From The State Geologist

Reflections – A Look Back

By John P. Bluemle

This will be my last "From the State Geologist" article. Effective June 30, I will end just over 42 years with the North Dakota Geological Survey. That's also the length of time I've lived in North Dakota. And, for the past 14 years, I have been State Geologist and Director of the Survey.

My journey began, and I expect it will end in the Great Plains: I was born and grew up in Iowa. Following graduation from high school in 1956, I headed for Iowa State College (it changed to a University in 1959) to become a chemical engineer. That was about the time of the Soviet Sputnik and, with it, the perception that the US had fallen behind, technologically. It was probably for that reason so many in my small high school class (43 graduates) chose to study engineering when we graduated. Of the 23 of us who went on to college, I think about a dozen planned to become engineers. Some of us persisted and several of my classmates had successful and distinguished careers as engineers. I took nearly all of the physics, chemistry, and math courses necessary to become an engineer – I even became proficient on the slide rule, an anachronistic curiosity in this age of computers – but it was a geology course that caught my attention. It was taught by a stately professor, Leo Thomas. Thomas may have been British – he resembled Boris Karloff, both in appearance and speech, but in any case he was an engaging teacher whose own passion for geology convinced me to give it a try. I did, graduating in 1960 with a degree in geology.

With my B.S. in geology from Iowa State in hand, I headed west to Montana for a master's degree. I don't recall exactly why I chose Montana, but I think it was because the geology there is so spectacular. When I arrived in Bozeman, I struck gold. My major professor turned out to be an extraordinary person and an absolutely marvelous teacher, totally dedicated to the science of geology. John de la Montagne (he shortened it, dropping the "de la" part about the time I arrived) is the most inspiring teacher I ever had! John has an enormous technical knowledge of geology, but more importantly, he has a wonderful ability to convey a sense of the ethic of geology – a profound respect for the earth coupled with the knowledge, deep understanding, and appreciation of our natural surroundings that is so very important and fulfilling and which should be an intrinsic part of every geologist's sensibility.

Montana State College, as it was called in the early 1960's when I was there, was a school that boasted an unparalleled array of field possibilities, a geology staff of three (all of them excellent teachers) and, at that time, little else – almost no lab equipment or any of the other trappings of a major geology department. That was fine with me – even then I realized that the field is the best laboratory. I headed out to study glacial geology and geomorphology in the Crazy Mountains (they were formerly the "Crazy Woman Mountains," but this was about the time that political correctness was taking hold and the name was shortened – and well it should, in this case certainly!).

When I received my M.S. degree from Montana State in 1962, I took a position as a geologist with the NDGS in Grand Forks. After four years of mapping the geology of North Dakota counties, my boss, State Geologist, Wilson Laird suggested that, since I was located at the University of North Dakota, I ought to see if I could earn a Ph.D. It took me about five years to do it, working on the geology of McLean County, while I continued in my full-time job as a Survey employee. My good luck in choosing major professors held at UND too. Lee Clayton, who was already a good friend, has one of the most analytical and enquiring minds I can possibly imagine. He is also an excellent editor, and he invariably butchered whatever I wrote, marking it with red corrections – and improving it immensely. Whatever writing and editorial skills I have, I learned from Lee. Lee also taught me a lot about interpreting air photos, a skill absolutely essential in studying the subtleties of glacial geology in North Dakota.

I eventually had my degrees, but most of my real knowledge of geology came as a result of my field work. Over the years, I mapped the geology of 23 North Dakota counties, all of them in the glaciated part of the state. I became particularly interested in, and studied, the geology of Devils Lake off and on for about 20 years. I discovered, mapped, described, and tried to understand hundreds of glaciotectonic structures in North Dakota. I also learned a bit about North Dakota's past climate and used that knowledge to try to understand and explain how (and why) our modern climate is changing.

