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THE SALVAGING AND DOCUMENTATION OF TRACE FOSSILS FROM THE UNION CHAPEL MINE

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ABSTRACT: The discovery of high-quality vertebrate and invertebrate trace fossils at the Union Chapel Mine in late 1999 led to an extraordinary salvaging effort by members of the Birmingham Paleontological Society (BPS, incorporated as the Alabama Paleontological Society, or APS, in 2002) during the following 18 months. Trackways, fish trails, feeding traces, a pair of wings, and other fossils were collected from the residual rock piles left by the mining operation, and could be found at most locations in the mine. So many high-quality trackways were found that the BPS/APS organized four "Track Meets" to photographically document the finds as well as record the current repository (e.g., in private collections, museums, universities, etc.). We describe here the salvaging and documentation of Union Chapel Mine trace fossils and how this led to a remarkable cooperation between amateur and professional paleontologists in Alabama and elsewhere. We also describe what the mine was like before and after its partial reclamation in December 2000, and what kinds of rocks yielded different kinds of trace fossils.

INTRODUCTION

The BPS/APS began its explorations of the rocks and fossils of the Union Chapel Mine in January 2000. At the regular BPS meeting held at the Homewood Public Library that month, Ashley Allen (see Allen, 2005) recounted his initial findings of tetrapod trackways at the mine, and the group decided to make the mine the focus of its next field trip. Mrs. Dolores Reid, owner of the New Acton Coal Mining Company, gave her permission to collect fossils from the site. The field trip took place on January 23, a rather bleak day that started out rainy but ended up being just mostly cloudy during the BPS visit. Because of the weather, only 11 people attended the event. Several of these later became part of a core group that diligently hunted for trackways at the site on as many visits as possible. Over the next year, the BPS also held several more organized field trips to the site. Minkin (2000) wrote a preliminary review of the group's findings.

The trackways were found in spoil piles of rocks left over from the mining operation (Figs. 1 and 2). The spoil piles came from the overburden of the Mary Lee coal seam of the Mary Lee cycle of the Pottsville Formation, below the New Castle coal seam (Pashin, 2005; see also Fig. 3). The way trackways were found among these piles depended as much on the diligence of the collector as it did on the recognition of the right types of rocks. Any fine-grained, layered rock could potentially hold tracks. For the smaller tetrapod tracks (*Cincosaurus cobbi* and others; Haubold et al., 2005), the best rock type was a clay shale. This shale is mostly gray but occasionally had some reddish tint, likely due to oxidation of the sediments when they were exposed to the atmosphere at the time of deposition. Shale that contained silt, sand, or mica grains yielded few of the small tetrapod trackways. Burrows were generally absent from the vertebrate trackway-bearing shale.

Another type of rock that yielded trackways was a gray siltstone, in which burrows are common. This rock type indicates a standing body of water that animals walked in. It was a common host rock for the larger vertebrate trackways, especially *Attenosaurus subulensis* (Aldrich and Jones, 1930; Haubold et al., 2005).

Although invertebrate traces were found in similar kinds of rocks, certain vertebrate and invertebrate traces are rarely found on the same slabs. In fact, multiple trackways on the same bedding plane are commonly either the same kind of trackway or a mix of different kinds of vertebrate or invertebrate trackways. The trackmakers evidently did not intermingle very much, although several examples of vertebrate and invertebrate trackways on the same bedding plane have been found.

A few other features correlated with the presence of tracks. For example, small circular depressions or elevations, superficially resembling raindrop imprints and their counterparts (but which are more likely to be gas-escape features; Rindsberg, 2005a), were commonly associated with tracks, as were uncommon small plant parts (such as individual pinnules of seed ferns). Occasionally, a whole fern frond would be found on a track-bearing slab. The track-bearing slabs themselves are also found mixed with slabs bearing many fossil plant impressions, including casts of lycopod trunks and *Calamites* piths.

The weather and time of day were also important factors in the finding of trackways, which were most easily noticed on sunny days when the Sun was not too high. On less favorable days, moisture can enhance the appearance of trackways that might be virtually invisible on a dry, overcast day. Although trackways were found over most of the mine, some areas were clearly richer in trackways than others. Before the reclamation

FIGURE 1. Spoil piles at the Union Chapel Mine yielded numerous trackways.

