Palynological investigations in the Pennsylvanian of Kentucky--II.

by

Robert M. Kosanke

U. S. Geological Survey.
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Weld - Int. 2905

GEOLOGIC DIVISION
U.S. GEOLOGICAL SURVEY
Washington, D. C.

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OPEN-FILE REPORT

Palynological Investigations in the Pennsylvanian of Kentucky - II

by

Robert M. Kosanke

Denver, Colorado

This document has not been edited

or reviewed for conformity with

U. S. Geological Survey standards or nomenclature

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by Robert M. Kosanke

INTRODUCTION

This is the second open-file report concerned with palynological analyses of Pennsylvanian coals, underclays, and shales. It is a part of the cooperative mapping project between Kentucky and the U. S. Geological Survey.

This report contains palynological analyses of samples from Millard, Carrie, Oil Springs, Milo, Offutt, Whitesburg, and Jenkins West Quadrangles of eastern Kentucky. A total of 105 samples of coal, shale, and underclay have been examined. Statistical analyses have been run on 86 of the 105 samples, and more than 21,500 specimens were identified and counted.

All analyses completed during 1965 are included in this report; others will be placed in open-file when they are completed and are released for general use.

REPORT ON REFERRED FOSSILS

P&S Branch, Denver Lab, U.S.G.S.
Bldg. 25, Federal Center, Denver, Colo.

Stratigraphic range: Pennsylvanian

Kinds of fossils: pollen.

General locality: Kentucky

Quadrangle: Millard quad.
Carrie quad.

Referred by: Donald C. Alvord, 7/21/64
Victor M. Seiders, 9/23/63

Shipment No.: KG-64-24D & KG-65-6D
Regional Geology in Kentucky

Report prepared by: R. M. Kosanke, 3/30/65

Date material received: 7/21/64
9/23/63

Status of work: KG-64-24D - Incomplete; KG-65-6D - Complete.

Macerations 64 A-CC - coals, shales, and underclays occurring between 20.0' and 243.9' in USGS DDH 2 -L-85, 5,240' FEL X 17,450' FNL at the head of Wolfpen Fork of Lower Pompey Creek, Millard Quad., Pike County, Kentucky (KG-64-24D).

64 A-C	20.0'- 21.5'	(Hamlin?)
64 D-E	82.5'- 84.5'	
64 F-N	89.7'- 97.5'	(Fire Clay Rider)
64 O-T	153.6'-155.6'	(Fire Clay)
64 U-X	166.9'-170.0'	(Little Fire Clay?)
64 Y-Z	229.0'-230.7')	(Whitesburg Zone)
64 AA-CC	243.2'-243.9')	

Macerations 24 A-L - coal and shale from Fire Clay and Fire Clay Rider coal zone, 21-J-77, 150' FNL X 2,350' FWL, road cut just above 1008' BM at mouth of Big Branch of Lotts Creek, Carrie Quad., Kentucky (KG-65-6D)

24-A	S11A	1" coal	
		1" shale*	
24-B	S11B	3½" coal	
24-C	S11C	2" dull coal	
24-D	S11D	25" coal	
		18" shale*	
24-E	S11E	2 3/4" coal	
		11½" clay, shale, and bone*	
24-F	S11F	7½" coal	
		1" shale*	
24-G	S11G	7½" coal	
		28" shale and clays*	
24-H	S11H	1" bone coal	
		5" shale*	
24-I	S11I	1 3/4" coal	
		28" shale*	
24-J	S11J	23½" coal	)
24-K	S11K	2" coal, canneloid	) Fire Clay
24-L	S11L	3½" coal	)
		flint clay and clay*	

* not sampled

Distribution Chart 3 illustrates the distribution of small spores obtained from macerations of the 64 series of DDH 2 down to 243.9'. The spore and pollen recovery from coals was good except in macerations 64 H-J. These three samples required special attention to obtain yields comparable to the other coal samples. Spore and pollen recovery from shales and clays varied from nearly barren in 64-U and X to abundant and perfectly preserved in 64-N. No major floral break is evident between 64 F-N and 64 O-T, your Fire Clay rider and Fire Clay coals respectively. Vestispora does not occur below 64-N, and this could ultimately prove to be of importance, but I do not consider this of great significance at this time because Vestispora tends to have an interrupted range and never is very abundant. It does occur consistently through 64 A-F so that this is encouraging. Subsequent examination of coals lower in the section should delineate whether or not 64-N represents the oldest occurrence of Vestispora. Reinschospora occurs in very limited quantities in both the Fire Clay and Fire Clay rider coals. It definitely has an interrupted range and occurs much lower and higher in the section. Renisporites, previously reported from only the Tartar coal of the Abbott Formation in Illinois, has been identified in very limited numbers as shown on Chart 3. Triquitrites, spore 298, and spore 490 do not occur below the Fire Clay coal, however, species of Triquitrites are known to occur in older Pennsylvanian rocks. The diminution of Triquitrites in the position of the Little Fire Clay and Whitesburg coals could prove helpful. Spore 298 has been reported in very restricted numbers from the basal portion of the coal and underclay at 624.7'-627.7' in DDH 8.

Lycospora is dominant in one or more segment samples from each of the coals examined from the 64 maceration series. Densosporites alternates with Lycospora in numerical importance throughout the Fire Clay rider, Fire Clay, and your Little Fire Clay coal, macerations 64 G-W, and this could be interpreted as an alternation of herbaceous plants (Densosporites) with arborescent plants (Lycospora). This could be related to fluctuations in water levels for it is doubtful whether herbaceous plants could persist under high water levels. Laevigatosporites, Granulatisporites, and Cristatisporites are next in numerical importance. A total of 6,000 specimens were identified for statistical purposes in maceration of the 64 series thus far in addition to examination of all of the slides with additional identifications recorded on Chart 3 as present but not observed in the statistical count.

Based on generic occurrence augmented by abundance, it seems plausible to distinguish 64 BB-CC from 64 Y-Z, coals from your Whitesburg zone, and these from the rest of the coals. Major breaks in the abundance patterns occur between these two coals, and between these coals and the rest of the coals. Spores assigned to Callisporites in previous reports have been transferred to Savitrisporites inasmuch as Sullivan (1964) reported the type species of Callisporites clearly is assignable to Savitrisporites.

A total of 234 species are recognized in macerations 64 A-CC and 77 of these species are potentially useful for correlation purposes. Nineteen species appear to be restricted to single or individual coals, 24 species to two coals, and 10 species to three coals. Further, 24 species appear to originate or terminate their ranges within the sequence of coals under discussion.

Fire Clay Rider Coal

A comparison of macerations 64 F-N and 1 A-K has been made and 23 genera are common to both sets of macerations. Maceration 64 F-N has both Renisporites and Reinschospora that have not been observed in macerations 1 A-K while 1 A-K has Stellisporites which has not been observed in 64 F-N. I do not consider the discrepancies in the occurrence of Renisporites and Reinschospora serious for a number of

reasons some of which have already been discussed. I am more disappointed than concerned that Stellisporites cannot be used even though it was present only in minor amounts in 1 A-K.

An overall similarity exists in abundance between 64 F-N and 1 A-K. This is especially true in the case of the alternation of Lycospora and Densosporites in two of the segment samples. Further, Cristatisporites is absent in the underclay and lowest coal segment of both sets of samples, and Densosporites is absent in both underclay samples and rare in the lowest coal segment of each of the coals. In all, 2,000 specimens were identified for the statistical portion of 64 G-N plus additional specimens for 64-F.

Sixty-three species are common to both sets of samples out of a possible 106 species. Ordinarily, a correlation between two sets of samples might require better than a 60 percent comparison. However, 10 species, 364, 366, 381, 383, 387, 388, 391, 395, 396, and 732 are common to both sets of samples and do not occur above or below 64 F-N. Further, species 368, 369, and 763, occurring in both sets of samples, are restricted in occurrence to the Fire Clay rider and Fire Clay coals. In addition, species 373 apparently terminates in the Fire Clay rider coal as it has not been observed in the coals above in the 64 maceration series.

I believe a correlation exists between 1 A-K and 64 F-N based on species occurrences, and to a lesser extent, the similarity in abundance ratios and generic occurrence.

