

SHORT COMMUNICATIONS

HOLOCENE SEA-LEVEL CHANGES: A DISCUSSION

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ABSTRACT

The sea-level curve by Greensmith and Tucker, based on coastal work in southeastern England, is said to conform with other worldwide evidence of Holocene sea-level changes, notably that of Fairbridge and Mörner. However, the curve shows little relation to that of any previous investigators, and contrasts greatly with that of Fairbridge because it shows a lack of appreciable sea level higher than that of the present day.

In a recent article, Greensmith and Tucker (1973) give substantial evidence of the transgressions and regressions of the sea along the Essex coast of England and the Outer Thames Estuary. The authors leave little doubt but that the general Holocene advance had definite reversals in trend. On the basis of their local findings, they produce a sea-level curve which they claim correlates closely with the sea-level curves of Fairbridge (1961) and Mörner (1971), and roughly indicates the global eustatic changes of sea level during the Holocene.

This is one of several recent attempts to establish eustatic sea-level curves without careful comparison with evidence from other areas of the world. The statement that the evidence from the Essex coast "correlates so closely with similar events in the Low Countries..." is particularly disturbing, because no attempt was made to compare the fluctuations with the well-documented dates from the Low Countries given us by the extensive work of Jelgersma (1961). Also, there is no comparison with the vast amount of data coming from the East Coast of the United States and adjacent continental shelf (Emery and Milliman, 1970).

When one plots sea-level stands against all available dates from the relatively stable coasts, it becomes evident that it is impossible to draw any simple sea-level curve, even for the past 7000 years. Examination of the curves proposed by several of us will illustrate this point (fig. 1). Most of these curves have been based on a few spot samples. The one that I attempted (Shepard, 1963) is a smoothed curve taking median points, and the curve of Emery and Milliman

(1970) is made on the same basis (fig. 2). It may be of interest to see how the curve offered by Greensmith and Tucker compares with the others. We find that the sea along the Essex coast apparently stood lower during all of the earlier part of the 7000 years of comparison, although it rose above the others in one large transgression about 5000 years B.P. After that, the curve is again well below the others until about 2000 B.P.

In some respects the Greensmith and Tucker curve seems to conform with the undulations of the Fairbridge curve, although the agreement is very minor and would suggest the likelihood that eustasy had been superimposed on earth movements. The Mörner curve appears to have no relationship to that of Greensmith and Tucker. Nor does Mörner's curve agree with any of the others. On the other hand, the curves by Jelgersma, Neumann, and Shepard agree closely, and the curve obtained in Micronesia by Bloom and in the Florida area by Scholl and others are slightly higher. Also, the curve shown partly in figure 2 by Emery and Milliman is slightly lower than the other groups. These differences probably reflect the earth movements in the different areas. Although the Emery-Milliman and Shepard curves were averaged and include all the points we had available, actually all of us drew more heavily on certain areas in which we had been working. Thus, there is some indication that the East Coast of the United States has been submerging in relation to Holland and Bermuda; whereas Florida and Micronesia have emerged in relation to the others.

The Essex coast seems to have had more and larger transgressions and regressions than is indicated by the Emery-Milliman and Shepard curves, but actually, rather large fluctuations could have been developed from choosing individual points from which the curves were averaged. This can be seen by reference to the actual points on the Emery-Milliman curve (fig. 2). It is certainly likely that the rising sea level during the Holocene did have fluctuations, but it is very difficult to determine their nature at present, because dates are not very accurate and often impurities in the samples give false information in the carbon-14 determinations. One may wonder if the large transgression 5000 years B.P. indicated on the Greensmith-Tucker curve could be due to an erroneous date or perhaps to a misinterpretation