FIGURE 2. Picture from the first visit to the Union Chapel Mine on January 23, 2000. The picture shows one of the steep rock piles that was typical of the site at the time.

of the mine in December 2000, searching for trackways was often a precarious process involving the climbing of steep spoil piles (Fig. 2).

Some trackways are exposed directly on the surface, either face-up or after turning over a slab, whereas others are found only after a slab was split along a bedding plane. In general, only one or a few bedding planes in a given rock yield trackways, implying that the main track-bearing layer is fairly narrow even within a boulder-thick interval. It is unlikely, however, that there is only one major track-bearing layer in the section. Commonly, only a single trackway is found in a given rock, but particularly for *Kouphichnium* (horseshoe crab trackways), there may be numerous criss-crossing trackways.

In some cases, the same trackway involves several impressions whose character differs with depth away from the animal's feet. These track imprints did not necessarily cut across several bedding planes but deformed bedding planes downward as the animal stepped on the soft sediment. These are particularly important because they can show how the morphology of a given track depends on the layer that is exposed. Such specimens are known as undertracks and allow one to connect trackways that, when found separately, might not be recognized as being made by the same trackmaker. Note, however, that some of the largest tracks may cut through different laminae.

Most of the trackways found were made by small animals whose track lengths range from a few millimeters to a few centimeters. Large tracks, more than 15 cm in length (the size of a human hand), were also found, but continuous trackways of animals this large are very rare owing to the broken nature of the spoil. Most slabs yield no more than one or a few tracks of the largest animals. The lack of *in-situ* excavations prevented us from finding the long, continuous trackways of larger animals that characterize other sites such as the Permian Robledo Mountains tracksite of New Mexico (MacDonald, 1994).

The diligence of the 23 collectors who contributed to the documentation of the Union Chapel Mine resulted in the salvaging of more than 1000 high-quality trackways and other traces over an 18-month period, followed by an additional 1500 specimens over the subsequent three and a half years. The convenient location of the mine, only 30 miles west of Birmingham, made it possible for collectors to access the site repeatedly. It was the landowner's cooperation that led to the salvaging of so many specimens in such a short period of time. Because the salvaging began almost immediately after the mining operations ended, it was possible to collect many specimens before they had a chance to suffer significant weathering.

RECOGNITION OF SIGNIFICANCE OF SITE

From the initial visits, it became clear to members of the core group mentioned above that the Union Chapel Mine was an extraordinary tracksite, especially significant for the early development of terrestrial vertebrate life in Alabama. We realized that the UCM trackways were extremely rare and that the academic community should be made aware of the BPS collection. Two critical decisions were made at this time (spearheaded by A. Allen and S. Minkin). The first was to hold a meeting to bring trackways to a central location for photographic documentation. The second was to invite local professional ichnologists to inspect the trackways and assess the significance of the site. Were it not for these decisions, the trackways collected would have simply ended up in private hands with no new knowledge coming out of their existence. The first studies of the trackways led Pyenson and Martin (2001a) to conclude early on that the Union Chapel Mine is "one of the most important Carboniferous tracksites in the world." The only comparable site for the same geologic period is found in Joggins, Nova Scotia (Ferguson, 1988).

THE "TRACK MEETS"

The meeting to photographically document the Union Chapel Mine trackways was held on August 19, 2000 at the Alabama Museum of Natural History, on the campus of the University of Alabama in Tuscaloosa. This event, jokingly dubbed a "track meet" during e-mail correspondence between the authors of this paper, turned out to be only the first of four such meetings that were needed to cover the significant quantity of material collected from the mine up to that time. The second meet-

FIGURE 3. The New Castle coal seam is visible as the dark band across the middle of this picture, taken before the mine was formally reclaimed. The Mary Lee coal seam is well below this layer and not visible above ground level.