Staying with one job for 42 years is unusual today, but great satisfaction can derive from such tenacity. For me, that satisfaction relates in part to my love for North Dakota's fascinating geology and myriad geologic issues. Another part of the reward has come from meeting so many interesting people, most of them with a story to tell. While working as a field geologist in rural North Dakota, I was able to visit with

several thousand farmers and I learned something from nearly every one of them. Not all farmers have a lot of technical understanding of geology, but they invariably know and love their land and they can tell you a lot about it. Over the years, I've known – and counted as friends – men and women in the mineral industries, avid environmentalists, school children, teachers and college professors. I've taken groups of all ages on countless field trips. I've worked closely on geologic issues with politicians at the federal, state and local levels. It has always been interesting – often fascinating and entertaining. Most of the reports I've written and published deal with the geology of North Dakota, but I've also worked with, and co-authored, technical articles on a variety of topics with geologists from other parts of the world.

Another satisfaction derives from the opportunity I've had to work so closely, over the years, with the people here in the North Dakota Geological Survey. Their work and creative ideas have played a major role in helping me to achieve the measure of success I have enjoyed as a geologist.

By working together, the geologists and staff of the NDGS have produced an amazing array of technical and educational studies and reports that have added immensely to our knowledge of North Dakota's physical characteristics. We have pointed the way to new mineral resources – oil, coal, gravel and other materials. North Dakota owes its coal industry, its clay industry, and its oil industry to work that Survey geologists did at some time during the past 109 years. Our geologists have identified and evaluated hundreds of sand and gravel deposits that have subsequently been used for construction purposes. Our studies of North Dakota's fossil resources have added another enriching dimension to our State's heritage.

Survey research has generated literally hundreds of millions of dollars in revenue for the State of North Dakota. Our studies have enabled us to learn about and understand a variety of environmental concerns. The State is able to deal with a variety of environmental issues because of work by NDGS geologists and, with that, it enjoys an effective system of checks and balances against undisciplined and unrestrained development. I feel fortunate that I've been able to be a part of some of these accomplishments.

One hallmark of a strong and successful state geological survey is its publications and, in this regard, the NDGS has excelled. In the past 14 years alone, our geologists have produced over 200 technical and educational publications, a number that compares favorably with the output of some state surveys much larger than ours. The challenge of communicating newly-acquired knowledge is, to most geologists, almost a passion, a near-religion to which other people need to be converted! We geologists, in our enthusiasm for our science, have a tendency to nearly force our knowledge of geology on others. Now, with our internet website, we have yet another powerful tool for getting the word out.

Still another facet of my career satisfaction derives from the opportunity I've had, since 1990 when I became State Geologist, to meet and learn from my counterparts in the other 49 states. They – we – are a fascinating bunch, referred to as the Association of American State Geologists. We meet in a different state annually, almost always in a geologically fascinating setting. The state geologists are true professionals, intensely interested and concerned about the welfare of their particular state, and how they can do their part to make it better. Admittedly, some of us are a bit quirky, but I doubt that there is another organization of men and women, representing every state, that is more dedicated to a cause. We learn from one another and we support one another. It's been a privilege to be a member of the Association of American State Geologists, and I've enjoyed the chance to work closely with so many leaders in the geology profession.

My work has been interesting and rewarding and I've enjoyed it. Geology is a dynamic science that demands an open, objective, and imaginative mind. Most of the time it requires us to see what is not there, rather than what is – to tease the past out of the clues the earth provides in its rocks and landscapes and apply the knowledge gained to an uncertain future. Every day on the job has been different for me, although each one always began with the same thought – what will I learn today? Whether it was the glorious summers in the field, mapping North Dakota's geology, or the wintry days I spent in my office, piecing together what I had seen and mapped the previous summer – it was always fascinating!

Only those who truly love geology should choose to make a career of it. It's true that some geologists become wealthy as a result of their profession, but few people become geologists so they might become rich. Like most geologists, I love the science because of its ties to nature and to the outdoors. Years of field work have allowed me to enjoy – as an amateur – the biology, meteorology, archaeology, sociology, and agriculture of North Dakota. There is so much to learn! Over the years I have been able to enjoy its flora and I have learned to identify most of the prairie grasses, wildflowers, and trees – and ponder those I didn't recognize. I've seen nearly all of the animals and birds North Dakota has to offer. I've experienced almost every conceivable kind of North Dakota weather (although I suspect I may yet have a lot of surprises on that count!). And I've learned a great deal about the people of our state.

