuring a baseline and building a system of triangles, the corners of which are marked by beacons. These have to be clearly visible from the survey launch at sea to enable the surveyor to measure the angles in between. If possible, a Wild-T2 theodolite was used. In some cases, when measuring floating beacons or along rivers with unstable borders, a sextant had to be used; not the one used for sounding but a far more delicate instrument.

The length of a baseline or the legs of a traverse were measured by the 'invar basislat'. This comprised two halves of aluminium tubing connected by a hinge (for folding), the base of which could be attached to a tripod, their ends forming a triangle fixed between an invar wire and a spring (invar is an alloy of steel and nickel). In short, the distance between the triangles was two metres and, thanks to the invar, almost indifferent to changes in temperature. A table supplied the distance for each angle. Depending on the scale of the survey, the sections to be measured varied between 75 and 100 metres in length.

Beacons were an essential part of the survey. These were erected in the corners of the triangles. During the first half of the 20th century elaborate constructions were made from bamboo and cotton. They were huge lampshades and, for still better visibility, a big red or blue flag was sometimes put on top. In 1954, Lt Cdr. Wijnand Langeraar introduced the 'American beacon'. Triangles of cotton were sewn to a cotton cylinder that was pushed onto a bamboo pole. The use of these prefab beacons saved a lot of time. Their colour could be white, yellow, red or blue, depending on their background. The bamboo could be hoisted into a tree, simply be put on the ground or fixed to a bamboo tripod; this latter method mostly used on reefs. Junior officers with an able seaman and a few Papua ratings spent days preparing the survey area in this way. And then, of course, there was the Egeria beacon, the floating beacon used during the extensive wire-dragging surveys.

If outsiders thought surveyors a special race, they must have been entirely convinced of this arriving on the forecastle, where we kept a sewing machine. If they were lucky they could watch the able seaman sewing pieces of cotton cut from large bales.

One might be inclined to think that nothing of interest could be written about sounding with the Kelvin & Hughes MS 21F echosounder. But how could one forget the recorder that marked the depth on moist paper? In the tropics this frequently led to trouble.

But perhaps of more interest is the construction of the position on the boatsheet. For the British the one and only possible method was by

station pointer. We did not use this instrument; we were even forbidden to use it. Compasses and a protractor were our tools and it is difficult to describe in a few words how it worked. With the help of a few sketches I shall give it a try.

Tidal observations also differed amongst the various services. Not, of course, the simple tide pole which was read every half hour. The moment the survey moved offshore to such a distance from the coast that values could no longer be derived from shore stations, we used a bottom tide gauge, which our British colleagues found most unreliable. This instrument, protected and kept watertight by a steel hood, was lowered onto the sea bottom. The open end of a hollow spring (Bourdon spring) was connected to a small space in the bottom sealed from the seawater by a membrane. The other closed end was linked to an arm which could move up and down a piece of waxed paper.

As a result of the change in seawater level and consequently in pressure, the Bourdon spring stretched or bent, moving the arm up and down. Every half-hour a frame hit the arm, at the end of which a pin punched a little hole in the wax paper. Thereafter the paper moved slightly and was ready for the next punch. Thus a small tidal curve was created which, by means of a gauging result, was transformed into the actual values. But there was far more to it than this, like the advance pressure that depended on the depth of the instrument. A disadvantage was the time it had to remain on the bottom: at least a month if tidal constants were to be derived and a reliable mean level calculated.