ing was held on October 14, 2000 at Oneonta High School in Oneonta, Alabama; the third was held on May 12, 2001 at the Anniston Museum of Natural History in Anniston, Alabama, and, finally, the fourth was held on August 9, 2003 at Buta's private residence. We will refer to these meetings as TM1, TM2, TM3, and TM4 respectively. It was felt appropriate that TM1 be held at the Alabama Museum of Natural History because of cooperation with local paleontologists at both the Museum and the Geological Survey of Alabama, also on the campus of the University of Alabama, and also because the Museum houses some of the original track specimens described by Aldrich and Jones (1930). The event was held on the ground floor and in two second-floor rooms close to the glass case with the stunning Aldrich and Jones specimens. Figure 4 shows a T-shirt designed by Ron Buta and Deborah A. Crocker to commemorate the event.

TM1 was the best organized of the four track meets. Collectors arrived at the Museum at 9 a.m. to prepare their specimens for labeling and inspection. Several tables were set up for this purpose in the ground-floor foyer. Two types of labels were used. One was a permanent label, glued on the reverse side, indicating the name and location of the mine. The second was an address label with a running UCM number for cataloguing purposes. As each specimen was inspected, a tally sheet listed the UCM number, the identity of the collector, and a brief note about what the trackway was (vertebrate, invertebrate, etc.). These inspections were carried out mainly by Andrew K. Rindsberg of the Geological Survey of Alabama (GSA), who also made the selections as to which specimens would be photographed. High-priority specimens were given two red dot stickers, while low-priority specimens were given a green dot. The tally sheet was compiled by T. Prescott Atkinson, who entered the information into a computer database that could be accessed by all the APS members and others who might be interested in studying the tracks. Once all labels and stickers were affixed, the specimens entered an "assembly line" where the higher priority specimens were taken to the second floor for photography.

In addition to the labeling and selection, TM1 included several oral presentations, giving the event an air of professionalism. The group was welcomed by Richard Diehl, then Director of the Alabama Museum of Natural History. Ed Hooks, former Collections Manager of the museum, spoke on the importance of the amateur paleontologist. Kathy Twieg, former president

