

The Present Status of Paleobotany in Indiana with Special Reference to the Fossils of Pennsylvanian Age¹

JOSEPH M. WOOD and JAMES E. CANRIGHT, Indiana University

Paleontologists have long recognized the importance of the strategic position of the state of Indiana, situated as it is on the west side of the famous Cincinnati arch. Here fossiliferous rocks from the Ordovician through the Carboniferous are exposed for ready examination and collection. More specifically, Indiana lies on the Kankakee branch or arm of the Cincinnati arch. This arch began to rise sometime in the Ordovician and thereafter fluctuated around sea level so that sedimentary deposits were continually being added. In time, erosion levelled the surface so that now we have the layers exposed in such a way that if we go from a point halfway down the Indiana-Ohio border southwestward to the toe of the state, we pass over Ordovician, Silurian, Devonian, Mississippian, and Pennsylvanian formations in that order. All of the layers dip to the southwest at about 25 feet per mile. Thus, with this excellent cross section of time laid out before us so precisely, it is a relatively simple matter to examine the various horizons of the majority of Paleozoic strata.

Although the paleontologists have recognized the significance of Indiana's position on the arch, they have been concerned primarily with the collection and identification of the remains of marine faunas of the older Paleozoic rocks. The result has been that the extensive terrestrial floras of the Carboniferous, especially the Upper Carboniferous or Pennsylvanian, are but little known in Indiana, despite the considerable contribution of these ancient floras to this state's economy, namely, in the formation of our vast coal deposits.

The uses of faunal index fossils as correlative tools, as indicators of paleogeographical conditions, as indicators of past climates, and as supporting evidence for the laws of evolution are all well known. On the other hand, the application of plant fossils, especially macrofossils, to these same areas of study has received little or no attention in this state. A significant exception to the above is seen, however, in the palynological investigations of Dr. J. E. Potzger (9) and his students, which have yielded conclusive evidence concerning past climates and vegetation in Indiana.

The Annual Reports of the Geological Survey of Indiana from 1869 to 1900 carry sporadic accounts of the discovery and/or description of plant macrofossils by such men as L. Lesquereux, E. T. Cox, E. M. Kindle, D. D. Owen, David White and G. H. Ashley. Of the above, only Lesquereux and White were trained paleobotanists. Therefore, it is unfortunate that their descriptions of Indiana fossils were not based on their own field work, but instead, merely on material sent to them by Indiana Geological Survey field parties. After 1900 the reports relative to the discovery of plant fossils in Indiana are comparatively rare.

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By contrast, paleobotanical studies on Paleozoic floras in the surrounding states have been and are now being carried on by a relatively large group of workers. Lesquereux's fossil floras of Pennsylvania, of Illinois and of Kentucky were published between 1850 and 1883. Newberry's "Carboniferous Flora of Ohio" was published in 1873. David White described the fossil floras of West Virginia and Missouri between 1899 and 1907. C. A. Arnold, H. N. Andrews, and others are presently at work on the Paleozoic plants of Michigan, Iowa, and Kansas.

