

# FIELD NOTES FROM THE EDITOR



by Mark A. Gonzalez

## The Great Abyss of Time



One knows the end of another field season is drawing near when long shadows are evident even at noon, when the land grows mute, and tranquility descends upon the landscape, when desiccated vegetation sways stiffly, in rigor mortis, in the biting breeze of late autumn. We see the harbingers of change and know winter will prevail for the next

six months, a seeming eternity on the northern Great Plains. Six months an eternity? What do we humans know of eternity? I contemplated these questions on what proved to be my final field day of the past field season. It was that last furious day of covering as much ground and seeing as much geology as possible in the moments before the ensuing sunset and arrival of poor weather would conclude another field season.

I was mapping the geology northwest of Fryburg along the eastern escarpment of the Little Missouri Badlands. I climbed a knoll to improve my view of a nearby valley. The hilltop was entirely armored with flagstones. I paid them little attention initially; however, as I knelt down to draw on my map, details in the flagstones caught my attention. Here, frozen in time and rock were thousands of leaves, twigs, stems, and seeds (Fig. 1). These flagstones were also tombstones, the cemetery for the remains of a former, subtropical forest. I found leaves of the Wheel Tree (*Nordenskiöldia borealis*), needles of the Dawn Redwood (*Metasequoia* sp.) and Bald Cypress (*Paratoxodium* sp.), and nutlets of the Hazel tree (*Paleocampinus* sp.) with a host of other unidentified parts of plants. Now here was a semblance of eternity, the relicts of an ancient world inhabited by life forms, most now extinct. Here was eternity, the petrified remains that have lain hidden and forgotten beneath rock during the passage of countless seasons until their recent exhumation exposed them at the earth's surface.

The characteristic that distinguishes geology from nearly all other disciplines, save astronomy and cosmology, is the enormity of time that spans the discipline. How enormous is geologic time? Can we humans truly understand and appreciate the geologic scale of time? It spans thousands...of thousands...of thousands of years! In comparison, a human life is but a fraction of a single millennium, rarely a single century in duration. In the geologic realm, time is gargantuan. Geologists examine rocks and reconstruct events that

transpired thousands, millions, and billions of years ago. The time might be so great that geologists readily dismiss a few million years as casually as friends dismiss a few minutes tardiness over a lunch date. 'When did that trilobite live?' 'Oh, 540 million years ago, take or leave 10 million!'

During the infancy of modern geology, two prominent figures, James Hutton and John Playfair, made field trips to Siccar Point in Scotland. Siccar Point is renowned for a remarkable angular unconformity (Fig. 2). Hutton studied the geologic relations at Siccar Point in 1788 and deduced that one set of geologic beds (S, Fig. 2) had been laid horizontally, buried deeply, lithified, uplifted, upended, and tilted on end by powerful tectonic forces, then subjected to an unimaginably long period of erosion, followed by another period of deposition and formation of another generation of sedimentary rocks (D, Fig. 2) that are themselves slightly tilted. Confronted with such complexity of Earth's history, Hutton concluded that Earth must be old, very old, millions of years old or perhaps tens or hundreds of millions of years old. Such a notion was completely contrary to the then prevailing view of the world. [Note: Sir John Lightfoot in 1644 and Archbishop James Ussher in 1654 studied scriptures and concluded that Earth was created on October 23, 4004 B.C. Lightfoot even added that the time was 9:00 a.m., which I assume meant Greenwich Mean Time. These calculations were made before the Gregorian calendar was adopted by England. The



**Figure 1.** Fossil leaf of *Ginkgo adiantoides* from the Sentinel Butte Formation. The specimen photographed here was collected by Robert Randall of Bismarck and donated to the North Dakota Geological Survey. It is on display in our Bismarck office. Randall is a friend of the author and an octogenarian who knows a good bit about time, having used his wisely and productively.



**Figure 2.** Siccar Point, Scotland, is a famous geologic locality where James Hutton described the formation of an angular unconformity. Notice that the older rocks (S for Silurian greywacke approximately 425 million years old) have been tilted to nearly vertical and eroded away along an irregular plane and then buried by a younger set of rocks (D for Devonian Old Red Sandstone approximately 345 million years old; photo by John Bluemle).

calculations were incorporated into versions of the Bible that were published in the early eighteenth century.] Hutton summarized his temporal epiphany with his famous line, "...no vestige of a beginning, no prospect of an end."

In 1805, a few years after Hutton's death, a close colleague of his, John Playfair, came to view the same outcrop at Siccar Point. Playfair gazed at the complex history before him and recognized that the geologic forces observed here would require vast time. Playfair uttered, "*The mind seemed to grow giddy by looking so far into the abyss of time.*"

Viewed in sterile, clinical terms, geologic time is so gargantuan that it trivializes human existence. An individual's life is reduced to a fleeting and inconsequential blink of time. Viewed in the cold abstraction of our Universe's history, geologic time is so gargantuan that it contains infinite stories of places and events of mind-boggling proportions. John McPhee, a writer with a penchant for geology, captures poignantly the essence and inhumanity of geologic time:

*"If you free yourself from the conventional reaction to a quantity like a million years, you free yourself a bit from the boundaries of human time. And then in a way you do not live at all, but in another way you live forever."*

--John McPhee, *Basin and Range*

I drove the familiar miles back home encapsulated in darkness. I reminisced about the events I had seen and the geology I had studied during the past field season. I had put my finger on the so-called "K-T boundary," a cataclysmic instant approximately 66 million years ago when a massive meteoroid (bolide) struck the earth resulting in the mass extinction of almost 90% of the then-living species. I had walked the shoreline of an ancient lake where ripple marks with bird tracks were preserved for a geologist to find nearly 60 million years later. On the hilltops of Bismarck, I had found shark teeth that tell of the time when a sea inundated

North Dakota and stretched from the Gulf of Mexico to the Arctic Ocean. I had explored the ancient bayous of western North Dakota where bald cypress were buried and petrified beneath a blanket of ash deposited 58 million years ago, after a volcanic eruption rocked the Idaho plateau hundreds of miles to the west. I had walked through groves of giant sequoias that once towered over the prehistoric landscape of North Dakota. I had walked the rumpled dead-ice topography of the Missouri Coteau, which formed ten thousand years ago when giant ice sheets stalled and wasted away at the end of the Ice Age. And one of my most thought-provoking discoveries was a hearth I unearthed, evidence that prehistoric men had stopped to prepare a meal during a hunting excursion many hundred years ago. How impossible for them to imagine the future visitors that would find their remote hunting grounds and campsites.

What do we humans know of eternity? We know that its duration is beyond the limits of our ephemeral lives. However, we can glimpse eternity and the great passage of time in the geologic catacombs, where we find the rise and fall of seas, the evolution and extinction of species, the crash and plunge of tectonic plates, the growth and decay of mountain belts, the incessant swash of sand grains on beaches, the perpetual wind of change upon the landscape. Because we cannot physically attain eternity, we must make our actions and accomplishments eternal. We must live our fleeting time on Earth with purpose and enduring meaning. We need to know that our thin layer in the geologic record will be one that future generations will unearth and study in admiration and fascination.

\*Note: the collection of fossils on public lands is restricted by the Antiquities Act of 1906. Fossils, especially vertebrate fossils, should not, and cannot legally, be collected from public lands in North Dakota without a permit from the North Dakota Geological Survey and/or the federal agency overseeing federal lands. For more information, please contact John Hoganson, paleontologist with the NDGS.