

Earth Shocks Are Felt in Two Counties

Quake Rocks Area East of Malvern--Leola Re- ports Tremor.

Democrat 11-17-30
Malvern, Nov. 17.—(Special)—An earthquake was noted in the eastern part of Malvern some time between 6:15 and 6:30 Sunday morning and is said by those who observed it to have continued for about two minutes. Some excitement was occasioned and many persons left their beds, but no real damage was reported and the shock was not repeated.

The shock was felt at Damascus and Huskey Creek, small settlements south of here, and at the last named place three window panes were broken in the home of Mrs. Lee Anna Fitzhugh. The shock was distinctly felt at Perla, a half mile east of here, where there is a brick plant and other industries.

Leola, Nov. 17.—(Special)—A distinct earthquake shock was felt here at 6:30 Sunday morning. Persons throughout this community who were not up were aroused from their sleep and many of them ran from their houses much terrified. There was only one shock and it lasted only a few seconds.

There is no blasting in this vicinity nor was any sound of a blast heard previous to or following the shock. No damage was done. A report from Malvern indicates that the shock was felt there.

Seismograph Installed By College Here

First Tests of Instrument to Record Earth Shocks Completed.

Democrat 12-7-30
The seismograph, which was obtained several months ago for Little Rock College, was installed yesterday and the first test of the instruments was being made last night. The test will be completed today.

Plans for the seismograph were made about a year ago and a dark-room and vault were constructed in the basement of a building at St. John's Seminary in Pulaski Heights. The instruments have been at the college several weeks, but could not be installed until a clock had been made especially for the station.

The Rev. James B. Macelwane, S. J., director of the department of geophysics of St. Louis University, and the Rev. J. S. Joliet, assistant professor of seismology at St. Louis University, arrived here yesterday morning and spent the day with students of the college and seminary installing the instruments. The Rev. John J. Healey, registrar of Little Rock College, will have supervision of the seismograph.

Most of the day yesterday was spent in installing the instruments and adjusting them. Adjustments will be made as long as necessary, it probably taking a year or longer.

The instruments consist of two seismometers, two drums carrying photographic film, the clock, a radio and special equipment used in operation of seismographs. Each seismometer is operated with a drum which records any movements of the earth. One seismometer records movements of the earth in an east-west direction, the other recording north-south movements.

Movements of the earth are detected on the seismometer and are transferred to the photographic film by a small ray of light that is adjusted properly. If there are no earth movements, the ray of light makes a continuous line across the film.

The drums around which the film is placed turn over once in 24 hours by an intricate system of weights and pulleys. The clock is used to register the passing of each minute and hour by marking the film. The clock was made specially for the seismograph by a Chicago company after the Rev. Macelwane had spent some time in Europe in an unsuccessful search for the type he wanted.

The radio will be used to set the clock with the time signals broadcast three times daily from the Naval Radio Station at Arlington, Va. The time signals are broadcast at 3 and 11 a. m. and 9 p. m. The clock will be corrected each day at 11 a. m. until it is adjusted so that it will not need correction. It then will be checked daily.

*Other articles on seismograph
in scrap book under
"miscellaneous".*

The potential earthquake risk in the Mississippi valley has attracted much attention on the part of seismologists, according to the Rev. Macelwane. The New Madrid area in northeastern Arkansas, southeastern Missouri, southern Illinois, western Kentucky and Tennessee and northwestern Mississippi has been subject to earthquakes many times.

The most serious of the New Madrid earthquakes came shortly after 2 a. m. December 16, 1811. This was followed by another January 23, 1812, and at intervals by others. It is estimated that between December 16, 1811, and March 15, 1812, Jared Brooks of Louisville, Ky., noted 1,873 distinct shocks.

During the years 1815 to 1923, there are known to have occurred 20 earthquakes in Missouri, 27 in Tennessee and 28 in Illinois.

The department of geophysics of St. Louis University, immediately on its organization in 1925, fixed upon the study of earthquakes in the New Madrid region as one of its major research projects. With the co-operation of various agencies and organizations, encouraging progress has been made. The Mississippi River Commission, the United States Coast and Geodetic Survey, the Weather Bureau, the Postoffice Department and the United States Army in its flood control work have assisted.

The station of Little Rock College will be operated in conjunction with the work of St. Louis University, the results to be published in the name of the local institution. It will be a part of some 260 stations on an international list that exchange reports and information.

A third station will be located on the southeast side of the New Madrid area as soon as a suitable site is located. The Little Rock station is at the southwest side, while the station in St. Louis is at the northern edge. The reports of the three stations will be combined in an extensive study of the area.

Several local business firms and professional men assisted in the installation of the seismograph and in preparing the vault for its location. The Rev. Healey said he wished to thank each one. The following were the ones who assisted: Arkansas Foundry Company, Arkansas Power and Light Company, George C. Branner, state geologist; Arkansas Water Company, Darrach Company, Little Rock Gas and Fuel Company, E. F. Connelly Paving Company, W. Terry Field, L. J. N. Kellher, D. W. Dickinson, Finley-Turner Tire and Service Company, Justin Matthews, Big Rock Stone and Material Company, Arkansas Electric Company, 555 Tire and Service Company, the Right Rev. Msgr. H. H. Werneke and the Missouri Pacific Railroad.

FINAL TEST GIVEN TO SEISMOGRAPH

Instrument at Little Rock Col- lege Is Operating Sat- isfactorily.

Gazette 12-9-30
The Rev. James B. Macelwane, S. J., director of the Department of Geophysics at St. Louis University, and the Rev. J. S. Joliet, assistant professor of seismology at the school, left last night for St. Louis after supervising the installation of a seismograph laboratory Saturday and Sunday at Little Rock College. The seismograph is one in a chain of more than 260 in various parts of the United States.

The two members of the St. Louis University faculty, authorities in the field, came to Little Rock last week to supervise the installation of the instrument and to conduct initial tests of the seismograph. The tests were begun Sunday and completed yesterday. The instruments were declared to be working satisfactorily, although no unusual earth movement was recorded on the first films tried.

The observatory will be supervised by the Rev. John J. Healey, president of Little Rock College. Minor adjustments may be necessary for the seismograph for several months, but these will be handled by the Rev. Mr. Healey. Use of the federal radio station at Arlington, Va., will be made to adjust the timing of the instrument at 11 a. m. each day.

St. Louis Seismograph Records Earth Shocks.

12-10-30
St. Louis, Dec. 9.—(P)—An earthquake was recorded on the seismograph at St. Louis University today. The disturbance apparently occurred approximately 1,530 miles from St. Louis in a southwesterly direction.

The earthquake recorded at St. Louis University yesterday made no impression on the seismograph at Little Rock College, a representative of the college said last night.

Mysterious Shaking of Earth's Crust Studied at Harvard.

Gazette 12-18-30
Cambridge, Mass., Dec. 17.—(P)—Mysterious shakings of the earth's crust, as yet unexplained by science, have held attention of the Harvard seismograph station for four days.

Since Sunday, instruments showed, the ground has moved back and forth rhythmically and constantly. The shakings reached a climax late Tuesday Today, they were decreasing in severity and Dr. L. Don Leet, in charge of the station, expected that they would die out during the night.

Dr. Kirtley F. Mather, professor of geology at Harvard University, and Dr. Leet, said that as yet no satisfactory answer to the phenomenon existed. These unexplained oscillations have been observed from time to time by seismograph stations all over the world.

The oscillations recorded since Sunday at Harvard have been more severe than those usually observed. About six seconds were required to complete each swing of the rhythmically moving earth. While each movement was not greater than a couple of ten thousandths of an inch in either direction, the announcement said, "even that represents tremendous forces at work to maintain such motion for hours and days." The technical name for these microscopic shakings is microselsms.

Years of study, Dr. Mather said have evolved three theories. The first is the microselsms are caused by severe storm waves on the ocean beating upon the coasts.

"A second theory," Dr. Mather said, "is the shakings are caused by very distant earthquakes taking place on the other side of the globe."

"The third theory," Dr. Mather continued, "is they are caused by adjustments in the deep interior of the earth."

QUAKE RECORDED BY SEISMOGRAPH

Intensity, Distance and Loca- tion Not Registered, However.

Gazette 1-28-31
The seismograph at the Little Rock College observatory on Pulaski Heights yesterday registered an earthquake which began at 2:39 p. m. and continued for about an hour, it was reported last night. Some of the equipment for the seismological observatory has not yet been completed or installed, and it was impossible to determine accurately the intensity, distance and approximate location of the disturbance.

Short wave radio equipment will arrive Friday and will be utilized as soon as possible, those in charge of the observatory said. Several other earthquakes have been recorded by the college seismograph.

QUAKE RECORDED BY SEISMOGRAPH

Instrument Here Believed to Have Felt Shock in New Zealand.

Feb. 7-1931 Gazette
Between 5:06 and 7:29 p. m. on Tuesday, when the disastrous New Zealand earthquake occurred, distinct disturbances were recorded on the seismograph at Little Rock College, a check of the records yesterday revealed. The instrument, for recording unusual movements of the earth, was installed in a specially built room at the college several months ago, and daily recordings are made.

Operators of the instrument last night said they could not be certain the disturbances noted Tuesday were those caused by the New Zealand earthquake, as the Little Rock seismograph does not record location of local movements. However, by computing the differences in time between Little Rock and New Zealand, and by comparison of the duration of the shocks, it was said it is possible that the movements of the earth recorded here were caused by the earthquake.

A short wave radio receiving set, which has been under construction since the seismograph was installed, will be placed in operation at the station today. It will be connected with the seismograph instruments and will record exact time with each movement. The receiving set will "pick up" time signals from the government station at Arlington, Va. It will be tested tomorrow.

SEISMOGRAPH HERE RECORDS TREMORS

Believed to Have Resulted From Quake in Managua, Nicaragua.

Gazette 4-1-31
Earth tremors, believed to have resulted from the earthquake which destroyed the city of Managua, Nicaragua, were recorded by the seismograph at St. John's seminary, Pulaski Heights, yesterday morning.

Ordinarily the photographic record is removed from the machine about 6 p. m. each day, but when officials of the seminary heard of the earthquake in Nicaragua yesterday morning, they removed the photographic sheet and found that a sharp disturbance was recorded, beginning at 10:07 and continuing 26 minutes and 30 seconds.

Dispatches from Nicaragua said the quake began there at 10:10 and was of brief duration.

The Rev. John J. Healey of Little Rock College said the amplitude on the photographic record was small and sharp, indicating that the disturbance was comparatively near. He estimated the distance at 1,700 to 2,000 miles, but said the seminary staff is not equipped to determine accurately the distance or direction of disturbances recorded. He said disturbances are recorded frequently by the seismograph, but are not reported because the direction cannot be determined.

Recently the machine recorded a disturbance, estimated to be at a great distance from Little Rock, and this was confirmed by press dispatches telling of a quake in the Pacific ocean approximately 7,000 miles from here.

The seismograph was installed a year ago through co-operation of the Rev. John E. McElwane of St. Louis University, who is a member of a national organization for the study of earth tremors in the Mississippi valley.

Earth Tremors Rattle Windows At New Madrid, Mo.

7-20-31
Special to the Gazette.
Poplar Bluff, Mo., July 18.—Earth tremors in the vicinity of New Madrid today were felt by hundreds of persons. The quake rattled windows and swayed telephone lines.

ANOTHER QUAKE IN BIG BEND COUNTRY

New Cracks in Walls of West Texas Towns but No One Injured.

Gazette 8-19-31
El Paso, Tex., Aug. 18.—(P)—An earthquake in the Big Bend country of Texas this afternoon was felt westward in New Mexico. The tremor followed an earth disturbance felt in the section last Sunday. No one was reported injured.

The tremors appeared to have been of greatest intensity at Alpine, Tex., a village of 500 population, 160 miles east of El Paso.

Residents fled panic-stricken into the streets as new cracks appeared in walls already damaged by Sunday's quake. Most of the houses are of adobe construction.

In the Mexican quarter, many persons gathered around churches and prayed for protection.

The quake was reported at Alpine at 1:37 p. m., and was preceded by another shock early in the day at 2:42 a. m.

Many people in Alpine have slept in the open since Sunday's quake.

Railroad offices in El Paso said the tremor apparently was localized around Valentine. They reported it was felt at Pecos and Alpine, Tex., on the east and at Lobo, 20 miles west of Valentine, but not at Sierra Blanca, 60 miles west.

Some clocks were stopped at Valentine, Pecos and Lobo.

At Carlsbad, N. M., a shock was sufficient to rattle windows. Carlsbad received two shocks Sunday when two tremors were recorded in west Texas and southern New Mexico.

The seismograph at Regis College, Denver, Col., recorded an earthquake of two minutes duration, just before 1:20 p. m. (M. S. T.) Father A. W. Forstall, seismologist, said the quake was in Texas.

