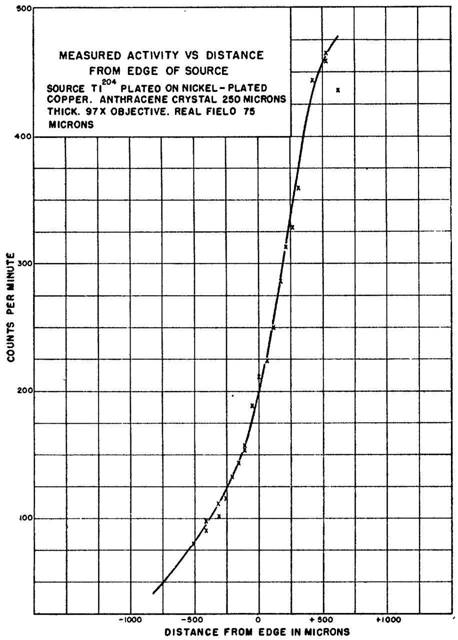

FIG. 5. Measured activity *vs.* distance from edge of source. Source, Tl^{204}, plated on nickel-plated copper. Anthracene crystal 250 microns thick. 97 × objective. Real field 75 microns.

micron-thick anthracene crystal. The best detection efficiency achieved with nickel-63 to date has been about 2 or 3 per cent.

Figure 5 is a plot of measured count rate against distance from the edge of a source. The source was thallium-204 plated on nickel-plated copper. Source intensity was about 1.5 microcuries per square centimeter. The source was flat, about 1 cm. square. The zero point on the abscissa was the approximate edge of the metal as observed visually with the microscope objective and an ocular.

An improved model of the microscope is now under construction, which will allow visual viewing of the selected field to be more easily accomplished. The adjustment of selected field diameter will also be easier on this model.

Additional investigation of plastic phosphors is also planned, because of the ease with which thin sheets can be fabricated. Those presently available have only about 40 per cent the conversion efficiency of anthracene, but it is possible that this can be improved.

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The Relationship Between Microseism Period and Storm Position[1,2]

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IN THE COURSE OF SEVERAL YEARS of microseism study, a wealth of data on the relationship of microseism period to the position of the generating storm has been accumulated. Since the work was performed by many different record readers, including the writer, over many years, and before this presentation was anticipated, the results are considered to be quite objective. Hurricanes were used for the correlations in this study since they present a fairly limited generating area and are the only storms of significant intensity occurring in lower latitudes. The seismograph stations used in this study are listed in Table 1 together with their symbols used on the charts and the type and peak response of the instruments available.

Average period data from the 16 hurricanes listed in Table 2 were utilized in this study and only the values corresponding to the times of the six hourly weather charts were used. These values were plotted along each hurricane track at six-hour intervals for each station that recorded microseisms that could be attributed to the hurricane. A total of 353 observations

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[2] Lamont Geological Observatory Contribution No. 93.

Table 1.

Station and symbol	Instrument	Peak response
Antigua—A	Sprengnether	7 sec
Bermuda—B	Sprengnether (U.S. Navy)	7
	Milne-Shaw (USC&GS)	10
Cherry Point—CP	Sprengnether	7
Fordham—F	Galitzin	12
Guantanamo—G	Sprengnether	7
Halifax—H	Milne-Shaw	10
Miami—M	Sprengnether	7
Palisades—P	Columbia (Galitzin-type)	12
Richmond—R	Sprengnether	7
Roosevelt Roads—RR	Sprengnether	7
San Juan—J	Wenner	10
Swan Island—S	Sprengnether	7
Trinidad—T	Sprengnether	7
Weston—W	Long-period Benioff	1*
Whiting—WH	Sprengnether	7

* Has 60-sec galvanometer.

of such six hourly period averages were entered. Then each five-degree square crossed by one or more tracks was quartered. The number of observations in any quarter depended on the number of tracks crossing it and the number of stations within range. Hence the frequency of period observations in any quarter varied from 1 to 19; the average frequency was 6. Depth contours in Figs. 1 and 2 are in fathoms.

