MOVEMENT OF THE MAIN SHINGLE BANK AT BLAKENEY POINT, NORFOLK*

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The changes in structure of Blakeney Point have been discussed in some detail by Hamond (1907), Oliver (1923), Steers (1949-53), Steers & Grove (1953), Bird & Wain (1963) and Hardy (1964). The shingle appears to have been subject to three main types of movement. Firstly, there has been a net westward longshore drift, though this may be reversed for short periods and may not be active now (Hardy, 1964). The long term effects of this drift are shown by the sharp change of direction of the Glaven estuary and are also documented in maps and charts (Hamond, 1907; Cozens-Hardy, 1924-9). The second main movement is a hooking back of the free end of the main bank at irregular intervals, which produces the shingle laterals. Thirdly, there is a landward rolling movement of the main bank, which occurs mainly, if not entirely, during storms when waves top the bank. It is with this movement that this note is concerned.

There are at least seven sorts of evidence showing that movement has occurred.

First, a layer of " mud " is sometimes exposed on the *seaward* face of the shingle bank, especially after storms. Lumps two to three feet across may be thrown up on top of the bank in storms. This " mud " is similar to that in the salt marshes in the lee of the bank and a layer of it presumably underlies the bank.

Secondly, a line of telegraph poles was put up behind the crest of the bank during the 1914-18 war. The surviving poles are now on the crest, and in some cases parts of the poles may be found on the seaward face in positions now covered by high spring tides.

Thirdly, fans of shingle may be found spread over the top level of the marshes after storms which top the bank. It is recorded by Oliver (1923) that these fans " show an intermittent advance amounting on the average to perhaps two feet a year." In the writer's experience the advance is so irregular in position and time that a yearly average means little.

Fourthly, the eastern (and presumably older) lateral ridges such as those at the Marams join the main bank at a sharp angle, unlike the western (younger) laterals which swing gradually into the main bank. The shingle surface of the older laterals is consolidated and contrasts sharply with that of the main bank where the two meet. At the Hood, and at the oldest of the Marams laterals, only the tip of the recurve is left, in each case enclosing a small lagoon.

Fifthly, at the point where the Yankee lateral ridge joins the main bank there are two remnants (about 200 metres square) of the Long Hills sand dunes, which until the late 1930's extended down the Yankee ridge. On the landward slope of the main bank may be found the isolated tops of dunes buried in the shingle. These are covered by *Ammophila arenaria* or *Carex arenaria,* neither plant being a usual component of the shingle

vegetation. Occasional groups of *Ammophila* may be found apparently growing in shingle but excavation will usually reveal the dune beneath. If dunes ever existed on the Marams (as maps, their position and name all suggest) they have left little trace today.

Sixthly, the course of the river Glaven when examined on the ground or, more easily, on an aerial photograph, shows evidence of the landward movement of the shingle bank (fig. 1). Both the river and its estuary run straight and abruptly into the bank. They are at present linked by a largely artificial channel. Evidence from maps (Cozens-Hardy, 1924-9) confirms, however, that subsequent to diverting the Glaven westwards the shingle bank encroached on a loop of this diversion.

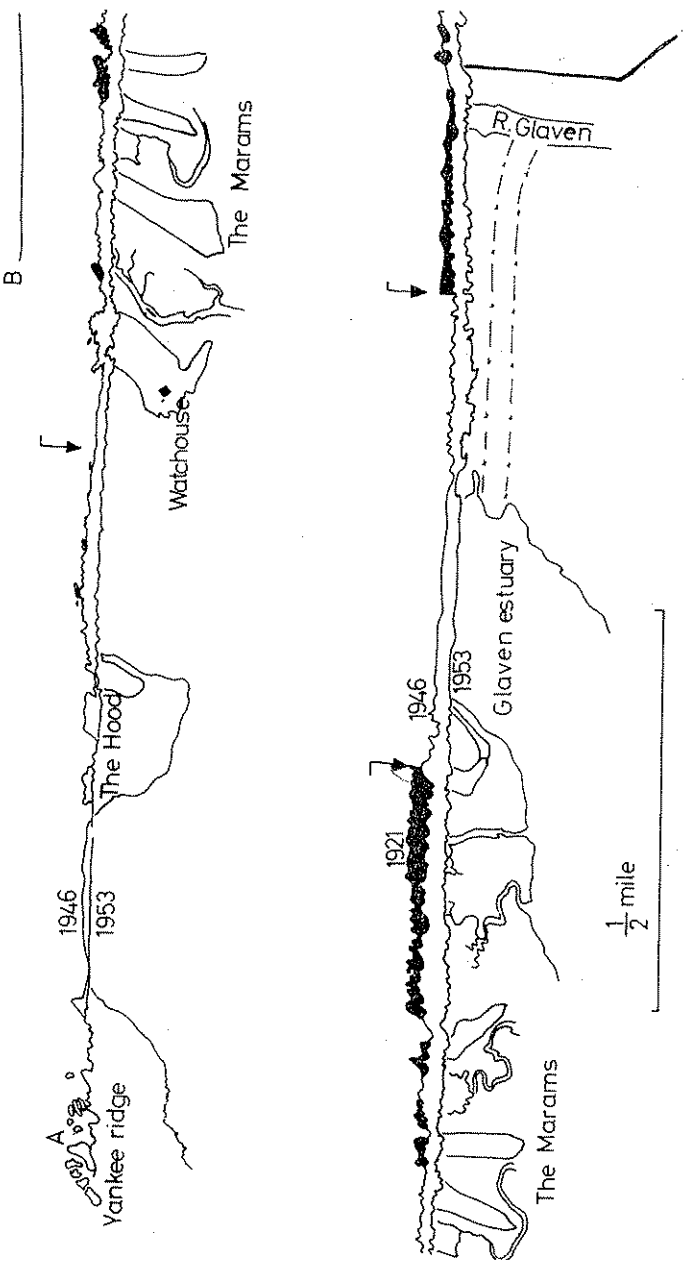
The seventh, last, and perhaps most impressive piece of evidence is provided by a comparison of aerial photographs taken in 1921, 1946 and 1953. The 1921 photographs, taken by F/O Allen and Major Griffiths, are amongst the earliest ever taken for scientific purposes. They were taken at the request of Prof. F. W. Oliver, who gives an interesting account of them (Oliver, 1923). Some are reproduced in his account, some in Tansley (1949), whilst the surviving negatives are now lodged with the Nature Conservancy. The 1946 and 1955 surveys were made by the R.A.F. (106 G/UK 1701/3046-56 and 82/1214/0170-0187).