A severe quake, lasting one quarter of an hour, was registered at 8:10 a. m. Father Forstall said this quake was not on the American continent.

Texas Shaken By Series of Earth Shocks

No Loss of Life Report- ed; Mexico Also Feels Tremors.

Democrat 8-17-31
Dallas, Tex., Aug. 17.—(P)—Earth tremors, described by the Rev. James B. McElwane, seismologist at St. Louis University, as strong enough to cause destruction if originating in populated regions, shook west and central Texas Sunday.

No loss of life was reported throughout an area of which San Antonio was the largest city to report the shock.

Father McElwane said the school's seismograph recorded the tremors as 830 miles southwest of St. Louis. This would place the origin in Mexico. Chihuahua City, Mexico, reported shocks and several persons were reported injured by tremors at Oaxaca, Mexico.

L. A. Nelson, head of the department of geology at Texas College of Mines and Arts, said the shocks probably were the "tail end" of intense disturbances in Mexico.

The Weather Bureau at San Antonio reported the tremors lasted 72 seconds.

Valentine, in the southern Sierra Vieja mountains, seemed to bear the brunt of the shock. Adobe houses were wrecked. The town's brick school plant was damaged badly and every chimney fell.

Corsicana was the farthest east city to report the tremors, giving the shock zone a width of at least 500 miles in Texas.

Comanche Springs, flowing 60,000,000 gallons of water daily, spouted muddy water for an hour after the tremor, but apparently the flow was not otherwise affected.

The last previous quake reported in Texas was July 30, 1925. Nine west Texas points at that time reported violent earth vibrations. Northwestern Oklahoma, New Mexico and Kansas points likewise reported tremors. There was little damage to property and no lives were reported lost.

Tremors in Mexico.

Mexico City, Aug. 17.—(P)—Several walls collapsed and a few people were slightly injured in a strong tremor which shook Pinotepa, Oaxaca, early yesterday.

Press dispatches said the shock, which occurred before dawn, threw the inhabitants into a panic and that they abandoned their homes and spent the rest of the night in the open.

Centered in Nicaragua.

Mexico City, Aug. 16.—(P)—The Tacubaya observatory here estimates that the epicenter of the earthquake felt in Texas and northern Mexico early yesterday was in Central America, probably in Nicaragua.

The quake was registered on the observatory's instruments, but was not strong enough to be noticeable to the public.

Intense Earth Tremor Felt at Blytheville.

12-11-31
Special to the Gazette.
Blytheville, Dec. 10.—An intense earth tremor which aroused slumbering residents here early today did no damage to buildings or streets. The quake was of a local nature, being felt only slightly in near-by towns, but was described by several persons as one of the most severe shocks to occur here in recent years.

The tremor occurred at 2:10 a. m. and brought many persons from their beds. It was accompanied by a heavy rumble that lasted several seconds, Charles Phillips Jr., local official weather observer, said.

Blytheville Has Quake

Windows Are Rattled but No Property Damage Is Caused.

Blytheville, Dec. 10.—(P)—Blytheville citizens were awakened from their slumbers at 2:10 a. m. today by an earth tremor of considerable intensity.

Charles Phillips Jr., official weather observer, said there was a single shock.

Homes were shaken and windows were rattled, but there was no apparent damage.

The seismograph at Little Rock College, located at the Pulaski Heights observatory, recorded an earthquake shock at 2:14 a. m. Thursday. It was said to have been slight—barely enough to register on the instrument. The distance and direction are not determined until the sheets are checked.

No record was obtained on the seismograph at St. Louis University, according to press dispatches from St. Louis.

Earth Temblors Shake Several Houses at Brinkley.

Brinkley, Dec. 17.—Earth temblors felt in a Mississippi and Tennessee and across the river in Arkansas were noticed at Brinkley about 9:30 last night. Several houses shook, with windows rattling for 15 or 20 seconds.

Earthquake Shakes Mid-South; Felt in Arkansas.

Memphis, Dec. 16.—(P)—An earthquake tremor was felt throughout the entire mid-South at 9:40 o'clock tonight and created consternation among residents in sections of four states.

Slight damage was reported. The tremor was felt from Helena, Ark., on the west, to Birmingham on the east and from Jackson, Miss., on the south, to Jackson, Tenn., on the north.

At Corinth, Miss., where the shock appeared to have been the greatest, windows were broken and walls cracked.

Professor W. L. Kennon, professor of physics and astronomy at the University of Mississippi, said it was the "third and most severe felt in northern Mississippi in the past 20 years."

"It was a mild earthquake shock with considerable rumbling and lasted about 30 seconds," Professor Kennon said.

Guests left their rooms in Memphis hotels, despite the downpour of rain, when the shock was felt. Houses were shaken but no serious damage was reported.

General advancement movements. Earth Shock Recorded.—Observers at the Little Rock College seismograph, earthquake recording instrument, said that a severe tremor was recorded at 12:20 p. m. yesterday. The disturbance continued for from 75 to 90 minutes, and was one of the most pronounced shocks recorded since the instrument was installed about a year ago. It was impossible to locate the place of the shock.

One Chance in Five Million.

On the heels of the recent earthquake disaster at Santiago, Cuba, comes the reassuring note that the region of the United States around New York is perhaps the safest place on the North American continent for this type of hazard. This fact comes from the exhaustive book of John Ripley Freeman, formerly president of the American Societies of Mechanical and Civil Engineers, just published. This volume of "Earthquake Damage and Earthquake Insurance" is based on a 25-year study by the author on the causes and effects of earthquakes.

A surprising note is the relatively small damage in the United States due to earthquake in the last century. Including the dangerous region west of the Rockies, Mr. Freeman finds that although 700 or more lives were lost in the San Francisco disaster of 1906, there were only 930 persons in the whole United States who died directly or indirectly through earthquakes in the last century. And this includes the Charleston, S. C., quake of 1886, where some hundred people lost their lives.

The property damage due to quakes in the last century is also relatively low, being given by Mr. Freeman as some \$40,000,000. This does not include the damage done by resulting fires.

Will Test Earthquake Theory Based On Shifting Earth Crust

Guantanamo Bay, Cuba.—A scientific explanation of earthquakes, called the theory of isostasy will be tested anew in the West Indies from a submerged submarine.

The International Science Expedition, based at Guantanamo and using American naval vessels, will do the testing, under direction of Prof. Richard M. Field of Princeton University.

The earth's crust, 60 miles thick, "floats" on heavier material below, most geologists believe. The underlying material is plastic and yielding under long-continued pressures.

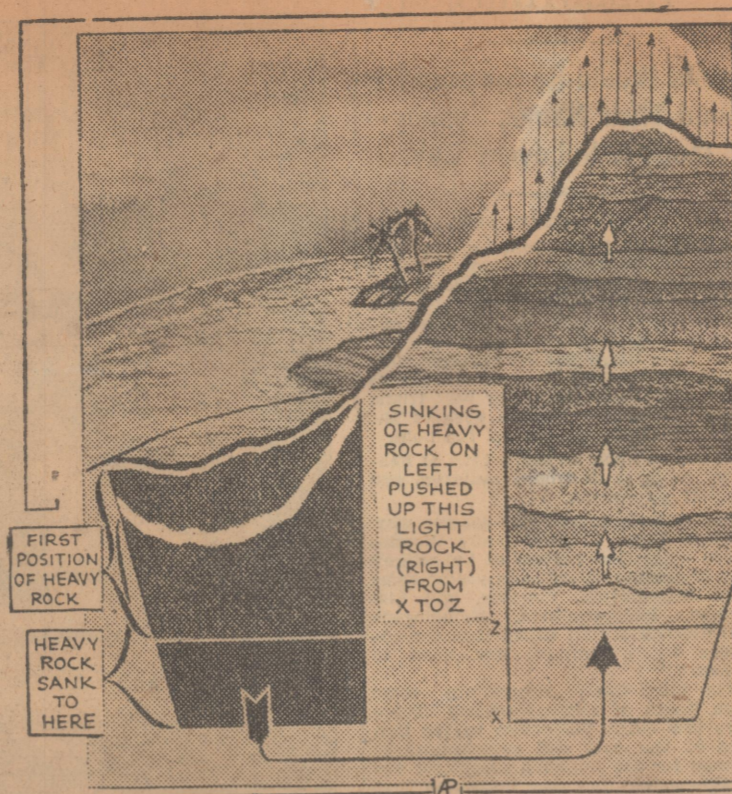
Any two equal-sized blocks of the earth's crust ordinarily are of equal weight, according to the theory of isostasy, and balance each other as they "float" on the heavy material below.

The balance is upset when material is shifted from one block to the other, as when rivers wash sediment off continents into the sea. The shift makes the under-ocean block heavier. It sinks, and the plastic material underneath is forced against the bottom of the other block, pushing it upward.

The sinking and rising take place very slowly. Tension accumulates gradually, then suddenly is released. The resulting shock is an earthquake. Scientists suspect this sort of activity under the West Indies.

The expedition, working ashore in the Bahamas and at sea in the U. S. submarine S-48, will check up on whether blocks of the earth's crust are shifting by measuring the pull of gravity at many different points. Gravity is strongest over heavy rock masses.

Many scientists believe the theory of isostasy is working along a line under the West Indies, through Mexico and on to the west coast of the United States. If such a line of activity exists it will betray itself because concentration of light material will record weak gravity values on the surface



A submarine equipped with pendulum devices to measure gravity's pull will be used in West Indies waters to test the theory of isostasy, which explains earthquakes as being the result of the release of tension produced when "blocks" of the earth's crust shift and cause strains in other parts of the crust (drawing).

above, says Dr. F. A. Vening Minesz of Holland, a member of the expedition. He has already found similar lines in the East Indies and the Pacific Ocean.

Gravity is measured by pendulums that swing fastest at points when gravity is strongest. At sea a submerged submarine avoids the interference of wave motion with the pendulum.

Science

"Electric Eye" Watches for Earthquakes.

Buffalo, N. Y.—To the "electric eye" has been assigned the new task of watching for earthquakes. At the Canisius College Seismic Observatory here, the Rev. John P. Delaney, professor of physics, has attached a photo-cell to the recording mechanism of his Galtzin seismograph. The function of the cell is to keep continual watch on the galvanometer light beam, and to send a warning signal to the observatory office whenever the light beam moves under the influence of an earthquake that is being recorded.

Ordinarily the seismologist discovers his earthquake only after the development of the seismograph record. The record is usually brought from the underground instrument vault only once in 24 hours, a fact which explains the paradox that even serious quakes often escape the notice of the vigilant seismologist for many hours, and even a day, after their occurrence. The new photo-cell attachment brings to the seismologist the assurance of immediate warning whenever a serious quake is recorded.

The same photo-cell attachment could serve advantageously in earthquake regions to set in motion any number of auxiliary instruments, such as accelerometers, and also to set in motion any available safety devices or alarm signals.

AT LEAST 30 DEAD IN MEXICAN QUAKE

Entire Country Shaken by Severe Tremor With Heavy Property Loss.

(Chicago-Tribune-Arkansas Gazette Special.) Mexico City, June 3.—At least 30 persons are dead or injured and property damage was estimated at \$300,000 in the city of Colima in a violent earthquake which rocked all Mexico at 4:36 this morning. Reports poured in from all parts of the country of severe tremors, but without further loss of life. A heavy rain followed the shocks.

The city of Guanajuato was isolated, as was the Pacific port of Manzanillo in the state of Colima, where it was feared the heaviest damage occurred. Leon and Iruato in the state of Guanajuato suffered material damage.

In the federal capitol thousands of residents rushed into the streets half dressed. Many fell to their knees and began to pray.

Every village in the federal district and the state of Mexico showed the effects of the quake in ruined buildings, inhabited largely by the lower classes. Only the fact that Mexico City is built on soft bottom lands saved it from disaster.

Chicago Seismographs Record Violent Earthquake.

(Chicago-Tribune-Arkansas Gazette Special.) Chicago, June 3.—An earthquake which for three hours shook the surface of Chicago and the Metropolitan area early today brought death to 30 persons in the state of Colima, Mexico, according to reports from Mexico City. The crust of the earth in Chicago danced one-twenty-fifth of an inch, making the seismograph needles at the University of Chicago and Loyola University take the high hurdles in a series of six-inch leaps.

Quake Believed in Asia When Recorded at London.

(New York Times Cable.) London, June 3.—Three London seismographs today recorded a violent earthquake believed to be somewhere in Asia lasting over an hour. The shocks swung the recording needles of the delicate instruments as far as 14 inches and was so severe that the needle of the new seismograph installed at Selfridges was thrown completely off balance. The average earthquake affects seismographs here no more than one-tenth of an inch.