The circled numbers in Fig. 1 show the average microseism period for each quarter of a five-degree square for which any observations were available. In Fig. 2, the maximum period in each quarter is shown. It is evident from Fig. 1 that a distinct short-period zone of 2.5 to 3.5 sec occurs in the Gulf of Mexico. The continental shelf generally exhibits 3 to 4 sec microseisms. The elongated zone between Bermuda and the 1000 fm contour off the east coast seems to be characterized by 4.5 to 5.0 sec. The ocean area generally southeast of Bermuda is characterized by 5.5 to 6.0 sec. Figure 2 showing maximum periods, indicates two other zones of long-period in the region south-southwest of Newfoundland, just beyond the 1000 fm contour, and a more restricted area just north of the eastern West Indies arc. This figure also emphasizes more strongly the region of long-periods southeast of Bermuda. In Fig. 3, the number of observations in each quarter are shown to the left of the slant within each circle. The average deviation of period is shown to the right of the slant.

Although the period observations are plotted in the

Table 2.

1. Aug. 19, 1944	9. Aug. 31–Sept. 11, 1949
2. Aug. 26–Sept. 3, 1948	10. Oct. 14–20, 1949
3. Sept. 10–15, 1948	11. Aug. 14–23, 1950
4. Sept. 19–26, 1948	12. Aug. 20–31, 1950
5. Oct. 5–8, 1948	13. Aug. 31–Sept. 14, 1950
6. Aug. 21–27, 1949	14. Sept. 1–7, 1950
7. Aug. 24–28, 1949	15. Aug. 11–16, 1953
8. Aug. 26–Sept. 5, 1949	16. Sept. 4–8, 1953

quarter in which the storm center lay at a particular time, it should be realized that the generating area, or area of high wind intensity of a hurricane, usually covers an area of about five degrees square in lower latitudes, with the dimensions about doubling as the storm moves through middle latitudes. Hence for many of the values shown in Figs. 1 and 2, part of the

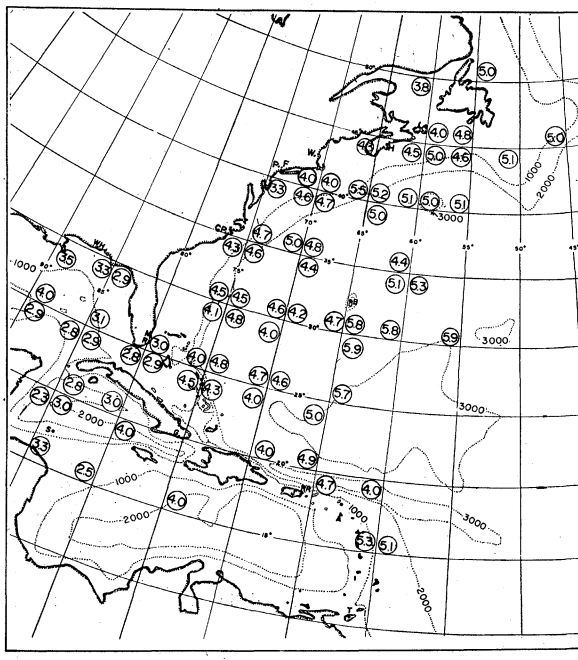

Fig. 1.

generating areas associated may have been over land, or part may have been over deep water and part over shallow. Some ambiguity is thus introduced for these cases if a real depth period relationship exists. Since it has already been shown (*1*) that coastal stations record a rather broad spectrum from coastal storms and a narrow spectrum from ocean storms, it must be realized that values near the continental margins may be averages of fairly broad period spectra, with the emphasis on the longer periods owing to the instruments used.

Figure 2, showing maximum periods, was plotted since a comparison of many records from several stations for distant storms has shown that the maximum period recorded may be more reliable for a position-period relationship. The signal to noise ratio for many of the stations, especially Bermuda, is sufficiently low at long periods that such microseisms, when of distant origin, require generation by very intense storms in order to show above high short-period microseisms of closer or more local origin. This has been verified by comparison of many instruments of different sensitivities at Palisades and Bermuda for the same ocean storms.

Although the general trends are the same in Figs. 1 and 2, more definite period "highs" are seen to exist in the regions south of Newfoundland and southeast of Bermuda in **Fig. 2.**

Bathymetric charts show that a small major deep area of 2900 fm to 3000 fm coincides with the period high south of Newfoundland, and that a major basin area of over 3000 fm lies to the southeast of Bermuda, coinciding with the period high there. A narrow trench of great depth (over 3000 fm) also coincides with the area of the less definite high just north of the West Indies. Here the trench is sufficiently restricted so that only part of a hurricane could overly it at any time, introducing some ambiguity in any period-depth relationship.

