

SEISMOLOGY

Your Chances of Death by Earthquake

Persons Living East of Rockies Have One Chance In Five Millions of Dying Thus Within Any Single Year

By WATSON DAVIS

EVERY DAY somewhere in the world there is an earthquake. Every so often there is trembling of the earth so severe that houses are destroyed and human lives are lost, as recently happened at Santiago de Cuba, the city famed for its severe earthquakes in the past as well as the shaking that was given the city by Roosevelt and his rough riders.

When next you read the news of a severe earthquake in some distant land and look apprehensively at the ceiling above you, wondering if the solid earth will prove traitorous in your own home town, remember these figures:

There is only one chance in five millions that in any one year you will be killed by earthquake, provided you live in the U. S. A. east of the Rockies.

There is only one chance in five millions that in any particular year the area about your home extending for 25 square miles will be stricken by a badly destructive earthquake, provided you live east of the Rocky Mountains.

These mathematical chances have been computed by John R. Freeman, Providence, R. I. engineer, who has just completed a survey of the earthquake risk in the country. If you live on the Pacific coast, the chances are about one in a million, and perhaps greater in certain coast sections which are admittedly an active earthquake region.

The danger from earthquakes is thus extremely small in comparison with hundreds of every-day situations and dangers, such as getting run over by automobiles.

But this does not mean that this country is immune from earthquakes, even in the area where no destructive quakes have been recorded in all the years that white men have been on this continent.

The experts confidently expect that somewhere in the 2,500,000 square miles east of the Rockies once in each century there will come a destructive earthquake resembling the shock that visited Charleston, S. C., in 1886. Within each century there is also ex-

pected another quake causing smaller damage.

West of the Rocky Mountains, particularly in California, the earthquake hazards are many times greater than those estimated for the eastern and central states.

History and geology show, according to Mr. Freeman, that somewhere within the State of California a seriously destructive earthquake like the one at Santa Barbara in 1925 should be expected at some one locality on the average of about once in from twenty to fifty years. These earth disturbances will probably occur not far from the ranges of hills and mountains near the coast. Less serious earthquakes are to be expected in California at more frequent intervals.

Destruction Confined

While we live with these probabilities hanging over our heads, it is somewhat comforting to know that even the great earthquakes do not spread destruction over very large areas. Mr. Freeman estimates that the one great quake of the century to be expected east of the Rockies will be felt destructively over an area of only twenty-five square miles. In that region, two-thirds of the chimney tops will be shaken off houses, and perhaps half of all the houses will have their plaster and partitions cracked. There will be a score or more poorly designed or poorly built structures which will collapse wholly or in part, causing some loss of life of persons in the houses or on the sidewalks outside.

Records assembled by Mr. Freeman show that only about 930 people have been killed by earthquakes within the United States and Canada during the last century. In the next century he estimates that there may be 2,000 killed by earthquakes occurring east of the Rockies, and there may be an equal or even greater number lose their lives on account of earth shocks in the Pacific Coast region.

Should a great earthquake come during business hours to a large city like Los Angeles, the death toll may run to many thousands. And the blood of

these earthquake victims will be largely upon the hands of the architects, builders and public officials who have allowed the construction of top-heavy buildings.

Mr. Freeman describes how he looked from the window of a tall office building in Los Angeles and imagined what would happen if an earthquake came.

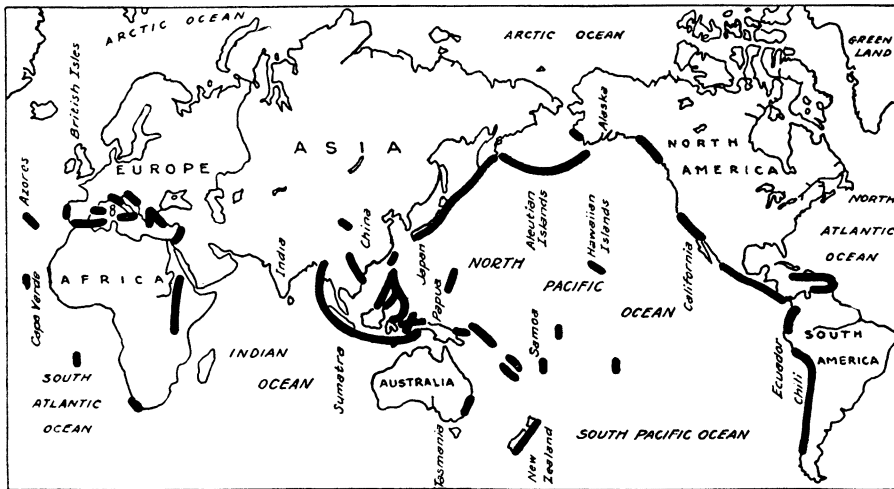
"I saw on a principal street the ordinary midday sidewalk crowds of more than a thousand people," Mr. Freeman said. "They walked beneath tall unbraced brick parapet walls and false fronts designed to make three or four-story buildings look taller. A severe earthquake, such as seems certain to occur in this region sooner or later, would instantly topple these walls on the heads of people below, killing literally hundreds."