The first shock was recorded by the Kew Observatory at 12:45 this afternoon. J. J. Shaw, a West Brumwich seismologist, estimated that the center was 5,000 miles away, probably in Asia.

New Quake and Tidal Wave Hits Mexican Town.

Mexico City, June 24.—(P)—Dispatches from Colima today said another earthquake and smaller tidal wave hit Cuyutlan late yesterday, but caused no damage or loss of life, because the town had been evacuated.

Yesterday reports placed the death toll of the former tidal wave at 100.

The dispatch said everything in the path of the first wave was leveled and the wave was 35 feet high as it left the sea.

Additional relief and rescue work was in progress today. The federal government sent 1,000 army tents to Colima to be used to shelter the homeless.

A dispatch from Guadalajara said 23 light shocks were felt there yesterday, but no damage was done. Five shocks were recorded in Mexico City.

Strains in Earth Cause of Quakes

(Science Service.)

Chicago.—Earthquakes are probably produced by a sudden release of strain within the crust of the earth, just as a column of steel fails when squeezed with great pressure, Rev. James B. Macelwane, S. J., professor of geophysics of St. Louis University, declared in a radio talk over the Columbia Broadcasting System arranged by Science Service, the institution for the popularization of science.

Scientists are not yet agreed as to the exact cause of earthquakes although they know that it is an elastic process within the earth, Professor Macelwane said.

Many centuries ago, Professor Macelwane explained, even scientists thought that earthquakes were caused by explosions down in the earth. It has also been believed that earthquakes were connected with volcanoes, and another theory held that lava inside the earth caused pressure and earthquakes. Others have visualized the

earth's crust as containing immense caves, and earthquakes were presumed to be breaks in the arches over the caves.

"But it has been shown since the discovery of the passage of earthquake waves through the earth and their registration by means of seismographs," said Professor Macelwane, "that the outer portion of the earth down to a depth of at least five-elevenths of the earth's radius is not only solid, but, with the exception of the outer layers, is more than twice as rigid as steel in the laboratory. It has also been shown that volcanoes are a purely surface phenomenon, that they have no connection with each other even when they are but a few miles apart. Hence it is clear that earthquakes connected with volcanoes must be of very local character, if they are to be caused by the movement of lava. This is found to be actually the case. It is also clear that some other cause must operate in producing earthquakes, since destructive earthquakes often occur very far from volcanoes. In fact, some regions where there are most earthquakes have no volcanoes at all."

Prof. Macelwane showed that the great earthquake belts of the world,

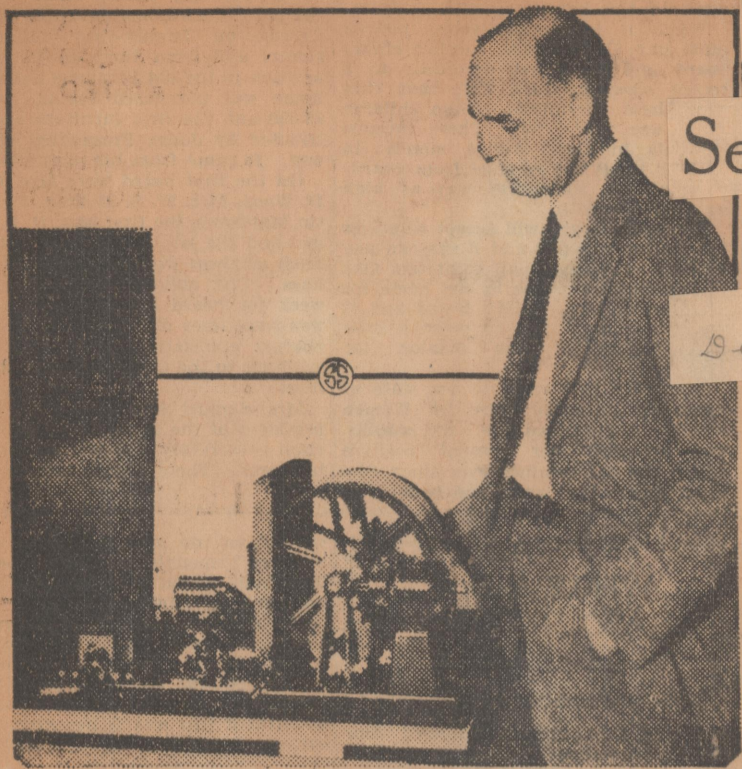
such as that which follows the rim of the Pacific, are areas of the earth where mountains are still in the making.

This has caused one current theory that holds that mountain building and earthquakes are caused by a shortening of the earth's crust caused by gradual cooling of the interior and consequent shrinkage. Prof. Macelwane pointed out that the earth instead is probably heating up due to internal radioactivity.

Some earthquakes seem to have originated at depths of some 300 miles, this leads to the theory that earthquakes are generated by a flow of material under the great pressures of the earth's crust.

"It may be that a strain is produced and gradually grows in such a way as to produce planes of shear such as occur when a column is compressed lengthwise," Professor Macelwane said. "These planes of maximum shear usually form an angle of about 45 degrees with the direction of the force. Recent investigation into the failure of steel indicates that it will retain its full strength up to the moment of failure when the steel becomes as plastic as mud along the planes of maximum shear. The two portions of the column then glide over each other on the plastic zone until the strain is relieved, whereupon the steel within the zone becomes hard and rigid as before. It may be that a process somewhat similar to this may take place deep down in the earth, and that the sheared surface may be propagated upwards through the zone of flow to the zone of fracture and even to the surface of the earth. In that case the plastic shear would give way to true fracture near the surface."

Record of Earthquake to Be Made
Photographically by Seismograph



(Science Service.)

Washington.—Not even an earthquake, one of the world's most unpredictable happenings will surprise the instrument shown above. For its job is to keep still and await the coming of quakes; but with the first good shock it will spring into action, ring a bell and begin to make a photographic record of the movement. A number of instruments of this kind are being installed in the basements of buildings, on bridge piers and in other

—Science Service Photo. vital locations in California, a likely earthquake region. When the next great earthquake comes, scientists expect some of these instruments to make records of what happened right on the spot, which will be valuable information with which engineers can erect safer buildings. Pictured with the seismograph is H. E. McComb of the Division of Seismology of the U. S. Coast and Geodetic Survey, by which the instrument was developed in cooperation with other agencies.

Five Earth Tremors Felt At Poplar Bluff.

Special to the Gazette. 3-7-2-33
Poplar Bluff, Mo., March 11.—Five distinct earth tremors were felt in the Poplar Bluff district last night and today, according to reports from throughout the community. Sheriff Lester Massingham said he and deputies felt the courthouse "rock and sway" shortly after 11 last night and Dr. J. L. Lindsay was first to report two distinct shocks about 7 this morning.

Later in the day reports were received saying the last two tremors had been felt by several persons who at first believed they were due to heavy traffic. Two other tremors were felt late yesterday afternoon.

Poplar Bluff is about 50 miles from the New Madrid area, center of the earthquake of 1811 which completely changed the topography of the section

Arkansans Need Not Fear

Another Ouake, Geologist Says Series of Minor Temblors Since New Madrid Earthquake in 1811 to '13 Means Gradual Earth Adjustment

Being Made Which Prevents Recurrence of Catastrophe Which Visited California

State Has an Average of One Minor Convulsion Every 6.7 Months, Records Show

By WILLIAM JOHNSON.

"Ah prehu terra firma," said Mose, when solicited to enlist in the navy. "An' the firma the less terra." The soundness of that view has been emphasized by the recent earthquake in California. Arkansans, reading accounts of that disaster and seeing pictures of the havoc it wrought, have breathed a sigh of thankfulness for the stability of their own landscape. At the same time, however, some have remembered that away back in 1811 and 1812, the northeastern corner of the state went into an epileptic fit which leveled much timber, opened great fissures in the earth, and sunk a large acreage of previously high land, transforming it into swamps and lakes. And perhaps an occasional citizen has wondered a little uncomfortably whether there is any danger of that convulsion being repeated. If so, the state Geological Survey offers reassurance and cheer. It announces, as the result of a study of earthquake risks in Arkansas, that the possibility of the state experiencing another severe earthquake is too small for anyone to worry about.

The Geological Survey made this investigation chiefly to allay doubts outside the state of Arkansas' freedom from calamitous quakes. It is general knowledge that Arkansas lies within one of the five large regions of the United States where "sure-enough" earthquakes have occurred. This region also includes eastern Missouri, southern Illinois, southwestern Indiana, western Kentucky and Tennessee, and a little of northwestern Mississippi. Another such region extends diagonally down through New England into northern Georgia and Alabama. A third covers eastern Kansas and Nebraska and southwestern South Dakota. The Rocky Mountain country comprises a fourth, and California a fine, large, active one all by itself.

Insurance companies are much interested in earthquake hazards, since the property damage resulting from one may strike pretty deeply into their coffers. Accordingly, they wrote to the State Geological Survey, asserting that they had observed the earthquake-area maps take in most of Arkansas, and how about it? Was there danger of the buildings they insure being tumbled down sometime by a robust tremor? Dr. George C. Branner, head of the Geological Survey, felt quite certain of Arkansas' immunity from any quake of the ruinous California breed, but he has the scientist's enthusiastic preference for facts over guesses. So he and J. M. Hansell made an analysis of the state's known earthquake history in the light of its geology. And the gladdening conclusion was that Arkansas got its heavy earthquaking all done up in 1811 to '13, and isn't likely to be agitated that way again.

Quake of 1811 to '13. The study has been published in a neat little bulletin entitled, "Earthquake Risks in Arkansas." This will be valuable, the authors explain, not only to insurance companies, but also to engineers and architects, besides having historical and educational interest for Arkansas folks in general. For the bulletin contains a brief account of the great quake of 1811 to '13, with dated records of other tremors and shocks since 1877. Of the latter, there have been many. Probably most Arkansans will be surprised to learn that their state has an average of one tremor every 6.7 months.

But exactly in that fact, Dr. Branner's study reveals, the state gets its security from disastrous earth convulsions. A full-grown earthquake, in the opinion of scientists, is a commotion in the ground caused by a fracture of the earth's crust. The deep rock breaks under a strain on it, causing vibrations which travel out from the center of disturbance, through the soil, like waves. If a strain is relieved from time to time, the result will be only mild quivers and jars. And that, we are told in Dr. Branner's bulletin, is what has been happening in Arkansas. A strain on the rock in the vicinity of New Madrid, Missouri, has given way as it formed, resulting in occasional harmless tremors, instead of accumulating over a long period, and then letting go with destructive violence.

And so in the guarded language of science, Dr. Branner's and Mr. Hansell's study ends with these auspicious words:

Beginning of Quake.

Dr. Branner's account of the earthquake continues:

"Perhaps the most severe shock was felt at the beginning of the New Madrid disturbance, on December 16, 1811, although two other shocks of nearly equal intensity, one on January 23, 1812, and the other on February 7, 1812, were felt over two-thirds of the area of the United States, and as far away as Charleston, S. C., Washington, D. C., and Detroit, Mich. These three earthquakes created havoc in the area where the shock was greatest and strongly affected the states of Missouri, Arkansas, Illinois, Tennessee and Kentucky. In the area of greatest intensity, sand and water were forced to the surface along fissures forming sand blows. Narrow trenches were formed by subsidence along faults. Landslides occurred along steep stream banks. And warping of the surface produced domes and depressions, the latter being known as 'sunk lands.' St. Francis lake, Tyronza lake and Big lake in Arkansas, Lake Nicormy in Missouri, and Reelfoot lake in Tennessee, as well as numerous swamps, occupy portions of the sunk lands. The Tiptonville, Tennessee, dome was formed by this earthquake, and also possibly the domes at Blytheville, Arkansas, and west of Tyronza lake."

Several descriptions of the upheaval were left by men who experienced it, and on these a federal geologist, Myron L. Fuller, based the following word picture:

"The evening of December 15, 1811, in the New Madrid area was clear and quiet, with no unusual conditions which could be regarded as portending the catastrophe soon to take place. A little after 2 o'clock on the morning of December 16, the inhabitants of the region were suddenly awakened by the groaning, creaking and cracking of the timbers of the houses or cabins in which they were sleeping, by the rattle of furniture thrown down, and by the crash of falling chimneys. In fear and trembling they hurriedly groped their way from their houses to escape the falling debris, and remained shivering in the winter air until morning, the repeated shocks at intervals during the night keeping them from returning to their weakened or tottering dwellings.

Ground Like Sea Waves.

