When SIU geologists discovered fossilized amber embedded in 320-million-year-old Illinois coal, the history of flowering plants on Earth leaped backward.

A Revised Natural History of Plants

Story and Photos By Joe McFarland

Buried for roughly 320 million years, a chunk of southern Illinois coal reveals the tiny deposit of amber that changed what we now know about early plants on Earth.

The conspicuous, folded sheet of paper someone had taped to his university office door struck Ken Anderson as rather ill-mannered. Scholarly men and women do not communicate by plastering notes on each other's door. It's one of those assumed, unwritten rules of professional behavior. Mildly irritated, Anderson unlocked the office door and snatched away the paper, which he unfolded to read.

"There were a series of figures and numbers," the Australian-born geologist recalled of the message he found dangling from his door one day in July 2008. Anderson now remembers it as the day the history of Earth was revised.

The paper note turned out to be the handiwork of one of his Southern Illinois University-Carbondale graduate students, who'd stuck it there the night before in a moment of near-panic excitement. The figures and numbers Anderson was staring at—the analysis of fossilized plant resin known as amber he and his students found in a chunk of Illinois coal—represented nothing less than a 190-million-year adjustment to what is known about plants on Earth. Specifically, one of the most important defensive mechanisms known to have been developed by flowering plants—those sticky, gooey resins that thwart invaders—seemed to have evolved in at least one other kind of primitive plant 190 million years before flowering plants appeared on Earth. Yet this 320-million-year-old amber, the one whose molecular identity was now revealed on a piece of paper, wasn't known to occur until 190 million years later.

Scientists are used to minor tweaks of the known facts. But this was no minor adjustment—and Anderson knew it. Yet he also knew his subject.

"Not all ambers are the same," explained this career specialist in the study of fossilized plant resins. "There are many different kinds and qualities of amber, depending on the plant that produced the resin and the circumstances under which it was preserved."

Many plant resins, he noted, whether from a pine or a cherry tree or even a simple annual plant, can turn into petrified amber, that golden, static-electricity-generating gem many of us recognize from polished jewelry and those insect-trapping time capsules of the ancient world. The amber found embedded in southern Illinois coal clearly dated it to the Pennsylvanian Period, roughly 320 million years ago. But the kind of amber revealed by the analysis, the kind of resin-turned-amber only flowering plants produce, wasn't supposed to exist 320 million years ago.

A brief history: When the coal of southern Illinois was being deposited as peat beds, the Plant Kingdom was dominated exclusively by giant ferns and early gymnosperms (non-flowering plants) which were the ancestors of today's palm-like trees known as cycads. Flowering plants do not appear in the fossil record until roughly 130 million years ago. And while those early, non-flowering plants of 320 million years ago produced their own resins that commonly turn up as fossilized amber today, scientists know that the molecular "fingerprint" of gymnosperm resin clearly differs from the fingerprint of resins produced by flowering plants.

From an evolutionary standpoint, it was believed that flowering plants developed their own unique resins independently when flowering plants appeared 130 million years ago. It's a molecular difference scientists such as Anderson can easily spot today when comparing fossilized resins from angiosperms and gymnosperms.

Ken Anderson with common amber

As he stared at the sheet of paper that morning, Anderson knew this discovery of "flowering plant" resin from an entirely different, vastly older, geologic era was huge news. If the analysis was correct, the scientific understanding of when and how plants evolved on Earth was about to change. Immediately he ordered the analysis to be repeated, over and over.

"We had to be absolutely positive there hadn't been a mistake," the geologist explained. "But every time we ran it through the spectrometer it came back with the same results."

Satisfied he'd examined everything correctly, Anderson faced a puzzle. How or why a 320-million-year-old, non-flowering plant would produce a resin found only in flowering plants 190 million years later seemed to have no quick answer. It remains an evolutionary puzzle today. Just as the evolutionary tree of life we know sprawls with similar branches that appear to have evolved independently, Anderson's anachronistic amber represents yet another puzzling branch of this scientific work in progress.

DNR Mines and Minerals inspector Don McBride (left) and Illinois State Geological Survey geologist Scott Elrick point out fossil impressions often found directly above the layer of Illinois' rich coal deposits.

Thus, scientists are constantly revising what is known about the history of life on Earth. And sometimes it happens through startling, unimagined discoveries.

This discovery began innocently enough as a routine examination of ancient amber. In the laboratory one day earlier, Paul Sargent Bray, a master's degree student in geology, had run what was expected to be an ordinary molecular analysis on a few bits of fossilized plant resin he and his classmates had recently found embedded in southern Illinois coal. Anderson often takes his students to local coal mines for hands-on geology field trips. Around the aptly named Carbondale, the Carboniferous geologic period of 320-450 million years ago is ripe with fossilized evidence of early plant and animal life. Everything from ancient tree trunks to fossilized shark teeth has been found in Illinois coal mines.

"There are coal mines in Illinois where you will see on the 'roofs' above the coal seam monstrous trees, 6 feet wide and 100 feet long," explained Illinois State Geological Survey Geologist Scott Elrick, who said the shale layer directly above coal often reveals beds of fossils that were trapped suddenly by rapid depositions of silt. Miners for years have been chipping out the fossils they find above the coal, often contributing to science. A "petrified rain forest" revealed by coal mining near Danville a few years ago became the subject of much scientific excitement worldwide when the massive, intact "artwork" was announced. "Much of what we know about that period of geologic time has been learned from the excellent fossil record above coal."

For Anderson and Bray, who's since graduated from SIU, the spotlight of the scientific world would soon focus on their discovery. The New York Times ran an article last fall. The journal Science published their paper, along with a second article. For a geologist studying ancient plant resin, it was as much celebrity fame as one could hope for.

Back in the laboratory of SIU's Parkinson Hall, Anderson recently opened a very small envelope and tapped out the contents onto a display table.

"It doesn't seem like much, does it?" the proud geologist said, smiling.

The big discovery turns out to be no larger than a few grains of sand, now removed from the coal. Still, as anyone who's ever been around amber knows, there is always the chance of being shocked.