The creek systems in the salt marshes have a remarkably constant shape and can be used as reference marks to collate the different surveys. Tracings of the position of the landward edge of the shingle are shown in fig. 1. The ramifications of creeks which now pass abruptly into the shingle (for example, that in the western-most of the Marrams marshes) may be seen on the 1921 photographs. They also explain the sickle shaped lagoon to be seen at present at the base of the shingle in the same marsh, as a meander in a side creek which has been cut off at both ends by the advancing shingle.

The movement has not been uniform in space or time. At the western end of the Marrams there was almost no change during the 25 years before 1946; to the east a movement of 40-50 yards occurred. Between 1946 and 1953 a movement of 50 yards or so occurred along most of the bank as far as the Yankee ridge. Most of this was probably caused by the 1953 storm surge during which "almost throughout its [the shingle bank's] entire length it was rolled inland, for an average distance of 30 or 40 yards" (Steers & Grove, 1953).

This sort of measurement can also be made on maps. Hardy (1964) gives figures based on the 1905 O.S. and his own 1956 survey showing a movement of 3 feet a year. Since the criteria used by the 1905 surveyors are not known the errors in this estimate are difficult to assess, but Hardy's estimate does agree with that from aerial photographs, as also does that of Cozens-Hardy (1924-9) based on a chart of 1649. This chart is clearly not reliable in anything but broad outline and the main importance of the estimate (275 yards in 275 years) is that it covers a much greater time span than the aerial or ground surveys.

The distribution of bushes of *Suaeda fruticosa* on the main bank is of some interest. An extended account is given by Tansley (1949). In 1921


B
The Marams
Watchouse
The Hood
1946
1953
A
Yankee ridge
R. Glaven
1946
1953
Glaven estuary
1921
The Marams
½ mile

there were three parallel belts at different levels on the landward side of the bank, one being at the foot of the shingle. These belts were still present in 1946, individual bushes in them being recognisable since they occupied the same relative position. (On the laterals, old trunks have at least 90 growth rings and bushes only 18″ across have been shown by repetition of photographs taken on the ground in 1923 to have changed little in size in 40 years). The 1953 storm surge caused all but a few of the bushes on this part of the bank to be buried and only a few have subsequently grown through the shingle again. The density of *Suaeda* (and other plant) cover in 1921 indicates that no event comparable in severity to the 1953 storm surge had happened for many years. For this reason it seems possible that both the aerial photograph estimates and Hardy's (1964) map estimates may be of the same shingle positions, though one is nominally 1921-53, the other 1905-56. The three lines of bushes probably represent former shingle margins, partly covered by shingle washed over in storms. The last recorded big storm was in 1897. Whatever the stabilising effects of *Suaeda fruticosa* in "normal" times (Carey & Oliver, 1918) it is not very effective here during rare, but physiographically important, big storms.

Finally, it is interesting to notice that, if the bank moves back at a rate of about 100 yards a century (though, as already mentioned, rate can hardly be applied usefully to such an intermittent process) and the marshes are 400—800 yards long to start with, then four to eight centuries might be the life of the Marrams salt marshes at Blakeney Point. When the general lowering of land in relation to sea level in these parts is considered, this time might be insufficient for accretion to raise large areas to levels where vegetation characterised by, for example, *Juncus maritimus* could develop and it is perhaps to this factor that the paucity of such types of vegetation at Blakeney point is owed.

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Fig. 1. Tracing from aerial photographs of the landward edge of the main shingle bank at Blakeney Point between the Yankee ridge and Cley.

The photographs were taken in 1921, 1946 and 1953; the area covered by the surviving plates of the 1921 survey is shown between arrows. The region covered by shingle between 1921 and 1946 is shown solid black. At "A" are shown isolated sand dunes, which were visible in 1946 but covered before 1953. At "B" is shown the seaward edge of the shingle in 1921. The dashed lines joining the Glaven estuary and the R. Glaven shows the general position of the channel which now links them.