A comparison has been made with Seiders' Fire Clay rider zone, macerations 24 A-I, from Carrie Quadrangle. The distribution of spores is depicted on Chart 1. The abundance ratios are based on 1955 specimens counted. Twenty-two genera occurring in these samples are present in 64 F-N and 1 A-K. Foveolatisporites and Stellisporites, present in very limited amounts in 1 A-K, are not present in 24 A-I from Carrie Quadrangle. However, 3 of four species of Densosporites occur in both 1 A-K and 24 A-I, but only 2 of the 5 species of Cristatisporites present in 1 A-K have been identified from 24 A-I. A total of 58 species are common to both 24 A-I and 1 A-K and of these, 4 species, 366, 381, 387, and 388, restricted to the Fire Clay rider coal of the Pikeville area, are present. In addition, species 368 restricted to 64 F-N and 64 O-T, and occurring in 1 A-K, occurs in 24 A-I.

I believe that probably all of 24 A-I, the Fire Clay rider zone, could correlate with 64 F-N and 1 A-K. Seiders indicated that perhaps his samples S11A-S11D, 24 A-D, were the Fire Clay rider coal, but I find it necessary to include samples down to S11H or 24-H in the rider zone.

Fire Clay Coal

A comparison has been made between 64 O-T and 42 A-F. Macerations 42 A-F are from USGS DDH 8 with the top of the coal at 588.2'. Twenty-one genera are common to both sets of samples plus spores 298, 136, and 490. These last two spore types were classified under "all other taxa" in my previous report. Macerations O-T have very limited occurrences of Renisporites and Reinchospora that were not observed in 42 A-F. This is discussed under the Fire Clay rider coal.

To some extent, the abundance ratios compare in that Lycospora is dominant with one alternation with Densosporites except that Lycospora is dominant in 42 A-B. This might be accounted for if the top part of the Fire Clay coal is thin or missing in 64 O-T. In all, 1,500 specimens were identified from 64 O-T for statistical purposes.

In the overall picture, 60 of 92 species are common to both sets of samples plus spores 136, 298, and 490. Three species that are restricted to the Fire Clay coal in the 64 maceration series occur in macerations 42 A-F. These species are 493, 540, and 797. Eight species restricted to both the Fire Clay Rider and Fire Clay coals of the 64 maceration series occur in 42 A-F. These species are 320, 369, 459, 503, 510, 528, 735, and 808. In addition, there are a number of species in the 64 maceration series that appear to terminate or originate in the Fire Clay coal that occur in 42 A-F. Two of these are most interesting and are species 103 and 275. These are Laevigatosporites minutus and L. globosus mentioned in my previous report as being absent from the coal occurring between 624.7'-627.7' in USGS DDH 8. We now know that these two species are not present in maceration 64-U through 64-CC. In Illinois, the first occurrence of these two species is in the Abbott Formation of the McCormick group.

While the overall comparison between 64 O-T and 42 A-F seems reasonable in terms of a correlation, the flint clay sample of 42-C and 64-Q leave something to be desired. The flint clay of 42-C was hard, brown, and in all ways seemed to me to be lithologically what I would expect for the flint clay. The flint clay of 64-Q was soft, in part gray, in part light to medium brown, and appeared lithologically related to an underclay. In order to explore this matter further, the flint clay of USGS DDH 6 at 220.0'-220.3' has been prepared as maceration 68-A and will be reported upon at a later date.

A comparison has been made between 24 J-L, Seiders' Fire Clay coal from Carrie Quadrangle, and 42 A-F. There are 19 genera common to both sets of samples while 42 A-F has Savitrisporites (Callisporites) and Knoxisporites which are absent in 24 J-L. Stellisporites is present in 24 J-L and not present in 42 A-F. Both sets of samples have spores 136, 298, and 490.

The abundance ratios, Chart 2 of this report compared with Chart 2 of my previous report shows Lycospora is the overall dominant genus in both sets of samples, but 24 J-L does not possess Densosporites or Cristatisporites in the same abundance as 42 A-F. If one were to conclude that 24 J-L represented only the portion of the Fire Clay coal above the flint clay, the abundance ratios would compare reasonably well. In favor of such an idea would be the occurrence of Savitrisporites and Knoxisporites below the flint clay in 42 A-F, and their absence in 24 J-K. But by the same reasoning, Convolutispora, Crassispora, Cristatisporites, Dictyotriletes, Reticulatisporites, and spore 298 should be absent from 24 J-K, and they are present. Because of this, the comparison between the two sets of samples is based on all segment samples between the two areas.

The preservation of spores and pollen of maceration 24 J-L is not as good as for 42 A-F, and only 67 species have been identified from 24 J-L. Fifty of these 67 species occur in 42 A-F. Of the fifty species common to both 24 J-L and 42 A-F, only species 493 appears to be restricted to the Fire Clay coal. Four other species that occur only in the Fire Clay Rider and Fire Clay coals are present and are 320, 459, 503, and 528. Three species which appear to terminate in the Fire Clay coal are present while four species which appear to originate in the Fire Clay coal are present in both sets of samples including species 103 already discussed. I will have to conclude that 24 J-L and 42 A-F are related on the basis of the species discussed,

but the evidence is not nearly as good as for the other correlations mentioned. Unfortunately, I have not examined other samples of the Fire Clay rider and Fire Clay coals from the Hazard Reserve District and have been forced to use the samples from the Carrie Quadrangle.

Coals Below the Fire Clay Coal

There is a significant break between the Fire Clay and Little Fire Clay coals, 64 O-T and 64 V-W, on the species level in that 34 species occur in one but not the other of these two coals. These occurrences are largely in the Fire Clay coal so that the distinction is not nearly so clear cut. Five species appear to be restricted to the Fire Clay and Little Fire Clay coals indicating a relationship between these two coals. Only 14 genera have been identified from the Little Fire Clay coal (64 V-W) and all of these are present in the Fire Clay coal (64 O-T). All that can be said so far is that differences exist and whether or not additional samples will substantiate these findings or not I do not know.

Based on abundance, certainly Densosporites is at least co-dominant with Lycospora and this dominance of Densosporites occurs in the bottom of the Little Fire Clay coal (64 V-W) rather than in the top as in the Fire Clay coal (64 O-T).

The two coals from your Whitesburg zone, 64 Y-Z at 229.0'-230.7' and 64 BB-CC at 243.2'-243.9' clearly can be distinguished from each other based on abundance ratios, species content, and to some extent on generic occurrence. Certainly, Lycospora is the dominant in 64 Y-Z while in 64 BB, Granulatisporites, Laevigatisporites, Lycospora, and Punctatisporites share dominance. This diversification of numerically important genera in 64 BB also occurs in the coal at 624.7'-627.7' in USGS DDH 8, but the similarity appears to be more apparent than real. Further, in 64-BB there are several species, especially 856, that have not been encountered elsewhere. Species 856 occurs at the rate of 4.4 percent and tentatively has been placed in Punctatisporites. Perhaps some of these problems may be resolved when macerations 65 A-C and 66 A-C, your collections of the Whitesburg coal from the type locality, are studied.

Megaspores

I had originally hoped to include a summary statement concerning the occurrence of megaspores in the coals discussed. Miss Noble has isolated and mounted these for me. I have identified the megaspores from macerations 1 A-K, and a rather nice assemblage is present. Only two segment samples of 64 F-N have been mounted to date so that whatever information we can obtain from an examination of the megaspores will have to be deferred for the present.

Robert M. Kosanke

Robert M. Kosanke

rmk

Charts 1, 2, and 3 attached.

REPORT ON REFERRED FOSSILS

P&S Branch, Denver Lab, U.S.G.S.
Bldg. 25, Federal Center, Denver, Colorado

Stratigraphic range: Pennsylvanian — Kinds of fossils: Spores & pollen

General locality: Kentucky — Quadrangle or area: Oil Springs quad.

Referred by: W. F. Outerbridge, 11/24/64 — Shipment No.: KG-64-33D
Regional Geology in Kentucky

Report prepared by: R. M. Kosanke, 5/19/65 — Date material received: 11/27/64

Status of work: Complete

Macerations 69 A-C - roof shale, coal (Mine Fork coal of Adkison and Johnson), and fire clay from locality just north of the Irvine-Paint Creek fault in a road cut above Little Paint Creek (Lat. 37°51'23.5" N, Long. 82°56'41.8" W).

69-A roof shale
69-B 8" coal
69-C fire clay

Twenty-three genera and 43 species were identified from macerations 69 A-C. Preservation of spores and pollen is reasonably good in 69 A-B, but rather poor in 69-C. An exhaustive examination of these samples probably would delineate the presence of several new species. The basis for this statement is the presence of these forms as single occurrences.

