WHAT CAUSES EARTHQUAKES?

(From a talk broadcast from 4YA by DR. F. J. TURNER, Lecturer in Geology at the University of Otago)

SENSITIVE modern instruments distributed widely on all the continents show that the outer part of the earth trembles almost constantly, even though the majority of the tremors recorded by instruments—seismographs—are too slight to be perceived by human beings. If you watch the seismograph at the Kelburn Observatory on a windy morning, you will see the continuous record of the earth's vibration under the impact of heavy seas breaking on the coast some miles away. In New York the pavement vibrates continuously under the rush of wheeled traffic. But there are also tremors that arise from natural movement within the rocks of the earth's crust. The majority are weak, but some reach destructive violence. All are termed *earthquakes*. Thousands of destructive earthquakes have been recorded during the tiny fraction of geological time comprised by the span of human history. And a considerable mass of earthquake lore — much of it illogical, inaccurate and tinged with magical or religious belief—has gradually accumulated. Human interest in earthquakes has ever been emphasised by the terrifying nature of such events—the sudden unheralded impact, the destructive effects on life and property, and the somewhat mysterious origin of the phenomena.

DR. F. J. TURNER
The ancients said it was just wind

In this evening's talk I propose to say something of the cause and results of earthquakes, of the distribution of seismic activity in New Zealand, and of the nature of earthquake vibrations, as revealed by the science of seismology, and the light these vibrations throw upon the nature of the earth's interior.

Origins

First, then, the origin of earthquakes. Philosophers of the ancient world were content to attribute earthquakes to rather fantastic causes. Aristotle, for example, taught that they originated in the rush of winds through vast subterranean caverns. But we can pass on to more modern times, when it was found that earthquakes tend to recur in well-defined zones on the earth's surface—seismic zones — such as that which borders the Pacific Ocean, and incidentally passes through New Zealand. Some of these, such as The Circum-Pacific zone to which I have just alluded, are also regions of volcanic activity, and consequently there is a strong though erroneous popular belief that volcanic activity is the cause of earthquakes. Actually, the two sets of phenomena are mutually independent, but they both may be traced to a common cause. The rocks of the earth's crust are constantly in a state of strain. This is periodically relieved along geographic zones of crustal weakness, where the rocks tend to buckle and fracture along mountain folds and fault zones. Local melting of deep-seated rock, and squeezing up of the molten material so formed along great fractures leads to volcanic activity at the surface in such regions; but, quite independently, the accumulated strain in the crust may be relieved by sudden movement of earth-blocks along fault-lines, and the vibrations set up in the surrounding rocks by such movements are what we know as earthquakes. This is why earthquakes tend to occur in regions where volcanoes are active.

A Typical Case

Let me describe a typical instance of the events leading to an earthquake. The high mountain ranges of New Zealand, such as the alpine system of the South Island, or the Tararua and Rimutaka Ranges, are composed essentially of giant blocks of rock that have been lifted bodily to their present elevation—some thousands of feet—by vertical movements upon fault-planes whose individual outcrops on the surface can often be traced for 50 or 100 miles. This elevation has been a slow process, spread over a period of time reckoned in hundreds of thousands of years. Among the score or so of northward-trending major faults and fault-zones that bound the mountain blocks of Nelson Province is the one that runs along the eastern face of the Lyell Range, a few miles west of the township of Murchison. On June 17, 1929, there was a sudden movement by which the earth block lying on the Murchison side of the fault zone was raised nearly 15 feet, and moved laterally some six feet in a north-westerly direction. For years stresses had been accumulating in the Nelson mountain systems, until at last the great rock mass had yielded along the fault of which I have spoken. Release, when it came, was instantaneous—like the springing of a steel trap. And the resultant jolt, accompanying the sudden displacement of a whole mountain range by 15 or 20 feet, threw the surrounding sector of the earth's crust into the violent vibration which came to be known as the Great Murchison Earthquake. As is usually the case with violent earthquakes of this kind, the main shock was followed during the rest of June 17 and the next few days by many relatively minor

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