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# This Is Earthquake Country

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By ROBERT KELLET

THE Central Mississippi Valley gets shaken up a bit from time to time, as residents of the area know full well. And if the frequency and intensity continues, experts say many of those who live in Memphis and other parts of the Mid-South are going to be dangerously ill-prepared for what may happen.

ALTHOUGH THE Central Mississippi Valley is clearly earthquake country and the location in the early 1800's of the three greatest earthquakes ever recorded on the North American continent, amazingly little is known about the subsurface faults and fracture systems which have repeatedly sent the temblors through the valley.

Unlike on the West Coast where the famed San Andreas fault is mapped as carefully as many highways and is very much in the consciousness of Californians, Mid-Southerners usually have only a vague knowledge of what some believe to be a potentially volatile fracture system.

Accordingly, little has been done to guard against potential disaster.

"It is truly frightening to think what an Intensity VIII earthquake like the one at Newhall (Calif., Feb. 9) in Memphis would do," said Dr. Fred Followill, director of the seismological observatory at the University of Mississippi.

DR. FOLLOWILL is one of several professionals who measure disturbances beneath the earth's surface and feel that new examinations are needed along the fracture systems that produced the three great New Madrid earthquakes in 1811-12, shook the small Missouri town of Charleston in 1895 with a quake believed strong enough to cause general disaster if it hit today, and on Nov. 9, 1968, released a relatively minor earthquake that was felt in 22 states.

"There is no evidence to suggest that the adjustments which produced the New Madrid earthquake are completed," Dr. Emil J. Mather concluded after reviewing a report he wrote at Washington University in St. Louis in 1968.

"On the contrary, all available evidence indicates that they are continuing," said Dr. Mather, who is currently with Western Geophysical Co. in Houston.

While at Washington University, Dr. Mather and Dr. Leroy Sharon examined some of the fracture systems and provided some of the best new information since 1912, when geologist Myron L. Fuller carried out a surface study of the disturbance areas and came up with observations still used.

THE INFORMATION, along with

records of past earthquakes in the region, supply the basis for scientific assertions that future earthquakes can be expected in estimable periods under a system of "statistical prediction."

The basis of statistical prediction, according to Dr. Followill is that earthquakes, like floods and other natural disasters return in certain dimensions over specified periods.

"In statistical prediction, there can be 100-year, 50-year, 5-year or 1-year earthquakes," he said. "The larger the earthquake, the longer the return period."

To gauge the size of a tremor, two scales are generally used: Intensity, always noted by Roman numerals on a modified Mercalli scale which measures observed effects on structures and residents in the so-called "felt" regions of the earthquakes, and magnitude, recorded in arabic numbers on the Richter scale, to measure earthquake velocities in an area remote from the earthquake.

"You can expect an Intensity V every two and a half years," said Dr. Followill. "a VI every five years, a VII every 15 years (like the one in 1968), and an Intensity VIII, believed dangerous for non-reinforced structures, every 100 years."

"The last one in the 100-year category was the one at Charleston in 1895. There have been six VII's in the past 100 years, all well documented, 20 in the VI category and 40 V's."

