Stump Casts of Arborescent Lycopods

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Abstract

Stump casts of arborescent Lycopsida, *Sigillaria* and *Lepidodendron* were exposed recently in strip mining operations in western Indiana. These stumps were found in place in the high wall of a mine in a shale unit above the Springfield Coal (Coal V). This report is a brief account of these lycopod stump casts.

Introduction

During the spring of 1971 the paleobotany class from Indiana University discovered several casts of stumps standing upright and in place where they grew. The stumps were exposed during strip mining operations of the Hawthorne Mine of the Peabody Coal Company south of Pleasantville, Indiana. Pennsylvanian age plant remains are common in the shales overlying the coals mined in western and southern Indiana. Both Canright (1959) and Wood (1963) have described a number of these plant remains and several localities in which they may be found. Many of these localities are now inactive mines. We have found that some of the most spectacular and useful plant remains for teaching and research presently can be collected best at the strip mines in eastern Sullivan County, Indiana from the shales exposed as the mining operations are in progress. This report deals specifically with the fossil stumps found in place as casts in the shale overlying Coal V and includes a preliminary listing of the associated plant compressions found in this shale. This shale unit is between Coal V which is the top of the Petersburg Formation and the Alum Cave Limestone Member or the Antioch Limestone Member of the Dugger Formation.

Description and Discussion

The size of the stump casts varied, however most of the stumps found were .75-1 m in diameter where the roots spread out at the base of the stump and tapered to .35-.5 m at the top of the stump. Four of the stump casts are illustrated in figures 2, 3, 4, 5 and 6. They were generally about .3-.45 m high and were not preserved above that height. Two large round sections of casts of Sigillarian trunks and the sandstone cast shown in figure 6 were found already removed from the high wall by the mine operators. No evidence of roots were associated with these casts and they were probably sections of stump casts broken out above the basal area where the origin of the roots is evident. These casts were .9-1.25 m in diameter and were the largest observed.

The stigmarian roots arising from the base of the stump casts were not well preserved. Four large branches spread out from the base of the trunk. These roots branch once near the base of the trunk and then merge with the underlying shale and could not be followed further. One of these major stigmarian root systems is seen in Figure 2.

FIGURE 1. *High wall showing Coal V and overlying shale. The coal has been mined out but is shown in section view in the lower right of the photograph. Three stump casts are exposed in place in the shale and are marked by arrows. Hammers are on top of each stump cast for scale.*

The fossil-bearing shale in which the stumps were found was about 2 meters thick and the shale bed was about 4.5 to 5.5 meters above the top of Coal V. Both of these dimensions varied slightly along the length of the high wall exposed during mining operations. The tree stumps were found within this shale layer at varying heights above the coal. In figure 1 the stumps illustrated from left to right

