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OPEN-FILE REPORT

Palynological Investigations in the Pennsylvanian of Kentucky - III

by

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CONTENTS

INTRODUCTION

This is the third 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 Slade, Tiptop, and Broad Bottom quadrangles of eastern Kentucky, Elkhorn City and Regina quadrangles of eastern Kentucky and Virginia, Toms Creek and Haysi quadrangles of Virginia, and Holden and Matewan quadrangles of West Virginia. A total of 131 samples of coal, underclay, and shale have been examined. Statistical analyses have been run on 111 of the 131 samples, and more than 27,750 specimens were identified and counted.

All analyses completed during 1966 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, Colorado

Stratigraphic range: Pennsylvanian

General locality: Kentucky

Referred by: Ralph L. Miller, 10/14/65

Report prepared by: Robert M. Kosanke, 1/6/66

Status of work: Complete

Kinds of fossils: Spores & pollen

Quadrangle or area: Slade quadrangle

Shipment No.: OF-65-10D
Organic Fuels Branch

Date material received: 10/25/65

Macerations 86 A-F - coal, shale, and underclay from road cut along the Kentucky Mountain Parkway approximately 2 miles E. of Slade, Kentucky.

Mac. No.	Thickness	Lithology	Field No.
86-A	6"	Shale	Y-1a
86-B	11"	Coal	Y-1b
86-C	11"	Coal	Y-1c
86-D	2½"	Underclay	Y-1d
86-E	12"	Coal	Y-2a
86-F	12"	Underclay	Y-2b

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SUMMARY

All of the samples are considered to be of Early Pennsylvanian age and hence within the Lee Formation.

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The spore and pollen recovery from these samples was good although somewhat variable in 86-D, an underclay. The majority of the specimens from 86-D were readily identifiable to the species level. However, this was not always the case so that should an equivalent sample with better preservation be encountered subsequently, some changes in abundance ratios might be expected.

Twenty-four genera and 67 species have been identified. In addition, three unassigned species have been observed and are reported under all other taxa in table 1. Lycospora is clearly the dominant genus in all of the samples with L. 440 the most abundant species followed by L. 423. This dominance of Lycospora is shown in table 1. Laevigatosporites is consistent in occurrence in 86 A-D, and is present in 86-F. This is significant for correlation purposes

inasmuch as such an occurrence of Laevigatosporites is not known from Mississippian rocks of United States. Four species of the genus are present which commonly occur in the Pennsylvanian. Laevigatosporites is absent from the lower coal (86-E) which is compatible with published data from Illinois and Tennessee.

Schulzospora is present in the coal samples 86 B-C and E, and occurs in Late Mississippian and Early Pennsylvanian rocks throughout the world. Densosporites irregularis Hacquebard occurs in both of the coal samples of this series. I have previously observed this species in Late Chester and Early Pennsylvanian coals of Illinois, and reported it present in a Pennsylvanian shale sample from the Ano quadrangle from Kentucky (report of 6/24/64).

Samples 86 A-F have a similar spore and pollen assemblage to those of some Early Pennsylvanian samples from the Oil Springs quadrangle (report of 5/19/65) in the dominance of Lycospora and consistent occurrence of Laevigatosporites and Schulzospora. Other similarities could be cited as well as some significant differences. No direct comparison can be made between these two sets of samples other than that both are considered to be representative of the Early Pennsylvanian.

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TABLE 1

GENERIC SUMMARY OF THE SMALL SPORES FROM SECTION ON KENTUCKY MOUNTAIN PARKWAY TOLL ROAD

Slade Quadrangle approximately 2 miles E. of Slade, Kentucky

	86-A	86-B	86-C	86-D	86-E	86-F
AHRENSISPORITES	+			+		
ALATISPORITES			+			+
CALAMOSPORA	.4	.8	2.8	11.6	+	5.2
CAMPTOTRILETES	+		+			
CIRRATRIRADITES			+		.4	
CONVOLUTISPORA	+		+	.4		.4
CRASSISPORA	.4	+	+		1.2	4.4
CRISTATISPORITES		+	+		+	
DENSOSPORITES	23.2	25.2	7.2		1.6	6.4
DICTYOTRILETES			?			
ENDOSPORITES			?			
FLORINITES		+	.4	.8		
GRANULATISPORITES	.4	1.6	1.2	16.0	1.2	1.2
KNOXISPORITES	+		+	.4		+
LAEVIGATOSPORITES	.4	1.6	2.0	14.0		+
LYCOSPORA	73.6	69.2	79.6	40.8	91.6	80.0
PUNCTATISPORITES	.8		+	2.4	.4	1.6
RAISTRICKIA	.4	.4	1.2	9.6	.4	+
REINSCHOSPORA			+	+		
RETICULATISPORITES	+		.8	+	+	.8
TRIQUITRITES	+	+	+	+		
SAVITRISPORITES				.8	+	
SCHULZOSPORA		1.2	3.2		3.2	+
WILSONITES	+	+	+			
MONOSACCATES	.4		1.6	3.2		
ALL OTHER TAXA			+	+		+
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

86-A = 6" shale

86-B = 11" coal

86-C = 11" coal

86-D = 2½" underclay

86-E = 12" coal

86-F = 12" underclay

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 and pollen

General locality: Kentucky

Quadrangle or area: Tiptop quad.

Referred by: Charles L. Rice, 8/13/65

Shipment No.: KG-65-13D
Regional Geology in Kentucky

Report prepared by: Robert M. Kosanke, 2/14/66

Date material received: 8/27/65

Status of work: Complete

Macerations 85 A-R - coal, shale, and underclay from the type locality of the Skyline coal located approximately 18,130' west and 21,070' north of the SE corner of Tiptop quadrangle in eastern Kentucky.

Mac. No.	Thickness	Lithology	Field No.
85-A	14 "	Shale, silty, carb.	S-1
85-B	16¼ "	Coal & bone at base	S-2
85-C	8 "	Shale, carb.	S-3
85-D	17½ "	Coal	S-4
85-E	11 "	Coal & shale	S-5
85-F	153/4"	Coal	S-6 A and B
85-G	10 "	Coal	S-7 A, B, and C
85-H	33/4"	Coal-shale-coal	S-8
85-I	12 "	Coal	S-9 A and B
85-J	6 "	Shale, silty	S-10
85-K	4¼ "	Coal with ½" clay	S-11
85-L	183/4"	Coal	S-12, 13, 14
85-M	13 "	Coal	S-15 A, B, and C
85-N	11 "	Coal	S-15 D, E, and F
85-O	13½ "	Coal	S-16 A and B
85-P	15 "	Coal	S-17 A and B
85-Q	9 "	Coal	S-17 C and D
85-R	3 "	Underclay	S-18

The Skyline Coal

All 18 samples yielded spores in sufficient quantity to permit statistical analyses. The quality of preservation was good in all coal samples except for 85-F, and generally poor in non-coal samples although spores and pollen grains were abundant.

The Skyline coal contains 24 genera and 117 species have been identified. In addition, a fragment of a specimen was questionably assigned to still another genus, Reinschospora. Numerically, Lycospora and Laevigatosporites are most abundant representing 38 and 25 percent respectively of the composite overall percentages. Densosporites, Torispora, Radiizonates, and Triquitrites are present at the rate of 8.4, 7.7, 7.3, and 2.4 percent respectively of the composite overall averages. The statistical data for the Skyline coal are given in table 1.

The most abundant species are Laevigatosporites 106 and 159 followed by Lycospora 423. Of significance are the occurrence of two new species of Triquitrites and one of Laevigatosporites as well as the presence of Torispora 962 and Radiizonates 93.

In summary, the Skyline coal contains an abundance of Lycospora and Laevigatosporites as evidenced by the fact that these two genera represent 63 percent of the combined total spore and pollen assemblage. This coal contains an average of 7% Torispora (Laevigatosporites with an unusual thickening) and thus is within the zone of Torispora previously reported. Every sample of the 85 series contained specimens of Torispora. Radiizonates occurs nearly as abundantly as Torispora, but not consistently because it is present in only 11 of the 18 samples. Triquitrites occurs in 16 of the 18 samples which in itself is not significant. However, in 85-J and 85-K, Triquitrites occurs at the rate of 18.4 and 12.4 percent respectively. Such an abundance for the genus is not common.

Comparison of the Richardson and Skyline Coals

The Richardson coal (report of 12/8/65) at the type locality occurs in two benches. The top bench is separated from the lower bench by an underclay. The total aggregate thickness of these two benches excluding the roof rock and underclay is just under 10 feet. The Skyline sample from the type locality on the same basis is in excess of 15 feet.

Generically, 22 genera are common to both coals. The Richardson coal contains Knoxisporites, Murospora, and Simozonotriletes which are not known from the Skyline coal, and the Skyline coal contains Renisporites and possibly Reinschospora which are not known to occur in the Richardson coal. Numerically this discrepancy is minor inasmuch as it represents only a fraction of one percent of the total assemblage.

Statistical comparisons between the two coals can be made only between the lower bench of the Richardson coal and the Skyline coal because the yield and preservation in the upper bench of the Richardson coal prevented a meaningful statistical analysis. Considering this limitation, numerically Lycospora and Laevigatosporites occur most abundantly in both coals. These coals are similar in the occurrence of Torispora, Triquitrites, and to some extent Densosporites. The Skyline and Richardson coals contain the same species of Radiizonates, but

the genus is more abundant in the Skyline coal. Triquitrites occurs in two samples of the Richardson coal (74-D and E) at the rate of 9.2 and 14.8 percent respectively. A similar occurrence of the genus in the Skyline coal is mentioned previously in this report.

