A fair shake

UK earthquake research has far-reaching impact

Kentucky Geological Survey and the Department of Geological Sciences work together to increase safety

By Linda Perry

Here's an odd fact: the U.S. Geological Survey National Seismic Hazard Maps show Paducah with a higher risk of destruction from an earthquake than the San Francisco, Calif., area.

Jim Cobb at the Kentucky Geological Survey (KGS) at the University of Kentucky would like to change that. To that end, he and Zhenming Wang '93 '98 AS, '96 '98 EN, KGS Geologic Hazards Section head, travelled to a Memphis, Tenn., conference last November to present three scientific arguments against the higher risk in Paducah. The conference was a meeting of the country's foremost earthquake experts, the Advisory Committee for Earthquake Hazard Reduction, a federally appointed oversight committee.

Cobb, KGS director, says that the reason Paducah is in a higher hazard category than San Francisco is that the methodology used to make that determination was wrong to begin with and the information needs to be corrected. "We consider that Paducah has a significant hazard but it just can't be worse than California. That's just crazy," he says. "We have lost about $2 billion in economic investment in Kentucky because people go somewhere else. We want the rating to be moderate, not higher."

Paducah isn't getting off scot-free, though. It's relatively close to the infamous New Madrid seismic zone, which caused huge earthquakes in 1811 and 1812. But Cobb believes the area is not "getting a fair shake," so to speak, and this impacts economic development because industries might choose to locate in other cities or states.

"I have statements from the chamber of commerce, the development district and other officials who know of specific cases where that has happened. The economic damage is actually worse than if the Paducah area had the earthquake," he says.

Bolstering Cobb's assertion is the comparative research the KGS and the UK Department of Earth and Environmental Sciences have done with the Chinese province of Gansu and with the Lanzhou Institute of Seismology in Gansu Province, China, due to an agreement begun about six years ago. This arrangement allows the researchers on different sides of the world to exchange valuable scientific information about earthquakes that can potentially save lives. Representatives from UK and China have visited each other's countries in that regard, including the vice governor of the Gansu province arriving to meet with then Kentucky Gov. Ernie Fletcher.

"We've worked in Wenchuan, China, where they've had an 8.0 earthquake with almost 90,000 people perishing. We have the records for that 2008 earthquake to compare against what the U.S. federal government says can be expected for western Kentucky. It just turns everything upside down," says Cobb.

