Geotechnical America
at the
38th Parallel

Part I -- "Shaken, Not Stirred"

My subject is "Geotechnical America at the 38th Parallel of Latitude," subtitled "Part I -- 'Shaken, Not Stirred'," taking that phrase from a recent local headline, which of course echoes James Bond's classic directions, usually specified while under considerable duress, ~~stress,~~ for mixing his favorite cocktail.

As indicated by the handout, the original presentation was a photographic survey of the landforms and geotechnical aspects along a narrow transect of the United States, east to west, at its approximate center. From the Assateague and Chincoteague islands on the Atlantic coast, at the Virginia--Maryland state line, to Point Reyes a short distance north of San Francisco Bay, on the Pacific. With inbetween the small Missouri town of St. Genevieve, the earliest settlement in the state, roughly fifty miles to our south, on the Mississippi River. St. Genevieve can, or at least could, be, accessed by a ferry, seen at center, from a landing at Modoc, on the Illinois side.

But a geologic event that occurred on August 23 of the summer just past has prompted me to drastically narrow my focus. That event was an earthquake in the Piedmont geologic province of Virginia, about 25 miles southeast of my home near Charlottesville, of 5.8 on the Richter scale. The epicenter was identified in the media as Mineral, Virginia, but more specifically was the small community of Cuckoo, locally pronounced "coo-coo." Here is situated the previous home, and nearby the present one, of our former ACE colleague, now of the Virginia Department of Transportation, Mark Wood, who like myself was mentored in the Lands and Engineering Division of the Virginia Department of Game and Inland Fisheries by the late Lloyd Byrd, a longtime member of our Association, who, along with his dear wife, Virginia, was a faithful attendee of the annual conference.

What I will be focusing on the next few minutes, then, will be this recent earthquake, which at 5.8 was a tie with the previous quake

of record in Virginia, in 1897, with an epicenter in Alleghany County, bordering West Virginia.

We will also briefly consider the seismic zones which produced the New Madrid earthquakes of 1811-12, centered along the Mississippi River, with an epicenter at the town of that name in the Missouri bootheal. As well as the San Andreas fault zone in California, responsible for the San Francisco quake of 1906, as well as others.

So, I would now like to ask for a show of hands as to how many live in an area where the August quake was felt. Later on of course I would be interested in your own personal experience with it.

I will mention in passing, though will not elaborate upon, the fact that an incident at the Cuckoo Tavern during the Revolutionary War may have saved the life of Thomas Jefferson, or at least spared him from imprisonment. Whose Thomas Jefferson National Expansion Memorial (the classic arch of the St. Louis skyline) I look forward to revisiting tomorrow.

Let us move inland from the Atlantic coast across country to the earthquake's place of origin. From Assateague and Chincoteague islands again. Where, if you look closely at center, I believe you will see at least one of the popular Chincoteague ponies. In passing, I'm wondering how many of us have read, or perhaps read to a child, the engaging horse story, Misty of Chincoteague?

At the ooean's edge begins the Coastal Plain geologic province, often referred to in Virginia as the "Tidewater" region, characterized typically by relatively unconsolidated sediments, as evidenced in this fossil rich gravel pit. We will traverse the Eastern Shore of Virginia, sail across the Chesapeake Bay, and then venture overland across what was referred to historically as the Western Shore. Before eventually arriving at the Fall Line, more properly characterized as the Fall Zone, where the rivers great, like the mighty James, and small, like the Little River to the north, create falls and rapids as they flow from their venerable beds in the old metamorphic rock of the Piedmont geologic province and cut down into the softer lands of the Coastal Plain. The falls were natural trading places, initially with the Native American people, and this activity, along with milling, manufacturing, and trans Atlantic shipping, was the origin of such

present day Virginia cities as, from north to south, Alexandria, Fredericksburg, Richmond (the capital), and Petersburg.

As noted, beyond the Fall Zone lies the Piedmont, typically underlain by ancient metamorphic rocks characterized for the media recently by a geologist reflecting on the quake as, "old, hard, and cold," and thus apparently capable of transmitting shock waves very effectively. As these field geology students seem to be confirming.

We will pause briefly at Lake Anna, constructed for purposes of the North Anna nuclear power station in Louisa County not far from the quake's epicenter, before continuing to visit my neighborhood on the eastern edge of the first small range encountered on moving inland from the ocean, the Southwest Mountains, and drop in on the home of its most famous former resident.