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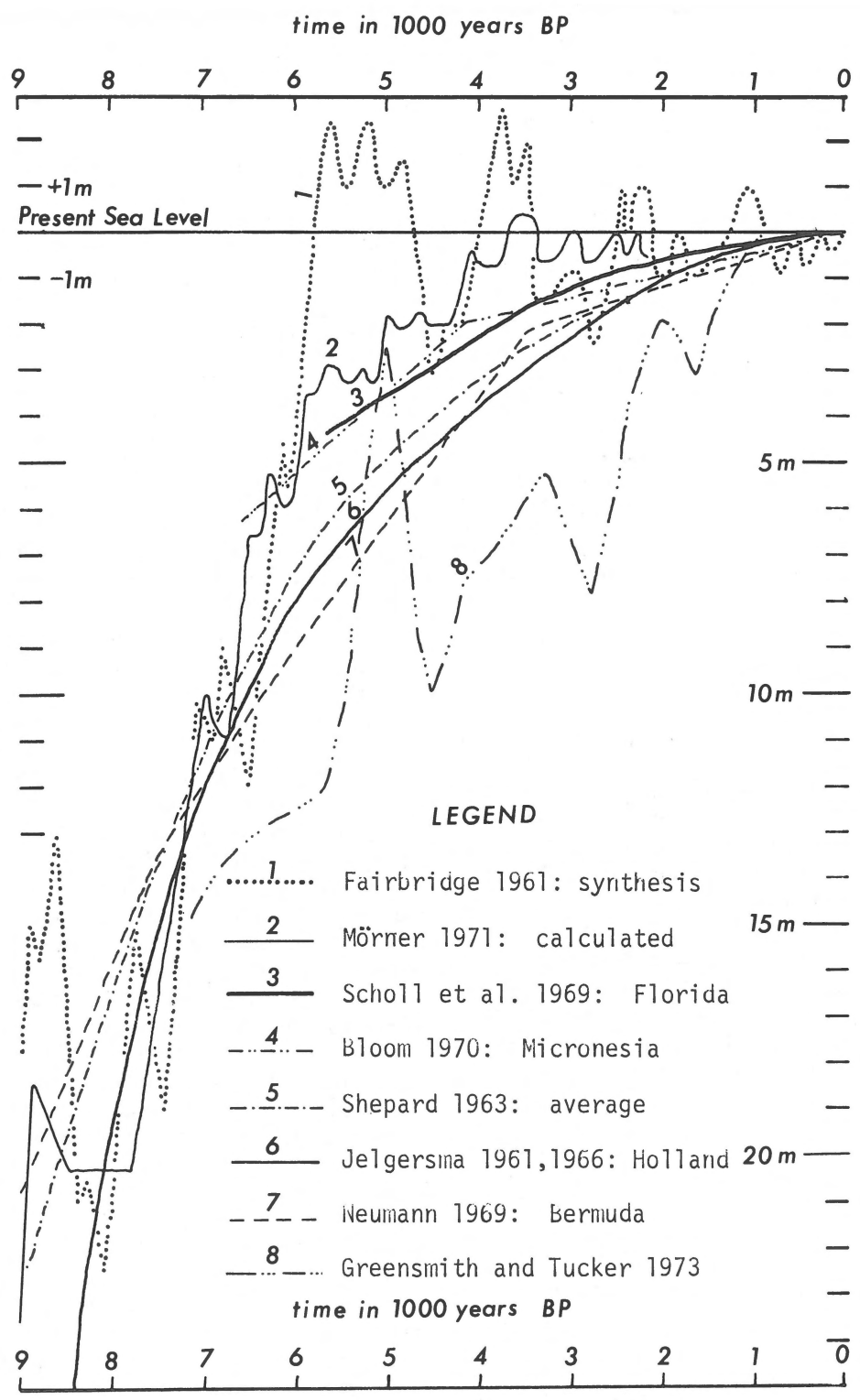


Fig. 1 Attempts by various authors to develop sea-level curves for the past 9000 years. From Mörner (1971) with addition of the curve from Greensmith and Tucker (1973).

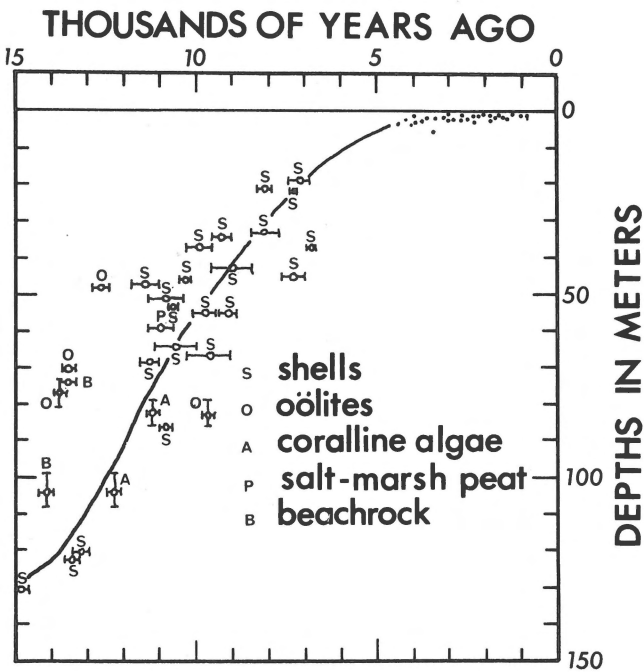


Fig. 2
Sea-level curve of the Holocene from Emery and Milliman (1970) showing points from which the curve was averaged and the nature of the older samples.

of the nature of the peat used for this date. If it had been a freshwater peat it could have been well above sea level. A relatively high sea level at this time needs more confirmation.

The fact that the curve from the Essex coast lies well below the other curves except at 5000 B.P. would lead to the belief that the area has subsided. The map by Valentin (1954) of the annual changes in level in northeastern Europe shows the area in question as having a subsidence rate of about 2 mm/yr. This would practically account for the

difference of the curve from that of Jelgersma for Holland.

Accordingly, one should never assume from comparisons of various curves of supposed sea-level change that any particular coast is stable, nor is it safe to use a single age determination to indicate eustatic sea-level change. Too many causes for error come into the picture. We desperately need to have more substantial information from many of the relatively stable areas before we can safely speculate on where the sea stood during parts of the Holocene. We may even learn that some supposedly stable areas have been subject to continentwide displacements, possibly even differences in the hemisphere may have existed.

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