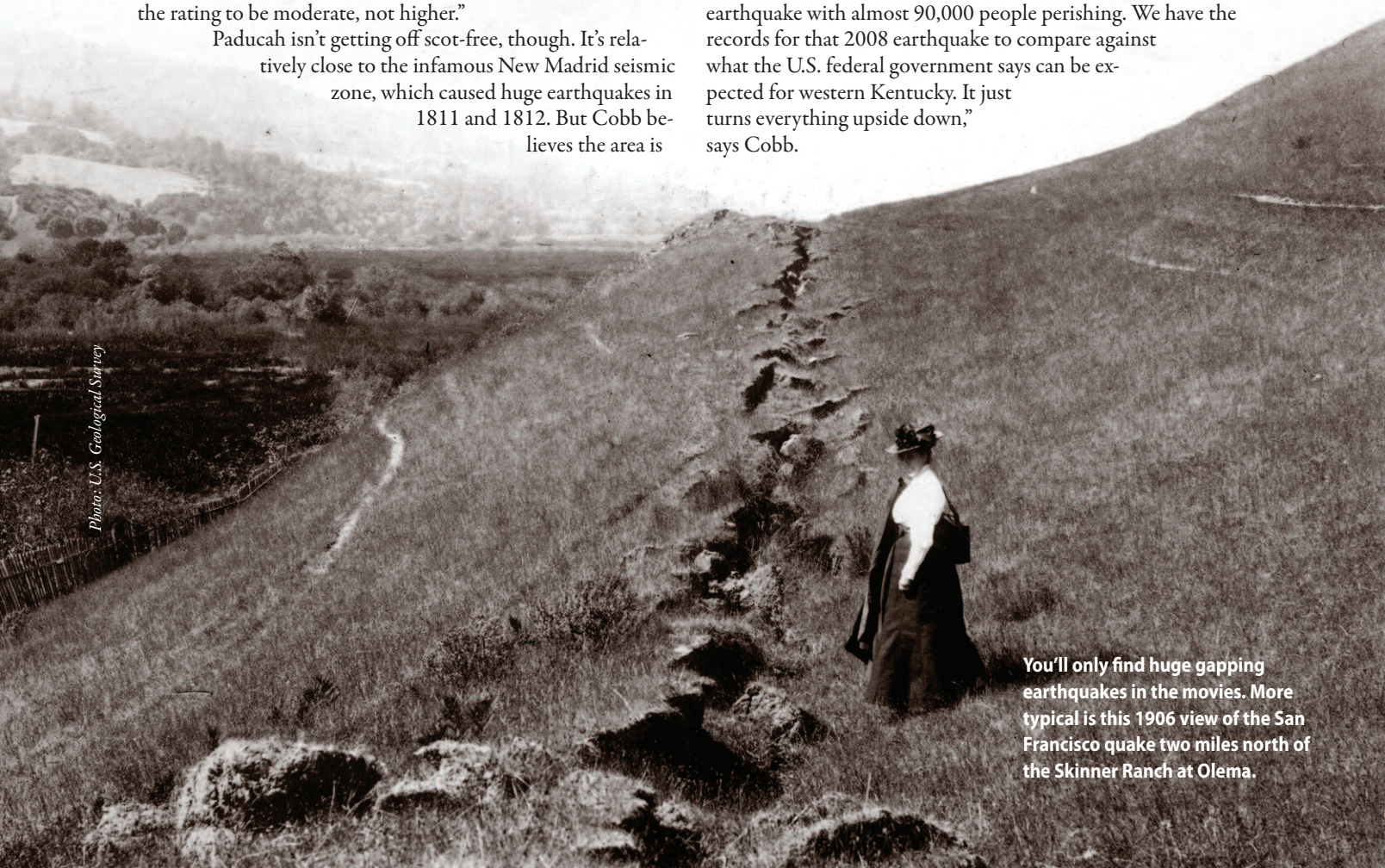

Photo: U.S. Geological Survey

You'll only find huge gapping earthquakes in the movies. More typical is this 1906 view of the San Francisco quake two miles north of the Skinner Ranch at Olema.

