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PLANT MICROFOSSILS IN CORRELATION  
OF COAL BEDS

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# PLANT MICROFOSSILS IN CORRELATION OF COAL BEDS

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## ABSTRACT

An intensive study of fossil microspores, isopores, and prepollens isolated from Illinois coal beds has proved that numerous genera and species are present. The correlation of coal beds is possible because the geological range of many genera and species is proved, by this investigation, to be quite restricted.

Preliminary experiments with specific interregional correlations have demonstrated a wide lateral distribution of plant microfossils necessary for the correlations of this type.

## INTRODUCTION

The purpose of this paper is to show that plant microfossils may be used effectively in the correlation of spore-bearing strata. The extent to which they may be used interregionally is of utmost importance if rapid progress is to be made in stratigraphic studies. These preliminary results will therefore help to evaluate the role which plant microfossils can play in interregional correlations. A final report will include descriptions of the many new genera and species of plant microfossils isolated from Illinois coal beds and the methods of isolating them for study.

Although plant spores were observed in coal more than a hundred years ago, it is only recently that these microscopic remains have been used by European geologists in solving stratigraphic problems. Their use is practically unknown in this country. This is readily understood by paleobotanists familiar with the numerous taxonomic problems which they present. A recent publication<sup>2</sup> has considerably lessened the taxonomic problems, so that investigators may now place plant spores in their appropriate

genera. The present investigation is the first comprehensive survey of isolated microspores, isopores, and prepollens of Paleozoic strata in this country. J. M. Schopf,<sup>3</sup> using megaspores, indicated their possible use in correlating coal beds. The first correlation studies of two Ohio coal beds based on isolated small spores proved successful.<sup>4</sup>

## DISTRIBUTION OF SMALL-SPORE GENERA IN ILLINOIS COAL BEDS

### THE CASEYVILLE GROUP

The oldest Pennsylvanian strata in Illinois contain ten established genera and at least three new genera. *Densosporites* and *Lycospora* are the dominant genera, and thus in all probability the coals of this group were largely derived from the parent-plants of these two genera. The parent-plant of *Densosporites* is unknown, but certainly the spores of *Lycospora* are those of the arborescent lepidodendrons.

The Wayside, Battery Rock, and

<sup>3</sup> "Spores Characteristic of Illinois Coal No. 6," *Trans. Ill. Acad. Sci.*, Vol. XXVIII, No. 2 (1936), pp. 173-76; "Spores from Herrin (No. 6) Coal Bed in Illinois," *Ill. Geol. Surv. Rept. Investigations No. 50* (1938), pp. 1-73.

<sup>2</sup> J. M. Schopf, L. R. Wilson, and Ray Bentall, "An Annotated Synopsis of Paleozoic Fossil Spores and the Definition of Generic Groups," *Ill. Geol. Surv. Rept. Investigations No. 91* (1944), pp. 1-66.

<sup>4</sup> R. M. Kosanke, "The Characteristic Plant Microfossils of the Pittsburgh and Pomeroy Coals of Ohio," *Amer. Mid. Nat.*, Vol. I (1943), pp. 119-32.

Reynoldsburg coal beds from southern Illinois are considered to be of Caseyville age, which is in agreement with J. M. Weller, L. G. Henbest, and C. O. Dunbar.<sup>5</sup> The coal beds of the Caseyville group appear to lack species of the genus *Cirratriradites*, and the genus *Laevigato-sporites* may have originated in Reynoldsburg time. At least, *Laevigato-sporites* is represented in the Caseyville by only a few specimens, which is surprising, because spores of this type are known to have an almost continuous range from the Pennsylvanian to the present day.<sup>6</sup> If *Laevigato-sporites* originated in Reynoldsburg time, there must have been a major floral change. Such a floral change supports the correlation<sup>7</sup> of the Babylon coal bed as post-Caseyville, because the genus is abundantly represented in the Babylon coal bed, as is the genus *Cirratriradites*. The Babylon coal bed was formerly considered to be Caseyville.<sup>8</sup>

#### THE TRADEWATER GROUP

The Tradewater group contains species of fourteen established genera and at least two new genera which are present in the Caseyville group. The flora was more diversified, and the dominant genus throughout most of this period was *Laevigato-sporites*, which was scantily

<sup>5</sup> "Pennsylvanian Fusulinidae of Illinois," *Ill. Geol. Surv. Bull. No. 67* (1942), pp. 9-34.