Of significance for correlation purposes is the presence of Laevigatosporites in all three samples varying in abundance from less than 1 to more than 6 percent. Three species of Laevigatosporites are present. These three species are common to the Pennsylvanian and not known to occur in the Mississippian. Cropp (1963, Jour. Paleontology, v. 37, no. 4, p. 900-916) reported the oldest occurrence of Laevigatosporites in Pennsylvanian coals of Tennessee to be the Clifty coal although unpublished information indicated this genus might occur in the Sewanne coal. The Sewanne coal is just below the Clifty coal in the Whitwall shale. These coals are in the lower to middle part of the Crab Orchard Mountains Group of Wilson, Jewell, and Luther (1956, Tenn. Geol. Survey) or the Lee Formation of Wanless (1946, Geol. Soc. Mem. 13). Schulzospora, present on a more or less world-wide basis in the Late Mississippian and Early Pennsylvanian, is present in all three samples (69 A-C). Cropp (1963) reported Schulzospora present to the Morgan Springs coal just above the Clifty coal. Spencerisporites, a large spore, normally does not occur in the size fraction utilized for small spore studies, however, a specimen was observed in 69-A. Winslow (1959, Ill. Geol. Survey Bull. 86) reported Spencerisporites present to the base of the Pennsylvanian in Illinois and absent from the Mississippian.

The dominant genus in all three samples is Lycospora with species 440 and 423 most abundant. Lycospora attains a maximum abundance in the coal sample (69-B). Such an abundance of Lycospora in Early Pennsylvanian coals is not uncommon.

The evidence accumulated indicates the coal sample (69-B) is of Early Pennsylvanian age. From my experience in Illinois and Cropp's (1963) data from Tennessee, the coal sample is low in the section, but not necessarily at the base of the Pennsylvanian.

I am including a generic summary because it is an excellent example of the differences that sometimes can occur between fire clay, coal, and roof samples, and why care must be taken in the collection of samples for palynological analysis. I would like to call your attention to the abundance of Camptotriletes in 69-A and its absence in 69 B-C. Only one species of this genus is present and it resembles C. superbus Neves, 1961 that Neves reported from the Namurian B, C, and into the Westphalian of England. Similarly, Savitrisporites nux (Butterworth and Williams) Sullivan, 1964 occurs rather consistently in 69-A, is absent in 69-B, and present in 69-C. I have observed S. nux from just below the Mississippian-Pennsylvanian boundary to the Middle Pennsylvanian.

GENUS	69-A	69-B	69-C
AHRENSISPORITES	1.2		
CALAMOSPORA	+	+	.4
CAMPTOTRILETES	14.4		
CIRRATRIRADITES	+		.4
CONVOLUTISPORA	.8	+	
CRASSISPORA		.4	.4
CRISTATISPORITES	.4	.4	2.8
DENSOSPORITES	3.6	.8	6.0
ENDOSPORITES	.4	+	.8
FLORINITES			.8
GRANULATISPORITES	25.6	+	12.4
KNOXISPORITES	.4	+	
LAEVIGATOSPORITES	6.4	4.0	.8
LYCOSPORA	38.0	94.4	66.4
PUNCTATISPORITES	2.4	+	1.6
RAISTRICKIA	.4	+	
RETICULATISPORITES	.8	+	
SAVITRISPORITES	4.8		+
SCHULZOSPORA	+	+	.4
SIMOZONOTRILETES		-	+
SPENCERISPORITES	.4		
TRIQUITRITES	+		
WILSONITES			.8
MONOSACCATES (poorly preserved)			6.0
	100.0%	100.0%	100.0%

+ = present but not observed in statistical count. 750 specimens counted.

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P&S Branch, Denver Lab, U.S.G.S.
Bldg. 25, Federal Center, Denver, Colorado

Stratigraphic range: Pennsylvanian

Kinds of fossils: Spores & pollen

General locality: Kentucky

Quadrangle or area: Milo quad.

Referred by: W. F. Outerbridge and E. C. Jenkins, 3/10/64

Shipment No.: KG-64-10D
Regional Geology in Kentucky

Report prepared by: Robert M. Kosanke, 7/19/65

Date material received: 3/23/64

Status of work: Incomplete

Macerations 71 A-K - coal, shale, and clay from the type locality of the Peach Orchard coal, Milo Quadrangle on the south side of the left fork of Nats Creek, Lat. 37°56'38" N., Long. 82°36'11.6" W. at an elevation of 760 at the base of main seam.

71-A	3 5/8" clay
71-B	9 5/8" coal
71-C	3 5/8" clay
	30' of Ss. and Sh. no sample
71-D	"roof clay", no thickness reported
71-E	2 3/8" coal
71-F	2 3/8" clay
71-G	2 3/8" coal
	7 3/8" claystone not sampled
71-H	1'6" Sh., black
	4'6" claystone not sampled
71-I	2' coal
71-J	2' coal
71-K	underclay, thickness not reported

- - -

SUMMARY

I definitely believe these samples of the Peach Orchard coal have a relationship with the Francis coal of the Hazard Reserve District rather than to the Hazard No. 7 coal.

- - -

Non-coal samples 71-A, 71-C, and 71-H did not yield a sufficient number of well preserved specimens to warrant anything more than reporting the occurrence of identifiable genera (see chart 1 and table 1). The balance of the samples yielded spores in reasonable abundance although in samples 71-B and 71-K some of the specimens were corroded or thin. This was especially true of the monosaccate genera Endosporites, Florinites, and Wilsonites. Specimens that definitely were monosaccate but could not be assigned to one of these genera were placed in the monosaccate category in chart 1 and table 1.

The Peach Orchard coal generically is characterized by an abundance of Lycospora, Laevigatosporites, and Densosporites listed in the order of their numerical importance. The Francis coal from the type locality and from two additional localities in the Hazard Reserve District is characterized by these three genera and displaying essentially the same abundance pattern. I would like to call your attention to my report of March 4, 1964 to Victor M. Seiders concerning the Francis coal from Carrie and Hazard North quadrangles.

Laevigatosporites and Densosporites are the dominant genera of the Hazard No. 7 coal from the type locality and one additional locality in the Hazard Reserve District. Lycospora is very poorly represented in the Hazard No. 7 coal when compared to the Francis coal. Thus, on the basis of generic abundance, the Hazard No. 7 and the Peach Orchard coals do not compare favorably. See my report of 12/16/63 on the Hazard No. 7 coal from the Hazard Reserve District. This report was prepared for Victor M. Seiders and Willard P. Puffett.

Before making species comparisons, I should point out that since my report to Seiders was prepared on the Francis coal, certain generic nomenclatural changes have been published. Certain taxa of the genus Densosporites have been separated out of that genus. For the purposes of this report, Radiizonates and Cristatisporites are included within Densosporites. As a result, a direct comparison may be made between this report and those of the Hazard No. 7 and Francis coals.

Callisporites was reported as occurring in one of the Francis coal samples. Sullivan (1964) reported this genus to be conspecific with an older genus Savitrisporites and so transferred Callisporites to Savitrisporites. Subsequently, Marshall and Smith (1965) described a new species of Savitrisporites which is conspecific with my species 298 that I had classified with all other taxa in my Francis coal report. Thus, Callisporites and species 298 of my earlier reports now appears as Savitrisporites.

Reinschospora appears in the data on the Peach Orchard coal and the identical species was present in the Francis coal (maceration 6) and classified under all other taxa because only one specimen was observed. Knoxisporites appears in the data on the Peach Orchard coal and a specimen of this genus was present in the Francis coal (maceration 6) and classified under all other taxa. A specimen assignable to Ahrensisporites was reported for one sample of the Francis coal but none have been observed in the Peach Orchard coal.

A comment should be offered concerning generic abundance. The overall abundance ratios reported for the Peach Orchard and Francis coal samples are quite similar, but not precisely identical. One should not expect precise similarity as a result of inherent vegetational differences between areas. I also believe part of the differences can be attributed to the sample intervals.

A total of 104 species have been identified from the Peach Orchard coal of which 99 are known to occur in the Francis coal. Forty-three of these species are known to occur in the Hazard No. 7 coal. Some of the remaining 56 species appear to be restricted to the Francis coal while others occur in the Francis and younger coals. Admittedly, the evidence for a correlation between the Peach Orchard and Francis coals is justifiable based on the species occurrences. It should be pointed out that more species were identified from the three samples of the Francis coal than from one sample of the Peach Orchard coal.

All evidence considered, that is generic abundance and occurrence, and species occurrence suggests a definite relationship between the Peach Orchard and the Francis coals.