We geologists tend to travel to fascinating places, for reasons relating to our science. My geologist wife, Mary, and I frequently choose travel destinations for their geologic interest. Every part of our world – and beyond – has its own geology. Geologists have already been on the moon and it's likely that the first visitors to Mars will include geologists.

During my tenure here, I've learned much about North Dakota geology, but I realize that a great deal remains to be done – we've barely scratched the surface. And even though

I've tried to "get the word out," I know that North Dakota's rich geologic heritage is still a well-kept secret. It would be great to be able to spend another 40 years working on, and enjoying, the state's geology. I hope those conducting future geologic studies in North Dakota will enjoy them as much as I have!

Lights and Noises

By John P. Bluemle

In the last issue of the NDGS Newsletter, I included an article about some "unsolved mysteries" in North Dakota. In the 1920's, then-State Geologist A. G. Leonard received several letters from two people in south-central North Dakota describing 1) peculiar lights that hovered over certain places on a farmer's land and 2) odd rumbling subterranean noises that were so persistent and troubling that the farmer was considering moving to a different location.

The strange light was described by A. V. Arvidson in a letter dated December 22, 1922. It occurred on his farm near Kulm, which is on the Dickey-LaMoure county line. I think the explanation I offered for the light is plausible. I suggested that the light might have been caused by burning peat in a slough or bog. The combustion of either peat or lignite could give off light.

I really couldn't provide a logical explanation for the subterranean noises, which C. C. Huber described in a letter he wrote on November 12, 1926. Mr. Huber lived on a farm near Zeeland in McIntosh County. He wrote the following letter to Dr. Leonard:

Zeeland, N.D.
Nov. 12, 1926

State Geologist
c/o State University
Grand Forks, N.D.

Dear Sir:

For the past eight years I have at certain times heard certain strange, thundering noises which seem to be far in the earth directly under my house on the farm, 16 miles north of Zeeland, N.D. The most severe crack took place about two and a half years ago, when it was so bad that my house shook and the paines (sic) in the windows broke. I never have tried to find out what the reason for this is because I thought maybe they would cease but it seems to be getting worse. My family is scared out and are afraid to live in the house. Will you please let me know what your opinion for this is. If there is other information you desire - let me hear from you and I will answer at once.

Yours truly –
C. C. Huber
Zeeland, ND

After I wrote my newsletter article last fall, and that issue of the newsletter had already gone to press, I recalled some work I had participated in in 1977, which resulted in a short article published in in *The Prairie Naturalist*, the journal of the North Dakota Natural Science Society. The article, titled "Alfalfa and the Occurrence of Fissures on the North Dakota Prairies," was authored by John Bluemle, Alan Kehew, Erling Brostuen, and Ken Harris, all NDGS employees.

Our article described fissures and caverns on two farms: the Richard Holmes farm near Guelph in Dickey County, and the Dewey Lawler farm near Temvik in Emmons County. These localities are both close to the area described by C. C. Huber. It seems possible that some of the things we described in our article might offer a possible explanation for the noises.

The gist of our 1977 article was that alfalfa, a plant with a high water requirement, requires about 800 to 900 kg (1800 to 2000 lb) of water to produce one kg of dry matter, which is about two to three times the water requirement of small grain crops (Jung and Larson, 1972). We concluded that the alfalfa had dewatered the soil, causing it to shrink, resulting in fissures and caverns. We also noted that, in some instances, other crops can use sufficient water to cause the soil to shrink (Fishel and Leonard, 1955). In all cases we could document, the shrinking (resulting in fissuring and cavern-formation) occurred following a period of several years of below-normal precipitation; the instances we documented included the presence of an alfalfa crop.

Here are three quotations from our 1977 article:

"The fissures at the Holmes site were as much as 1.5 meters wide, but they averaged about one meter wide and ranged in depth to about two meters. The open fissures were partially filled with topsoil that had dropped in from above. Where the topsoil had not yet collapsed, the bottoms of the fissures were as much as three meters below the ground surface."

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"Fissures at the Lawler site in Emmons County may not have reached as advanced a stage of development as have the Dickey County ones. Unconnected caverns were more common than were continuous fissures. The caverns were as deep as four meters and some of them were partly filled with water from recent rains."