"Daylight brought little improvement to their situation, for early in the morning another shock, preceded by a low rumbling and fully as severe as the first, was experienced. The ground rose and fell as earth waves, like the long low swell of the sea, passed across its surface, tilting the trees until their branches interlocked and opening the soil in deep cracks as the surface was bent. Landslides swept down the steeper bluffs and hillsides; considerable areas were uplifted, and still larger areas sunk and became covered with water emerging from below through fissures or little 'craterlets' or accumulating from the obstruction of the surface drainage. On the Mississippi great waves were created, which overwhelmed many boats and washed others high upon the shore, the return current breaking off thousands of trees and carrying them into the river. High banks caved and were precipitated into the river, sand bars and points of islands gave way, and whole islands disappeared.

"During December 16 and 17 shocks continued at short intervals, but gradually diminished in intensity. They occurred at longer intervals until January 23, when there was another shock, similar in intensity and destructiveness to the first. This shock was followed by about two weeks of quiescence, but on February 7 there were several alarming and destructive shocks, the last equaling or surpassing any previous disturbance, and for several days the earth was in a nearly constant tremor. For fully a year from that date small shocks occurred at intervals of a few days, but as there were no other destructive shocks the people gradually became accustomed to the vibrations and gave little or no further attention to them."

That would be like those Arkansas pioneers—to size up the earthquake, and then noting that turbulent and furious as it was, it probably would not actually tear the earth to pieces, to give it "little or no further attention."

Traveler's Story.

A fragment of drama within the drama of that historic convulsion was chronicled in a traveler's diary. Writing of a steamboat commanded by Captain Carpy, of St. Louis, he says:

"They (the steamboat) tied up at an island (near Vicksburg) on the evening of the 15th of December, 1811. In looking around they found that a party of river pirates occupied part of the island and were expecting Sarpy with the intention of robbing him. As soon as Sarpy found that out he quietly dropped down the river. In the night the earthquake came and next morning when the accompanying haze disappeared, the island could no longer be seen. It had been utterly destroyed as well as its pirate inhabitants."

What were the thoughts of that lawless gang when the island sunk under their feet, and the river overwhelmed them?

Other accounts of the earthquake mention "the awful darkness of the atmosphere," and "a dense black cloud of vapor that overshadowed the land." Sulphurous gases escaped from the fissures in the earth and tainted the air. Those fissures, occurring frequently, constituted a very real danger to human life. Families, driven from their homes, would cut down a tree and sit on it, so that if the earth yawned open they would not fall into the cavity. One writer says that some of the fissures were 600 to 700 feet long and 20 to 30 feet across, "sufficiently wide to swallow horses or cattle."

Weird lights flashed through the murky atmosphere, some records assert, though the scientists say this was lightning, it being cloudy and rainy much of the time. All of the observers agree that there were ominous rumblings in the earth as it heaved like the waters of a sea, causing the trees to oscillate like a field of corn in a wind. The result on the forests was "a horrible disorder of the trees, which everywhere encountered each other, cracking and splitting, and falling by thousands at a time."

Aside from the drowning of those river pirates, only one life was lost, so far as is known. In that case, the heaving of the earth threw a man off the bank of the Mississippi river into the boiling current, and his companions were unable to rescue him.

There have been distinctly recognizable tremors in Arkansas since the upheaval of 1811, but nothing remotely approaching the severity of that disturbance. However, in late October and early November of 1895, six shocks which centered at Charleston, Mo., gave northern Arkansas quite a perceptible jar. The tremors were felt as far away as Wichita, Kan., and Atlanta, Ga. Altogether, of a total of 192 quakes, big and little, in the Mississippi Valley since—and including—the great shake of 1811, 64 have been felt in Arkansas, says Dr. Branner. But only eight were recognized over the entire state. Mostly they produced nothing more than harmless ground ripples in the northeastern or northern portion.

And so, as Dr. Branner points out, Arkansans may regard their landscape as a safely stable one—a land where Nature has finished her heavy shifting around of the topography, and now is content with a few minor adjustments so carefully made as to create no commotion.

REPORTS ON QUAKE RISKS IN ARKANSAS

State Geologist Publishes Data Showing 190 Shocks in 80 Years.

A report entitled "Earthquake Risks in Arkansas," a statistical study covering the period from 1811 to 1931, by State Geologist George C. Branner and J. M. Hansell, formerly an assistant to Mr. Branner, shows that the state has had 190 earthquakes during the 80 years. First copies of the published report were received from the printer a few days ago, Mr. Branner said yesterday.

In his letter of transmittal to the governor, Mr. Branner said that information concerning earthquakes in Arkansas has been requested from time to time by insurance companies and by residents of northeast Arkansas.

"Northeast Arkansas lies within the central Mississippi valley earthquake region of the United States," the abstract of the report indicates. "The three greatest earthquakes which have affected Arkansas have been the New Madrid earthquake of 1811 to 1813, the Memphis earthquake of 1843, and the Charleston earthquake of 1895. Of the total number of earthquakes which have been felt in Arkansas, 95 per cent have affected the northeast portion of the state while eight per cent have affected the entire state. The greatest percentage (85 per cent) of earthquakes felt in the state has been of medium intensity. Only nine per cent have been of sufficient intensity to endanger life. Since 1909 the average periodicity has been one earthquake every 6.7 months. The continuation of frequent small shocks of low intensity in northeast Arkansas may probably prevent the building up of earth stresses which will produce an earthquake of great severity. The earthquakes of northeast Arkansas are apparently caused by movements in the basement rocks underlying the gulf coastal plain."

The New Madrid earthquake referred to in the report was one of the most severe in the history of the country. The area of the greatest disturbance was between New Madrid, Mo., and Tyrone, Poinsett county. The shocks started December 16, 1811, and continued through 1813, a total of 1,822 shocks having been recorded.

In addition to assisting insurance companies in fixing rates for earthquake insurance, Mr. Branner believes the report will prove valuable to architects and contractors in determining the necessity for earthquake types of construction.

Geologists Expected California Earthquake; Collapse of Floor Off Coast Caused Slipping of Crust of the Earth

Washington, March 25.—That the Southern California earthquake which stunned the entire nation and spread death and devastation over a wide area had been expected by geologists and seismologists for the past 20 years, is the surprising statement of Dr. A. T. Jagger, volcanologist of the Hawaii National Park, whose practical entire life has been devoted to study of the earth's crust.

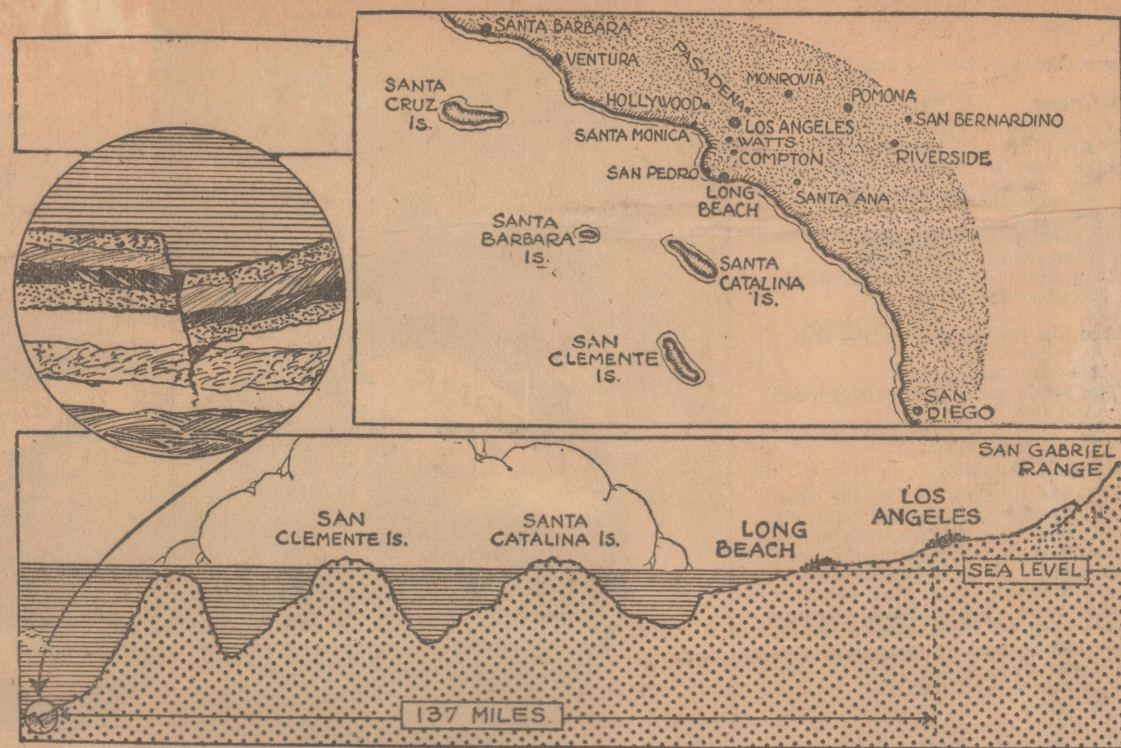
According to Dr. Jagger, the cataclysm that resulted in the loss of at least 120 lives, thousands of injuries and millions of dollars' worth of property damage was directly due to what geologists call a fault in the ocean floor of the Pacific, about 137 miles southwest of Los Angeles, near the island of San Clemente. This crack in the ocean floor is shown on a large fault map of California. It runs northwest to southeast on land near Long Beach, the city which bore the brunt of the earthquake, and extends to sea southward.

It is believed to be a movement in this fault which caused the slipping and rocking of the earth's surface along the California coastline as disturbed geological strata strove to readjust themselves. Seismologists regard the succession of shocks as a favorable symptom of future stability at that particular point. For, they say, it shows that the business of readjustment is proceeding normally. Even the layman can understand the terrible cataclysm that would have ensued if the slip of the earth's crust had been made in one intensified movement instead of in several minor shocks as was the case.

Mild and local earthquake shocks are no novelty in southern California, but it is seldom that the small earth tremors which are recorded in that area do serious damage. In one period of eleven months the seismological laboratory of the Carnegie Institution of Washington, situated at Pasadena, Calif., recorded eight hundred shocks, none of which did any damage.

The severity of the recent earthquakes is said by geologists to be due to their occurrence underneath loose beds of sand and other movable sediment rather than to any extraordinary violence of the earth slidings themselves.

The San Francisco earthquake and fire of 1906, which resulted in the loss of 452 lives and \$350,000,000 worth of property damage, was due



That "for twenty years geologists and seismologists have known the Los Angeles district must eventually have serious earthquakes," is the surprising declaration of Dr. A. T. Jagger, volcanologist of the Hawaii National Park. The existence of an active fault, or collapse, in the ocean floor, about 137 miles southwest of Los Angeles, is believed to have been the direct cause of the earth tremors that cost at least 120 lives, thousands of injuries and millions of dollars in property damage. A large fault map of California shows this fault running northwest to southeast near Long Beach, the center of the seismic disturbance, and extending southward to a point south of San Clemente Island. The recent series of shocks that rocked the coast of Southern California struck places almost parallel with the line of this fault, according to geologists. It is regarded as a favorable symptom that the quake was broken up into a succession of small shocks, for it is an indication that readjustments of the strata that form the earth's crust are proceeding normally toward a new basis of stability. The San Francisco earthquake and fire of 1906, which resulted in the loss of 452 lives and \$350,000,000 worth of property damage, was due to slipping caused by a similar readjustment of the earth's crust on the northern end of the San Andreas fault line. In that instance the shocks were much more severe.

For some reason unknown to seismologists, the present century has been cursed with great volcanic activity. The following are some of the major earthquakes which have occurred since the turn of the century:

1902—St. Pierre, Martinique, suffered an earthquake and eruption of Mt. Pelee, which caused a loss of 30,000 lives. 1906—Valparaiso, Chile, lost 1,500 lives and \$100,000,000 worth of property. 1908—An earthquake took a toll of 76,483 lives in Sicily and Calabria. 1915—Eruptions and earthquakes in Central Italy wiped out several large cities and 372 communes, taking a toll of 29,978 lives. 1919—Thirty-one villages were wiped out by a quake in Java

and 5,100 persons were killed. 1920—A quake and tidal wave destroyed 10 cities and wiped out 200,000 lives. 1923—Tokyo and Yokohama, Japan, were shaken by terrific earth shocks, followed by a tidal wave that resulted in nearly 100,000 deaths. 1929—Southern Italy shaken by a quake that killed 1,475. And in the same year Managua, Nicaragua, was almost razed by earth shocks which took a toll in lives estimated at 1,000.

New Device Solves Earthquake Engineering Problems.

(Science Service.)

Cambridge, Mass.—Earthquakes will have less terror for cities in active seismic regions as the result of engineering data obtainable with a new device demonstrated here, at the Massachusetts Institute of Technology. It is known as a stress recorder, and is the invention of A. C. Ruge, research associate in seismology in the department of civil engineering.