Because the section of the Peach Orchard coal is interrupted by lithologic changes indicated by partings of clay, shale, and perhaps more importantly black shale, the idea that more than one coal might be represented was considered. However, the species content of coal samples 71-B, 71-E, and 71-G do not differ drastically from 71-I and 71-J except in minor instances. Then too, lithologic partings are common to the Francis coal.

Robert M. Kosanke

Robert M. Kosanke

RMK

TABLE 1

GENERIC SUMMARY OF THE SMALL SPORES OF THE PEACH ORCHARD COAL FROM THE TYPE LOCALITY

Milo Quadrangle on south side of the left fork of Nats Creek, just above BM 613 at Lat.37°56'38"N., Lon. 82°36'11.6" W. at an elevation of 760 feet at base of main seam

	71-A	71-B	71-C	71-D	71-E	71-F	71-G	71-H	71-I	71-J	71-K
ALATISPORITES									+		
CALAMOSPORA	+	6.8	+	3.6	1.6	2.0	5.6	+	.8	3.2	
CIRRATRIRADITES		1.2		.8	+				.8	.4	+
CONVOLUTISPORA		.4	+	+							
CRASSISPORA		.4		4.0	1.2	+			.8	.4	+
DENSOSPORITES		+		2.0	5.6	+	.4	+	32.8	.4	1.2
DICTYOTRILETES											+
ENDOSPORITES		.8		.8	3.2	15.2	2.8		6.4	2.0	+
FLORINITES	+	12.4		1.2	2.0	3.2	.4	+		.4	+
FOVEOLATISPORITES				1.6	+	.4	+		+		.8
GRANULATISPORITES	+	1.6	+	5.2	6.8	10.8	3.6	+	4.4	2.4	11.6
KNOXISPORITES				.4		.4			+	+	
LAEVIGATOSPORITES	+	29.2	+	14.4	10.0	9.6	19.6	+	27.2	6.4	11.2
LYCOSPORA	+	29.2	+	53.2	62.0	46.4	61.6	+	16.8	83.2	68.4
MUROSPORA					+	.4					
PUNCTATISPORITES	+	5.2	+	4.4	.8	.4	2.8	+	4.4	+	.4
RAISTRICKIA	+	2.4	+	.4	.4	+			+	+	+
REINSCHOSPORA					.4						
RETICULATISPORITES		+					+		2.0		.4
SAVITRISPORITES					2.8						+
TRIQUITRITES	+	.8		3.2		4.4	.4		.4	+	.8
VESTISPORA	+	2.0		2.4	2.8	1.2	2.8		+	.4	+
WILSONITES	+	2.0	+	1.6	.4	+	+		3.2	.8	2.4
MONOSACCATE		5.6									2.4
ALL OTHER TAXA				.8	+	+	+		+		.4
		100.0%		100.0%	100.0%	100.0%	100.0%		100.0%	100.0%	100.0%

+ = present but not observed in statistical count, 2000 specimens counted. No statistical counted attempted in 71-A, 71-C, and 71-H.

71-A = 3 5/8" clay
71-B = 9 5/8" coal
71-C = 3 5/8" clay
71-D = "roof" clay
71-E = 2 3/8" coal
71-F = 2 3/8" clay
71-G = 2 3/8" coal
71-H = 1'6" Bl. Sh.
71-I = 2' coal
71-J = 2' coal
71-K = underclay

REPORT ON REFERRED FOSSILS

P&S Branch, Denver Lab, U.S.G. S.
Bldg. 25, Federal Center, Denver, Colo.

Stratigraphic range: Pennsylvanian.

Kinds of fossils: Spores and pollen.

General locality: Kentucky.

Quadrangle or area: Offutt quadrangle.

Referred by: W. F. Outerbridge and E. C. Jenkins, 3/10/64

Shipment No.: KG-64-10D - Regional Geology in Kentucky

Report prepared by: Robert M. Kosanke, 8/24/65

Date material received: 3/23/64

Status of work: Incomplete.

Macerations 72 A-E - coal, shale, and underclay from the type locality of the Broas coal (Outerbridge), Offutt Quad. at the head of Right Fork of Greasy Creek on a nose SSE of BM 895 at Lat. 37°47'05" N., Long. 82°40'75" W. at an elevation of 995' to the base of the coal.

72-A 1' coal, weathered
72-B 4 7/8" shale, claystone, carbonaceous
72-C = 2'4 7/8" top half of weathered coal
72-D bottom half of weathered coal
72-E underclay, sandy, thickness not reported

All samples yielded sufficient specimens to permit analyses although a number of spores observed from the coal samples were thin or corroded. This was most obvious in the case of spores assigned to Lycospora, Densosporites, Radiizonates, and saccate spores and pollen. It is interesting to note that despite the lack of really good preservation in many instances, 26 genera and 77 species were identified.

The Broas coal generically is characterized by a dominance of Laevigatosporites in all samples, see table 1. In the underclay, Laevigatosporites and Lycospora are essentially of equal dominance. Only Radiizonates other than Laevigatosporites occurs at the rate of more than 10 percent in the coal samples and this is restricted to 72-C and 72-D. Radiizonates formerly was classified with Densosporites. By combining the percentages of these two genera, a direct comparison may be made with previous reports. The generic abundance ratios of the Broas coal samples are vastly different than those reported for the Peach Orchard coal samples in my last report. This is the result of the overwhelming abundance of two species of Laevigatosporites in the Broas coal (L. minutus and L. globosus). Both of these species are present in the Peach Orchard coal but represent only a small percentage of the total spore and pollen assemblage. A total of 41 species present in the Broas coal also occur in the Peach Orchard coal. The genus Torispora, which in this case is basically Laevigatosporites with an unusual thickening, is not reported as present in the Broas coal although the suggestion of such a thickening is present on some specimens of Laevigatosporites. Torispora definitely does occur in the partings of the Richardson coal and in the unnamed coal above the Richardson, the highest coal that outcrops in the Offutt quadrangle.

One of the most interesting features of the Broas coal is the occurrence of some unusual microfossils in 72-B, the parting in the upper one-third of the coal. These microfossils must be related to Schizocystia and Horologinella which were originally described from Cretaceous and Tertiary rocks of Australia by Cookson and Eisenack in 1962. R. H. Tschudy of our Denver laboratory has observed these microfossils from similar age rocks of United States. Morphologically, I believe the specimens observed from 72-B could be related to the Chlorophyta, the green algae. If so, there would be no reason why they should not occur in the Paleozoic although they have not been reported present below the Cretaceous.

I am not able to establish a correlation between the Broas coal and any of the coals previously examined from the Hazard Reserve District. As indicated, the preservation of spores and pollen of the Broas coal leave something to be desired. Similarly in the Hazard Reserve District, the spores and pollen of the Hindman coal are poorly preserved only to a much greater degree. So much so that a meaningful palynological analysis is impossible. I have reference to a sample of the Hindman coal from the Hazard S. Quad., Leslie County, and to a coal thought to be the Hindman occurring between 345.8'-350.9' in the U.S.G.S. DDH 5. The condition of the spores and pollen from the DDH is somewhat better than those from the outcrop sample, but they are not abundant. The limited number of spores and pollen observed from the DDH samples are compatible with those of the Broas coal, but I do not have enough evidence for a correlation.

RHT

Robert M. Kosanke

Robert M. Kosanke

GENERIC SUMMARY OF THE SMALL SPORES FROM THE TYPE LOCALITY OF THE BROAS COAL

Macerations 72 A-E, sample from head of Right Fork of Greasy Creek on a nose SSE of BM 895 at Lat. 37°47'05"N., Lon. 82°40'15.5"W. at an elevation of 995 at base of coal, Offutt Quad., Kentucky

	72-A	72-B	72-C	72-D	72-E
ALATISPORITES	+	.8	1.2		
CALAMOSPORA	.4	.8	.4	+	.8
CIRRATRIRADITES	+		.4	+	+
CONVOLUTISPORA	+			.4	
CRASSISPORA	+				+
CRISTATISPORITES					+
DENSOSPORITES	.8	.8	6.0	8.0	2.0
DICTYOTRILETES					+
ENDOSPORITES			+	+	1.2
FLORINITES	+	2.0	.8	+	1.2
FOVEOLATISPORITES	+				
GRANULATISPORITES	.8	1.2	2.4	1.6	6.4
KNOXISPORITES		+			
LAEVIGATOSPORITES	95.6	68.8	69.6	73.6	40.0
LYCOSPORA	.8	2.0	2.0	5.2	38.4
MUROSPORA				?	
PUNCTATISPORITES	.8	3.2	1.6	+	2.4
RADIIZONATES	+	.8	15.2	11.2	1.6
RAISTRICKIA	+		+		+
REINSCHOSPORA	+				
RENISPORITES		+	+		
RETICULATISPORITES	+	.8			
SAVITRISPORITES				+	
TRIQUITRITES	+	4.8	.4		1.6
VESTISPORA					+
WILSONITES	.4	1.2		+	1.6
MONOSACCATE		10.4			2.8
ALL OTHER TAXA	.4	2.4	+	+	
	100.0%	100.0%	100.0%	100.0%	100.0%

Maceration 72-A = 1.0' coal, weathered
" " " 72-B = 0.4' shale, claystone, carbonaceous
" " " 72-C = 2.4' top, coal and bone, weathered
" " " 72-D bottom, coal and bone, weathered
" " " 72-E (no thickness given) underclay, sandy

+ = present but not observed in statistical count. A total of 1,250 specimens counted in macerations 72 A-E.