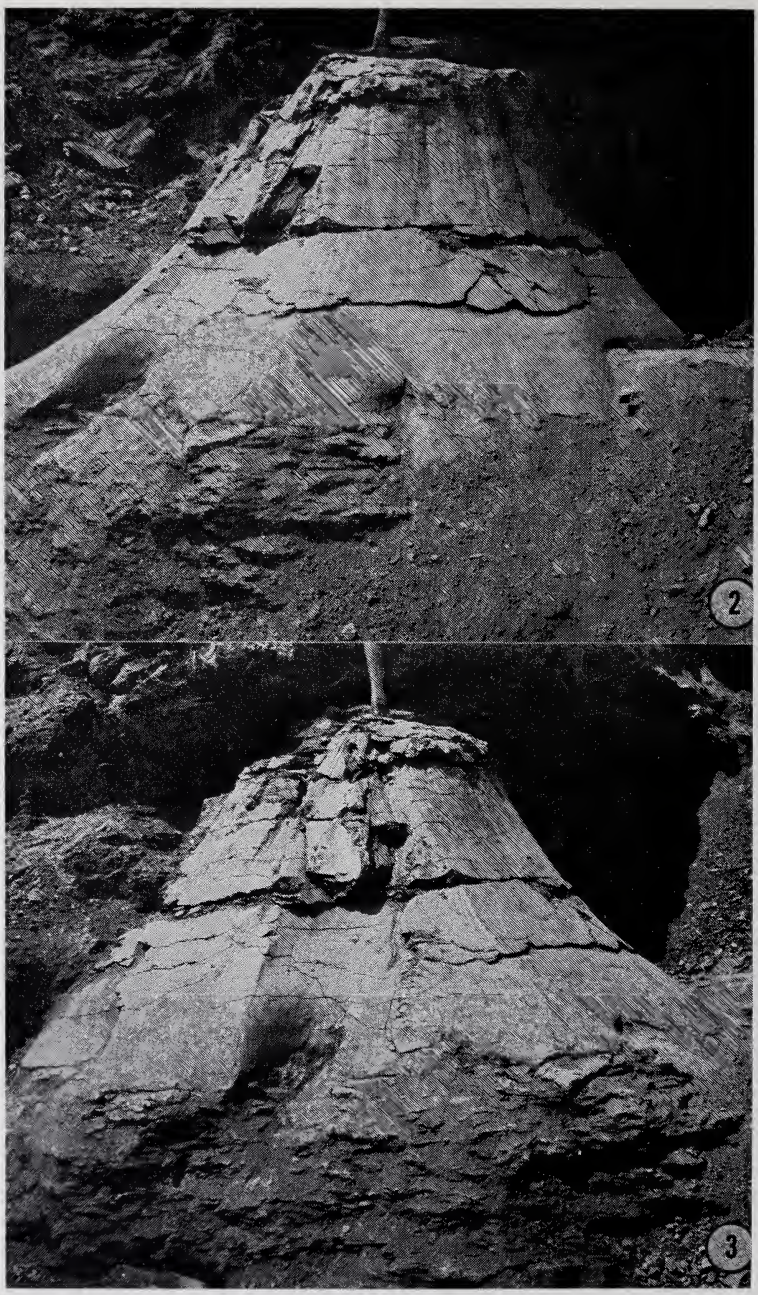

FIGURE 2. *Stump cast of Sigillaria. Widely spaced ribs with paired parichnos scars are evident. Large stigmarian roots merge with the underlying shale.*

FIGURE 3. *Same stump cast shown in figure 2. This stump cast is also illustrated in figure 1 on the left side.*