A species comparison of the two coals reveals that 64.5 percent of the species occur in both coals. I would like to see a better comparison than this, but considering the fact that this comparison is made between samples that are approximately 10 and 15 feet in thickness, this is not bad. Further, the upper bench of the Richardson coal (10 foot sample) contains poorly preserved spores which must be taken into consideration. The dominant species are the same in both coals, and both coals are in the Torispora zone. Two new species of Triquitrites and one of Laevigatosporites occur in both coals. The upper bench of the Richardson coal contains Knoxisporites 904 to the extent of 4 to 5 specimens per slide. A total of 180 slides of the Skyline coal were examined for this species - without success.

In summary, a correlation between the Skyline and lower bench of the Richardson coal is reasonable. The condition of the spores of the upper bench of the Richardson coal is in part the limiting factor so that this portion of the Richardson coal may or may not correlate with the Skyline coal.

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	85-A	85-B	85-C	85-D	85-E	85-F	85-G	85-H	85-I	85-J	85-K	85-L	85-M	85-N	85-O	85-P	85-Q	85-R
AHRENSISPORITES				+											+			
ALATISPORITES	.4		.4	+				+	+	+	+					+		
CALAMOSPORA	+	1.6	+		.4	.8	.4	1.2	1.6	.8	.8	.8	+			.4	1.6	1.6
CIRRATRIRADITES		.4	1.2	1.6	.8	+	.4	.8	+	.8	+	.8	1.2	1.2	+	+	1.6	+
CONVOLUTISPORA						.4	.4	+						+		+	+	+
CRASSISPORA	.4	4.8	.4					6.8	.4	+	4.8	1.6	.4	.8	.4	1.6	1.2	.4
DENSOSPORITES	5.2	1.2	2.8	32.0	32.0	3.6	2.4	.4	1.2	2.8	+	1.6	24.0	30.0	10.4	2.0		+
DICTYOTRILETES	+		+	+	+	.8	.4		+		.4		1.6		.4	+		
ENDOSPORITES	.4	1.6	.8	+			2.0	.4	.4	+	.4	5.2	+	2.4	.4		+	
FLORINITES	+	2.0	+	.4	+		1.6	.8	1.2		1.2	4.8	.8	2.4	+	.4	.4	.4
FOVEOLATISPORITES	+	.8		2.0				.4	1.6	+	3.2	.4		.4	+	.8	+	+
GRANULATISPORITES	2.4	1.6	.8	1.6	1.2	3.6	1.6	1.6	4.0	6.0	4.4	.8	1.2	4.0	1.6	2.0	2.0	2.0
LAEVIGATOSPORITES	5.6	30.8	14.8	26.0	32.4	30.4	31.2	15.6	31.2	15.2	13.6	30.4	23.2	22.8	48.0	27.6	20.0	29.2
LYCOSPORA	80.4	41.6	38.8	7.2	+	3.2	35.2	67.6	49.2	40.4	50.0	50.8	5.6	16.0	24.8	54.0	67.6	62.4
PUNCTATISPORITES	+	2.4	2.0	3.6	.8	2.0	2.0	1.2	2.8	2.4	2.4	.8	1.6	.8	1.2	2.0	.8	.4
RADIIZONATES	.8		18.4			45.2	21.6		1.6				25.6	13.6	.4	2.8	.4	+
RAISTRICKIA		.8	+	.4			+	+	+	.4	.4		.4	+		.4	+	+
REINSCHOSPORA								?										
RENISPORITES			+					+										
RETICULATISPORITES			.4	.4	+	+	+	.4	+				+		+	+	+	+
SAVITRISPORITES										3.2	.4	.4						
TORISPORA	2.0	6.0	18.0	22.0	27.6	9.6	+		2.0	5.6	+	.4	13.2	5.6	12.0	4.8	2.0	.8
TRIQUITRITES	.8	3.2	+	+	.8	+	.8	.8	2.4	18.4	12.4	.8	+			.4	1.2	2.4
VESTISPORA							+					.4	+			.4	1.2	+
WILSONITES				+	1.2		+	.4		1.2	2.0		+		.4	.4		+
SPORE 136	+			+	.4			+			+		.8			+		
MONOSACCATES	1.6	1.2	.4	2.0	2.4	.4		1.6	.4	2.8	3.6							.4
ALL OTHER TAXA			.8	.8	+			+					.4		+			

Each column totals 100.0%

+ = present but not observed in statistical count. 4,500 specimens counted

85-A = 14" Shale, silty, carb.
85-B = 16½" Coal + bone at base
85-C = 8" Shale, carbonaceous
85-D = 17½" Coal
85-E = 11" Coal + shale
85-F = 15 3/4" Coal
85-G = 10" Coal
85-H = 3 3/4" Coal-shale-coal
85-I = 12" Coal
85-J = 6" Shale, silty
85-K = 4¼" Coal with ½" clay
85-L = 18 3/4" Coal
85-M = 13" Coal
85-N = 11" Coal
85-O = 13½" Coal
85-P = 15" Coal
85-Q = 9" Coal
85-R = 3" Underclay

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 and Pollen

General locality: Kentucky

Quadrangle or area: Broad Bottom

Referred by: Donald C. Alvord, 4/25/63

Shipment No.: KG-63-5D
Regional Geology in Kentucky

Report prepared by: Robert M. Kosanke, 4/6/66

Date material received: 5/2/63

Status of work: Incomplete

Macerations 94 A-DD, samples of coal, shale, and clay from U.S.G.S. DDH 8, M84, 1900' FWL, 5000' FNL, Broad Bottom Quad., Pike County, Kentucky.

94 A-C 45.9'-46.6' (Log depth)

94-A	7½"	coal
94-B	7½"	coal
94-C	2-3"	black clay-shale mottled with lt. gry. sts., broken zone with bone coal.

94 D-K 110.5'-115.0' (Log depth)

94-D	3 3/4"	siltstone, gry., grades into gry. sh., carbonaceous
94-E	2½"	bone to cannel coal
94-F	1 3/4"	coal
94-G	3¼"	sh. gry. grades into dk. gry sh.
94-H	1'	coal
94-I	1'	coal
94-J	1'	coal
94-K	8"	underclay with thin vitrain lenses in top ¼"

94 L-Q 149.4'-153.7' (Log depth)

94-L	4 1/8"	shale, lt. gry., and plant fossils
94-M	1½"	shale, dk. gry. with lt. gry. lenses, vy. carbonaceous
94-N	1'	coal
94-O	1'	coal
94-P	1'	coal
94-Q	5½"	underclay, top ½" with thin lenses of vitrain, basal 1" silty

94 R-U 189.7'-193.0' (Log depth)

94-R	5"	shale, lt. gry., siderite nodules, carbonaceous with vitrain lenses in bottom 3/16"
94-S	1'	coal

	94-T	1'	coal (note: 94-T_1 = ½" bone in middle of 94-T)
	94-U	8"	underclay with top 1" carbonaceous
94 V-DD	228.4'-235.5'		(Log depth)
	94-V	1'	coal
	94-W	1'	coal
	94-X	1' 2"	coal
	94-Y	11"	coal
	94-Z	4"	shale, dk. gry. to black, some plant fossils
	94-AA	1' 2"	coal with two dull bands in middle of sample
	94-BB	5/8"	shale, top 3/16" black and transitional to dk. gry.
	94-CC	1' 1"	coal
	94-DD	10"	top ½" clay-shale, lt. gry., 1½" shale dk. gry. to black with vitrain lenses, 8" underclay, lt. gry., in part slip fractured

All 30 samples contained spores and pollen grains. Statistical counts were not attempted for 6 of the 30 samples because of low yield or poor preservation. The statistical counts are based on 6000 specimens. In addition, examination of many other slides resulted in recording the presence of other genera and species. The presence of these genera are recorded in tables 1-5 by a plus sign.

Macerations 94 A-C - 45.9' to 46.6' (Log depth)

A maximum of 15 inches of coal was logged in the laboratory prior to the preparation of the sample. The spores and pollen observed indicate the coal is older than the Richardson or Skyline coal. The coal contains an abundance of Laevigatosporites as shown in table 1. No specimens definitely assignable to Torispora were observed. The underclay contains Lycospora in abundance. Comparing macerations 94 A-C with those of the Broas coal from the type locality (maceration series 72, my report of August 24, 1965), some obvious similarities are apparent based on generic abundance. The coal from each locality contains a dominance of Laevigatosporites. Laevigatosporites declines in abundance in the underclay and Lycospora increases. However, in 94-C Lycospora is dominant and this is not the case in 72-E. Perhaps this in part is related to sample thickness or the fact a small amount of bone coal is present in the underclay of 94-C. All genera present in 94-C occur in the Broas coal including spore 136 which was classified under all other taxa in the Broas coal report. These genera are common to coals above and below the Broas. Six genera of minor numerical significance occurring in the Broas coal have not been observed in 94 A-C. Schizocystia and Horologinella, which were confined to a shale parting in the Broas coal, are absent from macerations 94 A-C which lacks a shale parting.

Although 58 species have been identified from 94 A-C, they are not especially diagnostic of the Broas coal in that they occur in several of the

coals in this part of the section. The dominant species of the Broas coal are Laevigatosporites minutus and L. globosus. These species are dominant in 94-A, but not more than subdominant in 94-B. Both of these species occur above and below the Broas coal.

Based on generic abundance and to some extent on dominant species, the coal represented by macerations 94 A-C could correlate with the Broas coal, but proof of such a correlation is not what I would consider adequate.

Macerations 94 D-DD - from 110.5' through 235.5'

Four coals are presented in this interval of 125 feet. The assemblages have been considered collectively and separately for each coal. The generic abundance for each coal is given in tables 2-5. Twenty-nine genera and spore 136 have been identified from macerations 94 D-DD, and 27 of these genera have previously been reported from the Francis or Peach Orchard coal. Renisporites and Simozonotriletes have not been reported for the Francis or Peach Orchard coal, but definitely occur in older and younger coals.

