CHAPTER 2

WAVES AT SEKONDI, GHANA

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ABSTRACT

Waves were recorded at Sekondi during 1958. The results of an analysis of these records is presented.

INTRODUCTION

During the International Geophysical Year the National Institute of Oceanography in collaboration with Ghana IGY Committee and the Ghana Railway and Harbours Administration made recordings of sea waves at a point 2,300 feet off Sekondi point in a direction 156°. The instrument used was an N.I.O. piezo-electric wave recorder of the pressure recording type.

Recordings started in June, 1958, and continued until the end of October that year when the cable suffered severe damage which could not easily be repaired. Because of the high cost of cable and the fact that a good series of records had already been obtained for a rough time of year, the instrument was recovered and used elsewhere. Records were taken every two hours and each has a useable length of twelve minutes. Most of the waves arriving at Sekondi are in the form of swell which has been generated by storms in the southern hemisphere; consequently wave conditions do not change very quickly, and it was found unnecessary to analyse every record except during rough conditions. The method of analysis used is that described in the associated paper "The Analysis and Presentation of Wave Data - a Plea for Uniformity".

DISCUSSION OF RESULTS

From Fig. I may be determined the proportion of time for which H_s or $H_{max(6\ hours)}$ exceeded any given height. For example, the significant height exceeded 3 feet for 70 per cent of the time. The variation in height from month to month is not sufficiently large to warrant separate presentation. Periods, however, do show significant variations, and tended to be longer in July and August than in June, September and October, presumably due to more severe wind conditions in the Southern Ocean during the Antarctic winter. The scatter diagram of Fig. IV relates the significant wave height to zero-crossing period. The most common situation was when the significant wave height was just greater than 3 feet and the zero-crossing period between 10 and 11 seconds. The depth of water in which the sea unit was immersed, 35 feet, means that waves of a period less than about 5 seconds were

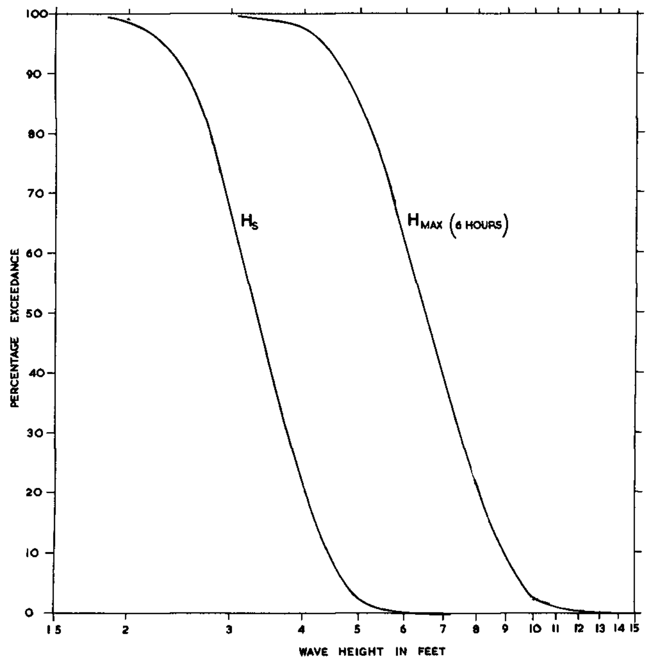

Fig. 1. The cumulative distribution of significant wave height and of the most probable value of the height of the highest wave in the recording interval.