Contrary to popular opinion the danger to human life from earthquakes in the United States is greatest not inside houses but on the sidewalks. This is the case because many American buildings are constructed with brick and other materials that a slight shaking would detach and throw down upon the sidewalks and into the streets. There are parapets upon the tops of buildings intended to make them look taller than they really are. Veneers of brick, tile and thin slabs of stone only weakly tied to the walls of the building and heavy overhanging cornices will under even a slight earthquake



LOCATING AN EARTHQUAKE

Making use of seismological records from widely separated stations, N. H. Heck, of the U. S. Coast and Geodetic Survey, determines the point on the earth's surface directly above the focus of the quake.



DANGER LINES

Map with heavy black markings which indicate the world's principal earthquake regions.

shock shake loose and fall to earth.

Loss of life has happened to be relatively small in the great earthquakes experienced by the United States because these have come outside of working hours when few people were on the streets. This may not be the case in the next great earthquake. There is no reason for earthquakes happening more often at night or outside of working hours. There is a chance of one in three (the ratio between eight hours and twenty-four) that the next great earthquake in a populated American city will come when many people are on the sidewalks. Down upon them will come loose bricks and stone, and there will be many fatalities. In the closely built business districts of most American cities life during an earthquake is much safer inside the buildings than immediately outside.

Of course, there are some buildings more dangerous to the lives of people inside the building during an earthquake than to those outside. These are structures in which walls are made of structural units weakly cemented together or with fronts or curtain walls insecurely fastened to the main body of the structure.

Outside of the United States the loss of human life in great earthquakes, aside from that caused by fire following the quake, has occurred largely inside of buildings of top-heavy construction which, falling, crush those within. In Italy, Greece, Central America, and Chile great losses of life have occurred because many of the buildings were made of stone feebly held together with weak lime mortar, and floors and roofs were heavy and only weakly supported.

Mr. Freeman recalls that the Mes-

sina-Reggio Italian earthquake of 1908 killed 100,000 people largely because this type of building predominated. If, Mr. Freeman says, an army equal in numbers to all the inhabitants of the stricken Italian cities had been encamped in tents on the same site probably not a single life would have been lost as the result of this earthquake.

To protect the American public from earthquake danger due to poor building, Mr. Freeman and other engineers are urging that architects, engineers and builders, as well as city officials, realize the necessity of building earthquake-proof structures. Only a small additional cost would be required to make practically all modern buildings fairly safe against a severe earthquake.

Earthquake Proof

Almost any building, according to Mr. Freeman, can be made earthquake proof if the designer and builder will provide sufficient strength so that the building will withstand a horizontal force, at each floor level, equal to a tenth of the weight of the building above that level. If all buildings were planned and erected with this provision as a rule, thousands of lives would undoubtedly be saved in future years.

If leading seismologists and earthquake experts were asked "what large American city is likely to be visited by a destructive earthquake?" many of them would answer:—"Los Angeles."

While California is admittedly in the active earthquake area of the world and the rest of the United States is not, this does not mean that earthquakes are impossible in other large American cities. The Charleston, S. C. earthquake of 1886 occurred in an area in which de-

structive earth shocks had never before been recorded. In 1811 in a then unsettled Mississippi Valley area, which now includes Memphis, Tenn., there occurred the New Madrid earthquake which is considered the most severe that the United States has ever experienced within the historic period. Boston in 1755, when it was a very small city, had a destructive earthquake which ranks among the largest felt within this country. Quebec and the lower St. Lawrence River experienced severe quakes in 1633, and in 1925 there was an earthquake which did considerable damage in the same region. While the destructive effects of the severe submarine quakes located on the Grand Banks off Newfoundland in 1929 were confined to the breaking of twelve trans-Atlantic cables, the tidal wave that it caused drowned thirty Nova Scotians at one point. If this quake had occurred upon land it would have undoubtedly caused much greater loss of life.

Confronted with this record of destructive earth disturbances in areas not popularly considered to be subject to earthquakes, there is nevertheless some comfort in the opinion of experts that nothing worse than the most severe past earthquakes, such as the San Francisco earthquake of 1906, the New Madrid earthquake of 1811, and the Great Owens Valley California earthquake of 1872, appear to be even remotely probable in the United States or Canada in the future.

As to New York, America's largest city, with its towering skyscrapers on the island of Manhattan, Mr. Freeman thinks it one of the safest spots from earthquake hazard along all of the Atlantic seaboard. This is because of New York's rigid bed-rock foundation which lies close to the surface and its favorable record of freedom from noteworthy quakes throughout a period of three hundred years.