Lycospora and Laevigatosporites are the two most abundant genera in the Francis and Peach Orchard coal, and in macerations 94 D-DD. Laevigatosporites is perhaps more abundant overall in 94 D-DD, but the same species are present.

One hundred and seventy-one species have been identified from 94 D-DD and 135 of these or 78.9 percent are known to occur in the Francis or Peach Orchard coal. A number of the 135 species have been observed only in the Francis or Peach Orchard or originate or terminate their ranges at this time. Six of the remaining species have not been observed previously and are considered to be new. Several of these occur in maceration 94-Z, a shale sample, which was unusually rich in spore and pollen content and contained 12.8 Ahrensisporites. This represents the maximum abundance of Ahrensisporites that I have observed. The 30 remaining species have been reported previously in other coals in the immediate sequences both above and below.

The characteristic assemblage of the Hazard No. 7 coal and abundance ratios do not appear to be present in any of the samples from 94 D-DD. As a matter of fact, the bottom coal sample of this series (94-CC) is strongly suggestive of the Francis or Peach Orchard coal. Because of this and other factors already discussed, I believe 94 D-DD represents a zone of coals related to the Peach Orchard coal.

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TABLE 1

GENERIC SUMMARY OF THE SMALL SPORES FROM USGS DDH 8

(M84, 1900' FWL, 5000' FNL, Broad Bottom Quad., Pike County, Ky.)

	94-A	94-B	94 A-B	94-C
CALAMOSPORA	+	.8	.4	8.8
CIRRATRIRADITES	.8		.4	.4
CONVOLUTISPORA		.4	.2	+
CRASSISPORA	.4		.2	2.0
DENSOSPORITES	.4	.4	.4	.8
ENDOSPORITES	+		+	+
FLORINITES	.4	1.2	.8	.4
FOVEOLATISPORITES				+
GRANULATISPORITES	2.8	1.2	2.0	2.0
KNOXISPORITES		.4	.2	
LAEVIGATOSPORITES	64.8	87.2	76.0	12.0
LYCOSPORA	28.8	1.6	15.2	71.2
PUNCTATISPORITES	.8	+	.4	1.2
RADIIZONATES	+		+	
RAISTRICKIA				.4
RETICULATISPORITES		+	+	
TRIQUITRITES	+	3.2	1.6	+
VESTISPORA				+
WILSONITES		1.6	.8	+
SPORE 136	+		+	+
MONOSACCATE	.8	2.0	1.4	.8
ALL OTHER TAXA		+	+	+
	100.0%	100.0%	100.0%	100.0%

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

94 A-C = 45.9' - 46.6' (log depth)
94-A = 7½" coal
94-B = 7½" coal
94 A-B = combined 15" coal
94-C = 2-3" clay-shale dark mottled with lt. gry. sts., broken zone with small amount of bone coal

TABLE 2

GENERIC SUMMARY OF THE SMALL SPORES FROM USGS DDH 8

(M84, 1900' FWL, 5000' FNL, Broad Bottom Quad., Pike County, Ky.)

	94-D	94-E	94-F	94-G	94-H	94-I	94-J	94-K
ALATISPORITES			+	+	+			
CALAMOSPORA	+	3.2	.4	2.0	3.6	2.0	.8	+
CIRRATRIRADITES	+		+	+	.4		+	
CONVOLUTISPORA			+	.4	.4	.4		+
CRASSISPORA			+	.4			+	+
DENSOSPORITES	+	8.4		32.8	1.6			+
DICTYOTRILETES	+							
ENDOSPORITES	+			+	.4		+	
FLORINITES	+		8.0	4.8	5.6	7.6	1.6	+
FOVEOLATISPORITES		+				+	.4	+
GRANULATISPORITES	+	3.2	5.6	12.0	13.2	4.4	4.8	+
KNOXISPORITES				+	+	+		
LAEVIGATOSPORITES	+	59.6	33.2	14.0	60.8	66.8	10.4	+
LYCOSPORA	+	16.8	47.6	27.6	8.8	8.0	73.2	+
MUROSPORA					+			
PUNCTATISPORITES	+	2.4	2.0	.8	.4	2.8	1.6	+
RADIIZONATES	+	5.2	.4	.8				
RAISTRICKIA			1.2	+	+	.4	.8	+
RENISPORITES			+					
RETICULATISPORITES		+	.4	.4	+		+	+
SAVITRISPORITES				+			+	+
TRIQUITRITES	+		1.2	1.2	2.0	4.8	1.2	+
VESTISPORA		+		+	.4		+	
WILSONITES			+	+	.8	1.2	2.8	+
SPORE 136			+	2.8				
MONOSACCATE		1.2			1.6	1.6	2.4	
ALL OTHER TAXA		+			+			
		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	

+ = present but not observed in statistical count or no count attempted. 1250 specimens counted

94 D-K = 110.5' - 115.0' (log depth)

94-D = 3 3/4" siltstone and shale, gry., carbonaceous
94-E = 2½" bone to cannel coal
94-F = 1 3/4" coal
94-G = 3¼" shale, gray, darker at base
94-H = 1' coal
94-I = 1' coal
94-J = 1' coal
94-K = 8" underclay

TABLE 3

GENERIC SUMMARY OF THE SMALL SPORES FROM USGS DDH 8

(M84, 1900' FWL, 5000' FNL, Broad Bottom Quad., Pike County, Ky.)

	94-L	94-M	94-N	94-O	94-P	94-Q
ALATISPORITES			.4		+	
CALAMOSPORA		+	.4	.8	1.6	
CIRRATRIRADITES		+	.4	.4	+	
CONVOLUTISPORA		+		+	+	
CRASSISPORA	.4	.4				
DENSOSPORITES	1.2	.8	21.6	2.0		
DICTYOTRILETES				+		
ENDOSPORITES	2.0	3.6		+		+
FLORINITES	.4		2.0	.4	5.6	+
FOVEOLATISPORITES	.4			+		+
GRANULATISPORITES	2.8	3.2	4.0	6.8	12.4	+
LAEVIGATOSPORITES	2.0	1.2	41.2	74.4	70.0	+
LYCOSPORA	83.2	89.6	27.6	8.0	4.0	+
PUNCTATISPORITES	1.6	+	.4	1.2	2.4	+
RADIIZONATES	.4		.8	2.4		
RAISTRICKIA	.8	+	.4		+	
REINSCHOSPORA	.4					
RETICULATISPORITES			+		+	
SAVITRISPORITES	.4				+	+
TRIQUITRITES	3.2	.8	.4	.4	.4	+
VESTISPORA	.8	.4	+	+		+
WILSONITES	+		.4	2.0	1.6	+
SPORE 136	+	+			+	+
MONOSACCATE				1.2	2.0	
ALL OTHER TAXA						
	100.0%	100.0%	100.0%	100.0%	100.0%	

+ = present but not observed in statistical count or no count attempted. 1250 specimens counted.

94 L-Q = 149.4'-153.7' (log depth)
- 94-L = 4 1/8" sh., lt. gry, carbonaceous
- 94-M = 1½" sh., dk. gry., and lt. gry, carbonaceous
- 94-N = 1' coal
- 94-O = 1' coal
- 94-P = 1' coal
- 94-Q = 5½" underclay silty at base

TABLE 4

GENERIC SUMMARY OF THE SMALL SPORES FROM USGS DDH 8

(M84, 1900' FWL, 5000' FNL, Broad Bottom Quad., Pike County, Ky.)

	94-R	94-S	94-T	94-U
ALATISPORITES			+	+
CALAMOSPORA		1.6		
CIRRATRIRADITES		.4	+	+
CONVOLUTISPORA		.4	.4	
CRISTATISPORITES		8.8	1.6	
DENSOSPORITES		14.8	7.2	+
ENDOSPORITES		+	.8	+
FLORINITES		4.8	3.2	
FOVEOLATISPORITES				+
GRANULATISPORITES	+	4.4	3.6	
LAEVIGATOSPORITES	+	34.0	72.8	+
LYCOSPORA	+	22.4	2.8	+
PUNCTATISPORITES	+	.8	1.2	+
RADIIZONATES		6.8	2.4	
RETICULATISPORITES				+
SAVITRISPORITES			+	
STELLISPORITES			+	+
TRIQUITRITES		.4	1.6	
VESTISPORA		+		
WILSONITES		.4	.4	
SPORE 136		.4	.8	
MONOSACCATE			.8	
ALL OTHER TAXA			.4	
		100.0%	100.0%	

+ = present but not observed in statistical count or no count attempted.
500 specimens counted.

94 R-U = 189.7'-193.0' (log depth)
94-R = 5" sh., lt. gry., carbonaceous
94-S = 1' coal
94-T = 1' coal
94-U = 8" underclay

TABLE 5

GENERIC SUMMARY OF THE SMALL SPORES FROM USGS DDH 8

(M84, 1900' FWL, 5000'FNL, Broad Bottom Quad., Pike County, Ky.)