The short-period values in the Gulf of Mexico are not significantly changed by consideration of maximum periods. It may be significant that the only areas of 4.0 sec microseisms recorded for the Gulf in this study are in the central deeper region (near the 90th meridian), and in the deep region south of Cuba. Since the Gulf and Caribbean stations used similar Sprengnether instruments with peak response at 7 sec, it appears that the low values for this region are not a function of the instrumentation.

Further, since hurricane winds and resulting swell in the Gulf reach measured velocities and wavelengths respectively, not significantly different from those in the Caribbean and Atlantic, it is difficult to explain the observed period discrepancies on the basis of wave or swell generation, either in the storm area, or at the coast. The only obvious correlation seems to be one of depth of water, or possibly depth of water and sediments. The latter would explain period variations where water depths appear to be the same. Owing to the broad area of generation the exact relationship is difficult to ascertain at present.

The use of instruments with increased sensitivity at long-periods, and in particular the use of resonant seismographs, have indicated even longer periods for the deep area south of Newfoundland than the values given here. Similar instruments will be placed on Bermuda and the results of these studies published separately. It now seems well established that restricted storms or cold fronts over relatively shallow continental shelf waters generate periods from 2 to 4 sec.

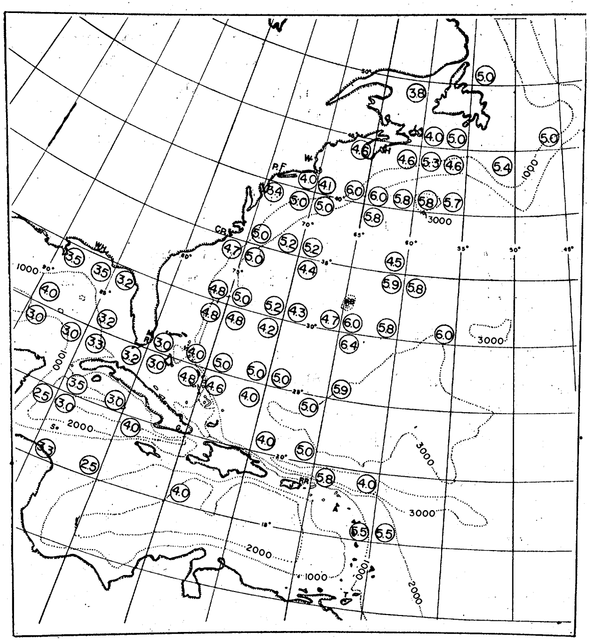

FIG. 2

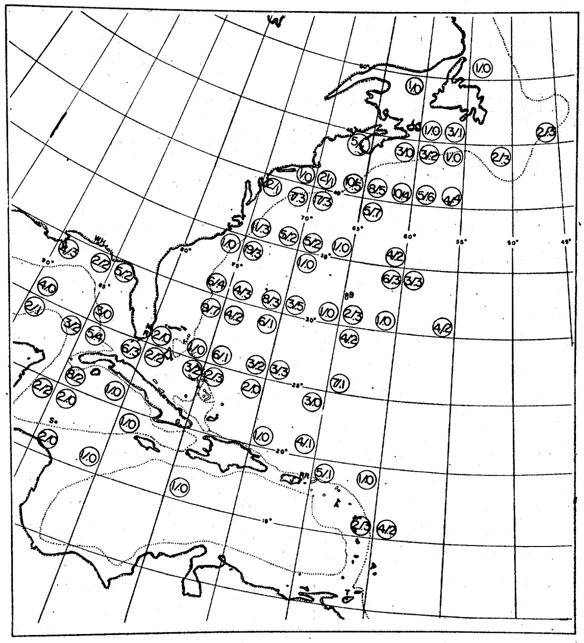

FIG. 3.

The effect of microseism path on recorded period seems to be unimportant in view of the generally small average deviations shown in Fig. 3. Since the precision of period measurements was 0.2 sec for most of the stations and as much as 0.4 to 0.8 for the rest, it is evident that most of the deviations lie within this reading error. Further, studies of numerous individual case histories (*1*) has shown apparently insignificant period differences at different stations from the same ocean storms.

In summary, a study of the distribution of microseism periods in the Gulf of Mexico, the Caribbean Sea, and the western North Atlantic Ocean recorded variously at 15 stations from 16 hurricanes shows that a definite relationship exists between microseism period and storm position. The only obvious correlation appears to be with water or water and sediment depth. The short periods characteristic of the Gulf of Mexico and the continental shelf tend to negate ocean waves or swell as the generating mechanism. R. Vestrich, M. Black, R. Katz, and J. Hirshman aided in reading the records and plotting data.

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