The stress recorder consists basically in a train of lenses and reflecting prisms, which pick up a slender beam of light and pass it on to a sheet of photographic paper mounted on a slowly rotating drum. So long as the system is at rest the pencil of light writes a straight line on the paper. But when a stress bends or displaces the support of one of the reflectors, the beam of light is correspondingly displaced, so that the line traced on the photographic paper becomes a curve, accurately recording the degree of bending and hence the force exerted at that point. A timing device which splits time up into thousandths of a second, makes its record on the same sheet of paper.

The optical parts of the stress recorder total less than an ounce in weight, and models of the essential structural units of a steel building can be kept down to a few feet in height and a weight of a hundred pounds, so that the entire arrangement can easily be mounted on a "shaking table" which will simulate under laboratory conditions any type of earthquake whose effects on structure it is desired to study.

QUAKE RECORDED ON SEISMOGRAPH

Great Shock 4,000 to 6,000 Miles From Little Rock Indicated.

Somewhere in the world yesterday there was an earthquake of large dimensions—greater, probably, than the disastrous quake at Los Angeles several months ago. The quake occurred in a northwesterly direction from Little Rock, and was from 4,000 to 6,000 miles distant.

The quake was recorded on the seismograph at St. John's Seminary, and lasted approximately an hour and 45 minutes. The Rev. Joseph A. Murray, who is in charge of the seismograph operations, discovered the shock when he removed the daily record at 6:30 p. m. The shock first was recorded at 29 minutes and 27 seconds after 5 p. m., and it was continuing strong when the record was changed.

A variation of nine centimeters from crest to crest of the markings on the record indicated that the earthquake wherever it was, was of unusual proportions. The shock was one of the greatest recorded here since installation of the seismograph under auspices of the Jesuits Seismograph Association of St. Louis University three years ago, Father Murray said.

Alaska is one of the recognized earthquake areas, Father Murray said, and it is possible that the shock occurred somewhere in that vicinity.

However, the seismograph here records only horizontal motions, and a report from a vertical recording instrument would be necessary to determine the exact location of the disturbance, Father Murray said. He had received no such reports last night. The shock apparently was of medium depth from the earth's crust, he said.

The seismograph at St. John's Seminary has recorded all major disturbances in the earth's surface since its installation, as well as many minor quakes which did not attract general attention, Father Murray said. A perfect record was obtained of the Los Angeles earthquake.

California Scientists Report Two Severe Shocks.

Pasadena, Cal., Nov. 20.—(P)—A very strong distant earthquake was recorded today on instruments of the Carnegie Institution of Washington Seismological Laboratory here. The scientists reported there were two shocks, one at 3:29:56 p. m. (Pacific Standard time) and a second at 3:36:44 p. m. They estimated the disturbance occurred at a distance of 3,170 miles. The direction was not ascertained.

Georgetown Also Reports 'Very Violent' Earthquake.

Washington, Nov. 20.—(P)—Georgetown University tonight reported a "very violent" earthquake, the shocks of which were so strong that the distance and direction could not be ascertained on its seismographic instruments. The first shocks were recorded at 6:28:19 p. m., with a maximum intensity reached at 7. The shocks were continuing at 10.

EARTHQUAKE SCENE STILL NOT LOCATED

Caribbean Sea Considered Likely Spot; Floods in Central America.

(By the Associated Press.) Seismographs in observatories all over the world recorded the most violent earthquake in recent years yesterday. Unprecedented wet weather sent floods raging through Colombia and Honduras.

Meteorological observatories in Victoria, B. C., at Fordham University in New York, in London, Budapest, Frankfurt-on-the-Main and Ottawa reported instrument recordings that showed an unusually severe disturbance.

No one was able to pin its location down, but the consensus pointed southward to the Caribbean or the countries bordering it.

Rivers Run Wild. In Honduras the Chameleon river ran wild above New La Lima, flooding large areas of rich banana lands and threatening homes and property of American citizens. The government reported two Honduran workers drowned and said that the Cangrejal river was threatening to flood the important American city of La Ceiba.

Colombia continued to suffer severe damage from floods and landslides.

Mina (Nev.) Buildings Damaged By Earthquake.

Mina, Nev., Jan. 30.—(P)—A severe earthquake damaged a dozen buildings here today and the shocks were felt over a wide area, extending from Salt Lake City, through Nevada and into Northern California.

The major quake occurred here at 11:24 a. m. (P. S. T.) and within an hour, 30 shocks, of decreasing intensity, were felt. They were continuing at intervals of every few minutes. Schools were dismissed and children kept outdoors. No injuries had been reported.

A garage building, a brick structure, was damaged badly and stores suffered heavily, the stocks being hurled to the floors. Chimneys toppled from homes.

At Salt Lake City, occupants of several tall buildings reported they felt the quake, although no damage was reported there.

Buildings swayed at Sacramento, Cal., and chandeliers in the state capitol swung for several minutes after the shock, felt at 12:18 p. m. (P. S. T.) The quake was felt also in California at Bakersfield, Modesto, Portersville and Fresno, where dishes rattled and pictures swung on their hangings.

A wall in the Lyon county courthouse in Nevada, cracked by a previous quake, was reported damaged.

Three shocks were recorded yesterday on the seismograph at St. John's Seminary, the Rev. Joseph A. Murray, in charge of the instrument, reported. A "normal light" shock, at 1,405 miles from Little Rock, was recorded at 1:28:47 p. m., and at 2:21:22 p. m. a very strong shock registered, Father Murray said. The second shock was 1,355 miles from Little Rock and apparently was centered off the west coast of Mexico. The third and slightest shock was recorded at 5:44:21 p. m. and was 2,900 miles from here.

Northern Luzon Island Rocked By Earthquake.

Manila, P. I., Feb. 14.—Manila residents were momentarily panic-stricken at noon today when Northern Luzon Island was shaken by an earthquake, centering 200 miles off its northern extremity in the China sea.

Townpeople of San Sebastian in Northern Luzon were nearly engulfed by waters of San Sebastian bay which receded and then abruptly flooded back in a miniature tidal wave. Townspeople had ventured out in search of fish when the wave swept in.

Two earthquakes were recorded Tuesday night and yesterday by the seismograph at St. John's Seminary, the Rev. Joseph A. Murray, in charge of the instrument, said. The first quake was recorded at 10:18:30 p. m. Tuesday and lasted an hour and 45 minutes. The quake was strong, Father Murray reported, and was 2,755 miles from Little Rock. Another was recorded at 4:22:55 p. m. yesterday and lasted 40 minutes. It was of normal intensity and was 9,660 miles from Little Rock.

TRI-STATE RAMBLES

Earthquakes in Arkansas—More About Blanche K. Bruce.

BY GEORGE M. MORELAND.

Thanks to Dr. George C. Branner, Arkansas state geologist, I am in receipt of another of those always interesting "Information Circulars" issued at intervals by the Arkansas Geological Survey.

The Arkansas Geological Survey under the direction of Dr. Branner is doing more to disseminate valuable information of a character peculiar to the state's geology to the people of Arkansas than any other agency of the state government. It is a department of our state government which functions smoothly and with efficiency without any fanfare or immodest efforts to seek the limelight but with that stern-set purpose to do capably the things it is supposed to do for the people of Arkansas.

I have many of the bulletins and circulars issued by the Arkansas Geological Survey in my little library. They are invaluable to a student of the geology of Arkansas. They set forth admirably, succinctly and authoritatively the assets of Arkansas as regards its mineral resources and are a persuasive force to induce investors to seek Arkansas as a field of endeavor for idle capital.

Many of the mining and similar industries in Arkansas were brought here because of information disseminated by the state's most efficient geological survey. It will be recalled with interest that but for our department of geology, or Arkansas Geological Survey, to give the department its official designation, our famous diamond mines might never have been exploited. Those mines have given to Arkansas an international publicity.

The new circular, which is designated as Information Circular No. 4, is entitled, "Earthquake Risks in Arkansas." It was compiled by George C. Branner, state geologist, and J. M. Hansell.

The circular, neatly bound in durable and attractive paper covers, con-

sists of 13 pages with appropriate maps and illustrations, and is a litho-print reproduction of the author's manuscript, a neat and inexpensive way to issue such bulletins.

The book is a statistical study of earthquakes within the Central Mississippi Valley region during the period from 1811 to 1931. Of particular interest to engineers, insurance companies and to residents of Northeast Arkansas, where so many of our earthquakes have occurred, this book will appeal to readers who care only for non-technical discussions. It touches on the New Madrid earthquake, the Charleston earthquake and other seismic disasters which affected Northeast Arkansas.

The maps are likewise of peculiar interest. One map, for instance, shows the area affected by earthquakes since 1811, the year of the greatest of them all, the so-called New Madrid earthquake which resulted in the creation of the interesting "sunk lands of Arkansas" in Craighead and Poinsett counties.

The book is not for free distribution, but it is being distributed at cost to all who are interested in the subject. The Arkansas Geological Survey never attempts to make any profit from any of its publications. They are compiled, printed and illustrated, and then are distributed at cost, plus postage, to all who are interested in the subjects they discuss. The little book referred to here, for instance, costs only 60 cents, including postage, and it is well worth the price, and more, because it is authoritative and to the point—covers an unusual subject in a distinctly original manner.

I thank Dr. Branner, who is my good friend, for remembering me with a copy of his valuable little book for purposes of review.

Quakes Recorded By Seismograph Here

Three earthquakes were recorded Sunday night and yesterday by the seismograph at St. John's Seminary, the Rev. Joseph A. Murray, who has charge of the instrument, reported yesterday.

The first quake began at 7:23:39 p. m. Sunday and lasted 15 minutes. The quake was 3,635 miles from Little Rock.

The second quake began at 6:05:50 a. m. yesterday and lasted an hour and nine minutes. This was superimposed on the third quake which began at 7:14:40 a. m. and lasted an hour and a half. The two latter quakes were 8,150 miles from Little Rock in the direction of Auckland, New Zealand. Father Murray said that if the quakes occurred in New Zealand, the time was about midnight March 6 there.

FAR WEST STATES ROCKED BY QUAKE

Center of Disturbance Near Salt Lake City, Seismologists Report.

Salt Lake City, March 12.—(P)—The heaviest earth shocks ever recorded here rocked cities in North Utah and south Idaho today, caused large buildings to sway, cracked the walls of some structures, and also jolted communities in southwest Wyoming, Nevada and California.

At Ogden, Ut., a young woman died, evidently of fright.

The Home Economics building of the Utah State Agricultural College at Logan, Ut., was damaged so badly it was stated it would be abandoned.

Schools here and at Logan and Pocatello, Ida., were closed pending an examination of all buildings for possible weaknesses. The city and county building here also was vacated.

Reports here said the Preston (Id.) High School building was cracked, the west wall being forced nearly six inches away from the side walls. School authorities expressed belief the building would have to be abandoned.

Tall Buildings Sway.

Large office buildings here shook and trembled in the shocks, beginning at 8:05 a. m. and continuing until 11:21 a. m. (Mountain Standard Time.) The adjoining Ezra Thompson and Salt Lake Tribune buildings rasped together, sending up a cloud of dust.

Delegates to the Western governors conference, in session here during the last tremor, made it the occasion for some good natured chaffing.

At Ogden Ida Atkinson, 21, ill for two weeks, asked the reason for the shaking of her bed. Told it was an earthquake, she died.

Charles Bithell, 55, an employe of the city Waterworks Department here, was buried in the cave-in of a six-foot trench. Foremen of the construction work blamed the quake, although the cave-in occurred some time after the first shock. His condition was said to be serious.

Shocks Heavy.

Seismologists said the quake, centering in the western mountains or desert, was heavier than that which caused great destruction at Long Beach last March. They thought it was caused by the slipping of a fault in the Wasatch mountains, or of one of the basin range faults between the Wasatch and the Sierra Nevada mountains.

Ten persons were under surgeons' knives in Salt Lake hospitals during the quake excitement and four babies were born.

Dr. Frederick J. Pack, head of the Geology Department at the University of Utah, fixed the center of the quake at the north end of Great Salt Lake near the town of Kelton, Ut. He believed it was due to a regular, natural slipping of a fault in the basin range about 30 miles west of this city.

He said that while slight tremors may follow during the next 24 hours, there was no cause for alarm.

Two Earthquakes Recorded On Seismograph in Little Rock.

Two severe earthquakes, one of which was that felt in Utah, were recorded yesterday by the seismograph at St. John's Seminary, the Rev. Joseph A. Murray said.

The first quake, described as violent, began at 9:09:40 a. m. and lasted an hour and 45 minutes. It occurred 1,330 miles from Little Rock, in the vicinity of Salt Lake City, Ut.