The actual motion of the earth that causes damage during an earthquake is very slight. It is estimated that the vibration is seldom more than a quarter or half an inch in extent, and even on soft ground where damage in the San Francisco earthquake was greatest, the total movement back and forth probably did not exceed one inch. Engineers and geophysicists believe this to be true even though eye-witnesses to earthquakes have claimed to have seen ground rise and fall several feet. These very large movements of the earth are attributed to fright rather than actual movement. (Please turn to page 312)

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Earthquakes occur because the earth is still growing. The outer shell of the earth, some forty to sixty miles in thickness, is cracked in thousands of places. As many thousands and millions of years of geologic time pass, blocks of the crust of the earth slip upon one another. A motion of only a few thousandths of an inch is sufficient slippage to cause a great earthquake.

When an earthquake takes place anywhere in the world it sends subterranean signals. These can be received and recorded by seismographs and interpreted by earthquake experts. In many cases long before telegraphic dispatches carrying the news of destruction and loss of life can reach the outside world, scientists are able to tell that an earthquake has occurred. Through an earthquake reporting service operated by Science Service with the cooperation of the United States Coast and Geodetic Survey and the Jesuit Seismological Association, it is now possible to locate definitely the center of each earthquake a very few hours after it happens. The earthquake sends its own dispatches to the seismologists who have the proper instruments and their experience allows them to read the story of the earthquake in these earth-conducted messages.

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PSYCHOLOGY

Lack of Ability Is One Cause of Illiteracy

LACK of educational opportunity is not entirely to blame for illiteracy in this country; many adults who have not completed the elementary school failed to do so because of relatively low native capacity for learning, it was indicated by a report of Dr. J. W. Tilton of Yale University to the New York Branch of the American Psychological Association.

Dr. Tilton's conclusion was based on tests given at a summer school for adults in grades 1 to 8 conducted by the South Carolina State Department of Education. Standard tests were used to measure progress in learning reading, writing, arithmetic, and spelling, and intelligence tests were also given. Those who had had the least schooling made the least gain and had the lowest average mental age.

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PHYSIOLOGY

Doctors Measure Blood Flow Without Cutting Open Vein

THE AMOUNT of blood flowing in veins and arteries can now be measured without cutting open the blood vessel, through the use of a "thermostromuhr" apparatus constructed by Drs. J. F. Herrick and E. J. Baldes of the Mayo Foundation. The method was invented by Dr. H. Rein, physicist of the University of Freiburg, Germany. It has not yet been applied to measurement of blood flow in man.

This result, useful to physiologists in estimating the efficiency of various organs of the body, has been achieved by steadily supplying a small amount of heat to the blood vessel and noting how much the temperature rises at that point. The faster the blood is flowing the smaller will be this artificial increase in temperature. It has then been possible for Drs. Herrick and Baldes, knowing the amount of heat supplied and the rise

in temperature, to calculate the volume of blood passing per second.

A comparatively simple operation is necessary to insert the necessary electrical terminals in the neighborhood of the vein. Two metal plates pressed on opposite sides of the blood vessel carry a high-frequency alternating current and thus heat the vein. This "diathermic" method of heating the body tissues by high-frequency electricity is widely used by the medical profession.

The temperature, which never rises more than a tenth of a degree, is measured with the help of a thermocouple, an electrical device which conveys the temperature change to an electrical recording instrument.

The flow of blood to the kidney under various conditions has been successfully measured here by the method.

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ANIMAL PATHOLOGY

War Against Foot and Mouth Disease Shifts to New Area

SOUTHERN California's war against foot and mouth disease shifted suddenly during the week-end of May 8 to San Bernardino County, forty miles from the scene of its first outbreak in Orange County and almost directly east of Los Angeles.

Near the town of San Bernardino a herd of three thousand infected and exposed garbage-fed hogs have been discovered, killed and buried. An area six miles square has been placed under strict quarantine by U. S. Department of Agriculture authorities, to prevent the movement of any animals or materials that might carry the disease.

Orange County, south of Los Angeles, now presents the appearance of a clean-up. A total of 16,300 hogs in several herds have been destroyed there since the first discovery of foot and mouth disease during the last days of April. Bright, warm, dry weather prevails, and this is always favor-

able to the efforts of the clean-up men.

As yet it has not become necessary to ask Congress for additional funds for use in the campaign. Dr. John R. Mohler, chief of the bureau of animal industry of the U. S. Department of Agriculture, stated to Science Service that the emergency fund left over since the California outbreak of 1924 has not yet been exhausted, and that thanks to the present low market price of livestock it may be possible to reimburse the farmers for the hogs which have been killed without asking for more money.

A feature of the present outbreak has been the confinement of the infection to hogs. There are very few cattle in the quarantined areas, and of these only thirty-three have been destroyed. None of these cattle actually had the disease, but they had been exposed; and since they were all dry cows of little value they were killed as a safety measure.

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