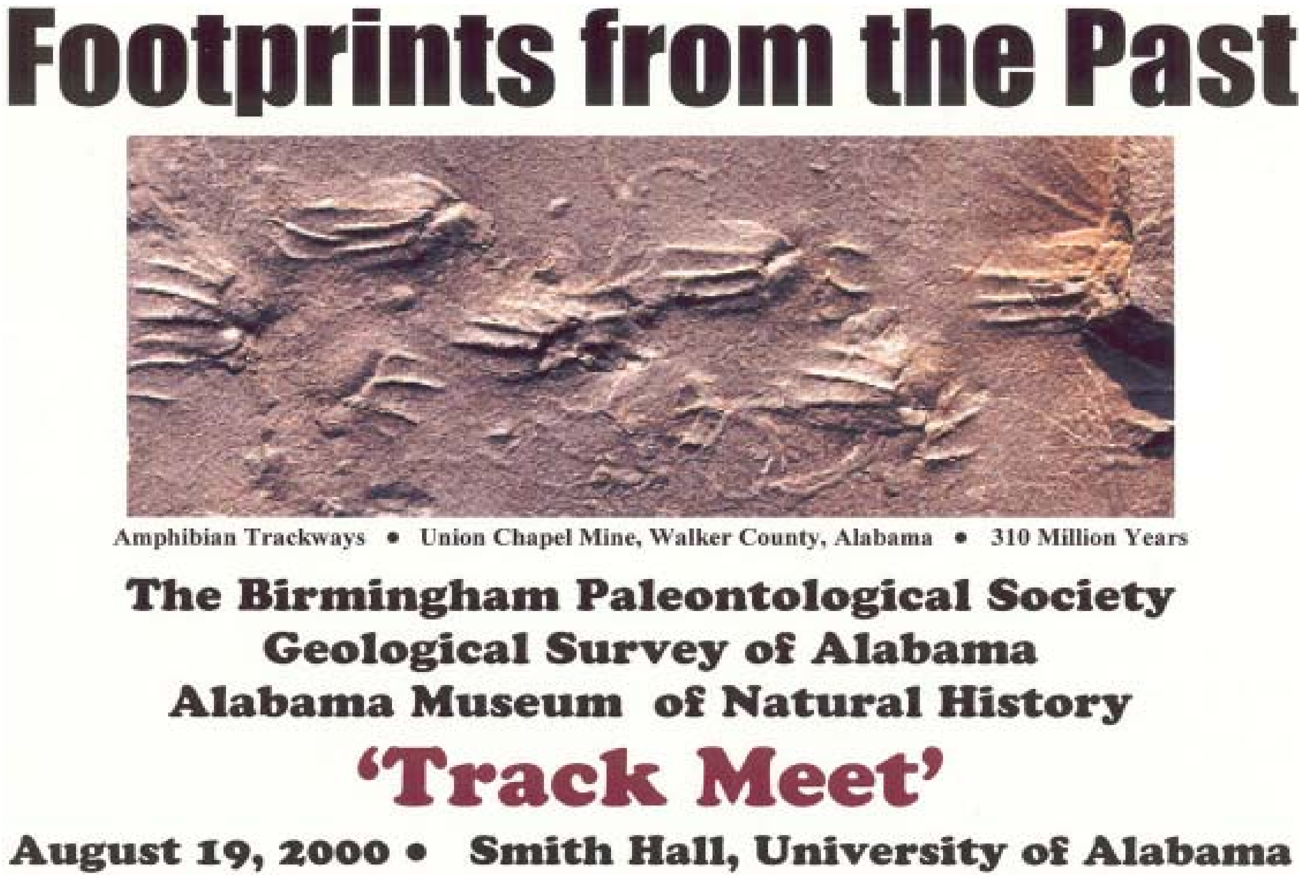

FIGURE 4. T-shirt design commemorating the first track meet (TM1) held at the Alabama Museum of Natural History.

of the BPS, spoke about the planned monograph to illustrate the trackways. A. K. Rindsberg (GSA) spoke on ethics in collecting, trading, and selling fossils, and Jack Pashin, also of the GSA, discussed the geology of the Pottsville Formation and its relationship to the Union Chapel Mine. Expanded and updated versions of some of these presentations are included elsewhere in this monograph (Hooks, 2005; Pashin, 2005; Rindsberg, 2005b).

The local press and media were invited to these presentations and inspections. Also, even before TM1, there was press interest in the tracks. Tom Spencer drove from Birmingham with a cameraman to talk about the tracks, and he wrote a thoughtful article for the August 20 *Birmingham News* (Spencer, 2000). Bob DeWitt (2000) wrote a similar article for the *Tuscaloosa News*. In both cases, they were drawn to see actual specimens of the tracks. A few days after TM1, Joe Bryant of the *Crimson White*, the University of Alabama student newspaper, wrote an article featuring a large picture of A. K. Rindsberg holding a track specimen (Bryant, 2000).

As in TM1, there was also professional inspection of trackways at TMs 2 and 3, this time by A. K. Rindsberg, Anthony J. Martin, and Nicholas D. Pyenson. At these later meets also, measurements of the vertebrate trace fossils, including trackway lengths, widths, paces, and relative manus and pes sizes, were obtained. Features related to behavior were also recorded. This information has formed the basis of some of the research presented elsewhere in this monograph (Martin and Pyenson, 2005). At TM4, A. K. Rindsberg was once again on hand for interpretation of specimens.

SELECTION OF SPECIMENS FOR PHOTOGRAPHY

The goal of TM1 was to photograph only the specimens of the highest quality or the greatest scientific interest. This was a subjective judgment that had to be made in haste owing to the large number of specimens. Although the event lasted all day, only 175 specimens were photographed at TM1. At TM2 and TM3, the selection criteria were relaxed for three reasons. The first was that photographing all specimens was more efficient than at TM1. All specimens brought to TMs 2 and 3 were immediately given UCM numbers and taken directly to the camera station. The judgment as to whether a specimen was important or not was deferred. The second reason for relaxing the selection criteria was the recognition that some weak or less than perfect specimens nevertheless contain important information. If these were left out of the database, then the sample would be biased. The time needed to inspect all specimens in sufficient detail was not available at the track meets. The third reason for photographing all specimens was the recognition of the significance of the site. It was deemed