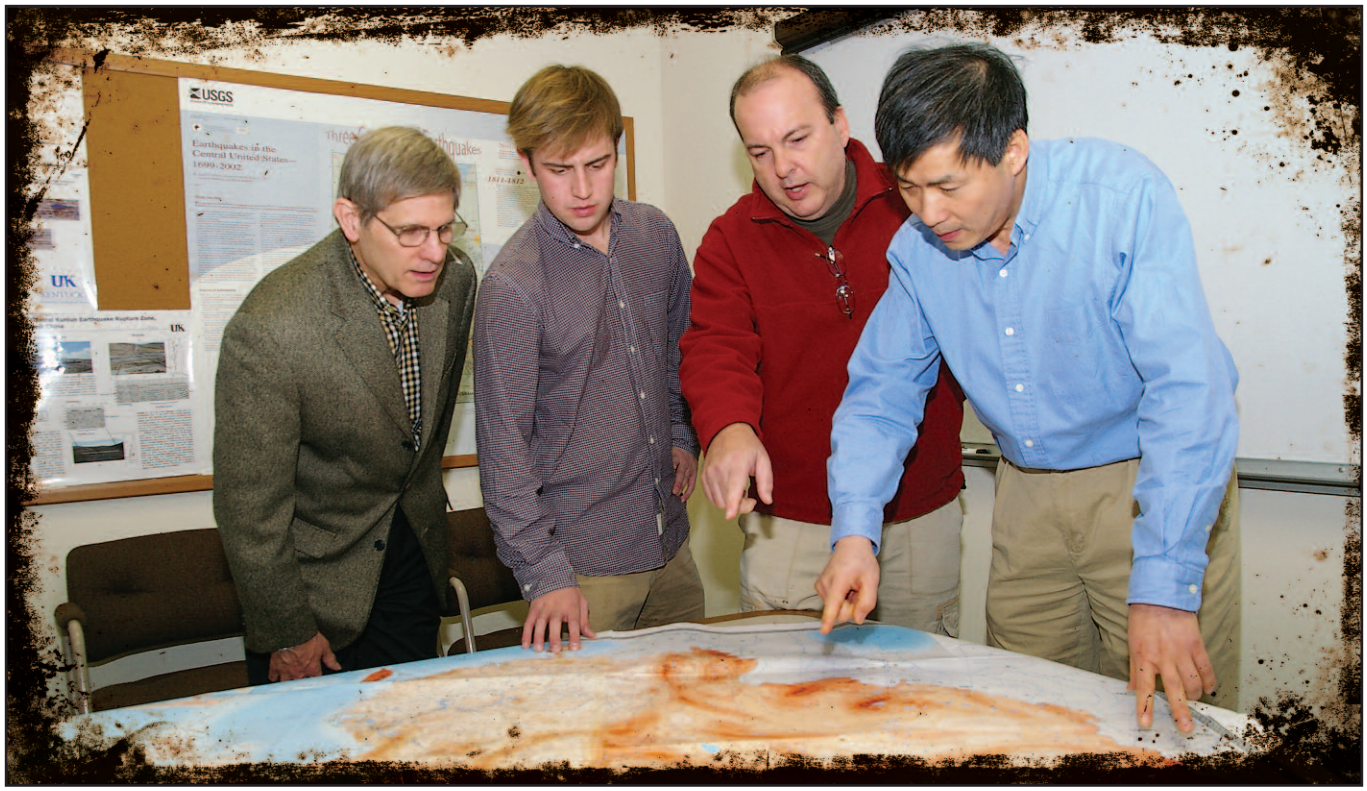

Photo: Mike Lynch, KGS

Zhenming Wang, right, discusses earthquake activity that has taken place in Gansu Province in northwestern China with, left to right, Jim Cobb, David Butler and Ed Woolery.

"Their faculty have come to UK and finished their degrees here under Ed Woolery and Zhenming Wang," he says. Woolery '93 '98 AS, '96 EN is associate professor in Earth and Environmental Sciences.

"And for the first time, one of our UK students, David Butler, went to China to do his research for his master's degree on earthquakes in China," Cobb says. Butler '10 AS focused some of his thesis work on estimating earthquake site-effects for the Tianshui urban area in Gansu Province.

A mission to help

The KGS has a mission to provide scientifically-based information on Kentucky's geology and mineral and water resources. The staff conducts research, collects data, and serves as Kentucky's official archive for data on petroleum, coal, minerals, ground water, and topographic and geologic maps. The study of earthquakes falls under their purview.

"Our research involves two things: where the activity is going on to locate the fault that actually creates the earthquake, and when the seismic waves hit Kentucky and travel to the surface, how those waves impact your home, school or hospital," Cobb says. "What type of material your structure is built on will determine how those waves from the earthquake affect it. So there's a big impact if it is loose material and it's deep."

The outcome of all this research contributes to better building practices, lessening destruction and saving lives.

Due to a joint effort between KGS and the Department of Geological Sciences, UK has the largest seismic network in the eastern United States, with about 30 stations across Kentucky monitoring earthquakes with a magnitude of 2.0 or larger. Most of these seismic instruments monitor locations in the western part of Kentucky. A hole is drilled into the earth for the sensitive scientific instrument. When an earthquake occurs, the instrument records the level of shaking and that information gets electronically sent back to UK's computers in the center of campus at the Mining and Minerals Resources Building.

In addition, one of Kentucky's monitoring stations is actually right in the heart of campus, so Lexington's potential quake activity is monitored.

"We drilled a hole outside and put a seismograph right next to our building," says Cobb. "But we also keep the old-fashioned helicorders that use pen and ink to record earthquake activity." Cobb says the helicorders can be turned on when there is a seismic event so that TV crews can show a better visual to viewers. Otherwise, data is being recorded daily and sent to computers at KGS.

Cobb says that anyone can visit the KGS website and see real-time seismic recording in action every day. "If there is an earthquake in Chile or Haiti or anywhere in the world for that matter, we record it. This is amazing and people can't believe it, but we recorded the recent earthquake in Indonesia all the way from Kentucky. The travel time is very long, like 15 or 20 minutes, but those waves get transmitted through the crust of the earth and are actually recordable.

"The earthquake in 2006 in Sumatra where all those people were killed — we recorded that earthquake for about two hours on our seismographs. Those waves circled the earth about four times," he says.

When the UK "delegation" (Cobb, Woolery, Wang and Butler) visited China last summer, they traveled into cities as well as re-

Earthquakes can happen anywhere at any time. Just ask UK fans who experienced a 4.7 quake while attending the Maui Invitational to see Wildcat basketball in Hawaii. (There was no significant damage reported.)