The second quake, almost as violent as the first, began at 12:18:04 p. m. and lasted an hour and 15 minutes. It took place 2,370 miles from Little Rock and the direction was not determined. A trace of a third quake was recorded shortly before 6 p. m., Father Murray said.

Four Earth Tremors Felt In Western States.

Salt Lake City, March 15.—(P)—Four earth tremors, one strong enough to shake buildings and rattle dishes, were felt here today and some 30 new shocks were reported about the north end of Great Salt Lake where Muddy water flowed afresh from wide creeks opened in the earth's crust by Monday's quakes.

Two earthquakes and three slight traces of tremors were recorded on the seismograph at St. John's Seminary here yesterday, the Rev. Joseph A. Murray reported. The first quake was at 6:09:49 a. m. and lasted 15 minutes. It was of normal intensity and was 1,435 miles from Little Rock. The second was at 7:55:48 a. m., lasted 15 minutes, was of normal intensity and was 4,995 miles from Little Rock. Traces were recorded at 4:02:15 a. m., 6:39:15 a. m. and 10:56:15 a. m.

Earth Tremors Recorded On Seismograph Here

Salt Lake City, Utah, March 16.—(P)—Four earth tremors, one strong enough to shake buildings and rattle dishes, were felt here yesterday and some 30 new shocks were reported about the north end of Great Salt Lake where Muddy water flowed afresh from wide cracks opened in the earth's crust by Monday's quakes.

The seismological instruments at St. John's seminary recorded two earth shocks and three slight movements Thursday, according to the Rev. Joseph A. Murray, in charge. The quakes were recorded at 6:09:49 and 7:55:48 a. m., each lasting 15 minutes and being of normal intensity. The first was 1,435 miles distant and the second was 4,995 miles distant. Slight movements were recorded at 5:02:15, 6:39:15 and 10:56:15 a. m.

WHEN SOMETHING HAPPENS TO THE EARTH'S INNARDS.

One day last week the guardian of the seismograph at St. John's Seminary reported two earthquakes, one 1,435 miles from Little Rock and the other nearly 5,000 miles away. A few weeks before that he had spotted an earthquake more than 10,000 miles distant, and presently dispatches came telling of a disturbance in the bed of the China sea north of the Philippine Islands.

You can go down into the cellar of your house and tap out a message on a water pipe for somebody upstairs to hear. Your blows on the pipe cause vibrations to run through the metal and the surrounding air which your listener's ear catches as sound waves. The seismograph detects vibrations in the structure of the earth and records them by movements of its sensitive needles.

If you could find a steel frame tower 500 feet high without an encrusting shell to damp its resonance, you might be able to tap a message from its lowest corner post to its pinnacle. And the interior of the earth, under its tremendous compression, is vastly more rigid and elastic than steel and transmits vibrations many times further. If the whole earth were "dirt" like parts of its surface, earthquakes couldn't be constantly

calling up the Little Rock seismograph on long distance. But steel is a soft and unelastic substance compared with the dense material composing the earth's interior.

Brine Fountains Spout After Utah Earthquake.

Salt Lake City.—Fountains of brine and mud volcanoes were numbered among more than 100 new springs that broke from the floor of the desolate and uninhabited Hansel valley at the north end of Great Salt Lake, when the recent earthquake tore the desert rocks and soil with mile-long rents.

Three great faults were formed in the Hansel valley floor. Their length ranged from a fourth of a mile to over a mile, with a vertical displacement of "throw" varying from six to 15 inches. One of the fissures is six inches wide and sinks into the earth to an unknown depth.

Occasioned by the fracturing and settling of the valley floor, more than 100 new springs appeared. Most of them flowed for only a few hours. Some of the new springs, however, still are producing salt water.

Scores of mud volcanoes also resulted, with cones ranging from one to 10 feet in diameter. The great Locomotive Springs temporarily disappeared, only to continue flowing half an hour later, with increased volume.

The earthquakes were occasioned by movements on one of the most easterly of the basin-range faults. If the earthquake had originated in a populous locality, its results would undoubtedly have been disastrous.

SEISMOGRAPH HERE TELLS OF QUAKES

One Only About 550 Miles From Little Rock, Says Father Murray.

Two earthquakes—one of them so far from Little Rock—were recorded yesterday on the seismograph at St. John's Seminary, foot of North Tyle street, the Rev. Joseph A. Murray reported.

The first quake, said to be violent, began at 6:32:13 a. m. and continued two hours and 20 minutes. It was 354 miles from Little Rock. The second shock, described as slight, began 5:02:46 p. m. and lasted eight minutes. This was only 550 miles from Little Rock, Father Murray said.

Observatory at Victoria, B. C. Records Severe Shock.

Victoria, B. C., March 24.—(P)—A severe earthquake was recorded at the Victoria observatory today, starting at 4:17:30 a. m. and continuing five hours.

"It was one of the best defined earthquakes we have had here for some time," said F. Napier Denison, superintendent of the observatory. "The waves were very regular." He estimated the distance from here at approximately 5,860 miles, perhaps to the north of India.

Tilt of Ground May Allow Prediction of Earthquakes.

Brooklyn, N. Y.—Prediction of earthquakes a few hours before they occur may be possible in the future as a result of studies that have been made in Japan, Capt. N. H. Heck, chief of the United States Coast and Geodetic Survey's division of terrestrial magnetism and seismology declared here in an address before the Brooklyn Academy of Arts and Sciences.

A new machine for measuring tilt of the ground has been invented by George E. Merritt, formerly of the United States Bureau of Standards, and installed in California through the cooperation of the United States Coast and Geodetic Survey and the University of California. This apparatus is expected to throw new light on California's earthquake problems. Tilt on a large scale and the creep of the earth's crust, known to be a factor in earthquake production, can be detected through triangulation and leveling, such as being undertaken by the Coast and Geodetic Survey.

Prediction of earthquakes, however, lies in the future, Captain Heck emphasized. We now have, he said, no possibility of prediction beyond indicating whether or not a certain region is likely to have an earthquake in the not too distant future.

Science

Himalayas' 'Growing Pains' Blamed for India Quake.

Washington.—"Growing pains" in the most tremendous mountain system in the world, which is still getting bigger, are probably responsible for the disastrous earthquake in northern India. The whole south slope of the great Asian mountain mass is a very active seismic region, and shakedown of major intensity, such as always accompany the upfolding of mountain ranges, can be expected there at any time.

It is just short of an even generation since the last major earthquake in that neighborhood. In 1905 occurred the great Kangra quake, which was strongly felt in Simla, summer capital of British India.

Major earthquakes in northern India might have been more frequent in recent decades, but for the relief to internal strains in the earth's crust that must have been afforded by the exceedingly severe Assam quake of 1897, in the opinion of Capt. N. H. Heck of the U. S. Coast and Geodetic Survey. This was the most terrific earthquake recorded in the history of the world. It was felt over two and a quarter million square miles, and caused total destruction of all buildings in an area

of 12,500 square miles. The tremors it sent through the earth were visible on lake surfaces in Europe.

Other and more recent earthquakes traceable to growth movements of the Himalaya system have caused widespread death and destruction in Burma.

Earthquakes are always most frequent and most severe in regions where the earth's crust is being wrinkled and folded to form mountains. The younger the mountains the greater the seismic activity. Thus, earthquakes have been few and far between in the eastern United States, where the mountain systems are old. The Rockies, which might be classified as mountains in early middle age, are the scene of occasional quakes, while the Pacific coast, with its young and actively growing Coast Range infants, have earthquakes with considerable frequency. The great mountain arc that starts in Alaska and swings down the western shore of the Pacific through Kamchatka, Japan and the Philippines, is one of the most actively growing mountain regions of the world, and also one of the most lively of the earth's earthquake zones.

Earthquake Recorded.—A severe earthquake was recorded early yesterday on the seismograph at St. John's Seminary, the Rev. Joseph A. Murray reported. The quake began at 4:58:04 a. m. and the second wave was recorded at 5:01:40 a. m. The tremor was 1,325 miles from Little Rock, probably near Ogden, Ut., Father Murray said, although it may have been in Cuba or Mexico. The shock lasted 30 minutes.

Long Rise in Earth Level Preceded Indian Quake.

London.—The level of the part of India where the disastrous earthquake of January 15 occurred has been rising at an average rate of .06 foot a year or six feet a century, for the last 70 years at least. The earthquake was associated with this change of level, together with the unique state of internal stress which has hitherto occurred in this region.

Such is the conviction of Dr. J. de Graaf Hunter, former director of the Survey of India. He explained it at a geophysical discussion held at the headquarters of the Royal Astronomical Society here in London.

Two years ago, when Dr. de Graaf Hunter was endeavoring to reconcile the numerous spirit-level observations made in Bengal between the years 1862 and 1930, he found evidence that the land was rising at a regular rate. He constructed a diagram in which lines drawn on a map of northern India indicated the various rates at which the rise of level was taking place.

The lines passing through places having the same rate of change ran approximately west-southwest to east-northeast. The line indicating zero change of level passed about 50 miles north of Calcutta. The line indicating the maximum change of .06 foot a year ran about 30 miles north of Benares, and passed through the position calculated to be the epicenter of the January 15 earthquake. This position is latitude 26 degrees 8 minutes, longitude 86 degrees 3 minutes.

SEISMOGRAPH HERE REGISTERS QUAKES

Reports of Shocks Received From Missouri and Caribbean Island.

Three earthquakes were recorded yesterday by the seismograph at St. John's Seminary, the Rev. Joseph A. Murray reported. News dispatches told of two of these quakes. One, a slight tremor, occurred at St. Mary, Mo.

Father Murray said that the record showed that the shock occurred at 33 minutes and 48 seconds past 8 o'clock, that the shock continued for 24 seconds, that it was very mild and that the distance was 255 miles from Little Rock.

One of the earth shocks recorded here took place 2,215 miles from Little Rock at 7:19:30 a. m., with a recurrence at 7:24:50 a. m. This, Father Murray said, was the earthquake which occurred at Plymouth, Montserrat, British West Indies, in the Caribbean sea.

The other quake recorded here took place at 4:21:31 p. m. and was 5,285 miles from Little Rock, probably in Chile, Father Murray said.

Island in British West Indies Shaken by Severe Quake.

Plymouth, Montserrat, B. W. I., May 14.—(P)—The most severe earthquake shock experienced on this Caribbean island in 30 years rocked buildings in Plymouth today, damaging walls and breaking crockery.

Slight Temblor Third in Year At St. Mary's, Mo.

St. Mary's, Mo., May 14.—(P)—A slight earth tremor of about 10 seconds' duration was reported here tonight, the third temblor in less than a year.

The shock, which was sufficient to rattle windows, came about 8:28 p. m. St. Mary's is in southeastern Missouri.

Terrific Earthquake Occurs In Afghanistan and Baluchistan.

Calcutta, India, June 14.—(P)—A terrific earthquake which it is feared may have killed many persons shook Afghanistan and Baluchistan early today.

No detailed reports from the affected area, reported to extend along the whole northwest Himalaya range, had been received here tonight, and it was recalled that the quake in Bihar province last January so disrupted communications that it was more than a week before details of the disaster were learned.

Other researches carried out by Dr. de Graaf Hunter during his directorship of the Survey of India showed, as a main feature of the figures obtained for the "overloading" and "underloading" of the earth's crust in that country, that there is (or was before the earthquake) an area of about 100,000 square miles with a high average "underload." This "underload" was equivalent to a tickness of approximately 3,000 feet of surface rock, after allowing for full isostatic compensations.

This region, whose crustal stress Dr. de Graaf Hunter believes to be unique when its large extent and great underloading are both considered, is centered at about latitude 27 degrees, longitude 84 degrees, which is only 140 miles west of the epicenter of the earthquake. The region stretches roughly from the Himalayas to the Ganges, and from Meerut, near Delhi, to Jalpaiguri, near Darjeeling, and it includes the whole of the earthquake zone.

The earthquake of January 15 was the culmination of the long-continued stress due to this widespread underloading and to the consequent rise of level. Dr. de Graaf Hunter believes, the earthquake, indeed, afforded spectacular evidence of his rise-of-level theory, which was published in a Survey of India report long before it occurred.

He suggests that further spirit-level observations should now be made to determine what sudden changes of level have occurred and thus to what extent the earthquake has removed the crustal stresses.

Earth Shocks Are Felt in Nebraska

Chadron, Neb., July 30.—(AP)—The entire breadth of the Nebraska panhandle southward to Sterling, Colo., felt a light earthquake shortly after midnight Sunday night, but there were no reports of injuries or serious damage.

Chadron felt the first tremor at 12:14 a. m. (M.S.T.) and a second half a minute later. Each lasted about 10 seconds. Scotts Bluff reported feeling one quake at 12:12 a. m. (M.S.T.).