<sup>6</sup> L. R. Wilson and R. M. Webster, "Plant Microfossils from a Fort Union Coal of Montana," *Amer. Jour. Bot.*, Vol. XXXIII, No. 4 (April, 1946), pp. 271-78; Olof H. Selling, "Spores of Hawaiian Pteridophytes. I." *Spec. Pub. 37, Bishop Museum, Honolulu, Hawaii* (Göteborg, Sweden, 1946), pp. 1-87.

<sup>7</sup> R. C. Moore, H. R. Wanless, J. M. Weller, *et al.*, "Correlation of Pennsylvanian Formations of North America," *Bull. Geol. Soc. Amer.*, Vol. LV (1944), pp. 657-706.

<sup>8</sup> Weller, Henbest, and Dunbar, *ftn. 5*; Harold R. Wanless, "Pennsylvanian Correlation in the Eastern Interior and Appalachian Coal Fields," *Geol. Soc. Amer. Spec. Paper 17* (1939), pp. 85 and 108.

represented earlier. Only *Lycospora* replaces *Laevigato-sporites* as the dominant floral element in one coal bed. The subdominant genera during part of this time are *Granulati-sporites*, *Cirratriradites*, *Triquitrites*, and *Lycospora*. In most cases each of the momentary periods of subdominance indicates the origin of new species, which serve as guide fossils. Also *Alati-sporites*, *Cirratriradites*, *Florinites*, and possibly *Reinschospora* appear for the first time during the Pennsylvanian period in Illinois.

The Willis and Tartar, Pope Creek and Delwood, Seville and Rock Island coal beds are to be correlated on the basis of plant microfossils, which is in agreement with C. L. Cooper.<sup>9</sup> The Curlew coal bed is thought to be younger than the Rock Island and Seville coal beds,<sup>10</sup> and this view is held by the author. The Bald Hill coal bed, originally described by G. H. Cady,<sup>11</sup> is younger than the Curlew coal bed. The Davis and Wiley are correlated and likewise the DeKoven and Greenbush; this is in agreement with Wanless' suggested correlations.<sup>12</sup>

#### THE CARBONDALE GROUP

The coal beds of the Carbondale group present fewer correlation problems than any other group in Illinois. One new genus is of utmost importance in correlating the No. 2 coal bed and is known to occur only in the lower half of the bed. This coal bed has species of *Lycospora* as the dominant microfloral element; and a species of *Laevigato-sporites*, with its origin in the DeKoven coal bed,

<sup>9</sup> "Pennsylvanian Ostracodes of Illinois," *Ill. Geol. Surv. Bull. 70* (1946), p. 16.

<sup>10</sup> C. O. Dunbar and L. G. Henbest, "Pennsylvanian Fusulinidae of Illinois," *Ill. Geol. Surv. Bull. 67* (1942), pp. 20-21.

<sup>11</sup> "The Areal Geology of Saline County," *Trans. Ill. Acad. Sci.*, Vol. XIX (1926), pp. 259-60.