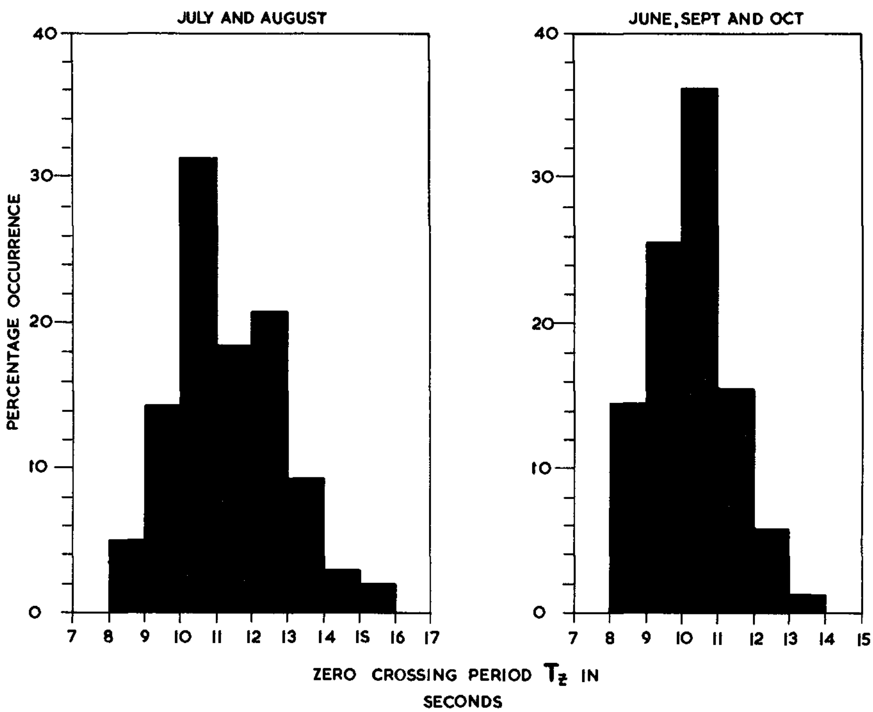

Fig. 2. The distribution of zero-crossing period.

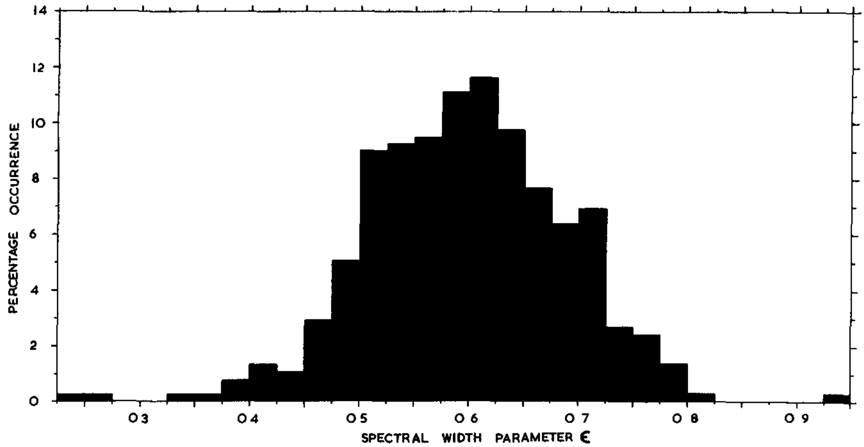

Fig. 3. The distribution of the spectral width parameter.