Other cities of Nebraska to report feeling the shock were Gordon, Rushville, Hay Springs, Crawford and Alliance. Sterling, Colo., also reported experiencing the vibrations. They were not severe enough, residents here said, to shake dishes from their shelves.

Residents of the Nebraska panhandle were aroused from their sleep, and kept telephone operators busy with queries as to what was the matter. They described the sensation as the same as of the nearby passage of a heavy motor truck.

Such sensations are new to Nebraskans, although one was reported in central Nebraska several months ago.

Earthquake Felt in Reelfoot Lake Area

Memphis, Tenn., Aug. 20.—(AP)—The slight earthquake which rocked the Reelfoot Lake area along the Kentucky-Tennessee line last night recalled the terrific quake of 1812-13 which caused the formation of Reelfoot Lake, a Tennessee "paradise for sportsmen".

The lake reportedly was formed from waters of the Mississippi river when the quake caused the caving of the river's banks in the territory, creating a new channel. The bed of the lake was formed by the steady sinking of the ground in the territory.

The 1812 quake, known generally as the New Madrid quake, cost many lives.

Last night's tremor was felt at Mayfield and Fulton, in Kentucky, and Tiptonville and Union City, in Tennessee. No damage was done. In Mayfield, window panes rattled and stocks of merchandise in stores were shaken. The tremor at Hickman lasted about a minute, being "preceded by a roar like a storm".

Quake Causes Slight Damage In Southeast Missouri

Charleston, Mo., Aug. 19.—(AP)—An earthquake shook Charleston early tonight, causing some damage. No one was injured.

Several chimneys collapsed and slight damage was caused to many houses. The earthquake, which lasted two or three seconds, first was felt at 6:45 p. m. (Central Standard Time.)

The quake was felt in Cape Girardeau and other points in southeast Missouri and in the vicinity of Cairo, Ill.

Hickman and Mayfield, Ky., also reported the shock was felt in that vicinity about 6:30 p. m. Hickman reported slight damage and said window panes were shaken.

Severe Earthquake Reported In Mexico

Guadalajara, Mexico, Sept. 16.—(AP)—Walls of buildings in several towns in the states of Jalisco and Nayarit were cracked by a strong earthquake early today and some inhabitants fled their homes. No damage was done here.

Earthquake Causes Excitement At Erie, Pa.

Erie, Pa., Oct. 29.—(AP)—Erie was shaken today by an earth disturbance. Buildings swayed, housewives reported dishes fell from cupboard shelves and there was intense excitement but no serious damage. One woman said she was thrown from her bed while asleep.

The shock occurred after 3 p. m., and was felt only for an instant. The seismograph observer at the University of Pittsburgh reported a very slight shock had been registered.

Many residents thought the shock might have been caused by an explosion at some nearby industrial plant, but a check did not disclose any had occurred. The shock was felt along Lake Erie but apparently did not affect points 10 miles distant.

Erie last experienced an earth disturbance eight years ago, of about similar proportions to today's.

Sharp Earthquake Felt in Long Beach Area

Long Beach, Cal., Nov. 4.—(AP)—An earthquake, described as one of the strongest since the disastrous shocks of March 10, 1933, shook Long Beach, Huntington Park, Anaheim and nearby areas at 6:39 tonight. Damage was limited, however, to a few broken dishes and window panes.

The quake was from one to two seconds duration.

Many lives were lost and immense property damage done in this area in the 1933 quake which occurred early in the evening. Buildings not securely constructed toppled and damage was heavy in schools.

Seismograph Records Quake.—An earthquake of considerable force was recorded by the seismograph at St. John's Seminary yesterday afternoon, the Rev. Joseph A. Murray reported. The first shock occurred at 5:10:41 p. m. and the second at 5:18:59 p. m. Movements of the earth continued for 45 minutes. The quake was 4,025 miles southeast of Little Rock, probably in the South Atlantic ocean, Father Murray said.

Earthquake Recorded.—An earthquake of "fair" intensity was recorded early yesterday by the seismograph at St. John's Seminary, the Rev. Joseph A. Murray reported. The quake was 1,075 miles southwest of Little Rock, probably off the Mexican coast near Tampico, Father Murray said. The first shock was recorded at 3:37:14 a. m. and the second, 3:40:16 a. m. The shocks lasted 15 minutes.

Masonic Reunion Closes.—The an-

Panama Buildings Damaged By Moderate Earthquake

Panama City, Aug. 10.—The entire republic of Panama quivered this morning when an earthquake shook the isthmus. The lobby walls of the Panama Canal's administration building at Balboa Heights were damaged, and many buildings were cracked, but the canal's locks were not damaged.

The canal's chief of surveys said a moderately heavy seismic tremor was reported from 9:27 a. m. to 9:30 a. m. with the center of the disturbance about 50 miles from Balboa Heights.

The city of David, which recently suffered heavy quake damage, reported the disturbance was not felt there. Balboa Heights reported a vertical movement was shown on the machines, which has been lacking in previous quakes.

Seismometer Here Records Quakes

Two earthquakes of great intensity were recorded Friday night by the seismograph at St. John's Seminary, Pulaski Heights, according to Anthony Egging, student in charge of the instrument. The first was registered at 7:39:50 p. m. Friday and the second at 12:37:20 a. m. yesterday.

Reports from other cities yesterday indicated the first shock might have been the recording of an earthquake from the Arctic region, north of Canada. The shocks were recorded in London, England, and in northern United States. The second earth movement recorded here probably was that recorded in Bombay, India, about 1 p. m. Saturday and believed to be centered in the Himalayan mountain range, north of India.

The Friday night shock lasted about 25 minutes and was very noticeable. It was a surface shock and was the same type as that which occurred last year at San Diego, Calif. The intensity was about double that of the San Diego shock.

The movement early yesterday was intense because of the distance the shock is believed to have been. The movement early yesterday was intense because the waves lasted about 15 minutes and were earth waves. However, the distance was not estimated or direction determined.

Provincetown, Mass., Rocked By Severe Earthquake

Provincetown, April 23 (AP)—An earthquake rocked this town on the tip of Cape Cod tonight, shaking houses, rattling dishes, and terrifying the inhabitants. Buildings swayed for the few seconds' duration of the quake.

Dr. L. D. Leet, director of the Harvard seismograph, reported that in the past year 65 other earthquakes of similar intensity had been recorded on his apparatus, but because they occurred in less populated areas or at sea, only three of them had been reported to him. Dr. Leet suggested that the quake had "possibly occurred off the coast under the ocean." His apparatus showed the shock occurred within a radius of 77 1-2 miles from the observatory.

At Gloucester, police reported that while the shocks was slight, there was much apprehension among residents of the city.

Earthquake Among Most Severe Ever Recorded Here

One of the most severe earthquakes ever recorded on the seismograph at St. John's Seminary here occurred yesterday and lasted intermittently for more than an hour.

Seventeen Eastern states and three Canadian provinces were reached by the earthquake. The Rev. Joseph A. Murray, in charge of the seismograph, estimated the center of the disturbance to be about 980 miles from Little Rock.

The first wave was recorded at 12:07:02 and the second at 12:09:49, Central Standard Time. Several aftershocks of slight duration were recorded.

The intensity indicator on the seismograph reached six on a scale of 10, and a wave amplitude of 90 millimeters was produced, Father Murray said.

New Tremors Felt in East

New York (AP)—"After shocks" of yesterday's earthquake were felt in parts of upper New York state and in Ontario, Canada, today.

"The shocks were slight and caused little, if any damage," commented Rev. Joseph J. Lynch, seismographer of Fordham University.

Rev. John P. Delaney of Canisius College, Buffalo, N. Y., said the after shocks were caused by the earth's crust adjusting itself to the change in position caused by the earthquakes yesterday.

Buffalo instruments recorded the new shocks at 9:33:40 a. m.; while those at Fordham were timed at 9:35:13 a. m.

The shocks bore out predictions of scientists that additional disturbances might be felt "in the next day or two."

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Intense Quake Recorded Here

The seismometer at St. John's Seminary, Pulaski Heights, recorded an earthquake of "considerable intensity" yesterday afternoon, according to the Rev. Joseph A. Murray, in charge of the instrument. The shock was one of two recorded since Friday night.

The first wave was recorded at 4:09:52 p. m. and the second at 4:13:32 p. m., the entire duration being about one and one-half hours. The wave amplitude on the record was 55 millimeters. It was estimated the earthquake was about 1,355 miles distant, the direction not known.

A record of another earth shock was recorded Friday night, the first movement being at 7:38:56 p. m. and the second at 7:45:09 p. m. It was reported a mild shock and was estimated to be about 2,740 miles distant, probably in South America. Press reports today said a shock was felt Friday night in Peru and Bolivia.

The TERROR of the EARTHQUAKE

By DR. FRANK THONE
Acting Director, Science Service.

Dec 29, 1935

Arkansas Reville



Capt. N. H. Heck, principal seismologist of the United States Coast and Geodetic Survey, locating the epicenter of a quake on a large globe.

Science Can't Predict Earth Tremors Yet But Through Seismological Observatories, One of Which Is Located at Little Rock, Location of Quakes Can be Determined Speedily.

Once more America has become earthquake-conscious. Once more, after a considerable lapse of years, have people in the United States and Canada had the uneasy truth brought home to them that no part of this continent is quite free from the possibility of one of these terrifying experiences, and that "no man knoweth the day or the hour" when such a wrecking visitation of the dark powers of nature shall come.

There is something peculiarly sickening to the human mind about an earthquake. We are used to the idea of devastation by fire, flood or hurricane. These are unstable elements; and more or less instinctively we expect them to be capricious at times. But the earth itself, the

very figure and type of stability—when that begins to heave and shake and throw itself into sea-like waves, we simply do not know what to do. We are bewildered like children who see their mother suddenly go mad.

It is for this reason, probably, that we like to console ourselves with the belief that our part of the country, our particular city, is in no great danger from earthquakes. Those of us who do not live in California like to think of that state as peculiarly the land of earthquakes, just as non-Floridians jest about Gulf hurricanes.

But recent events have done much to shake us (quite literally) out of that rather smug assurance. Wreckage-littered streets



These cable-car tracks in San Francisco ran athwart the famous San Andreas fault, which slipped sideways in the classic earthquake of 1906.

in Montana's capital, midnight shivers rattling walls and windows in a score of great Eastern cities, give us all the uneasy knowledge that we also live in glass houses—where stones may fly at any moment without being thrown by any human hand.

The dread of the earthquake, an entirely natural and normal emotion in all of us, was without doubt the motivating force behind the curious apparent dispute among seismologists for a few days after the far-felt Ontario earthquake of November 1. These students of earthquakes and their causes were eagerly interviewed by newspapermen, with the insistent demand. "Prophecy! Prophecy!"

The resultant apparent disagreement among them was not due to any real difference in scientific opinion on their own part, but rather to differences in interpretation by the scribes who questioned them. If the question were, "Will there be another quake?" the answers might properly enough be, "Yes;" for most major shocks are likely to be followed by lesser ones known as aftershocks.

But these aftershocks are usually not felt very far from the immediate neighborhood of the main shocks' greatest disturbance. So if the question were, "Will there be another quake, right here, in this town?" all the honest seismologist could answer was "I don't know; but probably not." And by the process of simplifying and at the same time fortifying somebody else's statement when you repeat it, these provisional and qualified answers of the scientists came to look a bit odd when they appeared in print.

Scientists regret that they simply are not able to give prompt and sweeping responses to demands for earthquake fore-

considerable group of seismologists, with dozens of sensitive instruments, are making a concentrated study of the tiniest tremors that sometimes run through the earth before a big earthquake happens, in the hope that they may some day be able to join their brethren of the Weather Bureau in dependable forecasts.

One of the seismological observatories in the United States is located at St. John's Seminary in Little Rock. It is equipped with machines of the Wood-Anderson type, perfected in 1923.

Capt. N. H. Heck, principal seismologist of the United States Coast and Geodetic Survey, declares categorically, "No reputable seismologist will venture an earthquake prediction."

But although scientists can not yet predict earthquakes, they can explain them rather completely, and during recent years they have also become able to locate them rapidly, even in the most inaccessible parts of the world.

The explanation of earthquakes is relatively simple. The solid, rocky crust of the earth is always in a state of strain, due to shifting forces, such as those of the slow but powerful shrinking movements that through the ages cause the growth of mountain ranges. These strains in the rock eventually cause it to crack, sometimes in lines hundreds of miles long. Such cracks in the earth's crust are called "faults" by geologists.

A fault is not an open crack; it is a tightly closed line like the contact of a stuck cork in a bottle, or a jammed dresser drawer. And as the opening of such a bottle or drawer is likely to be rather sudden, with a good deal of a jar, when it finally does give after persistent pulling, so also is the movement of the rock strata

to yield and readjust its position.