	94-V	94-W	94-X	94-Y	94-Z	94-AA	94-BB	94-CC	94-DD
AHRENSISPORITES					12.8	2.0			
ALATISPORITES	.4		+	+	2.8	.4			
CALAMOSPORA	+	.8	.4	.4		.4		2.8	.4
CIRRATRIRADITES		+	+	.4		+			
CONVOLUTISPORA					1.6	.4			
CRASSISPORA	+								
CRISTATISPORITES	8.0	5.2	1.6						
DENSOSPORITES	30.4	4.8	5.2						
DICTYOTRILETES		.4							
ENDOSPORITES	.4	+	+			+		+	.4
FLORINITES	+	+	6.0	9.6	1.2	17.6	+	1.6	
GRANULATISPORITES	.4	4.0	2.4	6.4	6.4	10.0	+	1.6	6.8
KNOXISPORITES			?	2.8	2.0	.4	+		
LAEVIGATOSPORITES	45.2	81.2	65.6	56.4	44.0	42.4	+	4.0	9.2
LYCOSPORA	6.8	2.0	15.6	2.8	7.6	13.2	+	88.8	75.6
PUNCTATISPORITES	2.0	1.2	.4	3.6	6.4	.4	+	.4	2.0
RADIIZONATES	4.8								
RAISTRICKIA	+	+	+	+	+	.8		.4	
RETICULATISPORITES	.4	+	+	2.8	1.6	1.2			
SAVITRISPORITES				?					
SIMOZONOTRILETES						.4			
TRIQUITRITES	.4	.4	.8	2.8	12.0	6.0	+	+	1.2
VESTISPORA						.8		+	.8
WILSONITES	.4	+	+	8.0	+	.8	+		.8
SPORE 136	+	+	+	.8	.8		+		.8
MONOSACCATE	.4		2.0	3.2		2.8		.4	2.0
ALL OTHER TAXA		+			.8				
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%		100.0%	100.0%

+ = present but not observed in statistical count or no count attempted. 2000 specimens counted.

94 V-DD = 228.4'-235.5' (log depth)
- 94-V = 1' coal
- 94-W = 1' coal
- 94-X = 1'2" coal
- 94-Y = 11" coal
- 94-Z = 4" sh., dk. gry. to black
- 94-AA = ½" coal with two thin dull layers
- 94-BB = 5/8" sh., black to dk. gry.
- 94-CC = 1'1" coal
- 94-DD = 10" top ½" clay-shale, 1½" sh. dk. gry. to black with vitrain lenses, 8" underclay, lt. gry.

REPORT ON REFERRED FOSSILS

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

Stratigraphic range: Pennsylvanian

General locality: Kentucky & Virginia

Referred by: Donald C. Alvord, 7/14/65

Report prepared by: Robert M. Kosanke, 4/29/66

Status of work: Incomplete

Kinds of fossils: Spores & pollen

Quadrangle or area: Pike Co., Ky. & Buchanan Co., Va.

Shipment No.: KG-65-11D
Regional Geology in Kentucky

Date material received: 7/22/65

Macerations 91 A-D, 45 inches of coal and clay from the type locality of the Elswick coal, 6,350' N.50°W. of gaging station at Elkhorn City, Pike County, Kentucky.

91-A	16¼" coal, weathered	R-1 samples of Alvord
91-B	16¼" coal	
91-C	5½" coal and clay	
91-D	7" coal	

Macerations 92 A-B, 32 inches of coal (Kennedy coal of Giles, 1921), 12,200' S.89°E. of gaging station at Elkhorn City, Kentucky, in Buchanan County, Virginia.

92-A	15½" coal, weathered	E-116 samples of Alvord
92-B	15½" coal, weathered	

All samples of the 91 and 92 maceration series yielded spores and pollen grains in sufficient abundance to permit statistical counts although preservation was somewhat less than average quality in 91-B and 91-C.

Elswick coal - Macerations 91 A-D

Twenty genera and 63 species were identified from these samples. Densosporites is numerically most abundant in 91-A, Cristatisporites in 91 B-C, and Lycospora in 91-D as shown in table 1. The composite overall abundance calculated on a per inch basis reveals that Lycospora is more abundant than Cristatisporites. The occurrence of Schulzospora in 91 A-B is important because the genus occurs in coals of the Chester Series of Illinois to approximately the Caseyville-Abbott boundary of the Pennsylvanian. Cropp (1963, Journal Paleontology, v. 37, no. 4) reported this genus present in the

coals of the Lee Formation of Tennessee through at least the Morgan Springs coal. Schulzospora occurs to the Westphalian A and B boundary in Europe according to Butterworth (1964, C.I.M.P. Report, Compte Rendu). The genus occurs to the Bashkirian-Moscovian boundary in Russia according to Ischenko (1958, Trans. Inst. Geol. Sci., no. 17).

The species occurring in the 91 maceration series confirm the general stratigraphic position of the Elswick coal. The dominant species is Lycospora 1158 followed by 423 and 440. The most abundant species of Cristatisporites is 1132 and that of Densosporites is 1134. The species of Camptotriletes and Savitrisporites identified from the Elswick coal likewise are known to occur in this portion of the Pennsylvanian. Before leaving our discussion of these samples, note should be taken of Granulatisporites which is reasonably abundant in 91 A-C and increases to more than 25 percent in 91-D.

Kennedy coal of Giles - Macerations 92 A-B

Eighteen genera and 42 species have been identified from these samples. Lycospora is clearly dominant with only Granulatisporites of significant numerical importance in 92-A as shown in table 2. Schulzospora occurs in both samples with Ahrensisporites present at the rate of more than 8 percent in 92-A.

The dominant species in both samples is Lycospora 1167 which occurs at the rate of more than 20 percent in both sets of samples.

Comparison of the type Elswick coal with the Kennedy coal of Giles (1921)

Clearly these two coals are not of the same age based on generic and specific composition or on abundance ratios. The coals are related, to be sure, so that I am convinced your interpretation of November 8, 1965, is proper and confirmed by spore and pollen evidence. Twenty of the 42 species identified from the Kennedy coal of Giles are present in the Elswick coal. Some of these species are significant in showing a relationship and include representatives of Schulzospora, Ahrensisporites, Densosporites, and Lycospora. The abundance of Granulatisporites in the basal sample of the Elswick coal (91-D) and the top sample of the Kennedy coal (92-A) could suggest a relationship also. The marked difference between these two coals is the presence of Lycospora 1167 in abundance in the Kennedy coal (92 A-B) and its absence from the Elswick coal (91 A-D). Conversely, species of Cristatisporites are abundant in the Elswick coal and almost lacking in the Kennedy coal.

Robert M. Kosanke

Robert M. Kosanke

TABLE 1

GENERIC SUMMARY OF THE SMALL SPORES OF THE ELSWICK COAL
FROM THE TYPE LOCALITY
(6,350 feet N.50°W. of gaging station at Elkhorn City, Pike County, Ky.)

	91-A	91-B	91-C	91-D
AHRENSISPORITES	2.4	1.6	2.8	+
CALAMOSPORA		.4	2.0	2.0
CAMPTOTRILETES			.4	
CIRRATRIRADITES		+	+	
CONVOLUTISPORA	+		.4	
CRISTATISPORITES	10.4	36.0	29.6	.8
DENSOSPORITES	36.8	1.6	2.4	.4
ENDOSPORITES	.8		.4	
FLORINITES	.8	1.2	5.6	.4
GRANULATISPORITES	14.8	12.4	16.0	25.6
LAEVIGATOSPORITES	4.4	4.4	1.6	4.8
LYCOSPORA	14.4	30.0	5.2	61.2
PUNCTATISPORITES	1.6	.8	2.0	.8
RAISTRICKIA	.8	.4	.4	+
RETICULATISPORITES	+		+	.4
SAVITRISPORITES	1.6	7.2	14.0	.4
SCHULZOSPORA	7.2	.4		
SIMOZONOTRILETES	1.2			
TRIQUITRITES				.8
WILSONITES	1.2	+	6.4	1.6
MONOSACCATE	1.6	3.6	10.8	.8
ALL OTHER TAXA			+	+
	100.0%	100.0%	100.0%	100.0%

+ = present but not observed in statistical count. 1,000 specimens counted

91 A-D = 45" of coal and clay
91-A = 16¼" weathered coal
91-B = 16¼" coal
91-C = 5½" coal and clay
91-D = 7" coal

TABLE 2

GENERIC SUMMARY OF THE SMALL SPORES OF THE KENNEDY COAL*
(12,200 feet S.89°E. of gaging station at Elkhorn City, Buchanan Co., Va.)

	92-A	92-B
AHRENSISPORITES	8.8	.8
CALAMOSPORA		2.8
CIRRATRIRADITES	.4	
CONVOLUTISPORA		+
CRISTATISPORITES		+
DENSOSPORITES	2.8	3.6
FLORINITES	+	
GRANULATISPORITES	29.6	8.0
KNOXISPORITES		+
LAEVIGATOSPORITES	4.0	10.0
LYCOSPORA	46.8	68.0
PUNCTATISPORITES	2.0	2.0
RAISTRICKIA	2.0	2.0
RETICULATISPORITES	+	+
SAVITRISPORITES	+	
SCHULZOSPORA	1.2	1.2
TRIQUITRITES	1.6	
WILSONITES		.4
MONOSACCATES	.8	1.2
ALL OTHER TAXA	+	
	100.0%	100.0%

+ = present but not observed in statistical count. 500 specimens counted

92 A-B = 32" coal
91-A = 15½" coal, weathered
91-B = 15½" coal, weathered

* Giles, Albert W., 1921. The Geology and Coal Resources of Dickenson County, Virginia. Bull. 21, Virginia Geol. Survey.

REPORT ON REFERRED FOSSILS

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

Stratigraphic range: Pennsylvanian

General locality: Kentucky

Referred by: D. C. Alvord 3/23/64

Report prepared by: R. M. Kosanke 7/29/66

Status of work: Complete

Kinds of fossils: Spores and pollen

Quadrangle or area: Pike County, Kentucky, and Logan and Mingo Counties, West Virginia

Shipment No.: KG-64-13D

Date material received: 4/3/64

Report not to be quoted or paraphrased in publication without a final recheck by the Paleontology and Stratigraphy Branch.

