SURVEY OF LOW WATER MARK

(Extract from a report on the use of air photographs at the Ordnance Survey, by Lieut.-Col. R. A. GARDINER, M.B.E., R.E., published in *Empire Survey Review*, No. 76, London, April 1950, pages 242 to 255).

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The Ordnance Survey is responsible for the survey of all land, including the foreshore. The limits of the "foreshore" in England and Wales have been defined as the High and Low Water Marks of a medium or average tide. In Scotland there has been no legal definition, but by ancient custom the limits have been accepted as those of ordinary spring tides. The lines shown on Ordnance plans of Scotland are therefore different in meaning from those shown on the plans of England. In England and Wales, the lines shown are those of "medium tides"—that is, of tides halfway between a spring and a neap. In Scotland the lines are those of "ordinary spring tides". The High and Low Water Marks shown on Admiralty Charts are those of mean spring tides.

The survey of High Water Mark in the field rarely presents any difficulty, since the receding tide usually leaves a clear mark and there is plenty of time in which to complete the survey. Low Water Mark surveys, on the other hand, often present great difficulties. The normal field method is to select a time from the Admiralty Time Tables when the actual level at low water is predicted to be close to the computed level at low water of a medium tide. A great effort is then made to survey as much of the tide line as possible in the short time in which no plottable change is likely to occur.

The air photograph enables us to capture a permanent record of the position of the tide at any selected moment, and leave the actual survey to be done in the office at a later date. Early experiments showed that, in spite of the convenience which air photographs provided, it was more satisfactory to continue with field methods where a shelving beach exists or where the foreshore consists of rock or similar material. The advantage of air survey methods in areas of mud and sand were, however, overwhelming, and these methods are now normal practice. Photography is carried out to the following specification :-

Scale : Variable, depending on the shape of the coast line.
Camera : Kodak K-17.
Lens : Usually 6-inch.
Overlap : Fore-and-aft 60 per cent.; usually only one strip is required.
Film : Infra-red, processed to give maximum contrast at the water line.

The most important items in the specification are, however, the timing and the navigation. Detailed time schedules are worked out by the Ordnance Survey giving the periods each day over a long period during which the actual tide level is expected to be within one foot above and below the calculated height and other conditions are suitable. Selection of suitable times is not easy since infra-red film is comparatively slow and does not give good results in the early morning or late evening, while at the middle of the day reflections from the sun may give trouble. Tides are also peculiarly sensitive to weather conditions; any unusual weather condition in the vicinity is liable to cause unusual tides. As a result, suitable conditions for photography are rare, and a great deal of computation is necessary, most of which is never used. A very high standard of navigation is also required, since much of the accuracy achieved depends on the proportion of each photograph which includes the land.

From the original negatives, enlargements on bromide paper are made to the scale of 1 : 10 560 at sea level. No attempt is made to eliminate tilt. The enlargements are studied under a stereoscope and the water line inked in ; at the same time, a network of "control" points are selected on the photographs and identified on the Six-inch map, which forms the document on which the survey is done. These control points are not permanent detail, and frequently fall on mud or sand banks. Almost any mark on the photograph whose position can be accurately located on the map is suitable. On the density of the network of control

points depends the accuracy of the survey. Using a Saltzman enlarger, an image of a portion of each photograph is projected on to the relevant Six-inch sheet; the scale and orientation of the image is adjusted to allow the images of three control points to be superimposed on their plan positions. The line of the low water mark within the triangle can then be pencilled in, and the process repeated until the entire water line has been completed. The map is then inked in as a permanent record. The work is carried out at the Six-inch scale because it is the largest scale on which the complete low water line is published. On the larger scales the seaward limit of survey is the high water mark; low water mark and foreshore detail are shown only to complete a plan to edge.