The Illinois Earthquake of November 23, 1939

and

Crustal Structure East of Saint Louis

by

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INTRODUCTION

On the morning of November 23, 1939, at about 9:15 C.S.T. an earthquake was felt throughout the southern and central portion of Illinois, beyond the western state line of Missouri and in several towns of southeastern Iowa. In Saint Louis, Missouri, and East Saint Louis, Illinois, the nearest large city, considerable excitement was aroused. A rapid survey of the reports indicated, however, that no serious damage had been done anywhere throughout the affected area.

The Department of Geophysics of Saint Louis University began at once a scientific study of this shock. On the basis of the seismograms of the Saint Louis and Florissant stations and of a report from the Reverend Alphonse R. Schmitt, S.J., Director of the Seismological Observatory at Loyola University, Chicago, the epicenter was tentatively placed at $38^{\circ}.2$ N, $89^{\circ}.9$ W. Questionnaire cards were then mailed to postmasters within a radius of 50 miles of this location, and to postmasters at selected towns throughout Illinois, southern Wisconsin, western Indiana, northern Kentucky, Arkansas, Missouri, Kansas, Nebraska, and Iowa. Requests for the loan of seismograms were dispatched to seismological observatories within a radius of 1000 miles.

The replies to these various requests as well as the records of the four observatories (Saint Louis, Florissant, Cape Girardeau and Little Rock) conducted by the Department of

Geophysics of Saint Louis University, soon indicated that sufficient material was on hand to justify a detailed study of this earthquake. Such a study seemed all the more advisable because one of the primary reasons for establishing the network of seismograph stations near St. Louis had been "to determine if possible by suitable research the influence of local structure on the seismic waves generated by earthquakes," and "to use this data for detailed studies of strong local earthquakes and those with unusual characteristics and to combine with investigations of this type questionnaire surveys to determine affected areas."(1)

Furthermore, this shock resembled the majority of near earthquakes occurring east of St. Louis in having more phases recorded at seismic observatories than those occurring in southern azimuths. These phases were recorded at stations such as Chicago, Cleveland, and Buffalo which the earthquake waves reached after traversing the structure east of the Illinois Basin. As pointed out by Walter,(2) one might expect the basement structure of this area to differ from that south of Saint Louis because it is represented near the surface by a synclinal basin instead of an anticlinal dome.

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1. Heinrich, R. R., A Contribution to the Seismic History of Missouri, Master's Thesis, St. Louis University, 1938, p. 3.
2. Walter, E. J., Earthquake Wave Velocities and Travel Times and Crustal Structure South of St. Louis, Maters Thesis, St. Louis University, 1940, p. 2.

It was decided, therefore, to investigate the crustal structure east of St. Louis by a study of the Illinois earthquake of November 23, 1939 and of a number of other well recorded earthquakes whose epicenters lay east of the meridian of St. Louis. This investigation is the subject of the present thesis.

Chapter I, therefore, will summarize and analyze both the macroseismic and instrumental records of the Illinois earthquake of November 23, 1939. Chapter II will contain the determination of the longitudinal wave velocities from this and other eastern earthquakes. Chapter III will present the crustal picture required by these velocities and the actual arrival times. Chapter IV will give the velocities and crustal structure determined by a study of the transverse waves. Finally, the arrival time tables for both waves will form the subject of Chapter V.