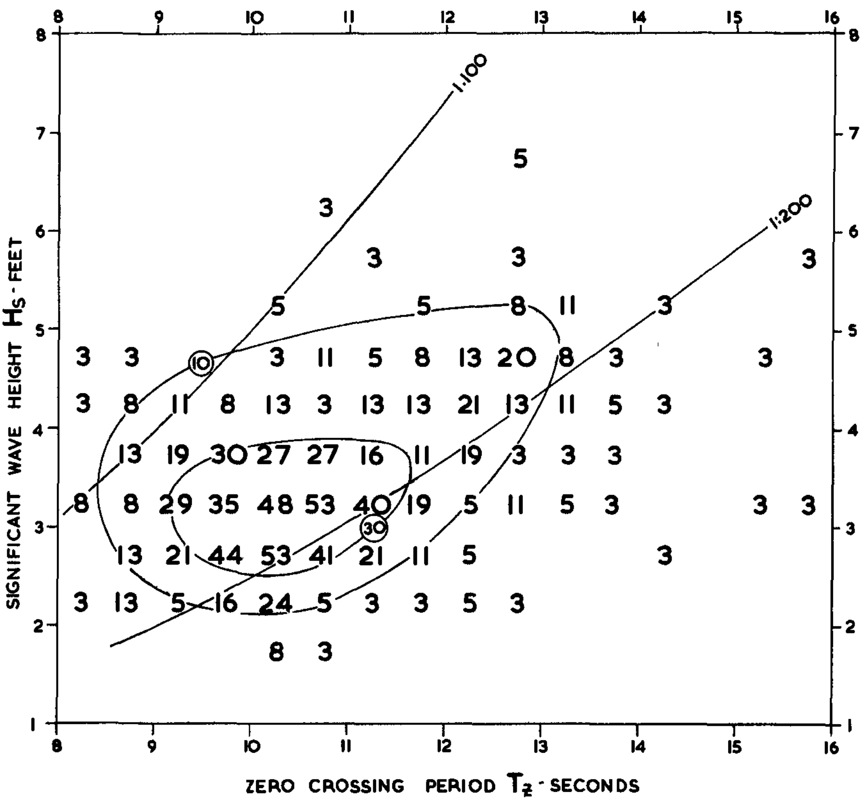

Fig. 4. A scatter diagram relating significant wave height to zero-crossing period.

not adequately recorded, but the absence of waves with a zero-crossing period less than 8 seconds suggests that the shorter locally-generated waves did not predominate over the swell at any time during the season when recordings were made.

An important feature of the waves is that the steepness is much lower than occurs in an area where waves are generated. Steepness is defined as wave height/wave length; it may also be expressed as a decimal number. In a generating area the significant-height steepness (of the significant wave height and using zero-crossing periods) sometimes exceeds 1:20, whereas at Sekondi no wave record exceeded a significant-height steepness of 1:60 and less than 8 per cent exceeded 1:100. The largest wave actually recorded had a height H_1' of 10.5 feet, and the zero-crossing period of the record was 13.0 seconds. In water 35 feet deep this wave would have had a steepness of 1:40.

Fig V. The data used in Fig. V are the calculated values of H_{max}(6 hours). This presentation suggests that the highest wave of all which will occur at Sekondi once in 25 years will be about 17 feet high.

Fig. VI. From this diagram may be deduced the number and duration of the occasions in one season (June-October) on which waves persisted at or above a given height. For example, if the limit for a particular operation of a vessel is a significant height of 4 feet, it would have been unable to operate for spells in excess of 10 hours on 16 occasions, or spells in excess of 50 hours on 4 occasions.

Subsequent measurements made at Sekondi by the Delft laboratory with both a pressure transducer and an accelerometer buoy (private communication) show most encouraging agreement with the data presented in this paper. An analysis of data obtained at Tema was published by Darbyshire (1957)[2], who also found that the worst conditions occurred in July and August. The heights and periods measured at Sekondi are similar to those which were found at Tema.

COMPARISON WITH OTHER PLACES ON THE GULF OF GUINEA

The position of the recorder at Sekondi is slightly sheltered from the south-west by the Takoradi headland. This must have made a small reduction in wave heights at Sekondi compared with other places on that part of the African coast. Also, refraction may have caused a small reduction in heights. It is difficult to assess the magnitude of these effects.