FIGURE 5. *Top left*: Ashley Allen sits among many specimens to affix the permanent labels at TM2. *Top right*: Kathy Twieg, Mike Robitaille, and Dave Claybourn prepare and label specimens for photography, also at TM2. *Bottom left*: A scene from the main hall at the Anniston Museum of Natural History, where TM3 was held. Gerry Badger is in the background. *Bottom right*: Sam Hood (right) and other TM3 participants prepare and label specimens.

prudent to take all material seriously. For these reasons, the number of specimens to photograph at TMs 2 and 3 became very large, and efficiency was critical to complete documentation. Figure 5 shows several scenes from TM2 and TM3. The general procedure at TM4 was the same as for TM2 and TM3.

PHOTOGRAPHY

Photographs of all specimens brought to TMs 1, 2, and 3 were taken using a Nikon 6006 35-mm camera. The procedure for doing the photography changed from TM1 to TMs 2 and 3. At TM1, large rocks were photographed by Ron Buta while smaller rocks were photographed by Larry A. Herr. It was considered desirable at first to include in all photographs the complete length of any trackway. However, because of the setup used, only a few closeups were obtained, especially on the larger rocks. At TMs 2 and 3, Buta adopted a policy of taking one or more closeups of trackway sections, in addition to complete trackways, in order to maximize the details documented. This approach, together with the improved efficiency, considerably increased the number of photographs taken in TMs 2 and 3 compared to TM1. Whereas 175 photographs were taken at TM1, 500 were taken at TM2 and 400 were taken at TM3. In addition to these, about 300 photographs were taken in Buta's backyard or on the loading dock of Mary Harmon Bryant Hall, of specimens that were not included in any of the track meets. Also, T. Prescott Atkinson took several hundred images with a digital camera in his backyard. TM4 was the first all-digital photography trackmeet.

The UCM numbers were assigned at the various photographic sessions. The largest number assigned up to TM3 was 1250. The Photographic Trackway Database (PTD), as of August 2004, includes 2853 photographs of 1929 slabs or specimens. It is stored on an internet website with the URL :

http://bama.ua.edu/~rbuta/monograph/

In the PTD, the traces are divided into groups referring to the basic kind of animal that likely made the trackway: "V" for vertebrate trackway or trace, or "I" for invertebrate trackway or trace. Of the nearly 3000 slabs/specimens, about half have definite or possible vertebrate trackways and traces whereas half have definite or possible invertebrate tracks and traces. About 30% of the slabs/specimens are part and counterpart of the same trackway or trace. In some cases, different collectors found the part or counterpart of the same trackway. In an unknown number of cases, the same trackway is represented on different slabs, separated because of the broken nature of the rocks.

The number of vertebrate genera and species in the

FIGURE 6. The "Track Meet" exhibit was on display at the Alabama Museum of Natural History for nearly a year.

database is still under debate. Pyenson and Martin (2001b; see also Martin and Pyenson, 2005) suggest that virtually all of the vertebrate trackways are due to a single species, *Cincosaurus cobbi* (Aldrich, 1930). In contrast, Haubold et al. (2005) present evidence for five different types of tetrapod trackways. The only other kind of vertebrate trace included in the database is the fish trail *Undichna* (Martin and Pyenson, 2005).

The invertebrate database includes a more varied range of traces than the vertebrate database, most of which are thought to be the horseshoe crab trace fossil *Kouphichnium*. Other invertebrate traces include likely arthropod traces, bivalve burrows, and the resting trace *Arborichnus*, thought also to be made by horseshoe crabs. The invertebrate tracks and traces are discussed further by Rindsberg and Kopaska-Merkel (2005) and Lucas and Lerner (2005).

The great value of the PTD website is that it allows the world community to access the entire photographic record of trace fossils from a single site. The website was developed by Buta on an 80 Gbyte hard drive purchased for another project. Despite the large number of images, the website uses less than 5% of the hard drive's storage capacity.