This report is concerned with 30 macerations of coal, clay, and shale from 8 coals including the "Type" Upper Elkhorn Nos. 3, 2, and 1 of Hunt (1933). Sample locations are given in tables 1-5 as well as a description of each of the samples macerated. All of the coal samples were reported to be weathered except those of macerations 100 A-H (Alvord samples S-3a through S-3h).

Macerations 76 A-C = "Type" upper Elkhorn No. 3 of Hunt (1933), Alvord samples S-5a through S-5c from Pike County, Ky.

Macerations 77 A-C = "Type" Upper Elkhorn No. 2 of Hunt (1933), Alvord samples S-6a through S-6c from Pike County, Ky.

Macerations 78 A-C = Upper Elkhorn No. 1 (? Alma) as defined in this region, Alvord samples S-7a through S-7c, Pike County, Ky.

Macerations 79 A-B = "Type" Upper Elkhorn No. 1 of Hunt (1933), Alvord samples S-D104 a and b, Mingo County, W. Va.

Macerations 80 A-D = Alma coal of Logan and Mingo Counties, W. Va., Alvord samples S-1r through S-1c, Logan County, W. Va.

Macerations 81 A-E = Upper and Lower Cedar Grove coals joined ("Island Creek" coal), Alvord samples S-2r through S-2d, Logan County, W. Va.

Macerations 100 A-H = "Lower Cedar Grove" coal of Island Creek Coal Company, Alvord samples S-3a through S-3h, Mingo County, W. Va.

Macerations 101 A-B = "Upper Cedar Grove" coal of Island Creek Coal Company, Alvord samples S-4a through S-4b.

The preservation of spores and pollen is generally poor for the majority of the samples, as a matter of fact, it has been necessary to re-prepare some of the samples with modified techniques in order to obtain sufficient data for analysis. Despite the problem of poor preservation, it has been possible to obtain statistical analyses on the generic level of 28 of the 30 samples, and 162 species have been identified.

The "Type" Upper Elkhorn Coals Nos. 3, 2, and 1 of Hunt (1933)

Twenty-two genera and 90 species have been identified from these coals (macerations 76, 77, and 79), and the statistical data is given in table 1. The Upper Elkhorn No. 3 is dominated by Lycospora (85 to 94 percent) with L. 440 most abundant in 76 A and C, and L. 281 dominant in 76-B. The Upper Elkhorn No. 2 contains an abundance of Densosporites in 77 A-B, and Lycospora in 77-C. Unfortunately, the majority of the specimens of Densosporites were too poorly preserved to be identified beyond the generic level. Four species of Densosporites were identified and these were 373, 401, 538, and 829. Lycospora 281, which was abundant in 76-B, is absent from 77 A-C, and those species present are 423, 440, 496, 1135, and 1146. Laevigatosporites is the most abundant genus occurring in the Upper Elkhorn No. 1 coal with species 106 dominant. Other species of Laevigatosporites identified are 140, 159, 165, 166, and 1194, and possibly one new species not assigned yet.

In summary of the "Type" Upper Elkhorn coals of Hunt (1933), Lycospora is dominant in the No. 3 coal, Densosporites in the top 2/3 of the No. 2 coal with Lycospora important in the bottom 1/3, and Laevigatosporites is numerically significant in the No. 1 coal.

Upper Elkhorn No. 1 Coal (?Alma) of Pike County

Macerations 78 A-C presented problems in obtaining sufficiently well preserved specimens for statistical analysis. Ultimately, preparations were obtained that provided sufficient data for comparison with Hunt's "Type" Upper Elkhorn No. 1 coal of West Virginia. Table two contains the data for macerations 78 A-C, and when compared to that of macerations 79 A-B (Table 1), a fairly close comparison is obvious between the coal portions of these two samples. Laevigatosporites is dominant throughout both coal samples.

Only 38 species could be identified from macerations 79 A-B, and of these, 22 occur in macerations 78 A-C. All of the genera occurring in 79 A-B are present in 78 A-C except Dictyotriletes although 78 A-C contains several genera not present in 79 A-B. On the basis of recoverable spores and pollen, a correlation between macerations 79 (Hunt's "Type" Upper Elkhorn No. 1) and 78 (Upper Elkhorn No. 1 of Pike County) is possible.

Table two records the statistical data for 78 A-C. Of special interest and unexplained is the occurrence of bisaccate pollen grains similar to Pityosporites in 78-A, and bisaccate striatite pollen grains in the clay parting of 78-B. One possible bisaccate pollen grain was noted in 79-B. Pityosporites does occur in Pennsylvanian rocks to a limited extent, and generally of younger age than represented by 78 A-C. Striatite bisaccate pollen grains similar to Striatites have been reported from Upper Pennsylvanian rocks in limited numbers, but are commonly present in Permian to Jurassic rocks. Lueckisporites is known from the Permian

to the Jurassic. Some of the poorly preserved monosaccate grains might be related to Permian genera. The presence of these genera in 78 A-B will be investigated subsequently.

Alma Coal of Logan and Mingo Counties, West Virginia

The statistical data for these samples (80 A-D) is given in table 3. Twenty-four genera and 65 species were identified. Densosporites is numerically significant in the coal samples (80 B-C) with Lycospora occurring significantly in the underclay (80-D). The preservation of specimens of Densosporites was poor and species 373, 401, 829, and 1086 were identified. Species of Lycospora include 423, 440, 496, 1135, and 1146. There are a number of generic discrepancies when comparing the Alma coal (80 A-D) as shown in table 3 with Hunt's "Type" Upper Elkhorn No. 1 coal (79 A-B) as shown in table 1. Furthermore, Laevigatosporites is dominant in 79 A-B while Densosporites is most abundant in the Alma coal (80 B-C) with Lycospora prominent in the underclay (80-D). A much closer comparison is present on a generic level by comparing the Alma coal (80 A-D) with Hunt's "Type" Upper Elkhorn No. 2 coal (77 A-C). As a matter of fact, more species are common to 77 A-C and 80 A-D than 79 A-B to 80 A-D. However, this will be discussed subsequently.

Cedar Grove and Lower Cedar Grove ("Island Creek") Coals

A comparison between maceration series 80 A-D and 81 A-E, the Cedar Grove and Lower Cedar Grove ("Island Creek") coals, should be made. The coal portion of maceration series 80 and 81 are similar in many respects except for the basal 26 inches of maceration series 81 which is 81-E. Lycospora is clearly dominant in 81-E, a condition not existing in 80 B-C. Lycospora is dominant of the underclay of maceration series 80 which is 80-D. This difference together with some differences of species of Punctatisporites and Raistrickia are the main items separating the two coals. Six species occurring sparsely in the 81 series that are assignable to five genera may be new. Sufficient specimens have not been encountered to make a judgment at this time. Twenty-three genera and 60 species have been identified from the 81 series. Densosporites is most abundant in 81-B, and dominant in 81 C-D. Lycospora clearly dominates the spore and pollen assemblage of 81-E. Although four species of Densosporites (373, 1131, 401, and 829) were identified from the specimens examined in the statistical count, 366 specimens could not be identified beyond the generic level. The statistical data for the 81 series is given in table 4.

The "Upper and Lower Cedar Grove" Coals of the Island Creek Coal Company

Maceration series 101 and 100, table 5, contains Lycospora in abundance or as the dominant genus throughout except for 100-G in which Densosporites is most abundant followed by Laevigatosporites with a return of Lycospora as the dominant in the basal samples of coal 100-H. The same pattern of spore and pollen occurrence of 100 G-H is present in 81 D-E, and the species check out fairly well. This would be correlating 45 inches of coal in 100 to 53 inches of coal in 81. Beyond this, the claystone and coal of 100 A-F do not

correlate closely. As indicated previously, Hunt's "Type" Upper Elkhorn No. 2 (77 A-C) exhibited certain similarities to the Alma coal of Logan and Mingo Counties (80 A-D). However, a closer comparison can be made to 100 G-H and hence to 81 D-E

The "Type" Upper Elkhorn No. 3 of Hunt (1933) has Lycospora as the dominant genus (85 to 92 percent). Similar occurrences are shown in table 5 for 101 A-B, 100 C and F. Inasmuch as parts of 77 and 100 are related, probably 76 should be related to 101 (table 5). However, difficulties are encountered in comparing 101 A-B with 81 B-C. I simply do not have the evidence for a correlation.

Summary

Hunt's "Type" Upper Elkhorn coals Nos. 3-1 (macerations series 76, 77, and 79) have a distinct and changing assemblage of spores and pollen. Maceration 78 A-C from Pike County, Kentucky, is correlated with Hunt's "Type" Upper Elkhorn coal No. 1 from Mingo County, West Virginia. The Alma coal of Logan and Mingo Counties, West Virginia (80) and the Cedar Grove and Lower Cedar Grove ("Island Creek") coal (81) display only a part of the spore and pollen assemblage pattern shown in the Elkhorn coals (76, 77, and 79). Hunt's "Type" Upper Elkhorn No. 1 coal (79) and the Alma coal of Logan and Mingo Counties, West Virginia (80) do not correlate. Hunt's "Type" Upper Elkhorn No. 2 coal (77) shows a relationship to both the Alma coal (80) of Logan and Mingo Counties and to the "Lower Cedar Grove" coal (100). Based on available evidence, I would have to go along with the maceration series 77 being more closely related to maceration series 100. The basal portion of the maceration series 100 is related to 81 D-E, the Cedar Grove and Lower Cedar Grove ("Island Creek") coal. Hunt's "Type" Upper Elkhorn No. 3 coal (76 A-C) shows a relationship to the upper portion of maceration series 100 and to 101, the "Upper Cedar Grove" coal. Quite possibly, maceration series 76 and 101 tie in more closely, but neither of these appear to have a counterpart in maceration series 81.