Earthquake-movement along a fault line may be either vertical or horizontal or occasionally both at the same time. Evidences of such movements persist, sometimes for untold ages, in the abrupt ends of rock strata that "match" similar layers found many feet up or down or to one side. Frequently you can see such faulted rock layers in deep railway cuts or on the faces of natural cliffs.

The fault movements that cause earthquakes may occur close to the surface, showing themselves in violent offsets of roads and railway tracks.

This was the case in the classic San Francisco earthquake of 1906. Or they may take place many miles down; in that case the disturbance is called a "deep focus" earthquake. In either type of quake, the spot on the earth directly above the focus is known as the epicenter. It is the point of greatest surface movement—and if there happen to be any of the works of man on or near it, it is of course also the point of greatest destruction. Woe unto that city that is built upon a "live" fault!

As a rule, the earth strain that causes an earthquake is relieved by one main shock, preceded perhaps by a few minor foreshocks and usually followed by a number of less severe aftershocks. But sometimes there will be a train of shocks of about equal severity; these the seismologists call "swarm" earthquakes. Helena, Mont., was tormented by such an earthquake swarm.

Scientific knowledge of the character of earthquakes is gained primarily with instruments known as seismographs. Basically, a seismograph consists of a pendulum that can write. It works on the same principle of inertia—the tendency of any solid object to stand still when its support or surroundings suddenly shift.

The pendulum stands still when the trembling earth moves beneath it, and the attached writing device registers the tremblings, either by mechanical magnification through a train of levers or (more commonly nowadays) by means of a tiny pencil of light reflected from a mirror onto a sheet of photographic paper.

The wiggly lines thus made are a record of the minute tremors in the solid earth that run out in all directions from the epicenter of an earthquake like ripples from a stone dropped into a pond. The farther away from the epicenter they are the fainter they will be, but the seismographs are so delicately constructed that they can record them thousands of miles away.

Seismologists, using laboriously worked-out mathematical methods, can tell from the form and spacing of the wiggles on the recorded line just how far away the epicenter was and exactly when the earthquake began, to a tenth of a second.

But the record from any one station cannot show exactly where the quake occurred. The best he can do is trace on the map a circle representing its distance from his station, and say, "Somewhere on this circle was the quake."

However, if a central information clearing house takes the records of three or more observatories and traces their circles, these will intersect at one point and at one point only. There, the seismologists can say with confidence, was the epicenter.

Formerly this collation of seismological data was done by mail, very slowly. Locating an epicenter of an earthquake in six weeks was a really quick job. But

now the results are handled by telegraph and radio, and epicenters are given at least a preliminary location in a few hours.

The setup is this: The many university and government earthquake observatories send their data, as code telegrams, to Science Service, in Washington, D. C. Science Service turns these messages over to the United States Coast and Geodetic Survey, and also telegraphs them to the headquarters of the Jesuit Seismological Association, in St. Louis.

These two latter organizations calculate the epicenter independently of each other, and then exchange information for the purposes of checking up and correction. In the meantime, the location of the epicenter is available for the press while it is still news, and not six weeks later when

most people have forgotten about it. The location of the Ontario epicenter, near the home of the Dionne quintuplets, was thus determined by mid-morning of the day on which the quake occurred.

It is perhaps not a mere coincidence that so many of the earthquake news items you see in the papers come from Georgetown, St. Louis, Fordham or some other Jesuit university. The "black robes" have a long tradition of interest in earthquakes. One of the oldest, and at the same time most interesting, of earthquake descriptions in North America was dug up out of the archives of his society by the late Father Tondorf, not long before he died.

It is a report of the great quake of 1663 in "New France" (now Canada), by a Jesuit missionary, Pere Charles Simon, translated into Latin by his friend, Pere Francois Ragueneau.



Looking at a fault in the side of a cliff.

Continued On Page 94

Jonesboro to Cape Girardeau, Route 637, Sept for this and the fact that Roosevelt

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22, 1936
Gazette

Power of Earthquake Imitated In Laboratory

By HOWARD W. BLAKESLEE.

(Associated Press Science Editor.)

A beam of light the thickness of a pencil is reflected from the corner of a metal table at Massachusetts Institute of Technology at Cambridge.

Put one finger in the beam, wiggle it, and the table—150 pounds of dow metal—shakes like a leaf.

Thus for the first time in the laboratory the real power of the earthquake is imitated—the nearest human thing to the irresistible force.

The shadows cast by the finger in the light beam shake the table—or differently stated the power in a shadow actuates a piston driving with a 2,000-pound push. This is a multiplication which is virtually infinite, even as the earthquake's power is infinite so far as man's puny handiwork is concerned.

The result is a shaking table, set up in the laboratory of Arthur C. Ruge, research associate in seismology, on which the realities of earthquakes can be reproduced in a new way. The fluctuating amount of light in the beam is converted by a vacuum tube into an electric current which regulates the driving piston that in turn shakes the earthquake table.

This makes it possible for the first time to repeat in the laboratory an earthquake that has happened in nature, reproducing it move by move.

Heretofore the seismologists have had to guess how much to shake their tables to imitate a real quake—where to mix little movements with big ones.

The new tech table will follow every up and down of the line drawn by the recording needle of a seismograph. Actually the line drawn by a seismograph needle is turned into cutout, like that of a paper doll. Its wavy edge runs through the beam of light, and the beam reproduces every variation.

It is planned to give this table all three motions of the ground during earthquakes, north to south, east to west and up and down. The control with a beam of light which is capable of actuating any number of tons desired, makes this possible.

What might have happened to a full sized water tank in the Long Beach, Cal., earthquake of 1933 is shown in the accompanying illustration. When the wavy outline of the shadowgraph of the Long Beach earthquake record interrupts a beam of light reflected from the table corner, a piston under control of the beam



shakes the table and the model tank upon associate in seismology at M. I. T., designed the machine.

Quake Recorded At Seminary Here

3-3-37 Gaz.
When the Rev. Joseph A. Murray removed the day's recording from the seismograph at St. John's Seminary last night he learned that there had been a mild earthquake in the Ohio valley during the morning. The first shock was recorded at 8:49:58 a. m. and the second at 8:51:57.

The intensity indicated that the center of the disturbance was 663 miles from Little Rock and Father Murray figured that it probably was north and east of Cincinnati.

It was the second time in recent weeks that the seismograph had detected an earth tremor in the area that has suffered so heavily from floods this year.

During the worst part of the Ohio-Mississippi flood the instrument recorded a quake in the vicinity of Tiptonville, Tenn., but it was even milder than those of yesterday.

Earth Shocks Reported In Five States

Gazette 3-3-37

Columbus, O., March 2 (AP).—An up-thrusting rock crust in the old glacial region of northwest Ohio caused earth tremors today from the Canadian border south into Kentucky. Five states recorded the movement, which brought slight property damage around Wapakoneta and other Auglaize county, Ohio, villages all near the epicenter. No injuries were reported.

Plate glass windows were broken, chimneys toppled and plaster knocked from walls in Wapakoneta, 80 miles northwest of Columbus.

Schools in Zanesfield, O., and in the hamlet of Anna were dismissed.

Two Distinct Shocks.

Father Victor Stechschulte, seismologist at Xavier University, Cincinnati, where buildings swayed and dishes rattled, said the tremor came as two shocks, over a period of 10 minutes beginning at 9:47:58 a. m. (E.S.T.). He estimated the epicenter as located in the vicinity of Lima and Bellefontaine, O.

From as far north as Windsor, Ontario, across the border from Detroit, to Louisville, Ky., on the south, residents reported quivering walls and other phenomena. Indiana, Michigan and West Virginia were included in the area.

Wilber Stout, Ohio State geologist, described the shocks as a natural reaction caused by relief of tension in upper strata of rock. The entire region, he said, was composed of old rock deposited by glaciers.

"These things are common; there is nothing serious about it," Stout said.

Earth Tremors Recorded Here

Gazette 3-10-37

Three earth tremors varying in duration from six to 45 minutes registered on the seismograph at St. John's Seminary yesterday and the day before. The Rev. Joseph A. Murray, seismologist, said that the last shock, starting at 9:51 a. m. yesterday and lasting 45 minutes, was severe but deep in the earth. He said it probably occurred about 2,150 miles from Little Rock.

A slight shock registered at 5:25 p. m. Monday. It lasted only a few minutes. Father Murray said that it probably resulted from a geologic shift within a radius of 50 to 100 miles of Little Rock.

At 11:46:49 a tremor of somewhat greater intensity was recorded.

From Searcy came reports of an earthquake at 4:10 yesterday morning, but the seismograph showed nothing to bear them out. Father Murray expressed belief that there must have been blasting in the vicinity that was mistaken for earth tremors.

Residents of Searcy said that whatever it was rattled the dishes in their cupboards.

Slight Earthquake Felt at Paragould

Special to the Gazette.

Paragould, May 16.—An earthquake lasting only a few seconds was felt here at 6:51 tonight. It shook buildings and rattled dishes and windows, but did no damage.

St. Louis, May 16 (AP).—Slight earth tremors were reported tonight from St. Louis to Memphis, Tenn. The Rev. James B. MacElwane of St. Louis University said there was no record of a disturbance on the seismograph there. There were reports of houses in the outskirts of St. Louis being shaken and some residents said dishes were jarred.

A 10-second earthquake was reported at Memphis.

A tremor of about 10 seconds duration at 7:53 PCS rattled doors and shook dishes at Poplar Bluff. A brief shock was felt at Kennett, Mo.

SEISMOGRAPHS AND RADIOS MADE HERE

Instruments Are Used in Lo-
cating Salt Domes and
Oil Fields.

Gazette 12-28-30
Probably you didn't know that seis-
mographs, which record vibrations of
the earth, and other delicate scientific
instruments are constructed in Little
Rock. They are, but not for sale to
the public.

The Geophysical Exploration Com-
pany has a suite on the third floor of
the Glover building, and there the in-
struments used by the company in its
geological investigations are made. One
of the rooms in the suite is fitted up
as a regular machine shop, but of
course on a small scale. Another is the
testing room.

The company, which has its head-
quarters at Washington, D. C., estab-
lished an office and instrument shop
here two months ago, following a sea-
son of geological research in this sec-
tion by an experimental party under
the leadership of Dr. L. Don Leet of
Harvard University. The local office is
in charge of H. G. Taylor, vice presi-
dent of the company. Carl Spriegel, an
expert instrument maker born in Ger-
many, is the man who works on the
seismographs and other such sensitive
contrivances. Raymond Wengel and his
assistant, Victor Gasser, work on radio
instruments, which are used in con-
junction with the seismograph by the
geologists.

First Used 10 Years Ago.

The seismograph first was used to
locate oil fields about 10 years ago.
The Geophysical Exploration Company
found its use of great advantage and
during the past six years it has made
all its own instruments.

Mr. Taylor said that seismographs
had proved especially successful in lo-
cating salt domes, indicative of oil
producing areas. Of the dozens of oil
fields along the coastal plane of Texas
and Louisiana, only four or five have
no connection with salt domes, he said.
The domes average about a mile in
diameter with the salt 300 feet or so
below the surface of the earth. In some

cases the domes cause a bulge in the
earth's surface, but in others there is
no outward indication of their pres-
ence. The oil producing areas surround
the domes.

Explosives are used to cause the vi-
brations recorded on the seismographs.
Three of the latter instruments
customarily are used by one field party.
Seismograph stations are set up at dis-
tances of five to eight miles from the
central station, where the blasting is
to be done. The radio is used for com-
munication between the seismograph
stations and the central station. One
of its important functions is to signal
the instant of blast.

The seismograph records of earth vi-
brations following the explosion indi-
cate whether there is a salt dome in
the line between the blast and any of
the instruments. By changing the lo-
cation of the instruments, figuring va-
rious angles and repeating the process
the exact location of the dome can
be fixed. The wave from the blast
travels much faster through salt than
through earth, stone or other sub-
stances.

The seismographs used by the ge-
ologists are much smaller than the in-
struments used by scientists to deter-
mine the location of earthquakes, Mr.
Taylor said. He showed two seismo-
graphs, one that had been used and
another with no experience so far.
They weigh only 10 pounds each and
their greatest dimension is about one
foot. Earthquake seismographs used to
weigh about a ton each, but they have
been cut down in size to 200 pounds.

Magnification of the 10-pound seis-
mographs is 10 times as high as that
of their big brothers, Mr. Taylor said.
They record vibrations as slight as one-
millionth of an inch. The company's
seismographs have been improved by
the instrument makers each year since
their manufacture was started.

Plans are underway to send out an-
other experimental party in this sec-
tion next month, Mr. Taylor said.
George C. Branner, state geologist, de-
scribed the work performed around
Little Rock last summer in an article
that was published in the Gazette No-
vember 30.