REPORT ON REFERRED FOSSILS

P&S Branch, Denver Lab, U.S.G.S.
Bldg. 25, Federal Center, Denver, Colo.

Stratigraphic range: Pennsylvanian

Kinds of fossils: Spores and pollen

General locality: Kentucky

Quadrangle or area: Whitesburg and Jenkins West quads.

Referred by: Donald C. Alvord, 7/21/64

Shipment No.: KG-64-24D
Regional Geology in Kentucky

Report prepared by: Robert M. Kosanke, 10/15/65

Date material received: 7/31/64

Status of work: Incomplete

Macerations 65 A-C Type locality of Whitesburg coal, 4000' S-SE of Whitesburg, Kentucky at head of Johnson House Branch of Little Cowan Creek, Whitesburg quad. These are your W-2 samples.

Macerations 66 A-C Type locality of Whitesburg coal located 150' west of above samples. These are your W-3 samples.

Macerations 82 A-E and 82 L-Y, samples of coal, shale, and clay from U.S.G.S. DDH 6, I83, 13625' FSL, 3250' FWL, between head of Tom Biggs Branch and unnamed branch of Elkhorn Creek, Jenkins West Quad., Letcher County, Kentucky.

82 L-R = 159'2 3/8"-162'1½"
82-S = 212'6"-213'3"
82 T-Y = 217'2 3/8"-221'3"
82 A-C = 262.0"-265'1 3/16"
82-D = 271'8 3/8"-272'6"
82-E = 278'8 3/8"-279'3 5/8"

Three of the 25 macerations failed to yield well preserved spores and are 82-M, 82-T, and 82-Y. No attempt was made to run a statistical analysis of 82-M, but analyses were run for 82-T and 82-Y. It is possible that the genus Lycospora is under represented in 82-Y judging by the condition of the spores.

TYPE WHITESBURG COAL

Both of your samples sets were examined in detail (see Table 1 and Chart 1), and a rich and varied spore flora is reported. Twenty-three genera, 82 species, and spore 490 occur in these two sets of samples. Three minor discrepancies are noted between 65 A-C and 66 A-C. These are the presence of Crassispora and Knoxisporites in the 65 maceration series and Renisporites in the 66 maceration series. Renisporites is a large spore and could be present in the plus residue (+210 microns), but this has not been investigated.

Statistically, the two sets of samples compare well as shown in Table 1. It should be noted that Densosporites reported for 65-A is relatively low and Lycospora for this same sample is high when compared with 66-A. This could be related to the fact that equivalent intervals are not represented. In any event, I am using 66 A-C as the type reference to the Whitesburg coal because it is the thicker of the two sections. Chart 1 shows that Densosporites is the dominant genus for the coal. D. 373 is the most abundant species. Four other genera are numerically significant since they attain a minimum of the 10 percent level in one or more of these samples. These genera are Cristatisporites (66-A), Granulatisporites (66-C), Lycospora (66 A-B), and Laevigatosporites (66 A-C).

Three species of minor numerical significance that are emerging as possible guide fossils because of consistent occurrence are Savitrisporites 298, Reticulatisporites 390, and spore 490. Spore 490 may be conspecific with Sinuspores Artuz 1957. Artuz reported this genus from Westphalian A coals of Turkey. Reticulatisporites 390 possibly is conspecific with Dictyotriletes cf. clatriformus (Artuz) Sullivan. Sullivan's material is from Lower Westphalian A. Savitrisporites 298 is conspecific with S. nux (Butterworth and Williams) Sullivan.

In eastern Kentucky, I have observed Savitrisporites 298 from the Whitesburg coal to and including the Francis coal. Reticulatisporites 390 and spore 490 have been observed from the Whitesburg coal to maceration 64 A-B in DDH 2. Control for the delineation of the range zones of these species is not perfect. Probably the upper limit of these range zones is better known. In DDH 6, these three species have not been observed in 82-D, 82-E, and a cursory examination of 82 F-K for spore 490 has proved negative. Based on the known distribution of Savitrisporites nux from other areas, I expect we will find it lower in the section in Kentucky when we work these coals. In DDH 2, these three species were found down to 64 O-T. In the 65-66 maceration series these species were found in the following samples:

		Species
		298, 390, 490
Samples	A	X X X
	B	X X X
	C	X X

The coal in DDH 6 occurring between 262'0" and 265'1 3/16" (82 A-C) is a close match to the Whitesburg coal in generic occurrence, abundance, and species content. Twenty-two of the 23 genera present in the Whitesburg coal are present in 82 A-C as well as spore 490. Only Knoxisporites is absent from 82 A-C and it is a minor member of the Whitesburg assemblage (65-C) and absent from 66 A-C. Statistically, 82 A-C is similar to the Whitesburg coal in that Densosporites is the dominant with D. 373 the most abundant species. Cristatisporites, Granulatisporites, and Laevigatosporites are present at the rate of 10 percent or more in an least one of these samples. Lycospora which is present in two samples of the Whitesburg coal (66 A-B) at the rate of 10.4 and 10.0 percent has a maximum of 6.4 percent in 82 A-C. Species 298, 390, and 490 occur in 82 A-C as follows:

		Species
		298, 390, 490
Samples	A	X X
	B	X X X
	C	X X

For additional data see Table 2 and Chart 1.

The two thin coals, macerations 82-D and 82-E, occurring below the Whitesburg coal (82 A-C) in DDH 6 at 271.8 3/8"-272!6" and 278'8 3/8"-279'3 5/8" exhibit a dominance of Laevigatosporites and Lycospora and lack species 298, 390, and 490. This assemblage is not characteristic of the Whitesburg coal at the type locality.

Initially, based on the sample collecting data in your letter of transmittal, and because I was considering 64 O-T representative of the Fire Clay coal (my report of 3/30/65), contamination of the type Whitesburg samples (65 A-C and 66 A-C) by the Fire Clay coal seemed plausible. However, the fact that analyses of 82 A-C from DDH 6 so closely approximate those of the Whitesburg type samples, I do not believe contamination is a factor to be considered further.

To this point, all is well with the Whitesburg coal so far as I am concerned. A problem does exist with the coal in DDH 8 occurring at 624.7'-627.7' represented by macerations 43 A-G. This coal certainly is in the Little Fire Clay - Whitesburg zone. When compared to the type Whitesburg coal on a generic basis a comparison is reasonable in that only Reinschospora and Renisporites are lacking both of thich are rare and not always present in the Whitesburg coal (65 A-C and 66 A-C). Statistically, 43 A-G is similar to the Whitesburg coal only to the extent that five genera are present at the rate of 10 percent in at least one sample. Densosporites is greatly reduced in abundance in 43 A-F, the coal portion of the sample, when compared to the Whitesburg coal and Laevigatosporites and Lycospora are dominant. Sixty-three species have been identified, but for the most part are not too helpful. Laevigatosporites 103 and 275 have not been observed as was the case with the Whitesburg coal. These species are present in 64 O-T of DDH 2. Species 298, 390, and 490 are present. Species 390 was classified under Reticulatisporites and 490 under all other taxa in my report of 7/29/64. About all I can do for you on this sample is to indicate it could be as old as the Whitesburg coal.

COAL BETWEEN 217-221 FEET IN DDH 6

This sample is represented by maceration numbers 82-T and 82-Y. These samples are characterized generically by a dominance of Lycospora above the flint clay-shale interval (82-W) with a modest abundance of Granulatisporites and Laevigatosporites. Below sample 82-W, Granulatisporites, Laevigatatosporites, and Lycospora share dominance with Densosporites increasing sharply in abundance and by sample 82-Y, Densosporites is dominant. This general overall picture may be viewed in chart 2, and the data is in table 3. This in general is somewhat comparable to the Fire Clay coal in U.S.G.S. DDH 8 with the coal top at 588.25'.

