SOME GEOMETRICAL CHARACTERISTICS OF EARTHQUAKE MECHANISM AS INDICATED BY AN ANALYSIS OF THE S-WAVE

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A Digest Presented to the Faculty of the Graduate
School of Saint Louis University in Partial
Fulfillment of the Requirements for the
Degree of Doctor of Philosophy

1957

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The purpose of this dissertation is to determine from the seismograms of a tectonic earthquake the line of the motion which generates the observed S-waves. The theory of the pattern of S-wave vibrations due to a faulting mechanism is developed and explained. By noting certain geometrical relationships between the mechanism and the emitted S-waves, a method is theoretically derived which permits the determination of the line of the generating motion from observations of the generated S-waves. A practical procedure corresponding to the theory of the method is then devised. This procedure is applied to the data collected from the original seismograms of four earthquakes as recorded at seismic observatories throughout the world.

The results of the application of the proposed method of S-wave analysis should theoretically be able to determine which of the two solutions given by the P-wave method of analyzing the tectonic mechanism of earthquakes is the correct solution. The present work finds such poor agreement between the S-wave results and the previous P-wave solutions that it

is necessary to conclude that one or more of the following must be true: either the assumption that for every earthquake the phase identified as S wave from the particle motion diagram corresponds to the first P-wave motion is wrong; the P-wave method is incorrect or inadequate; the S-wave method is incorrect or inadequate.

While the first condition is a possibility, it is opposed by much contrary evidence so for the present it is not considered as probable, only possible. To select between the other two conditions necessitates a discussion of the relative merits, defects, and potentialities of the two methods.

The P-wave method is defective in several aspects; first, because of the inductive procedure involved; second, because of the lack of a criterion to ascertain that the observed earthquake has the assumed mechanism; and third, the inherent impossibility of stating which of the two nodal circles actually represents the fault plane. At present it is only applicable to earthquakes having a magnitude greater than $6\frac{1}{2}$. Despite all these difficulties, it is apparently useful in practice.

The S-wave method is based on a deductive theory; because of this it must be considered to have the greater potentialities. The present investigation has definitely shown that the S-wave may be detected on seismograms by the use of the synthesized particle motion diagrams. The coherency of the S-wave results definitely shows that consistency in S-wave data does exist and therefore the S-wave can be profitably investigated experimentally. The theory of the proposed S-wave method of analyzing the mechanism of tectonic earthquakes has pointed out some geometrical relationships between the recorded S-wave vibration and the faulting mechanism which permit the determination of the line of the faulting motion at the focus of the earthquake. Such information should permit the choice of the correct solution from the two P-wave solutions. Further, although previous studies of initial direction of motion have indiscriminately used velocity data with an acceleration theory, a criterion has been developed herein which permits the use of S-wave velocity data with the acceleration theory. Finally, the proposed method of using S-wave data is sufficiently analytical that a standard deviation may be determined for the result -- a considerable advantage over the P-wave method. The major defect of the S-wave method is the assumption that the ratio of SV/SH does not vary during transmission of the vibration along the ray path. This problem deserves future study.