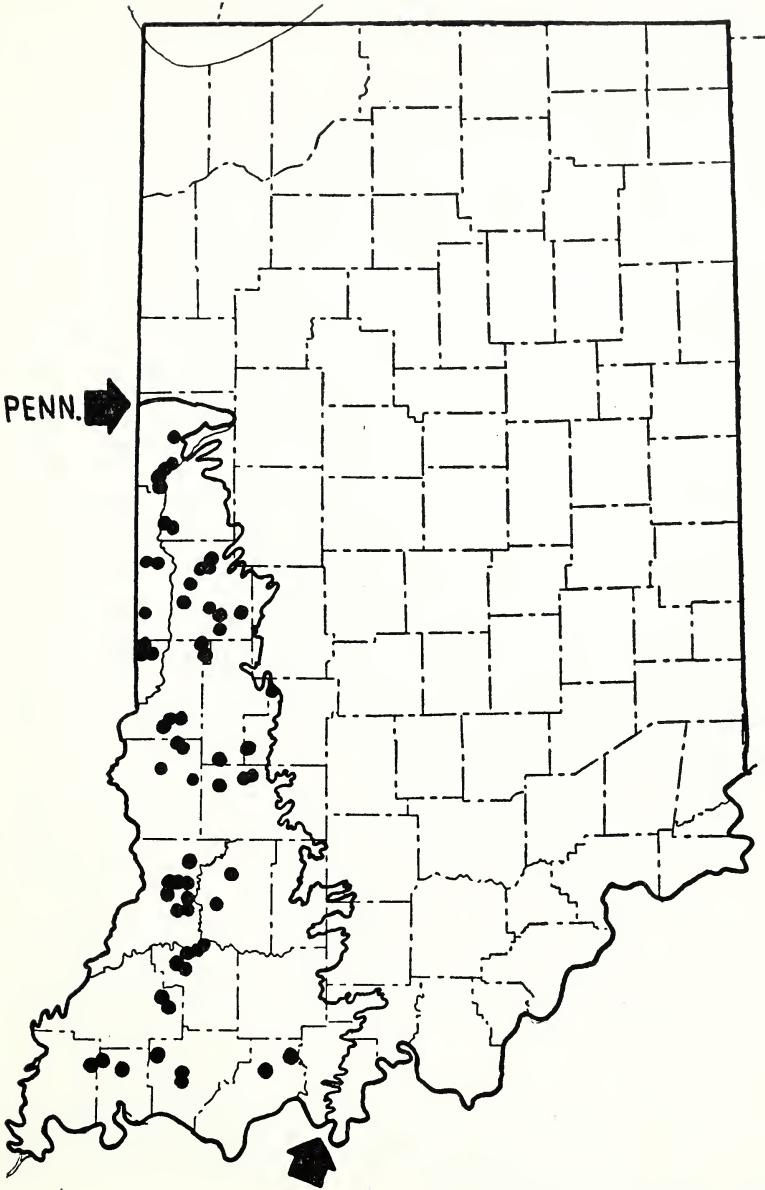
The main work in Indiana for the most part has been confined to the description of the floras as revealed in the casts, compressions, and/or coal balls of a few very localized areas. Thomas F. Jackson (5, 6) described some plants from the Lower Pennsylvanian rocks in the Bloomington quadrangle. R. W. Baxter (1) recently published an account of a new sphenopsid cone based on material found in coal balls that had been collected in the Pennsylvanian of Warrick County near Booneville. W. S. Benninghoff (2), a former student of W. C. Darrach's at Harvard, described a Pennsylvanian coal ball flora from species that he found at one mine near Petersburg in Pike County. Students of W. N. Stewart of the University of Illinois have published descriptions of psaroniaceae fern stipes from St. Wendell, Posey County, Indiana, coal balls (7, 8).

Work on a particular geological horizon of Indiana, such as the New Albany shales of Upper Devonian or Lower Mississippian age, by J. H. Hoskins and his co-workers (3, 4) provides an excellent exception to the general rule.

Nevertheless, the paucity of information on the Pennsylvanian of Indiana indicates that although several isolated floras have been described at this time, no one has assembled sufficient fossil material in order to ascertain the general overall picture of the Pennsylvanian flora of Indiana and its stratigraphic succession.

Last summer in preparation for the field work (under the auspices of the Indiana Geological Survey) the authors surveyed the literature pertaining to the plant fossils that had been reported in this state, especially those of the Pennsylvanian. These locations (144 in number) were transferred to a card file and also plotted on a sectional map of Indiana. Using these as guides, the authors set out, and in the course of four weeks, covered approximately 2,400 miles throughout the 23 counties of southern and western Indiana which are underlain by Pennsylvanian rocks. Needless to say, some of the slope mines and quarries which were glowingly described as good paleobotanical sites in the early pre-1900 reports are no longer of any value. Nevertheless, these reported sites often served as guides to other localities that did prove to be productive (Fig. 1).