Every effort has been made to utilize these samples despite the general lack of good preservation. In order to help understand some of the uncertainties, I hope it will be possible to examine the type Cedar Grove from Kanawha County ultimately.

Robert M. Kosanke

Robert M. Kosanke

TABLE 1

GENERIC SUMMARY OF THE SMALL SPORES OF THE "TYPE" UPPER ELKHORN NOS. 3, 2, & 1
HUNT (1933)

	76-A	76-B	76-C	77-A	77-B	77-C	79-A	79-B
AHRENSISPORITES	.4		+	2.8	.8			
ALATISPORITES	+			+		.4		
CALAMOSPORA	.8	.4	2.0		+	1.2	+	+
CIRRATRIRADITES	.4		+			.4		.4
CONVOLUTISPORA	.4		+	+	+	.8		
CRASSISPORA	+					.8		
CRISTATISPORITES				10.8	.4	.4	.8	.4
DENSOSPORITES	+	+	+	44.8	66.0	.8	4.0	12.0
DICTYOTRILETES	+			3.2	1.2			+
ENDOSPORITES		.4	+	+	.4	4.4	+	
FLORINITES	+			+	1.2	5.6	.4	1.6
GRANULATISPORITES	.8	2.8	2.8	.4	2.8	5.2	1.6	1.6
KNOXISPORITES				+				
LAEVIGATOSPORITES	4.0	.4	8.0	2.8	13.6	13.6	72.8	49.6
LYCOSPORA	92.4	94.4	85.2	29.6	11.6	53.6	15.2	14.8
PUNCTATISPORITES	.4	1.6	1.2	2.4	1.6	2.0	.4	2.0
RAISTRICKIA	+	+	+		+	1.2		+
REINSCHOSPORA				.4	+			
RETICULATISPORITES	+		+	1.6	+	.4	+	.8
SAVITRISPORITES		+				+		.8
SIMOZONOTRILETES				+				
WILSONITES	.4		.8			1.6	+	1.2
MONOSACCATE				1.2	.4	7.6	4.8	14.8
BISACCATE								?
ALL OTHER TAXA					+		+	+
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

+ = present but not observed in statistical count. 2,000 specimens counted

Macerations 76 A-C "Type" Upper Elkhorn No. 3 of Hunt (1933) from inside entry located 2000 feet SE of Hunt's Station 3494. This is 3000 feet E-SE of Shelbiana Post Office, Levisa Fork, Pike County, Ky.
76-A = 0.0-17.0" coal, weathered
76-B = 17.0-35.0" parting, claystone, silty
76-C = 35.0-63.0" coal, weathered

Macerations 77 A-C "Type" Upper Elkhorn No. 2 of Hunt (1933) at portal of Hunt's Station No. 3236 located on spur between Poor Bottom Fork and Big Branch of Marrowbone Creek, Henry Clay, Pike County, Ky.
77-A = 0.0-11.0" coal, interlaminated with partings
77-B = 11.0-35.5" coal with minor fusain partings
77-C = 35.5-54.5" coal with minor fusain partings

Macerations 79 A-B "Type" Upper Elkhorn No. 1 of Hunt (1933) taken at mouth of adit located 800 feet north of Hunt's Station No. 446. This is 3300 feet north of BM-960 at mouth of N&W tunnel at Sprigg or 5000 feet south of mouth of Sprouse Creek on east facing slope of hill on west side of Tug Fork of Big Sandy River, Mingo County, West Virginia.
79-A = 0.0-23.0" coal, minor fusain partings
79-B = 23.0-45.0" coal

TABLE 2

GENERIC SUMMARY OF THE SMALL SPORES OF THE UPPER ELKHORN NO. 1

Sample taken at mouth of adit 28 feet directly below "Type" Upper Elkhorn No. 2 at Hunt's Station 3236 located on spur between Poor Bottom Fork and Big Branch of Marrowbone Creek, Henry Clay, Pike County, Kentucky

	78-A	78-B	78-C
AHRENSISPORITES		.8	+
CALAMOSPORA	.8	+	.4
CAMPTOTRILETES			.4
CIRRATRIRADITES		.4	
CONVOLUTISPORA			+
CRISTATISPORITES		1.6	+
DENSOSPORITES		8.0	2.8
ENDOSPORITES		.4	.4
FLORINITES	1.2		.4
GRANULATISPORITES	1.6	15.2	5.6
KNOXISPORITES	+	1.2	2.0
LAEVIGATOSPORITES	73.2	8.0	47.6
LYCOSPORA	4.8	36.8	17.2
PUNCTATISPORITES	.4	3.6	8.8
RAISTRICKIA	+	2.0	.4
RETICULATISPORITES	.8	.8	
SACITRISPORITES	+	1.2	8.4
TRIQUITRITES	+		
WILSONITES	5.6		.4
MONOSACCATE	9.6	16.0	3.6
BISACCATE	2.0	2.8	
ALL OTHER TAXA		1.2	1.6
	100.0%	100.0%	100.0%

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

Macerations 78 A-C = 47.5" coal and parting
78-A = 0.0-26.0" coal with thin fusain partings
78-B = 26.0-37.0" claystone with seat structure
78-C = 37.0-47.5" coal with thin clay partings

TABLE 3

GENERIC SUMMARY OF THE SMALL SPORES OF THE ALMA COAL OF LOGAN AND MINGO COUNTIES
(60 feet north of Island Creek No. 33 Mine Entry, 30 feet above road level, Whitman Junction, Mouth of Whitman Creek, 1.75 miles east of Holden, Logan County, West Virginia)

	80-A	80-B	80-C	80-D
AHRENSISPORITES		1.6	4.0	
ALATISPORITES		+		+
CALAMOSPORA	+	1.2	1.2	1.6
CAMPTOTRILETES		.4		
CIRRATRIRADITES		+		
CONVOLUTISPORA	+		1.6	.8
CRASSISPORA				10.8
CRISTATISPORITES				.4
DENSOSPORITES	+	51.2	40.0	5.2
DICTOTRILETES	+			
ENDOSPORITES	+	+		.4
FLORINITES	+	1.6	1.6	.8
GRANULATISPORITES	+	2.0	6.0	5.6
KNOXISPORITES		+		.8
LAEVIGATOSPORITES	+	16.8	30.0	8.4
LYCOSPORA	+	18.4	7.6	60.0
PUNCTATISPORITES	+	2.4	.8	.4
RAISTRICKIA		2.0	.4	.4
RETICULATISPORITES		+	.8	1.2
SAVITRISPORITES	+		.4	
SIMOZONOTRILETES		.4	.4	
TRIQUITRITES				.4
VESTISPORA	?			
WILSONITES	+	+	.8	.8
MONOSACCATE			4.4	2.0
ALL OTHER TAXA		.8		
		100.0%	100.0%	100.0%

+ = present but not observed in statistical count

80 A-D = 53' coal and underclay plus roof rock
80-A = 6.0" laminated claystone roof
80-B = 0.0-25.0" coal, weathered
80-C = 25.0-45.0" coal, weathered
80-D = 45.0-53.0" underclay

TABLE 4

GENERIC SUMMARY OF THE SMALL SPORES OF THE CEDAR GROVE AND LOWER CEDAR GROVE ("ISLAND CREEK SEAM")

Sample taken from dozer cut directly above Island Creek No. 33 Mine Entry 35 feet above Alma coal, Whitman Junction, mouth of Whitman Creek, 1.75 miles east of Holden, Logan County, West Virginia

	81-A	81-B	81-C	81-D	81-E
AHRENSISPORITES	+	4.0	3.2	.8	
ALATISPORITES	+	+	+		
CALAMOSPORA	+	.4	.4		.8
CAMPTOTRILETES			.8		
CIRRATRIRADITES	+	.4	.4	.4	+
CONVOLUTISPORA		+	+		
CRISTATISPORITES	+		6.8	1.6	
DENSOSPORITES	+	43.6	68.4	64.8	1.2
DICTYOTRILETES		.4		.8	+
ENDOSPORITES		+			.4
FLORINITES	+	.8		.4	.8
GRANULATISPORITES	+	3.2	2.4	3.6	1.6
KNOXISPORITES			+		
LAEVIGATOSPORITES	+	33.6	7.2	19.6	16.0
LYCOSPORA	+	5.6	.8	2.0	73.6
PUNCTATISPORITES		+	3.6	4.0	+
RAISTRICKIA	+	.4	.8	.4	1.6
RETICULATISPORITES	+	+	.8		+
SAVITRISPORITES	+	.8	3.2		
SIMOZONOTRILETES	+	.4	.4		
TRIQUITRITES			+	.8	
VESTISPORA					.4
WILSONITES		2.4			.8
MONOSACCATE	+	3.6	.4	.8	2.8
ALL OTHER TAXA		.4	.4		+
	100.0%	100.0%	100.0%	100.0%	100.0%

+ = present but not observed in statistical count. 1000 specimens counted

Macerations 81 A-E = 82" coal and parting

81-A = 10.0" claystone
81-B = 0.0-26.0" coal
81-C = 26.0-29.0" clay parting
81-D = 29.0-56.0" coal, hard
81-E = 56.0-82.0" coal, hard