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"The effect of falling water levels upon the sediment should be considered in relation to effective stress in the sediments below the water table. The state of stress at any point in a saturated porous medium is the result of effects both of the weight of the entire saturated mass of material above the point (total stress) and the pressure within the fluid (pore pressure). Because pore pressure is exerted equally in all directions, part of the total load supported by grain-to-grain contact between the solid particles is determined by subtracting the pore pressure from the total stress. An increase in the grain-to-grain pressures (effective stress) results in compression, or reduction of volume in the sediment by decrease in pore space. Removal of most of the water could result in considerable shrinkage in volume in a material such as clay, which does not have a solid framework. By contrast, removal of all of the water from a gravel deposit will result in little or no shrinkage because the solid framework of the gravel cannot collapse.

As the water table drops, the pore pressure at any point below the former position of the water table is decreased. This, in turn, results in an increase in the effective stress and compaction of the sediment. Thus, as the level of the water table fell during the drought of 1975 and 1976, the sediment below the water table probably became slowly compressed. In areas planted with alfalfa, the dewatering effect may have been intensified. The heavy rains during the 1977 growing season may have provided the triggering mechanism for the fissures. As the water infiltrated into the dry upper portions of the soil, the total weight increased, causing failure in the compacted soil below. Material above the water table was then able to drop into the spaces created by compaction, forming the fissures.

The [nearly dry] slough at the Holmes site is reasonably uniform in texture throughout. Removal of a large percentage of the water from the silt may have resulted in a relatively uniform shrinkage in the volume of the silt deposit. The shrinkage may have led to the formation of the fissure system at the site. At the Lawler site, the silt above the shale is much less uniform and removal of water would not be expected to lead to uniform shrinkage. This may help explain the tendency for cavern development rather than fissuring at the Lawler site."

The Lawler site in 1977 may offer the best analogy to the C. C. Huber farm in 1926. Weather records from the 1920's indicate that rainfall was much below average for most of the years from 1917 through 1926, with particularly severe drought conditions in the central part of the state in 1926. Thus, precipitation conditions in the 1920's and 1970's were essentially comparable – drought or near-drought conditions prevailed at both times. I do not know whether alfalfa was the crop on the Huber farm in the 1920's as it was on the Lawler and Holmes farms in the 1970's. It may be that the subterranean sounds described by Mr. Huber were the sounds of overlying materials collapsing into caverns formed as a result of drought conditions and dewatering of the soil in the 1920's as we described in our 1977 article.

There is no way I know of to prove whether this hypothesis is correct. I simply offer it as a possible explanation for the sounds that C. C. Huber described.

References

Bluemle, J.P., Kehew, A. E., Brostuen, E.A., and Harris, K.L., 1977, *Alfalfa and the occurrence of fissures on the North Dakota prairies:* The Prairie Naturalist, vol. 10, no. 2, p. 53 - 59.

Fishel, V.C., and Leonard, A.R., 1955, *Geology and ground-water resources of Jewell County, Kansas:* Kansas Geological Survey Bulletin 115, 152 p.

Jung, G.A. and Larson, K.L., 1972, *Cold, drought, and heat tolerance in* Hanson, C.H., ed., Alfalfa Science and Technology, American Society of Agronomy, Inc., Monograph 75, p. 185 - 209.

Meyer, D.W., 1977, North Dakota State University, Fargo, personal communication.

O'Connor, H.G., 1978, Kansas Geological Survey, Lawrence, personal communication.

GEOLOGY, *n*. The science of the earth's crust — to which, doubtless, will be added that of its interior whenever a man shall come up garrulous out of a well. The geological formations of the globe already noted are catalogued thus: The Primary, or lower one, consists of rocks, bones or mired mules, gas-pipes, miners' tools, antique statues minus the nose, Spanish doubloons and ancestors. The Secondary is largely made up of red worms and moles. The Tertiary comprises railway tracks, patent pavements, grass, snakes, mouldy boots, beer bottles, tomato cans, intoxicated citizens, garbage, anarchists, snap-dogs and fools.

Ambrose Bierce (1842-1913)
The Devil's Dictionary