The authors attempted, whenever possible, to collect the fossil plant material *in situ* in order that it might be of maximum stratigraphic value; in many cases this was feasible. However, the majority of our material was collected from the spoil banks of active and abandoned slope and strip mines. In some instances, excellently preserved plant fossils from newly-discarded roof shales of active shaft mines were collected. In the collection of materials from the spoil banks and the mine dump



Legend for Text Figure

Figure 1. Outline map showing the limit of Pennsylvanian outcrop in Indiana and sites of the authors' paleobotanical collections.

heaps, the fact that the profile of the strata was visible along the rims of the mines, and the knowledge of the coal that was being or had been mined in that particular area aided in placing the specimens in their proper stratigraphic position.

The discovery of fourteen previously unreported coal ball sites in eight counties, yielding approximately 500 coal balls of various sizes should be of especial interest to students of plant anatomy and phylogeny. The majority of the coal balls taken (and these are by no means all of the coal balls that are available at these sites) can be classed as *bona fide* coal balls, that is, with a matrix mainly calcareous or dolomitic in nature, and not pyritic. Those that have been sampled indicate that the structures which they contain are preserved in such a manner as to permit detailed study of their anatomical features.

A number of coal balls from the Wasson Mining Company's Big Creek Mine (now the Buckskin Mine) in Warrick County were collected in 1948 by members of the Indiana Geological Survey. Of these coal balls, the authors have found about 125 suitable for examination. These have been cut, polished, and etched with acid, after which nitrocellulose peels were prepared in the usual manner. These peels are now being studied; a more or less cursory examination indicates that the Pennsylvanian flora of this region very closely resembles that which Benninghoff in his 1943 report on the Pike County coal balls described as a "*Lepidodendron-Calamites-Fern* assemblage."

The coal balls collected by the authors during this last field season are now being processed in the same manner as were those that were previously mentioned. Preliminary studies of these have revealed that a number of seeds, such as *Lepidocarpon* spp. have been preserved, in addition to the many Coenopterid fructifications and stipes, *Calamites*, *Sphenophyllum*, and *Lepidodendrid* organs.

Several pyritized seeds, tentatively classified as *Trigonocarpus noeggerathi* (Lindley & Hutton) von Sternb. were found in an excellent state of preservation. The endocarp of one of these was cut and found to have been replaced in such a manner that anatomical studies may be made of the included structures.

A considerable number of cone compressions, mainly *Sigillariostrobus*, *Lepidostrobus*, *Paleostachya*, *Macrostachya*, *Volkmanmia* and *Calamostachys* were found. Mr. G. K. Guennel of the Indiana Geological Survey has isolated spores from these samples so that these microfossils may be compared with presently-named spore materials found in our coal seams.

Impressions, casts and petrified woods were found in abundance in some areas, and these were often excellently preserved. Although the survey of this material is well under way, it would be premature at this time to make any statements as to the relative frequency of any of the genera that are included therein.

In summary, the following significant facts may be stated concerning the importance of continuing paleobotanical studies in Indiana: (1) with the material that is now at our disposal, a number of anatomical and morphological studies of phylogenetic importance can be made; naturally,

the collection of additional material will fill in conspicuous gaps in our present knowledge; (2) the possible use of plant macrofossils in the stratigraphic correlation of Indiana's coal beds is still in the process of evaluation, but seems to have considerable merit in several instances, particularly with Coals V and VII; (3) fossil plants in Indiana need description and cataloging for several reasons: a) to uncover more evidence concerning the Paleozoic floras and past climates of this region; b) for comparison with the better known Paleozoic floras of surrounding states as well as with those of the rest of the world; c) to determine whether a recognizable relationship exists between the floristic composition of Carboniferous climax types and the properties of the various coal seams in this state.

The wealth of the fossil plants that the authors were able to collect in Indiana in so short a time would suggest that literally "the surface has just been scratched." In this connection, the authors would like to quote a recent unequivocal statement made by one of this country's foremost paleobotanists, "Indiana is potentially one of the best localities in the world for the study of Pennsylvanian plant fossils."

In conclusion, therefore, the authors offer for your serious consideration the ancient Biblical quotation, ". . . seek and ye shall find . . ."

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