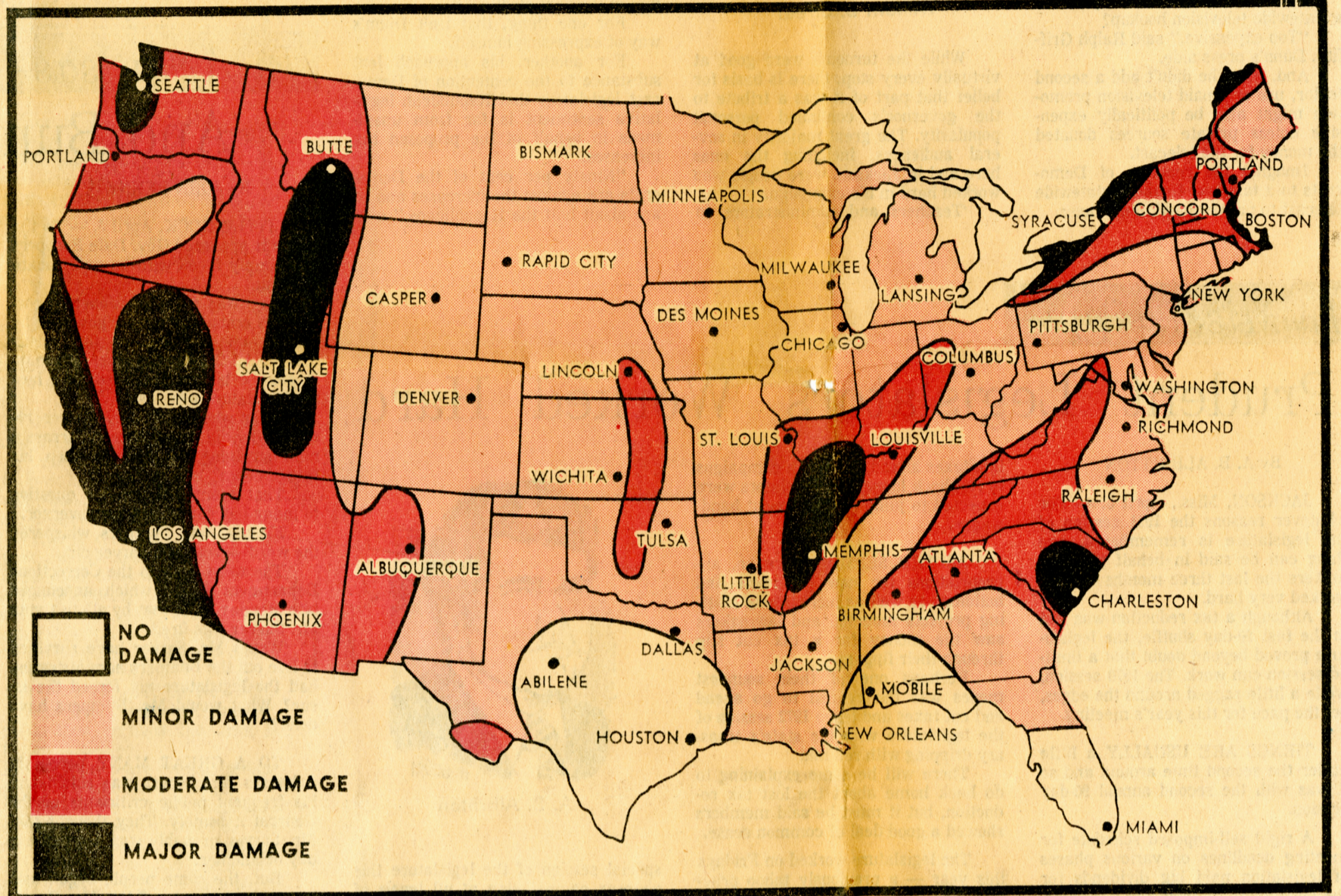
THE FULLER SURVEY findings give other evidence of recurring earthquakes over an even greater period of time. In addition to finding some support for Indian legends of great earthquakes in the region of the New Madrid Earthquakes of 1811-1812, the noted geologist found surface cracks as large as those known to have been opened by the 1811-12 sequence with trees at least 200 years old growing within the cracks.

This, geologists say, would indicate at least one earthquake since 1600 with an intensity equal to the New Madrid earthquakes.

Although the region was largely unpopulated and recorded casualties were few, accounts of the great earthquakes which had epicenters (that point on the earth's surface immediately above the disturbance within the earth) near New Madrid, Mo. — at about the time Lewis and Clark were exploring the Louisiana Purchase — show how the ground in the area and the Mississippi River behave during great stress.

A LETTER to a friend from Eliza Brown, a pioneer of the region, told of the series of quakes.

"On the 16th day of December, 1811, about 2 o'clock a.m., we were visited by the violent shock of an earthquake," he recalled in the letter



Intensity of Possible Earthquakes Is Based On History Of Temblors In Specified Areas. — Staff Map

dated March 22, 1816. The quake, he said, was "accompanied by a very awful noise resembling loud but distant thunder, but with more force and vibrating."

The earth heaved, "waving as a gentle sea" and the day was later darkened by "sulphurous vapor" and accented by the "screams of the afflicted (sic) inhabitants running to and fro, not knowing where to go or what to do, the cries of the fowls (sic) and the beasts of every species, the cracking of trees falling and the roaring of the Mississippi River, the current of which was retrograde (backward) for a few minutes, owing as is supposed, to an eruption in its bed."