The data plotted for 82-W is the flint clay and associated shale and does not compare well in abundance with the flint clay of DDH 8 or maceration 42-C. An earlier maceration of only the flint clay of sample 82-W is 68-A. The differences in abundance between 82-W and 42-C are greatly reduced in 68-A. In 68-A, Punctatisporites is reduced to 6.4 percent and Lycospora is increased to 12.4 percent. This still leaves a considerable gap in the abundance of Lycospora, but Granulatisporites, Laevigatosporites, and Lycospora are the only genera in both sets of samples with more than 10 percent of the spore population.

Generically, 21 genera are present in both 82 T-Y and 42 A-F. In addition to these 21 genera, 82 T-Y contains both Foveolatisporites and Vestispora which were not observed in 42 A-F. Samples 42 A-F contain species 298, 390, and 490 while 298 and 490 are present in 82 T-Y.

In my report of 3/30/65 I correlated 64 F-N, 1 A-K, and 24 A-1 as the same coal based on palynological similarities under the name of the Fire Clay rider coal. Based on your correspondence, 24 A-I is considered merely a split of the Fire Clay coal in your area. Evidence to support your view concerning the proper name to be applied to these coals will be presented with the discussion of the next coal. However, before moving on to this subject, I would like to make it clear that the distinctions previously cited between the Fire Clay and Fire Clay rider coals must of necessity be applied to differences between portions of the Fire Clay coal either above the flint clay or splits in the top portion of the Fire Clay coal.

COAL BETWEEN 159'.2 3/8"-162'1½" IN DDH 6

This coal is represented by macerations 82 L-R, and I believe it is what you now consider to be the Fire Clay rider coal. Twenty-four genera are recognized including Simozonotriletes sensu Potonie and Kremp 1954. This genus has not been previously observed within the interval between the Kendrick shale and the Magoffin beds although a limited number of specimens have been observed above in the Hazard No. 7 and Richardson coals. Simozonotriletes has a world-wide distribution ranging from the Mississippian through the Westphalian B. All of the specimens observed thus far in the Fire Clay rider coal are assignable to S. intortus (Waltz) Potonie and Kremp. The surprising feature of the presence of Simozonotriletes is not so much its occurrence, but that it is present at the rate of 3.2 per cent in 82-P. The analysis of this coal, table 4, and chart 3, also shows that Endosporites and Granulatisporites are present in greater numbers than I have previously reported for any coal in eastern Kentucky. Further, the following species are new: Punctatisporites 1015, 1034, and 1054. Reticulatisporites 1019, 1021, and 1031, Ahrensisporites 1025, Granulatisporites 1026, Lycospora 1056, and an unassigned spore 1050. Clearly the samples represented by 82 L-R are distinct and palynologically different from 64 F-N, 1A-K, and 24 A-I. For the record, I should report the presence of species 298, 390, and 490.

Robert M. Kosanke

Robert M. Kosanke

Table 1-4 attached
Charts 1, 2, and 3 attached

TABLE 1

GENERIC SUMMARY OF THE SMALL SPORES FROM THE TYPE LOCALITY OF THE WHITESBURG COAL
Macerations 65 A-C, 4000' S-SE of Whitesburg at head of Johnson House Branch of Little Cowan Creek, Whitesburg Quad., Ky. Macerations 66 A-C: 150' west of Macerations 65 A-C.

	65-A	65-B	65-C	66-A	66-B	66-C
AHRENSISPORITES	.8	+		+	+	+
ALATISPORITES	+	+		+	+	
CALAMOSPORA	+	1.2	2.0	2.4	.4	.4
CIRRATRIRADITES	.4	.4	.4	+	+	.8
CONVOLUTISPORA	+	.4		+	+	+
CRASSISPORA	.8					
CRISTATISPORITES	21.2	.4	1.2	19.6	2.4	.8
DENSOSPORITES	17.6	52.0	55.6	45.2	46.0	54.0
DICTYOTRILETES	1.6	+	1.6	+	2.8	.4
ENDOSPORITES	1.6	2.4	2.4	.8	3.2	
FLORINITES	1.6	2.4	.8	+	1.2	.4
GRANULATISPORITES	8.4	3.2	.8	2.0	3.2	16.0
KNOXISPORITES			+			
LAEVIGATOSPORITES	14.4	27.2	22.0	17.2	25.2	18.8
LYCOSPORA	26.8	8.8	11.6	10.0	10.4	6.0
PUNCTATISPORITES	2.0	.8	.8	1.2	2.8	.8
RAISTRICKIA	.8	.4	+	.8	.8	.4
REINSCHOSPORA	+	+		+	.4	
RENISPORITES				+		
RETICULATISPORITES	+	+		+	+	
SAVITRISPORITES		+	+	.4	+	.4
TRQUITRITES	.4	+		+		
WILSONITES	.4	+	.4	+	1.2	.4
SPORE 490		.4	.4	+	+	.4
ALL OTHER TAXA	1.2	+		.4	+	+
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Maceration 65-A = 1' coal
" " " 65-B = 1' coal
" " " 65-C = 1' coal (concealed below)

Maceration 66-A = 1' coal
" " " 66-B = 2' coal
" " " 66-C = 2'0½" coal

+ = present but not observed in statistical count. A total of 1,500 specimens counted in macerations 65 and 66.

TABLE 2

GENERIC SUMMARY OF THE SMALL SPORES FROM U.S.G.S. DDH 6

Macerations A-E, I83, 13625' FSL, 3250' FWL, between head of Tom Biggs Branch and unnamed branch of Elkhorn Creek, Jenkins West Quad., Letcher County, Kentucky.

	82-A	82-B	82-C	82-D	82-E
AHRENSISPORITES	+	.4			4
ALATISPORITES	+	.4	+	+	+
CALAMOSPORA	1.6	+	1.2	3.6	7.2
CIRRATRIRADITES	+	+	.8		2.0
CONVOLUTISPORA	+	+	.4		
CRASSISPORA			+		+
CRISTATISPORITES	9.6	10.0	.4		
DENSOSPORITES	37.2	43.6	38.4	+	2.0
DICTYOTRILETES	+	.8	+	1.2	
ENDOSPORITES	+	2.8	2.4	.8	.4
FLORINITES	.4	.8	2.4	2.4	1.2
GRANULATISPORITES	14.0	1.2	28.4	7.2	5.2
LAEVIGATOSPORITES	28.4	29.6	17.2	36.0	28.8
LYCOSPORA	6.4	6.0	2.0	44.8	46.4
PUNCTATISPORITES	.8		.8	2.4	1.2
RAISTRICKIA	+	+	.8	.4	.4
REINSCHOSPORA		.4			
RENISPORITES		+		+	+
RETICULATISPORITES	+	.4	+	.4	.8
SAVITRISPORITES	+		1.2		
TRIQUITRITES		+		+	
VESTISPORA				+	
WILSONITES	.4	.8	.8	.8	.8
SPORE 490	+	+	+		
MONSACCATES			2.8	+	2.8
ALL OTHER TAXA	1.2	..8	+	+	.4
	100.0%	100.0%	100.0%	100.0%	100.0%

Maceration 82 A-C, 262.0-265.1'
82-A = 1.0' coal, bright
82-B = 1.0' coal, bright
82-C = 1.1' coal, as above with a 1¼" durain band
Maceration 82-D, 271.7-272.5'
82-D = 0.8' coal with 7/16" shale excluded from sample
Maceration 82-E, 278.7-279.3'
82-E = 0.6' coal

+ = present but not observed in statistical count. A total of 1,250 specimens counted in macerations 82 A-E.

TABLE 3

GENERIC SUMMARY OF THE SMALL SPORES FROM U.S.G.S. DDH 6

Macerations 82 S-Y, I83, 13625' FSL, 3250' FWL, between head of Tom Biggs Branch and unnamed branch of Elkhorn Creek, Jenkins West Quad., Letcher County, Kentucky.