<sup>12</sup> *Ftn. 8* (1939).

becomes a prominent member of the flora. Number 5 coal bed is readily distinguished by an abundance of *Laevigatosporites*, fewer *Lycospora*, and the presence of several species of *Alati-sporites* and *Cirratiradites*. Number 5-A coal bed is distinct from both No. 5 and No. 6 coal beds. It does not correlate with the Grape Creek coal bed, which is in contrast to the correlations of J. M. Weller and H. R. Wanless<sup>13</sup> and of Wanless.<sup>14</sup> The correlation of the Grape Creek coal bed with No. 6 coal bed by F. H. Bradley<sup>15</sup> is upheld by spore studies in which no generic or specific differences have been noted. The Grape Creek coal bed has been variously correlated as No. 5 coal bed<sup>16</sup> and No. 5-A coal bed.<sup>17</sup> The large spores of No. 6 coal bed, megaspores, are known through the works of J. M. Schopf.<sup>18</sup>

#### THE McLEANSBORO GROUP

In the McLeansboro group there are more stratigraphic problems than in any other group in Illinois. Much additional work must be done before the problems can be solved. However, there are fourteen established genera known to occur and at least one new genus is present. Changes in the distribution and abundance of genera are most encouraging. Danville No. 7 coal bed is definitely

<sup>13</sup> "Correlation of Movable Coals of Illinois, Indiana, and Western Kentucky," *Bull. Amer. Assoc. Pet. Geol.*, Vol. XXIII, No. 9 (1939), pp. 1374-92; reprinted in *Ill. Geol. Surv. Circ. No. 48* (1939).

<sup>14</sup> Pp. 84 and 110 of ft. 8.

<sup>15</sup> "Geology of Vermilion County," *Ill. Geol. Surv.*, Vol. IV (1870), pp. 241-65.

<sup>16</sup> H. R. Wanless, quoted in G. H. Cady, "Classification and Selection of Illinois Coals," *Ill. Geol. Surv. Bull. 62* (1935), p. 39.

<sup>17</sup> Weller and Wanless, ft. 13; and Wanless, ft. 8.

<sup>18</sup> Ftn. 3.

younger than the Jamestown or Bankston Fork coal beds. It may be identical with the Cutler coal bed or the first Cutler rider coal bed. There exists a major floral break just below No. 8 coal, indicated by the fact that no species of *Lycospora* has as yet been observed in No. 8 coal. This is the approximate position of the boundary of the Des Moines and Missouri series of the Mid-Continent, according to Cooper.<sup>19</sup> Coal samples from type areas of the Shoal Creek and Carlinville show that they do not correlate and that they are separate and distinct strata. Further, they show that the Carlinville is probably older than the Shoal Creek. The presence of the genus *Pityosporites* in the Shoal Creek and younger beds strongly suggests the presence of an upland conifer flora.

#### SUMMARY OF SMALL-SPORE INVESTIGATIONS IN ILLINOIS

These remarks are based on more than six hundred macerations from forty-seven counties in the state. A study of Figure 1 readily reveals that, through a knowledge of the genera and their abundance, one can place an unknown coal bed in one of the four groups of the Pennsylvanian system, and in many cases even identify it specifically. A knowledge of the numerous species and their abundance readily permits the correlation of Pennsylvanian spore-bearing strata in Illinois.

#### PRELIMINARY INTERREGIONAL CORRELATIONS

After a comprehensive survey of the spore content of Illinois coal beds had been made, it was important to investigate the possibility of using plant remains isolated from spore-bearing strata

<sup>19</sup> Ftn. 9.