JOHN BRADBURY, English naturalist and fellow of the London Philosophical Society, was on a flatboat just below New Madrid at about 2 a.m., Dec. 16, 1811. It was a clear night when the first shakes began.

"I was awakened by so violent an agitation of the boat that it seemed in danger of upsetting," he wrote in his diary. "Immediately the banks both above and below us began to drop into the river in such vast masses as to nearly sink our boat by the swell they occasioned . . ."

"About 4 o'clock the next day (Dec. 17), we came in sight of a log house at the lower Chickasaw Bluffs. More than 20 people came out and entreated us to come ashore. They were almost distracted with fear and were praying together, an open Bible lying on the table. They told me that the greatest number of the inhabitants of that vicinity had fled to the hills for

safety, and that during the shock about sunrise on the sixteenth, a great chasm had been opened on the sandbar opposite the bluffs and on closing again had thrown the water to the height of a tall tree. They also affirmed that the earth opened in several places back of the river."

SOME OF THE BEST accounts of the river's activities were written by Nicholas Roosevelt, builder of the New Orleans, the first steamboat on western American waters. The craft was on its maiden voyage and anchored on the Ohio when the earthquake struck. Roosevelt, grandchild of Theodore Roosevelt and business associate of Robert Fulton, proceeded down the

Mississippi, however, and recorded changes in the river bed, great water spouts, and often violent waves.

As the water returned to its banks, entire forests were leveled and riverbanks were caved. Smaller quakes continued, diminishing each year, as Mr. Bryan noted in his letter. He noted that there had been two noticeable quakes the winter prior to his writing, but because of the lessening shocks, "we begin to hope that ere long they will entirely cease."

It was on the latter of the systems that the shaking that registered 4.5 on the Richter scale was registered in 1968.

Beyond this, few venture guesses about the age of the fractures. There are conflicting theories about whether the faults are vertical or horizontal, and disagreement about the manner and direction of their movement.

Dr. Mather, during his years of research, noted that there was more geologic detail available to indicate activity on the New Madrid fault and pointed out that of its major features are a northeast-trending fault that borders the eastern portion of Reelfoot Lake, a long northeast fault trend extending roughly parallel to Crowley's Ridge, Ark., and the Mississippi River and a northwest major fault north of New Madrid which connects the other two faults.

This, he suggested, "may explain why the earthquakes can be so intense in this region."

ALTHOUGH the highest risk zone barely dips into Northwest Mississippi and other parts of the state are in risk categories one and two, Dr. Followill has suggested that perhaps two more fractures may exist that would increase the risk rating if properly researched.

"We now suspect the existence of two more (fractures) in Mississippi," he said. "One is believed to run from Waynesboro, up between Greenwood and Greenville, to Hot Springs, Ark., and back down to Corsicana, Texas."

The other, more minor one, runs from Gulfport through Vicksburg, we think." In the past century, Dr. Followill contends, five earthquakes have had epicenters in the state of Missis-

siippi — the most recent a slight shock in Belzoni in 1967.

RELATIVELY LITTLE is known of the features, and therefore the risks and nature of risks, involving earthquakes in the Central Mississippi Valley because little research has been done.

By comparison to the much-discussed West Coast faults, relative knowledge is even less because the San Andreas fault and many of its tributaries are surface faults and readily visible in the features and movements.

"In the Western United States, we can relate the earthquakes to the active faults exposed at the surface,"

*'The Biblical contrast between the experiences of the man who built his house on a rock and the one who set his on the sand still holds true.'*



Four months after a mild earthquake rippled through the Central Mississippi Valley last Nov. 16, this chasm was discovered in west Lauderdale County, Tenn. A five-acre hill had sunk as much as 48 feet below the normal surface, and slid south about 50 feet. — Photo by Jan Taylor

said Dr. Followill. In addition, Californians have been engaging in extensive research and observation.

"IN CALIFORNIA, they are locating thousands of times as many earthquakes as we, simply because of their network of seismographs. They have available geological instruments along the entire San Andreas fracture system that are able to record earthquakes way below the felt line."

What the University of Mississippi's seismologist wants to do is to urge the establishment of a more sophisticated network of recording devices in the Central Mississippi Valley, to inform the public about hazards and possible preparations, and, somewhere in the future to have available means of improved prediction.

The first two goals follow closely the suggestions of Dr. Charles F. Richter, who invented the machine which measures earthquake magnitude 37 years ago. Pushed for years for recommendations for guarding against earthquakes, he has often replied: "Better construction, better preparedness, more public education."