The continental shelf off Sekondi is about 50 miles wide, which is more than at many other places along that part of the African coast. Over shallow water some wave energy is lost by friction on the sea bed, and consequently the wave conditions at Sekondi will be slightly less severe than at places having a narrower shelf, but the differences should not be large. An approximate calculation of this effect suggests that where the shelf is only about 10 miles wide, the wave heights at the shore seem unlikely to exceed those at Sekondi by more

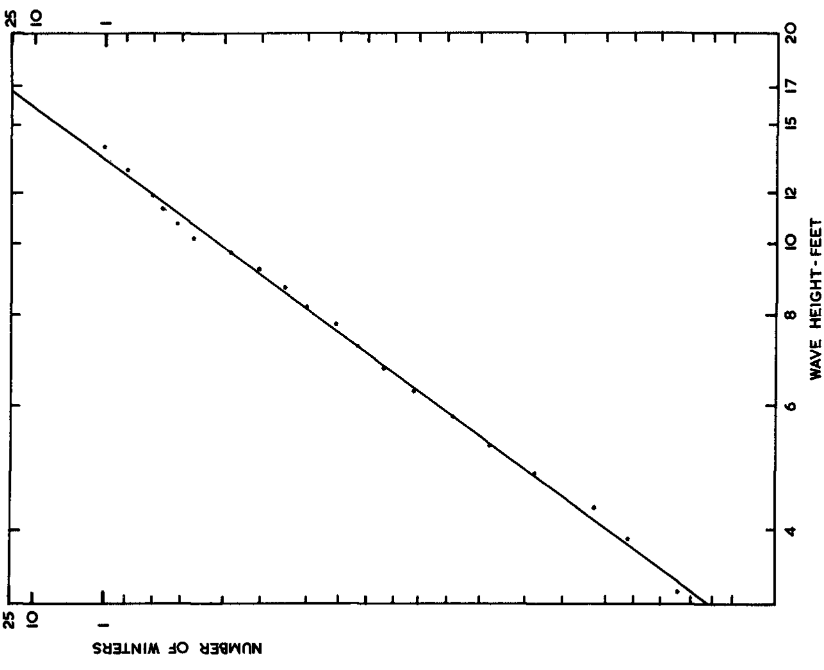

Fig. 5. Prediction of a "Lifetime" wave.

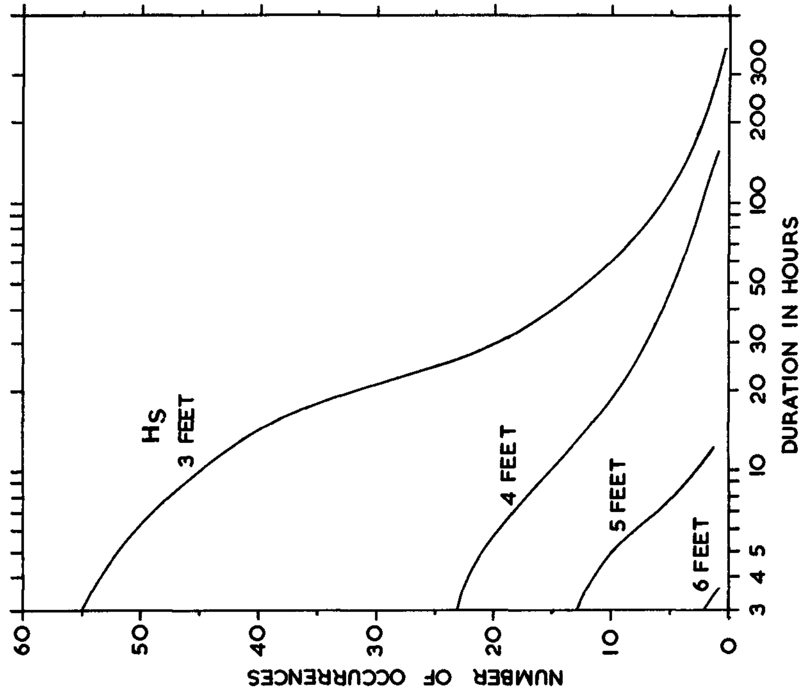

Fig. 6. Persistence diagram.

than about 20 per cent.

At any particular place, local variations in topography can cause refraction, and therefore wave energy can be focussed or de-focussed, resulting in greater, or lesser, wave heights in that locality.

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