TABLE 5

GENERIC SUMMARY OF THE SMALL SPORES OF THE "UPPER AND LOWER CEDAR GROVE" COALS

	101-A	101-B	100-A	100-B	100-C	100-D	100-E	100-F	100-G	100-H
AHRENSISPORITES	.4	.4	+		+		.4		+	
ALATISPORITES							+		.4	
CALAMOSPORA	.8	.4	.4	.8		4.0			+	.4
CAMPTOTRILETES			?							
CIRRATRIRADITES	+			+	+				+	+
CONVOLUTISPORA						+	.4	+	+	+
CRASSISPORA					2.0					
CRISTATISPORITES	.4		.8	+						.4
DENSOSPORITES	9.2	.4	4.8	3.6	2.8	.8	1.6		32.8	3.2
DICTYOTRILETES	+	+	.4	+		+		+	1.2	.4
ENDOSPORITES	1.6	1.2	+	.8		1.6	.8	.4	2.0	2.8
FLORINITES	.8	+	.4	.8			.4	+	.8	.4
GRANULATISPORITES	10.4	1.2	4.0	3.6	.8	2.4	4.4	1.2	8.8	2.8
KNOXISPORITES			+	+	+	5.2				
LAEVIGATOSPORITES	31.2	1.2	3.6	17.6	.4	28.8	7.6	.4	29.6	12.8
LYCOSPORA	33.2	94.0	84.8	65.6	90.4	44.8	77.6	97.6	12.4	68.4
PUNCTATISPORITES	1.6	+	+	1.6	2.4	2.4	1.6	+	3.2	1.2
RAISTRICKIA	.4		+	+	+	2.4	.4	+	.4	.8
REINSCHOSPORA							+			+
RETICULATISPORITES	+	+	+	.8		+	.4	+	.4	
SAVITRISPORITES	.4	+	+	+		1.2		+	+	+
SIMOZONOTRILETES					.4				+	+
TRIQUITRITES	.4		+		+					
VESTISPORA			+				+	+		
WILSONITES	1.2	.4	.4	.8		.8		+	.8	1.2
MONOSACCATE	7.6	.8	.4	4.0	.8	1.2	2.4	.4	7.2	4.0
ALL OTHER TAXA	.4	+	+			4.4	2.0		+	1.2
	100.0%	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. 2,500 specimens counted

Macerations 101 A-B = "Upper Cedar Grove" from rib of slope on Island Creek Coal Company No. 26 Mine level, mouth of Spring Branch, Rockhouse Fork, Pigeon Creek, 5½ miles east of Delbarton, Mingo County, West Virginia.

101-A = 0.0-40.5" coal with clay films
101-B = 40.5-50.5" claystone and coal mixed

Macerations 100 A-H = "Lower Cedar Grove" from drift wall, ca. 150 feet east of slope sump, Island Creek Coal Company Mine 25 at the same location as 101.

100-A = 4" claystone, laminated, grab sample
100-B - 7.0" coal, rider or split
100-C = 23.0" claystone, only basal 10" sampled
100-D = 0.0-6.5" coal with clay partings
100-E = 6.5-21.5" coal
100-F = 21.5-24.5" claystone
100-G = 24.5-47.5" coal
100-H = 47.5-69.5" coal

REPORT ON REFERRED FOSSILS

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

Stratigraphic range: Pennsylvanian

General locality: Kentucky

Referred by: Don C. Alvord

Report prepared by: Robert M. Kosanke
2/2/67

Status of work: KG-66-4D complete
KG-65-11D incomplete

Kinds of fossils: Spores and pollen

Quadrangle or area: Elkhorn City quad., Ky.; Virginia, Haysi, Toms Creek, and Richlands quads., Virginia

Shipment No.: KG-66-4D and KG-65-11D

Date material received:
KG-66-4D 5/16/66
KG-65-11D 7/14/65

Report not to be quoted or paraphrased in publication without a final recheck by the Paleontology and Stratigraphy Branch.

Macerations 87 G-K - 48 inches shale, coal, and seat rock from Splash Dam (?) coal, Alvord samples C121, 16,400' N.25° W. of gaging station at Elkhorn City, Pike County, Elkhorn City quad., Kentucky.
87-G - 6" shale
87-H - 10" coal
87-I - 11½" claystone, seat rock structure
87-J - 14½" coal, top 3" impure
87-K - 6" seat rock, silty

Macerations 90 A-D - 50 inches shale, coal, and underclay from Domas coal at type locality, Alvord samples R-4, 12,000' S. 48° E. of gaging station at Elkhorn City, Elkhorn City quad., Virginia.
90-A - 6" shale, silty
90-B - 14" coal
90-C - 13" coal
90-D - 13" coal
90-E - 4" underclay, carbonaceous

Macerations 89 A-G - 69½ inches shale, coal, and clay from Splash Dam coal at type locality, Alvord samples R-50, 5,400' N.24° W. of gaging station at Haysi, Dickenson County, Haysi quad., Virginia.
89-A - 12" shale, silty
89-B - 17" coal, weathered
89-C - 14½" coal, weathered
89-D - 2" shale
89-E - 10¼" coal, weathered
89-F - 9 3/4" coal with clay
89-G - 4" underclay

Macerations 104 A-F - 62½ inches coal, sandstone, and clay from Upper Banner coal at type locality, Alvord samples SC, from 0.9 mile ENE of Banner, Wise County, Toms Creek quad., Virginia.
104-A - 16" coal, weathered
104-B - 7" coal
104-C - 1½" sandstone, carbonaceous, micaceous
104-D - 16½" coal with ½" clay at base
104-E - 5" coal
30' sandstone unit directly over unit below, no sample
104-F - 16½" coal (Upper Banner leader)

Macerations 103 A-C - 32½ inches clay, shale, and coal from Lower Banner coal at type locality, Alvord samples SB, from 0.7 mile ENE of Banner, Wise County, Toms Creek quad., Virginia.
103-A - 3½" clay, shale, and coal films
103-B - 14" coal, weathered
103-C - 15" coal, less weathered than 103-B

Macerations 102 A-I - 92½ inches shale, coal, and underclay from Kennedy coal at type locality, Alvord samples SA, from 0.7 mile ESE of Banner, Wise County, Toms Creek quad., Virginia
102-A - 4" shale, silty
102-B - 5" coal, impure at base
102-C - 14½" coal
102-D - 14" coal
102-E - 11½" coal, impure, sheared
102-F - 19" coal
102-G - 15" coal
102-H - 5½" coal, sheared, peacock color
102-I - 4" underclay

Macerations 106 A-C - 44 inches of weathered coal, Kennedy coal of Giles, from 0.2 miles from mouth of Skillet Branch of Left Fork of Lick Creek, Haysi, Virginia.
106-A - 16" coal, weathered
106-B - 12" coal, weathered
106-C - 16" coal, weathered

Macerations 105 A-C - 33 inches of coal and underclay from Raven coal (Red Ash) at type locality, Alvord samples SD, 2.1 miles north of Red Ash, Russel County, Richlands quad., Virginia.
105-A - 13½" coal, weathered
105-B - 16" coal, weathered
105-C - 3½" underclay

General comments

Macerations 87-I, 89 A, B, and E, 106 A-C, and 105 A-C failed to yield a sufficient spore and pollen assemblage to permit a meaningful statistical count on the generic level. The occurrence of some specimens that could be identified to species in 105 A-C has proved to be of value. In general, recovery of spores and pollen and quality of preservation is better in macerations 87 and 90 than in the balance of the samples examined.

Schulzospora rara Kos. occurs in one or more segment samples from each of the maceration series under discussion. My report of 4/29/66 (KG-65-11D) indicates the known range of this species. Dictyotriletes bireticulatus (Ibr.) Pot. and Kr. occurs in maceration 87, 90, 89, 104, 103, and 102. Butterworth (1964) reported that this species originates in Europe in Late Westphalian A. Thus, Schulzospora rara and Dictyotriletes bireticulatus occur together in Late Westphalian A. The coals under discussion are within this zone. Based on the data of Cropp (1963) for Tennessee, the coals considered in this report could not be older than the Clifty coal (Lee Formation) or as young as the Hopper coal (Briceville Formation).

SPLASH DAM COAL - Macerations 89 A-G

The Splash Dam coal from the type locality contains 21 genera with Densosporites dominant in 89-C (see table 1), Granulatisporites most abundant in 89-D, and Lycospora numerically significant in 89 F-G. Restricting our discussion to the coal portion of the 89 maceration series, the overall abundance is as follows:

Densosporites	60.8%
Granulatisporites	7.2
Lycospora	20.2
	88.2%

On this basis, Densosporites is dominant and together with Granulatisporites and Lycospora, 88.2% of the total assemblage is accounted for.

Sixty-three species have been identified from 89 A-G. Only six of these species appear to have value for correlation purposes. They are Endosporites 1181, Florinites 203, Lycospora 496, Punctatisporites 1088, Reticulatisporites 1191, and Wilsonites 287.

SPLASH DAM (?) COAL - Macerations 87 G-K

Twenty-three genera have been identified from 87 G-K. All of the genera present in 89 A-G are present in 87 G-K except for Triquitrites which is restricted to the underclay (89-G). In addition, 87 G-K contains Knoxisporites and Reinschospora (see table 2), and a species restricted to the underclay (87-K) that I have provisionally assigned to Stenozonotriletes. Restricting our discussion to the coal portion of the 87 maceration series, the overall abundance is as follows:

Densosporites	41.9%
Granulatisporites	12.6
Lycospora	27.7
	82.2%

On the overall basis, Densosporites is most abundant followed by Lycospora and Granulatisporites. This is similar to the type Splash Dam coal.

Sixty-eight species have been identified from 87 G-K. Forty-three of these species occur in macerations 89 A-G. Of the 6 species of potential value for correlation purposes listed previously, only Wilsonites 287 is present in both the 87 and 89 maceration series. Two of the coal segment samples failed to yield spores, representing 27¼" of coal in the 89 maceration series. Had these abundantly

abundantly
two segment samples yielded spores, a closer comparison might have been possible. A correlation between the coal portions of the 89 and 87 maceration series is possible, but this is not evident from the underclays of the sets of samples.