Photo: Mike Lynch, KGS

Jonathan McIntyre shows the traditional helicorders recording seismic activity. Today data is sent from the field to UK computers.

mote rural areas that have sustained significant damage from earthquakes over the years. People's homes and schools are being rebuilt and one of the reasons UK representatives were there, says Woolery, was to deliver information on the best building practices to prevent damage and loss of lives during future earthquakes.

This exchange of information is important, he says, because UK researchers are also able to learn from the earthquake damage in China at the same time they are helping to provide the Chinese with technical information. Woolery says that the Chinese history of earthquakes is a cornerstone of his projects. "I'm looking at 31 damaging earthquakes that have been felt in Tianshui since 1,034 A.D. The oldest recorded earthquake in China goes back to the 23rd century B.C. They have incredible records," he says.

"Historical earthquake records in the central United States go back less than 200 years, whereas the Chinese historical records cover nearly 2,000 years," says Woolery.

"When we talk about historical geology in the central United States, it goes back to 1811. And now we are getting ready to mark the bicentennial of the New Madrid earthquakes that occurred on Dec. 19, 1811, and Jan. 17 and Feb. 7, 1812," he says.

"Even though satellites monitor weather today, we still get weather forecasts wrong. Well, earthquakes are discreet events. We have monitoring networks to collect the sparse information but trying to predict an earthquake is virtually impossible," says Woolery. "So what do you do? You look at where and when earthquakes have occurred historically and suggest when there might be an earthquake there again."

Woolery says when Chinese representatives visit UK, they are very eager to learn better ways to help their own people by paying attention to our local building practices.

"They come here and take pictures of residential buildings. In their cities, the engineering practices are not state-of-the-art, but they have progressed. In rural areas, there are still adobe buildings and mud type structures," Woolery says.

There are several universities in the central United States, he says, that are also conducting earthquake research. "But I think we distinguish ourselves because we are more practical. We ask ourselves the question, 'What does this mean for society?'"

Looking ahead

At the KGS, Wang leads the research and service group in the fields of geologic hazards — seismic hazards in particular — and their mitigation policies. He also operates and maintains the Kentucky Seismic and Strong-Motion Networks.

"Dr. Wang was the architect of our position statement for the conference in Memphis," says Cobb. "He is the person who actually did the work to pull it all together."

The conference was important because those in attendance have the ability to influence the people in federal government who make the hazard assessments and change them. A recommendation will be made about the Paducah situation, but it could take up to two years before a decision is made.

Wang says that using basic physics about how the seismic waves propagate can eventually be turned into a mitigation policy, with the potential to save thousands of lives. But you have to know what you are looking for in the data.

"How can you tell the difference between an earthquake and blasting during coal mining, for example? That's why we run a network, particularly in eastern and western coal mining areas," Wang says. "Pretty much every day from 8 to 5 you will see mine blasts popping up. It is easy to distinguish because an earthquake is recorded as being deep and a mine blast is on the surface. And with mine blasts, they don't explode just one, there are continuous explosions to loosen up big chunks of coal."

Wang says that the research at UK can ultimately be shared with engineers, echoing Woolery's perspective about practical applications and helping people around the globe, particularly in undeveloped countries. "If people in science are not connecting with the outside world, what is the meaning to other people? We can do so much to help," he says.

"The perception is that earthquakes are too big and we cannot do anything. But in reality, that's not true," says Wang. "You can do some very minimal things and have a life-saving point of view. It is easy to reach that goal."

This can be achieved on some level using very simple steps, including reinforcing building foundations, whether masonry or adobe-style.

"One word," says Cobb, with a smile on his face. "Rebar."

WebXtra **To read more and link to KGS real-time recording, visit www.ukalumni.net/earthquake**

Earthquake!

- **It is estimated that there are 500,000 detectable earthquakes in the world each year. 100,000 of those can be felt, and 100 of them cause damage.**
- **The largest recorded earthquake in the United States was a magnitude 9.2 that struck Prince William Sound, Alaska, on Good Friday, March 28, 1964, UTC.**
- **The largest recorded earthquake in the world was a magnitude 9.5 (Mw) in Chile on May 22, 1960.**
- **Florida and North Dakota have the smallest number of earthquakes in the United States.**
- **It is thought that more damage was done by the resulting fire after the 1906 San Francisco earthquake than by the earthquake itself.**

Courtesy United States Geological Survey