	82-S	82-T	82-U	82-V	82-W	82-X	82-Y
AHRENSISPORITES		.4	.8	.4	+	.4	.8
ALATISPORITES			+		+	+	+
CALAMOSPORA	2.4	+	1.6	2.0	4.0	1.2	+
CIRRATRIRADITES	+		.8	.8	+	+	+
CONVOLUTISPORA				+	?	+	.4
CRASSISPORA						2.0	
CRISTATISPORITES	+			+	+	2.4	2.0
DENSOSPORITES	13.6		+		+	14.4	58.8
DICTYOTRILETES	+	.4	3.6		+	+	+
ENDOSPORITES	5.6	1.2	1.2	4.8	.4	.4	+
FLORINITES	2.4	+	1.6	+	1.2	.8	
FOVEOLATISPORITES				+	2.0		
GRANULATISPORITES	2.8	15.6	24.4	4.4	29.6	22.4	8.4
KNOXISPORITES	+					+	
LAEVIGATOSPORITES	8.0	15.6	15.2	19.2	36.8	28.4	16.0
LYCOSPORA	61.6	64.4	45.2	66.4	1.2	22.8	6.4
PUNCTATISPORITES	1.2	.8	3.2	1.6	14.4	1.6	.4
RAISTRICKIA			1.2	+	.4	.8	.4
RETICULATISPORITES		+	+	.4	.4	.4	+
SAVITRISPORITES			+		+	1.2	+
TRIQUITRITES		1.2	.4		.4	.4	+
VESTISPORA	+		+	+	4.0		
WILSONITES	.4	+	+	+	.4	.4	+
SPORE 490		+	+	?		+	.4
MONOSACCATES	2.0	.4	.8		4.8		5.6
ALL OTHER TAXA	+		+	+	+	+	.4
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Maceration 82-S, 212'6"-213'3", 9" coal with some bone
Maceration 82-T to 82-Y, 217'2 3/8"-221'3"
82-T = 1'1" coal
82-U = 1' coal, in part core broken
82-V = 5 1/8" coal
82-W = 4" shale and flint clay
82-X = 11 1/2" coal
82-Y = 3" coal, canneloid

+ = present but not observed in statistical count. A total of 1,750 specimens counted in macerations 82 S-Y.

TABLE 4

GENERIC SUMMARY OF THE SMALL SPORES FROM U.S.G.S. DDH 6

Macerations 82 L-R, I83, 13625' FSL, 3250' FWL, between head of Tom Biggs Branch and unnamed branch of Elkhorn Creek, Jenkins West Quad., Letcher County, Kentucky.

	82-L	82-M	82-N	82-O	82-P	82-Q	82-R
AHRENSISPORITES		+	+		.4		
ALATISPORITES							+
CALAMOSPORA	2.4	+	3.2	.4	.4	.8	2.0
CIRRATRIRADITES		+	.8	.4		.4	.4
CONVOLUTISPORA			+	+	.4		+
CRASSISPORA	+		2.8			1.2	1.6
CRISTATISPORITES			+		7.2	.8	.8
DENSOSPORITES	+		1.2	29.2	59.2	+	5.6
DICTYOTRILETES							
ENDOSPORITES	15.2		13.6	.4	.4	+	.4
FOVEOLATISPORITES			+	.4			
FLORINITES	.8	+	1.6	.4	+	2.8	+
GRANULATISPORITES	.8	+	2.0	11.2	3.2	39.2	2.4
KNOXISPORITES				1.6	+		+
LAEVIGATOSPORITES	13.6	+	15.2	7.2	9.6	25.2	26.8
LYCOSPORA	61.2	+	52.8	37.6	7.6	24.4	55.2
PUNCTATISPORITES	3.2	+	3.2	+	4.0	2.8	.4
RAISTRICKIA	+	+	.8	+	.8	.4	+
RETICULATISPORITES	.4	+	+	.4	1.2	+	.8
SAVITRISPORITES		+	.4	.8	.4		
SIMOZONOTRILETES					3.2		
STELLISPORITES			.4				
TRIQUITRITES		+		1.2	1.6	1.2	+
VESTISPORA	1.2		.8				
WILSONITES	1.2	+	1.2	3.6	.4	.4	.8
SPORE 490					+		
MONOSACCATES				5.2			2.8
ALL OTHER TAXA	+			+	+	.4	+
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Maceration 82-L to82-R, 159'2 3/8" - 162'1½"
82-L = 3 5/8" coal, badly broken core
82-M = 1" coal, bone
82-N = 4" coal
82-O = 1" clay-shale
82-P = 1' coal
82-Q = 1'1¼" coal
82-R = ¼" shale and coal interlayered

+ = present but not observed in statistical count. A total of 1,500 specimens counted in maceration 82 L-R.

REPORT ON REFERRED FOSSILS

P&S Branch, Denver Lab, U.S.G.S.
Bldg. 25, Federal Center, Denver, Colo.

Stratigraphic range: Pennsylvanian — Kinds of fossils: Spores and pollen

General locality: Kentucky — Quadrangle or area: Milo and Offutt quads.

Referred by: W. F. Outerbridge and E. C. Jenkins, 3/10/64 — Shipment No.: KG-64-10D Kentucky Geology Branch

Report prepared by: Robert M. Kosanke, 12/8/65 — Date material received: 3/23/64

Status of work: Complete

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73 A-C - coal and clay from the upper bench of the Richardson coal at the type locality located SSW of gap labeled 1030 at Lat. 37°58'08.7"N., Lon.82°37'54.8" W. at an elevation of 1010 feet at base of coal, Milo quad., Kentucky.

73-A 0.5' clay, semiflint
73-B 1.4' coal
73-C 0.3' underclay

74 A-I - coal and clay from the lower bench of the Richardson coal at the type locality located ESE of gap labeled 1030 at Lat. 37°58'11.3"N., Lon. 82°36'01.2" W, at an elevation of 975 feet at the base, Milo quad., Kentucky.

74-A 0.4' coal and clay
2.3' clay not sampled
74-B 0.1' clay, roof of coal
74-C 0.8' coal, 0.1' clay, 0.3' clay, semiflint
74-D 0.15' coal, 0.1' clay
74-E 0.9' coal, 0.1' clay
74-F 0.5' coal, 0.6' clay
74-G 1.35' roof clay, sandy
74-H 1.2' coal
74-I 0.8' coal
ganister below, not sampled

75 A-B - coal and underclay of unnamed coal above the Richardson coal located in road cut on ridge crest south of BM 1171 at Lat. 37°46'59.1"N, Lon. 82°39'27.1"W, at an altitude of 1233 feet. This is reported to be the highest outcrop coal in Offutt quadrangle.

75-A ca. 2' coal bloom, top not observed.
75-B underclay, no thickness reported

Four of these 14 samples failed to yield either abundant or well preserved spores. Because of this, statistical counts were not attempted for 73 A-C and 75-B. Despite the fact that all of the samples of the upper bench of the Richardson coal were in this category, possibly some significant data has been accumulated relative to species content.

RICHARDSON COAL

Spores and pollen were not abundant or well preserved in the clay, upper bench of the Richardson coal, and underclay (73 A-C). Sixteen genera and 28 species were identified. The genera occurring in this sequence are shown in table 1. The coal is characterized by the occurrence of Knoxisporites 904, a new species which occurs at the rate of approximately 4-5 specimens per slide. The other most commonly occurring species are Laevigatosporites 106 and 275 while Foveolatisporites 272 is well represented. Of these species only Knoxisporites 904 has potential value for correlation purposes.

The clay above the coal (73-A) yielded a very poor assemblage. However, Knoxisporites 904 is present as well as Simozonotriletes 906 along with a limited number of other species not significant for correlation purposes.

The underclay (73-C) contained a larger assemblage of species than either the coal (73-B) or the clay (73-A), but two less genera than the coal. Laevigatosporites, Triquitrites, and Torispora are the most important genera numerically.

The maceration series 74 A-I, containing the lower bench of the Richardson coal, consists of clay and coal (74 A-G), two feet of coal (74 H-I), with a ganister seat rock. All of the samples submitted for analysis yielded a sufficient number of specimens of spores and pollen grains for statistical analysis with 74-D especially good. Twenty-six genera have been identified as indicated in table 2. Laevigatosporites and Lycospora are dominant with their combined percentage varying from 60 to more than 84 percent. I consider the consistent occurrence of Torispora significant, as a matter of fact, Torispora is more abundant overall than Granulatisporites, Triquitrites, Florinites, and Punctatisporites. Whatever the cause for the development of Torispora (Laevigatosporites with abnormal thickenings), it was present during the formation of the Richardson coal and the unnamed coal (74-A) above the Richardson.

