EARTHQUAKES

by

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The author's aim has been to give the reader a clear idea, in the present state of science, of what constitutes a seism, a phenomenon which is a chapter of physics : that of the propagation of elastic waves both inside and on the surface of the earth. The study of earthquakes is also connected with many chapters of geophysics, geodesy and oceanography. On this score, it is of interest to hydrographic surveyors and readers of this Review.

The work is divided into two parts, the first of which deals with the causes of earthquakes and the second with their effects.

One of the immediate causes of earthquakes may be defined as a return to stability through a sudden release of the unstable compartments which go to make up the terrestrial globe. Eminent seismologists are now of opinion that radioactivity may be considered as one of the possible primary causes of these phenomena. The *hypocentre* is the seat of the earthquake; it may be located at a depth of several hundred (600 to 700) kilometres, reaching even possibly as much as one fifth of the earth's radius. The *epicentre* is the meeting point of the earth's radius passing through the hypocentre, with the earth's surface.

In chapter II of the second part, with a view to determine the origin of *noises* due to earthquakes, which might undoubtedly throw so much light on subterranean geology, the author advocates the use of instruments designed on the lines of those employed for acoustic ranging. He attributes most of these noises to the *release of tensions.*

Chapter III, which is of particular interest to us, deals with the relationship of seismology to other parts of geophysics. As regards meteorology, it was possible to find that " the main *microseismic* disturbance is related to the deep nuclei of barometric fall moving rapidly and shifting above the seas ". The shock of the *swell* on the coasts may also be set forth as a cause of microseisms (1), and particularly shocks on escarpments, especially submarine ones. Here is a process which might surely commend itself to storm warning services, when the geological conditions of the sites of microseismic disturbance recording instruments are found favorable.

Many seats of seismic disturbances (2) and even of eruptions are found in the open sea, and it is with submarine seismic disturbances that can be connected seismic waves called *raz de marée* in France, *tsunami* in Japan and *maremoto* in Italy.

These waves are generally produced by a subsidence of the ground and mostly result in a withdrawal of the sea followed by its violent destructive return.

On the basis of A. Imamura's investigations, the author cites the main *seismic disturbances* and *tsunamis* which so often devastated the east coast of Japan; he indicates the conditions required for the occurrence of these disastrous accidents which are rendered more frequent by the existence of the great Tuscarora trough and by the shape of the very much cut up coast bays. Water walls-forming waves, 10 and even 24 and 30 meters high were observed in that area. He also recalls the main *maremotos* that occurred in Chile, where this phenomenon assumes a generally slower and therefore less disastrous motion, although the sea has been known to rise as much as 6 meters above the highest tides.

In chapter IV the author considers the relationship of seismology to deep geology. Deep seats (more than 300 km. from the surface) are fairly rare and are to be found mostly in the area N.-W. of Himalaya and Hindu-Kush or in that of Mindanao and the North of the Celebes or in Japan.

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(1) See : *Hydrographic Review,* vol. XIV, n° 2, page 271 and vol. XVIII, n° 2, page 82.

(2) See : *Hydrographic Review,* vol. XVI, n° 2, page 23. — See also : *Annales Hydrographiques* 1919-20, page 241, an article by E. Rothé on seismic disturbances at sea.

These seismic disturbances are generally located on a circumpacific belt including the submarine troughs of Tonga and Kermadec.

Normal seats (within 60 kilometers from the surface) of the Pacific Ocean are generally situated on the edge of the continental plateau.

There are under the earth's crust differences in temperature which give rise to matter movements, some upward, others downward and so-called horizontal compensating currents whose very slow speed might be 1 cm. per annum. *Pekeris* estimates the difference in temperature under continents and under the ocean at 200°.

Slow convection currents might be sufficient to account for many anomalies of gravity in relation to isostasy and particularly the excess of gravity generally found above the deepest oceanic basins, as indicated by Vening Meinesz.

A correlation has been ascertained between the seismicity and variations of the magnetic field. In particular, alterations occurring through magnetic anomalies may be attributed to a change in the physical properties of a more or less deep layer in consequence of magma shifting. These alterations are greatest in the vicinity of the epicentre.

Geodesy is an essential aid to seismology for ascertaining and measuring ground shiftings in various directions. Shiftings which occur at the same time as seismic disturbances are also accompanied by very slow motions which may last a few months or decades.

We can also see a possible relation between gravity anomalies and the origin of earthquakes.

All these investigations go to show a connection between seismology and most problems of geophysics. While being of special interest to geologists and students of the earth's crust structure, they cannot fail to appeal to scientists who are engaged in studies on isostasy, gravity, terrestrial magnetism, or geodesy. So that when International Unions were created, the same union quite rightly embraced these various sciences.

P. V.