Back to the consequences of the quake at our colleague Mark's homes. Unfortunately he lost chimneys at both his present and former residences. His former home, only a stone's throw from the Cuckoo signpost, required the services of a structural engineer for evaluation.

On the Modified Mercalli Intensity Scale, consequences of a quake of this magnitude are noted as follows: "Everybody runs outside. Damage negligible in buildings of good design and construction; slight to moderate damage in well-built ordinary structures; some chimneys broken." [1] True to form, I ran out of my house, too.

The following report, taken from an October 13th newspaper, summarizes damages in Louisa County: "Estimate of damage to residences tops $14 million, and the damage estimate to the public schools has climbed to $57.5 million. Both the county high school and one of the elementary schools are closed for the remainder of the school year.

According to the county, there have been more than 1,100 reports of damage caused by the earthquake and subsequent aftershocks. . . Frequent problems included shifted foundations and broken chimneys.

considerable damage in poorly built or badly designed structures;

. . . the Nuclear Regulatory Commission recently released a report stating that the 5.8 magnitude quake exposed the (nearby) North Anna power plant to twice the force it was designed to withstand. Though the NRC has since issued a statement maintaining that there's no risk to the public, the two reactors have not yet been restarted, and Dominion Virginia Power has been busy installing new seismic monitoring equipment. . ."[2]

News media reported that the quake was felt as far away as Montreal, and prominent among affected structures was the Washington Monument. If you watch network TV news, you may have seen film taken within it while the quake was occurring, or perhaps subsequent inspections undertaken by rapelling down the sides.

Now on to our present conference location, in proximity to the New Madrid seismic zone. For an overview of the consequences of the New Madrid earthquakes occurring between December 16, 1811 and late April 1812, along the Mississippi River Valley, I will quote from a popular book on the subject, When the Mississippi Ran Backwards, by Jay Feldman:

"Of the more than 2,000 tremors that rumbled across the land during this time, three would have measured nearly, or greater than, 8.0 on the not-yet-devised Richter Scale. Centered in what is now the bootheel region of Missouri, the New Madrid earthquakes were felt as far away as Canada; New York; New Orleans; Washington, D.C.; and the Western part of the Missouri River. A million and a half square miles were affected as the earth's surface remained in a state of constant motion for nearly four months. Towns were destroyed, an eighteen-mile-long by five-mile-wide lake (Reelfoot) was created, and even the Mississippi River temporarily ran backwards."[3]

On a definitely less consequential note, some years ago while passing through the town I saw tee shirts for sale with the statement, "It's Our Fault," New Madrid, Missouri.

Leapfroging across the prairies, the Great Plains, and the Rocky Mountains, we arrive at Point Reyes, California, where dramatic evidence remains, some distance north of the city, of the 1906 San Francisco earthquake.

A display on the Earthquake Trail at Point Reyes National Seashore illustrates the juxtaposition of the two plates which form the San Andreas Fault. The rocks west of the fault match those of the Tehachapi Mountains more than 300 miles to the south. The Point Reyes Peninsula rides high up the eastern edge of the Pacific Plate, which is one of the six great plates forming most of the earth's crust. Movement along the San Andreas Fault during the San Francisco earthquake rocked this barn from its foundation, and offset a fence sixteen feet. The National Seashore headquarters here is located directly over the fault.

Following this couple, we can descend some 300 stairsteps to the Point Reyes lighthouse on the tip of the peninsula, thereby crossing one last time the 38th parallel of latitude, and completing our journey.

In conclusion, what can, or should, we make of all of this. On a purely philosophical level, there are two extremes, it would seem. One is concisely expressed in lines from the old spiritual, "Oh, Mary, Don't You Weep:"

"One of these days, around twelve o'clock,
This old world is going to reel and rock!"

An alternative approach is suggested in the observation of Mark Twain that, "As an old man, I have known many troubles--most of which never happened." As engineers, with professional responsibilities for the protection of life, health, and public safety, our challenge would seem to be to successfully advocate design and planning from a reasonable perspective somewhere inbetween abject fatalism and over optimism. But where, exactly, is that position? The relatively recent, I believe, methodologies of Risk Assessment are of course one of the tools available.

We seem to have wound up with about ten minutes remaining for additional observations and questions, any of which I would be pleased to entertain at the present moment, or at some time during the remainder of the conference. Thank you very much!

NOTES

[1]Jay Feldman, When The Mississippi Ran Backwards (New York: Free Press, 2005) p. 175.

[2]Samantha Masone, "What's Shakin?" The Hook, Oct. 13, 2011, p. 30.

[3]Feldman, p. 175. dustjacket.