Eighty-two species are present in the lower bench of the Richardson coal sequence (74 A-I). Knoxisporites 904 occurs but is not numerically important. A new species of Laevigatosporites is present in both 74-F and 74-I, and occurs at the rate of 5.6 and .8 percent respectively. Two new species of Triquitrites occur throughout this maceration series, but are most abundant in 74-D, 74-E, and 74-I. These new species may prove to be important in subsequent correlation studies because they have not been observed below the Richardson coal or in the unnamed coal above the Richardson coal.

UNNAMED COAL

The unnamed coal (75-A) above the Richardson coal contains 17 genera with Lycospora clearly dominant as indicated in table 3. Next in numerical importance are Torispora, Florinites, and Laevigatosporites. The 16.4 percent reported for Torispora represents the highest abundance recorded for this taxon so far in Kentucky. The underclay (75-B) did not contain abundant or well preserved spores. Only 8 genera were identified, and all of these were present in the coal.

A total of 44 species were identified from the coal including 11 not present in the Richardson coal. Knoxisporites 904 observed for the first time in the Richardson coal has been identified from this unnamed coal.

SUMMARY

A comparison of the spore and pollen assemblage of the Richardson coal with that of the Broas coal (report of 8/24/65) shows a marked increase in Lycospora and a corresponding decrease in Laevigatosporites in the Richardson coal. This may in part be offset by the consistent occurrence of Torispora in the Richardson coal. Accessary genera occurring in the Richardson coal not known to be present in the Broas coal are Ahrensisporites and Simozonotriletes while those in the Broas coal not known to occur in the Richardson coal are Reinschospora and Renisporites. The unnamed coal above the Richardson shows a continued decrease in Laevigatosporites and an increase in Torispora and Florinites. Eight genera occurring in the Richardson coal have not been observed in the unnamed coal as shown in table 3.

The Richardson and the unnamed coal of this report are somewhat similar to the coals occurring between 70.9' and 151.0' in U.S.G.S. DDH 5 from the Hazard Reserve District. Analyses have not been run on the coals from DDH 5, but preliminary examination of these slides shows a similarity in the presence of Torispora. Preparations of the Skyline coal from the type locality have been completed, and a cursory examination of some of these slides indicates the presence of Torispora.

REMARKS

The Richardson coal has been thought to be correlative with the Lower Kittanning Coal of Ohio and Pennsylvania by Wanless (1939, p. 100). The assemblage of spores and pollen extracted from the Richardson coal at the type locality are not comparable with those of the Lower Kittanning coal from type locality in Pennsylvania. The Richardson coal would be older than the Lower Kittanning. A sample of the Princess No. 6 coal from the Armco Excavation Site ½ mile SE of Riverview, Greenup County, Ironton quad., Kentucky, possibly could correlate with the Lower Kittanning coal.

Robert M. Kosanke

Robert M. Kosanke

Tables 1, 2, and 3 attached.

TABLE 1

GENERIC SUMMARY OF THE SMALL SPORES FROM THE UPPER BENCH RICHARDSON COAL AT THE TYPE LOCALITY
MILO QUADRANGLE, KENTUCKY
SSW of gap labeled 1030 at Lat. 37°58'08.7"N, Lon. 82°37'54.8"W, at an elevation of 1010 feet at the base of coal

	73-A	73-B	73-C
AHRENSISPORITES		+	
ALATISPORITES		+	
CALAMOSPORA		+	+
CIRRATRIRADITES			
CONVOLUTISPORA			
CRASSISPORA			
DENSOSPORITES			
DICTYOTRILETES			
ENDOSPORITES			+
FLORINITES		+	+
FOVEOLATISPORITES		+	+
GRANULATISPORITES			+
KNOXISPORITES	+	+	
LAEVIGATOSPORITES	+	+	+
LYCOSPORA	+	+	+
MUROSPORA			
PUNCTATISPORITES	+	+	+
RADIIZONATES			
RAISTRICKIA		+	
RETICULATISPORITES		+	
SAVITRISPORITES			
SIMOZONOTRILETES	+		
TRIQUITRITES		+	+
TORISPORA			+
VESTISPORA			
WILSONITES			
MONOSACCATE			
ALL OTHER TAXA			+

+ = occurrence in sample as marked. No statistical counts attempted.

73-A = .5' clay 73-B = 1.4' coal 73-C = 0.3' underclay

TABLE 2

GENERIC SUMMARY OF THE SMALL SPORES FROM THE LOWER BENCH RICHARDSON COAL AT THE TYPE LOCALITY, MILO QUADRANGLE, KENTUCKY

ESE of gap labeled 1030 at Lat. 37°58'11.3"N, Lon. 82°36'01.2"W, at an elevation of 975 feet at the base

	74-A	74-B	74-C	74-D	74-E	74-F	74-G	74-H	74-I
AHRENSISPORITES							.4		+
ALATISPORITES			+			.4	+		+
CALAMOSPORA	.4	.8	.4	2.8	.4	.4	+	+	2.0
CIRRATRIRADITES	.4	+	.8	.8	.4	.4	.4		.4
CONVOLUTISPORA		+	+	+					
CRASSISPORA						.8	.4		+
DENSOSPORITES				4.8	?	1.6	14.0	2.8	3.6
DICTYOTRILETES							.4	+	
ENDOSPORITES	1.2		+	+	1.2	+	+	+	6.4
FLORINITES	8.8	2.0	2.0	6.0	1.2	1.6	.4	.8	2.0
FOVEOLATISPORITES		+		.8	.4	.4	+	+	+
GRANULATISPORITES	.4	.8	2.8	9.6	5.6	.8	4.0	5.2	4.4
KNOXISPORITES		+		+					
LAEVIGATOSPORITES	15.2	80.4	28.0	38.0	44.4	36.4	22.4	30.4	32.8
LYCOSPORA	69.6	4.8	50.0	22.0	18.8	37.2	52.4	54.0	38.4
MUROSPORA				+					
PUNCTATISPORITES	+	2.0	1.2	1.6	1.6	3.6	.8	.8	4.4
RADIIZONATES						1.2	1.2	2.0	
RAISTRICKIA	+	.4		.8	+	.4	+	.4	+
RETICULATISPORITES		+		.4	.4	+	+		.4
SAVITRISPORITES							+		
SIMOZONOTRILETES		.4		+			+		
TRIQUITRITES	.4	.8	1.6	9.2	14.8	2.8	.4	+	3.2
TORISPORA	3.6	5.6	13.2	1.6	10.4	9.6	1.2	2.8	.8
VESTISPORA					.4	+	.4		
WILSONITES	+	2.0		1.2				.8	+
MONOSACCATE						2.4	1.2		.8
ALL OTHER TAXA		+		.4		+	+	+	.4
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

+ = present but not observed in statistical count, 2,250 specimens counted.

74-A = 0.4' coal and clay
74-B = 0.1' clay, roof of coal
74-C = 0.8' coal, 0.4 clay
74-D = 0.15' coal, 0.1 clay
74-E = 0.9' coal, 0.1' clay
74-F = 0.5' coal, 0.6' clay
74-G = 1.35' roof clay, sandy
74-H = 1.2' coal
74-I = 0.8' coal

TABLE 3

GENERIC SUMMARY OF THE SMALL SPORES FROM AN UNNAMED COAL ABOVE RICHARDSON COAL

Road cut on ridge south of BM 1171 at Lat. 37°46'59.1"N, Lon. 82°39' 27.1"W, at an altitude of 1233 feet - Offutt Quad., Kentucky

	75-A	75-B
AHRENSISPORITES		
ALATISPORITES		
CALAMOSPORA	4.0	+
CIRRATRIRADITES	.4	
CONVOLUTISPORA		
CRASSISPORA		
DENSOSPORITES	.8	
DICTYOTRILETES		
ENDOSPORITES		
FLORINITES	15.6	+
FOVEOLATISPORITES	.4	
GRANULATISPORITES	4.4	
KNOXISPORITES	.4	
LAEVIGATORPORITES	11.2	+
LYCOSPORA	42.4	+
MUROSPORA	.4	
PUNCTATISPORITES	1.6	+
RADIIZONATES		
RAISTRICKIA	+	
RETICULATISPORITES	.8	
SAVITRISPORITES	+	
SIMOZONOTRILETES		
TRIQUITRITES	.4	+
TORISPORA	16.4	+
VESTISPORA		
WILSONITES	.4	+
MONOSACCATE		
ALL OTHER TAXA	.4	
	100.0%	

+ = present but not observed in statistical of 75-A, present in 75-B but statistical count not attempted. 250 specimens counted in 75-A.

75-A = ca. 2' coal bloom, top not observed

75-B = underclay, base not observed, no thickness reported for sample