"We will have to map the active faults in the Mid-South by recording the micro-earthquakes that are continually occurring," Dr. Followill said in a recent appearance in Memphis.

JUST MAPPING seismic risks in the Mid-South, he says, would take ten years and 5 million dollars. An ideal system could be installed, although the price tag was not immediately calculated, that would place seismographs 5 to 10 miles apart throughout the area. This standard, which seismologists generally agree is ideal, exists only in Los Angeles and the San Francisco Bay area in California.

"The public is going to have to demand studies," said Dr. Followill, who cites fiscal neglect both by the federal government in the Central Mississippi Valley and by states in the region. "The only sure way to get fed-

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# This Is Earthquake Country—

## Building Code Called Necessary

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eral funds may be to have the Intensity VIII earthquake at Memphis. That'll bring the funds in, but it seems an awfully expensive way."

If that Intensity VIII shocker does hit, Memphis, and nearly all of the rest of the region, will have structures unable to stand the lateral loading forces which cause buildings, bridges and other things to crack and shatter.

A UNIFORM BUILDING code, such as Los Angeles has adopted has been suggested as essential in any high earthquake risk area, by seismological observers. The Los Angeles code, which requires that structures be built by quake-resistive designs, was credited with saving many lives and buildings.

Locally, it has been pointed out, special risk factors are involved, not only because of the presence of the Mississippi River, its bridges, docks and transmission lines, and the density of utilities necessary in any urban area, but because of the unconsolidated alluvial soil on which much of the city stands.

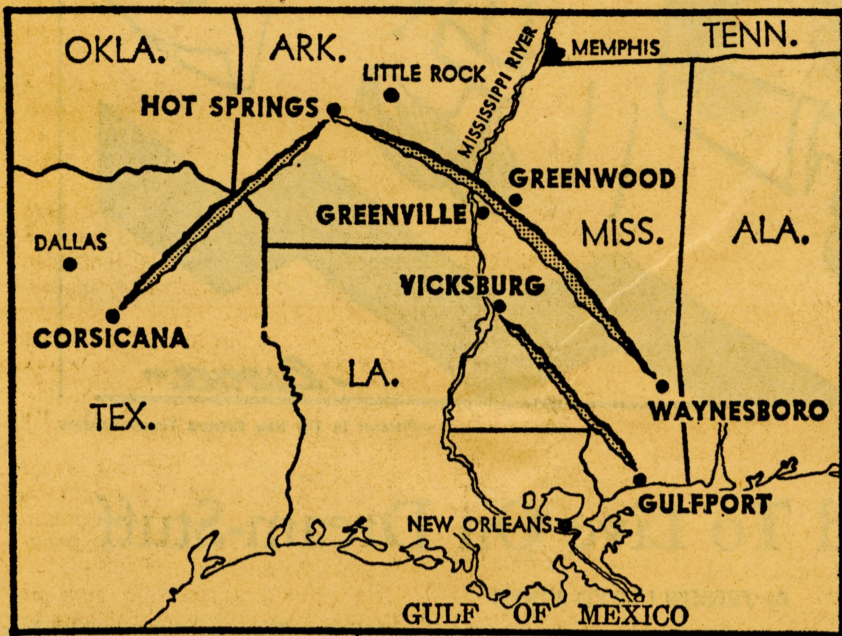
"The Biblical contrast between the experiences of the man who built his house on a rock and the one who set his on the sand still holds true," said Dr. Richter in an article which he wrote for *Natural History* in 1969.

"One might suppose that soft and unconsolidated material would serve as a cushion to moderate the effects of a shaking. This is true only to a limited extent; other, more important factors are at work, and centuries of observation have shown that generally the reverse is true. Other circumstances being equal, the intensity of shaking and, consequently, the destructive effects are much greater on alluvium, beach sands, artificial fill, or other unconsolidated foundation than they are on firm rock."

THE PEOPLE WHO suffered in the earthquakes in the region in the early part of the last century may have had some of the best resistive structures—log cabins. With their single-story design, often cross-braced with ceiling beams and hopefully, a solid foundation of some sort, the cabins often had the kind of combination that kept them standing, historians have observed.

When the danger of fire can be discounted, which is seldom, the single-story frame building is still one of the better quake-resistant structures, Dr. Followill says.