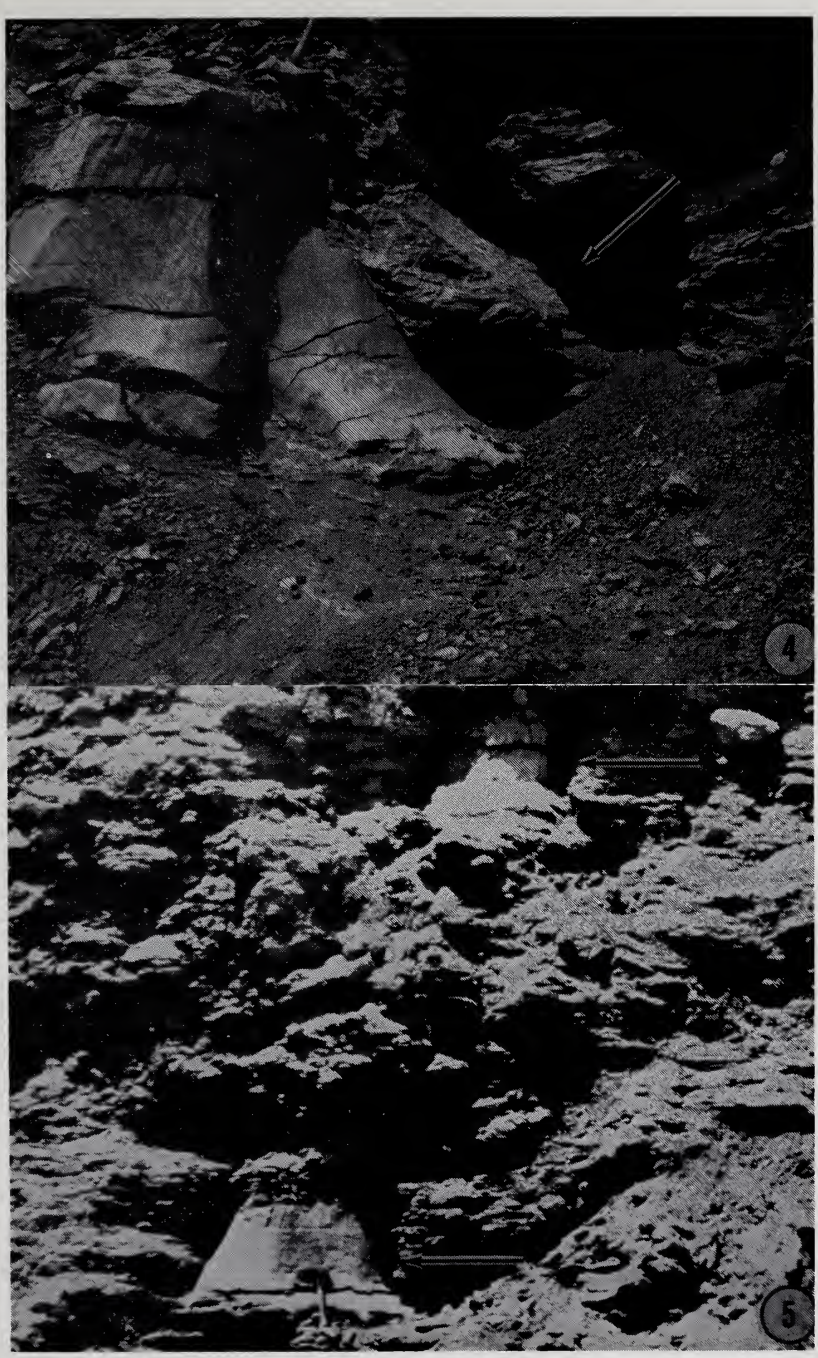

FIGURE 4. *Sigillarian stump cast which was illustrated in the center of figure 1. A stigmarian root cast was removed from the area indicated by the arrow.*

FIGURE 5. *Two stump casts in place in the high wall are indicated by arrows.*

are located respectively, 6.1 m, 6.6 m, and 5.4 m above the top of the coal.

Some stumps exposed in subsequent mining sat nearly one on top of another (fig. 5). This suggests that the shale unit contains a series of successive forests that were buried repeatedly by successive layers of fine grained sediments. This theory is further supported by the discovery of a stigmarian root cast (fig. 4) which extended down through the shale near one of the stumps from a level above the stump cast. The number of successive forests buried could not be determined but at least three levels of burial were evident. The height of the stump casts found varied from about .35-.5 m and this indicates the extent of the sediments deposited during the burial of the various forests. Other megafossils found throughout the shale unit are tabulated in Table I. This list provides some insight into the nature of the forest which continued to invade or persist in an area subject to repeated burials.

TABLE 1. *Plant fossils from the shale above Coal V, Hawthorne Mine.*[1]

Pteridophyta
- Lycopodiales
  - Lepidodendreae
    - *Lepidodendron aculiatum* Sternberg
    - *Lepidodendron lanceolatum* Lesquereux
    - *Lepidodendron enrietta* Langford
    - *Lepidophloios laricinus* Sternberg
    - *Lepidophyllum longifolium* Brongniart
    - *Lepidophyllum majus* Brongniart
    - *Lycopod* megaspores
    - *Sigillaria cumulata* Weiss
    - *Sigillaria laevigata* Brongniart
    - *Sigillaria mammilaris* Brongniart
    - *Sigillaria orbicularis* Brongniart
    - *Sigillaria rugosa* Brongniart
    - *Sigillaria scutellata* Brongniart
    - *Stigmaria ficoides* Sternberg
    - *Syringodendron* sp.
- Equisetales
  - Calamarieae
    - *Annularia sphenophylloides* Zenker
    - *Asterophyllites equisetiformis* Schlotheim
    - *Calamites cisti* Brongniart
    - *Calamites ramosus* Artis
    - *Calamites suckowi* Brongniart
    - *Calamites* sp.
    - *Macrostachya* sp.
    - *Paleostachya* sp.
    - *Pinnularia* sp.
- Sphenophyllales
  - Sphenophylleae
    - *Sphenophyllum emarginatum* Brongniart
    - *Sphenophyllum majus* Bronn
- Filicales and Cycadofilicales
  - Sphenopterideae
    - *Sphenopteris artemisaefolioides* Crépin
    - *Sphenopteris obtusiloba* Brongniart

[1] Briefly discussed by Pheifer and Dilcher (1973) in relation to the megafossils found in Coal VII.

Pecopterideae
Asterotheca arborescens Schlotheim
Dicksonites pluckeneti Schlotheim
Pecopteris clintoni Lesquereux
Pecopteris unitus Brongniart
Mariopterideae
Mariopteris anthrapolis Langford
Mariopteris decipiens Lesquereux
Mariopteris muricata Schlotheim
Mariopteris nervosa Brongniart
Alethopterideae
Alethopteris ambigua Lesquereux
Neuropterideae
Cyclopteris trichomanoides Sternberg
Linopteris muensteri Potonié
Linopteris neuropteroides Potonié
Neuropteris acutifolia Brongniart
Neuropteris fimbriata Lesquereux
Neuropteris gigantea Sternberg
Neuropteris plicata Sternberg
Neuropteris rarinervis Bunbury
Neuropteris scheuchzeri Hoffman
Incerta sedis—Seeds of seed ferns
Cordaitales
Cordaiteae
Cordaites sp.