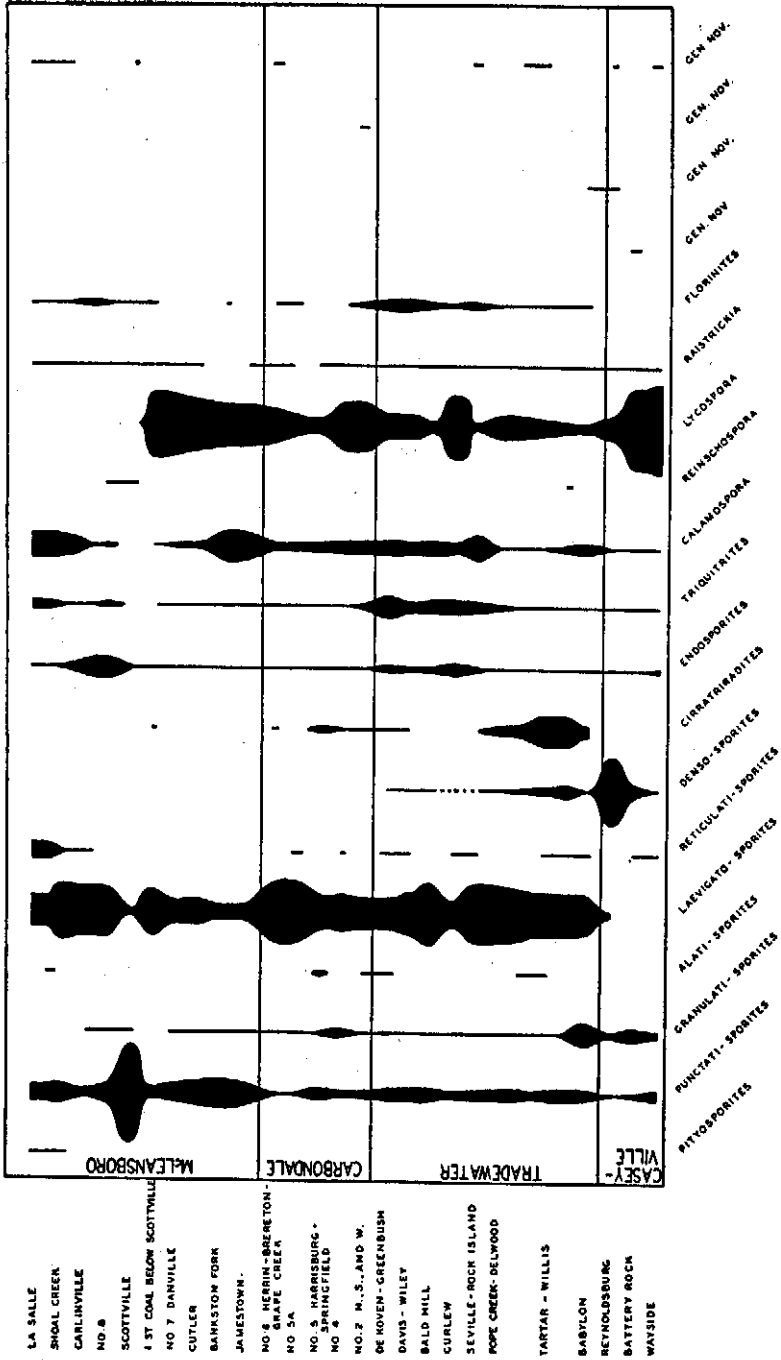


FIG. 1.—Distribution and relative abundance of the small-spore genera in a number of Illinois coal beds. The coal beds are listed to the left and the genera at the base. The genus *Punctati-sporites* for the Wayside coal bed represents 10 per cent, and this may be used as a scale.

for interregional correlations. Coal samples from Ohio, Iowa, and Missouri were prepared and examined. The results are encouraging and may be summarized as follows: Characteristic plant spores are present in the coal beds investigated, although their abundance is thought to be at variance with comparable horizons in Illinois. This may be due to ecological conditions. The preliminary tests suggested possible correlations with certain Illinois beds, but, because of limited samples, specific correlations should not be made at this time. Microfloral zones, known from Il-

linois coal beds, may be used to correlate interregionally.

#### CONCLUSIONS

Correlation of Pennsylvanian spore-bearing strata is possible by the use of microspores, isospores, and prepollens when prepared by the maceration method. This type of research gives promise of being a useful tool to the geologist and is of importance to the paleobotanist in determining the range and abundance of fossil plants. Numerous investigations of this kind should be carried out in critical areas throughout the country.