A "PLANT FEST"

The Union Chapel Mine also yielded many high-quality fossil plants associated with the track-bearing rocks. These fossils included compressions of lycopod bark, leaves, cones, ferns, and numerous "stump casts," all typical of Coal Age rocks in Alabama. Because these fossils provide important information on the ecology of the area at the time the track makers were alive, TM3 also included a "Plant Fest" at which several hundred of the more important plant fossils were photographically documented. These are discussed by Dilcher et al. (2005).

A TRACKWAY EXHIBIT

One of the great honors for the APS that has come out of the Union Chapel Mine experience is a display case that was in the Alabama Museum of Natural History for more than a year (Fig. 6). This was arranged by the Museum's former Collections Manager, Ed Hooks. The display included a large *Undichna* and several tetrapod trackways ranging from typical small specimens to one track as large as a human hand. The specimen used for the Track Meet T-shirts (Fig. 4) was one of the vertebrate trackways on display. The Museum display also included the fine pre-dragonfly wings discovered by Atkinson (2005), several photographs of the mine and some plant fossils from the mine, and one of the Buta/Crocker Track Meet T-shirts, of which about 20 were made.

FIGURE 7. The Union Chapel Mine after partial reclamation, February 2001.

WORKSHOP ON PERMO-CARBONIFEROUS ICHNOLOGY

By early 2003, so many high quality vertebrate and invertebrate trackways had been salvaged from the Union Chapel Mine that it was decided to hold a professional meeting to bring various trackway researchers together to discuss what had been found at the mine and to place these finds into a global context. This meeting, the Workshop on Permo-Carboniferous Ichnology, was held at the Alabama Museum of Natural History on May 2-4, 2003. Organized by Andrew K. Rindsberg, Anthony J. Martin, David C. Kopaska-Merkel, G. Ed Hooks, Nicholas D. Pyenson, and Ronald Buta, the meeting included speakers from as far away as Birmingham, England (see Atkinson et al., 2005)

THE APPEAL OF THE TRACKS

For an amateur fossil-collecting group like the BPS/APS, the discovery of the Union Chapel Mine trackways was an unexpected collectors delight. The appeal of the trackways to many of the collectors involved is the way these preserved traces depict life as opposed to death. The trackways record the ordinary behaviors of long extinct animals for which no bones have yet been found. The significant number of early tetrapod trackways further makes the Union Chapel Mine database one of the most scientifically valuable collections in the world. Even though most of the trackway research in this monograph is concerned with the tetrapod tracks, it is clear that the invertebrate traces also have a lot to offer and will provide further new insights on the paleoenvironment of the site.

The idea of preparing a monograph based on specimens collected by many different individuals from the site of a routine BPS field trip was unheard of prior to the UCM experience, at least in Alabama. The partial reclamation of the mine in December 2000 (Fig. 7) capped off a spectacular year of discovery for the group, and the UCM experience marked the beginning of a remarkable cooperation between APS amateur rock collectors and four professional institutions, the Geological Survey of Alabama, the Alabama Museum of Natural History, the Anniston Museum of Natural History, and Emory University, a cooperative venture that led to this monograph. It is significant that even three years after reclamation, the mine continued to yield high quality vertebrate and invertebrate traces, although at a reduced frequency than before.

On July 1, 2004, the Union Chapel Mine was transferred to the State of Alabama and exempted from the requirements of the Surface Mining and Reclamation Act of 1977 (Atkinson et al., 2005). This guarantees the preservation of the site for additional trackways and research for years to come. In September, 2004, after a bulldozer moved some of the buried rock piles, the site again began to yield trackways at a high frequency (Fig.

FIGURE 8. This specimen (UCM 2494, collected by Ron Buta) was found in September 2004 after the State of Alabama sent a bulldozer to the Union Chapel Mine and moved around some of the previously buried rock piles. The specimen shows numerous criss-crossing *Kouphichnium* trackways of high quality.

8). Thus, the future of the project will include more track meets, further documentation, and more knowledge of the natural history of Alabama. In fact, one of the most significant outcomes of the UCM experience is heightened awareness among both amateurs and professionals that Walker County could be a "megatracksite" similar to the one discovered in the Robledo Mountains in 1987 by Jerry MacDonald (MacDonald, 1994). If this is true, then paleo-ichnology has a bright future in Alabama.

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