He also recommends that any large structure that is "soft or weak horizontally is potentially fatal. Without lateral-resistive-design, specially for the Mississippi Valley, no structures should be taller than 20 stories,



Suspected Earth Faults, Mississippi to Texas

and it is probably unwise to construct anything in excess of six stories."

MEMPHIS BUILDING officials, urged by area engineers and seismologists, are beginning to seek an approach to the earthquake-building code questions.

"To date nothing has been done as far as requiring these (resistive designs)," said Frank M. Bosak, the city's building official. "The whole problem is under study now to see what our risk factor is.

"We are just into the initial stages of trying to determine what way to go and have been consulting with some people who will advise us as to what course of action we should take as far as conducting this study."

PART OF THE study, Mr. Bosak said, will be to determine if the Department of Commerce's risk factor chart properly places Memphis in the high risk Number Three zone.

"Right now, we don't call for anything other than wind bracing in the tall buildings," he said. "It could be a rather involved investigation. The risk factor map was based primarily on intensity of earthquakes and we were put in it (the high risk zone) because of a very intense earthquake in 1812.

"We just don't have sufficient statistical data to make an actual judgment. The question that comes to my mind as a building official is how much protection do you build into a building if your cycle is 50 or 100 years (for an earthquake or destructive intensity) and the building is to

last 25 or 30 years. There are many dark areas.

"The purpose of the study, the way we envision it," said Mr. Bosak, "is to determine what the risk is and what the cost would be to guard against this risk. The cure may be much more than the disease itself."

IS THE LOCAL earthquake risk really as great or greater than on the West Coast?

Some contemporary speculation contends that the answer is yes. The truth is that the question is unanswered.

In Shelby County alone there have been at least three instances of Intensity V earthquakes, and a similar fourth one in West Memphis in the past 100 years.

Dr. Followill says that in comparison of energy released over the past 200 years, the Central Mississippi Valley faults have been more active than those on the West Coast—primarily because of the great New Madrid quakes. In the last 100 years, however, more energy has been released on the West Coast.

If the intensities of the New Madrid quakes were overrated, said Dr. Followill, then perhaps the area is safer than suspected.

But, if experts are correct in their analysis, then, said Dr. Followill:

"I don't know if this should give us confidence or should panic us. Because if we released more (tectonic energy) over the last 200 years, and less in the last 100 years — then we're due for it."

Robert Kellett is a staff member of The Commercial Appeal

## Predicting Is Chancy

EXPERTS IN THE earth science fields have long disagreed about the feasibility of earthquake prediction. Some contend that improved systems of detection and monitoring of earth movement will permit earthquake forecasts, similar to turbulent weather forecasts, in the next 10 years. Still others have envisioned the time when major earthquakes can be prevented—perhaps by setting off explosives in fracture systems to cause minor, relieving earthquakes.

Nearly all theories in the field of quake prediction have been met with varying degrees of skepticism—some of the more outspoken from Dr. Richter.

SCIENTISTS WENT into 1971 with a critical eye on the straining earth and a theory that more tremors take place in the seventh year of the seven-year "wobble" cycle.

For some reason, the National Ocean Survey reported the earth's north-south axis wobbles a bit as the earth revolves in space every 24 hours. The motion reaches a maximum every seven years.

Charles A. Whitten, chief geodesist of the NOS, said 1971 should be a critical year. "This is the year in the seven-year cycle of the Earth's wobbling when the daily shift of the pole reaches its maximum," he said Feb. 3 and pointed out that the maximum wobble coincided with major quakes in 1950, 1957, and 1964—the year of the great Alaskan quake.

If anyone doubted Dr. Whitten, they were probably silent less than a week later when the earthquake struck the Los Angeles area.

THE CALIFORNIA earthquake refocused attention on the sometimes unsteady nature of the globe. There were renewed inquiries at many Memphis insurance firms about earthquake coverage, although insurance executives say that most buildings, in addition to not being built to resist quakes, are not covered by insurance.

In California, where earthquake insurance costs about the same as fire insurance, one proposal was advanced for the creation of a natural disaster category of insurance that would make policies more economic by spreading them to include damage from tornadoes, floods, hurricanes and other disasters.

Although earthquakes have long been studied, most individuals do not know what to do in an earthquake and most Civil Defense units have not made preparations for them, Dr. Followill said.