Several stump casts were unearthed during mining operations of Coal V in the spring and summer of 1971. Judging from the reports of those working in the stripping operation and our visits to the area there were at least 15 stump casts uncovered during this time. All of these were lost in the mining operations except for one that was collected by the Indiana Museum of Natural History with the help of

FIGURE 6. *Sigillarian stump cast removed from the Hawthorne mine by coal miners. They reported that this stump was associated with a sandstone layer in the overburden. The matrix of the cast consists of fine grain sandstone. It is on display in the front yard of Jordan Hall at Indiana University, Bloomington, Indiana. A 15 cm. (6 inch) ruler is in front of the trunk for scale.*

Peabody Coal Company. This section of the mine was closed about the middle of July 1971 and a new area was opened for strip mining Coal V in which, at first, no stump casts were noticed. However in the spring of 1972, while examining the shale unit above the coal in the new area being mined, we found 6 more stump casts. Of the total of more than 20 stump casts which we know to have been found, we have examined 10. Nine of these were clearly stump casts of *Sigillaria;* one was a *Lepidodendron.* All of the stumps showed clear impressions of the inner cortical layers typical of the arborescent Lycopods and these impressions extend to within a short distance above the origin of the roots. In fig. 2 the rows of parichnos scars, characteristic of the subsurface periderm layer of *Sigillaria* and generally referred to as *Syringodendron,* can be seen. Some stumps were still sufficiently buried in the shale when first discovered so that the impression of the outer layer of the stem could be observed in the surrounding shale. In all stumps, except two very large specimens which had been mined out and broken free from any remains of their roots before we saw them, these leaf bases or impressions of the leaf traces in the periderm were evident. The two large specimens were .9 m to 1.25 m in diameter and .3 m to .5 m in height with only the verticle ribbing, characteristic of *Sigillaria,* preserved.

The presence of leaf cushions to the very base of these stump casts seems contrary to Eggert's (1961) reconstruction of *Lepidodendron* and his interpretation that the outer periderm of the trunks of the arborescent Lycopods, which included the leaf bases, was lost as the trees matured. While Eggert's paper was in press he found a compression of a trunk which confirmed his reconstruction and interpretation. Perhaps the *Lepidodendron* which we found was either a young tree or a different species in which the leaf cushions persisted to the base of the tree. The stump casts of the sigillarian trees might be expected to show the parichnos scars in the older portion of the plant because of their extensive development in the periderm of this genus. The ribs are widely spaced in these stump casts suggesting that considerable growth of the periderm took place during their maturity.

Stump casts of the arborescent lycopods are not frequently reported in the literature but have been found previously in sediments of Pennsylvanian age. Owen reported fossil stumps of supposed palm trees from Posey County, Indiana in 1843 which were most probably stump casts of arborescent Lycopods (Owen 1843a, 1843b). Upright sigillarian trunk casts and calamitian pith casts are known from the Bay of Fundy near Joggins, Nova Scotia. The most well known Lycopod stump casts are those which are preserved at Victoria Park in Glasgow, Scotland; they have been illustrated in numerous textbooks (Seward 1898, Mägdefrau 1956, Walton 1958, and Andrews 1961). Some trunks have been found upright in Illinois, in their Coal No. 2 which is equivalent to Indiana Coal IIIa (Russell Peppers, personal communication). Several trunks have been reported, photographed and collected from the shales associated with Coals VI and VII near Dugger, Indiana. Weatherwax (1956, p. 398) illustrated a 12-foot section of a probable sigillarian trunk standing upright near Dugger. In the same area we recently

collected sections of a petrified sigillarian trunk, also standing upright, which was associated with erect calamitean pith casts. *Lepidophloios* trunk remains have also been recovered from this area. These longer upright trunks found near Dugger are composed of poorly petrified material and lack etxernal details of the base of the trees.

This report is presented here in order to record the occurrence of these fossil stumps, illustrate them, and provide some details of the stratigraphic section in which they were found. Certainly the localities discussed in this paper will continue to yield excellent fossil stumps for those who are there to search for them.

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