UPPER BANNER COAL - Macerations 104 A-F

The Upper Banner coal from the type locality contains 26 genera (see table 3) with Lycospora numerically most abundant in 104-A, Densosporites dominant in 104 B-C, and most abundant in 104-D, Laevigatosporites (largely L. 106) most abundant in 104-E followed by Lycospora and Granulatisporites, and Lycospora clearly dominant in 104-F, the "Upper Banner Leader" coal. Note should be made of the occurrence of Cristatisporites, especially in 104-D (25.2%). If one excludes maceration 104-F from consideration and restricts discussion to overall abundance in the coal segments, the following percentages apply:

Cristatisporites	10.2%
Densosporites	41.8
Granulatisporites	8.8
Laevigatosporites	12.6
Lycospora	17.5
	90.9%

Seventy-eight species have been identified from 104 A-F. Four of these species have not been observed below the Upper Banner coal and may be of value for correlation purposes. These four species are Alatisporites 460, Calamospora 76, Cristatisporites 1132, and Raistrickia 1233. A fragment of a specimen identified as Vestispora sp. is the oldest known occurrence of this genus in Kentucky.

A comparison with the Elswick coal, macerations 91 A-D, my report of 4/29/66, does not compare closely in that Alatisporites, Crassispora, Dictyotriletes, Knoxispora, Reinschospora, and Vestispora occur in the Upper Banner coal (104 A-F) and have not been observed in the Elswick coal (91 A-D). However, Alatisporites and Crassispora do not occur in the coal segments of 104 A-E so this may not constitute a serious discrepancy. The overall percentages for the coal portion of the Elswick sample shows that Lycospora is most abundant followed by Cristatisporites, Densosporites, and Granulatisporites.

Cristatisporites	20.5%
Densosporites	16.6
Granulatisporites	15.5
Laevigatosporites	4.1
Lycospora	26.1
	82.8%

Sixty-three species have been identified from the Elswick coal and 22 of these species occur in the Upper Banner coal. This is a very poor comparison not suggesting a correlation between macerations 104 and 91.

Maceration 104-F, the "Upper Banner leader" coal occurring 30 feet below 104-E, does show a strong resemblance to macerations 92 A-B, the Kennedy coal

of Giles (see my report of 4/29/66). The overall comparison of the coal portion is shown below:

	104-F	92 A-B
Densosporites	3.6%	3.2%
Granulatisporites	9.2	14.7
Lycospora	66.4	57.4
	79.2	75.3%

LOWER BANNER COAL - Macerations 103 A-C

The type Lower Banner coal, macerations 103 A-C, contains 18 genera (see table 4) with Lycospora most abundant followed by Granulatisporites and Densosporites in the roof clay 103-A. Densosporites is dominant in the top half of the coal (103-B) with Lycospora most abundant in the lower half of the coal (103-C). The overall percentages for the coal portions of the 103 maceration series shows Densosporites most abundant followed by Lycospora.

Cristatisporites	10.1%
Densosporites	47.2
Granulatisporites	10.7
Lycospora	22.3
	90.3%

This does not compare favorably with macerations 92 A-B.

Forty-two species have been identified from the Lower Banner coal (103 A-C). Twenty of these species occur in the Kennedy coal of Giles (92 A-B). This together with the poor comparison on the generic level suggests very little chance of a correlation between the Lower Banner and the Kennedy coal of Giles.

KENNEDY COAL - Macerations 102 A-I

The Kennedy coal from the type locality, macerations 102 A-F, contains 22 genera with Lycospora and Granulatisporites numerically significant throughout, and Densosporites numerically important only in 102-C (see table 5). The composite overall percentages of the coal segment samples follows:

Densosporites	9.0%
Granulatisporites	41.3
Lycospora	43.4
	93.7%

These percentages for the numerically important genera are quite unlike any thus far discussed. This is because Granulatisporites is almost co-dominant with Lycospora for the entire coal portion of the samples.

Fifty-four species have been identified, eight of which could have value for correlation purposes. Maceration 106, the Kennedy coal of Giles from near Haysi, Virginia, was barren of spores and pollen. This was not surprising in that the samples were badly weathered.

RAVEN COAL - Macerations 105 A-C

The Raven coal from the type locality, macerations 105 A-C (see table 6), was weathered and it was impossible to obtain a meaningful statistical count. By examination of a large number of slides, the presence of 11 genera and 27 species was established. Twenty-two of these species occur in the Domas coal from the type locality. Because of this and the fact that some of the 22 species appear to be restricted to the Raven and Domas coal, I consider the possibility of a correlation fairly good. This is despite the fact that the preservation of spores and pollen in the Raven coal samples is poor.

DOMAS COAL - Macerations 90 A-F

The Domas coal from the type locality, macerations 90 A-F, yielded 22 genera and 92 species (see table 7). The preservation of spores and pollen is excellent in all samples. Lycospora is dominant in 90-A, Densosporites in 90-B, Densosporites and Lycospora in 90-C, Lycospora in 90-D, and Savitrisporites in 90-E. The occurrence of Savitrisporites at the rate of 64 percent in the underclay is very unusual. For comparative purposes with the coals discussed, I am reporting the overall percentages for the numerically important genera occurring in the coal portions of the 90 maceration series.

Densosporites	36.4%
Granulatisporites	7.2
Lycospora	44.3
	87.9%

In summary, all of these coals are in the overlap zone of Schulzospora rara-Dictyotriletes bireticulatus. The Splash Dam (?) coal (87 G-K) could correlate with the type Splash Dam coal (89 A-G). The "Upper Banner leader" coal (104-F) shows a relationship to the Kennedy coal of Giles (92 A-B), and the Domas coal from the type locality (90 A-D) could correlate with the Raven coal from the type locality(105 A-C).

Robert M. Kosanke

Robert M. Kosanke

TABLE 1

GENERIC SUMMARY OF THE SMALL SPORES OF THE SPLASH DAM COAL FROM THE TYPE LOCALITY (5,400' N.24°W. of gaging station at Haysi, Dickenson County, Haysi Quad., Virginia)

	89-A	89-B	89-C	89-D	89-E	89-F	89-G
AHRENSISPORITES				.4		.4	
CALAMOSPORA				1.2		.4	
CAMPTOTRILETES						.4	
CIRRATRIRADITES				.4			+
CONVOLUTISPORA				.4			
CRISTATISPORITES	+		6.4	6.4	+	.4	+
DENSOSPORITES	+	+	79.2	18.0	+	32.0	2.8
DICTYOTRILETES				.4			+
ENDOSPORITES		+	.4				
FLORINITES			+			.4	.8
GRANULATISPORITES		+	2.8	25.6	+	13.6	2.8
LAEVIGATOSPORITES		+	2.8	13.2	+	5.2	1.6
LYCOSPORA	+		5.2	9.2	+	43.2	80.8
PUNCTATISPORITES			.8	2.8	+	.4	1.6
RAISTRICKIA			.4	.4		.8	+
RETICULATISPORITES			+	+			
SAVITRISPORITES				4.0		.4	1.2
SCHULZOSPORA		+	1.6				.4
SIMOZONOTRILETES			+				
TRIQUITRITES							.4
WILSONITES			+	+		+	.4
MONOSACCATE			.4	17.6		1.6	7.2
ALL OTHER TAXA		+	+			.8	+
			100.0%	100.0%		100.0%	100.0%

+ = present but not observed in statistical count. 1000 specimens counted

Macerations 89 A-G = 69½" shale, clay, and coal
89-A = 12" shale
89-B = 17" coal, weathered
89-C = 14½" coal, weathered
89-D = 2" shale
89-E = 10¼" coal, weathered
89-F = 9 3/4" coal with clay
89-G = 4" underclay

TABLE 2

GENERIC SUMMARY OF THE SMALL SPORES OF THE SPLASH DAM (?) COAL
(16,400' N.25°W. of gaging station at Elkhorn City, Pike County, Elkhorn City Quad., Kentucky)

	87-G	87-H	87-I	87-J	87-K
AHRENSISPORITES		5.6	+	.4	+
CALAMOSPORA	4.0	1.6		.8	+
CAMPTOTRILETES	.4				
CIRRATRIRADITES		+			+
CONVOLUTISPORA		+			
CRISTATISPORITES				+	4.4
DENSOSPORITES	.4	4.4	+	74.4	24.8
DICTYOTRILETES		.4			
ENDOSPORITES	+	2.0		.4	.8
FLORINITES			+	+	.8
GRANULATISPORITES	.8	20.4	+	6.4	4.4
KNOXISPORITES	.8		+		+
LAEVIGATOSPORITES	.8	2.4	+	2.4	2.4
LYCOSPORA	84.0	56.0	+	5.2	6.4
PUNCTATISPORITES	.8	3.6	+	.8	2.0
RAISTRICKIA	+	.8		1.6	+
REINSCHOSPORA		+			
RETICULATISPORITES	+			+	.4
SAVITRISPORITES	.4	.4		.4	.4
SCHULZOSPORA	7.6	2.0		2.8	.4
SIMOZONOTRILETES					.4
STENOZONOTRILETES					37.2
WILSONITES				.8	2.0
MONOSACCATE		.4		3.6	13.2
ALL OTHER TAXA				+	+
	100.0%	100.0%		100.0%	100.0%

+ = present but not observed in statistical count. 1000 specimens counted

Macerations 87 G-K = shale, coal, and clay 46"
87-G = 6" shale with thin coal lenses
87-H = 10" coal
87-I = 11½" clay-shale with thin coal lenses
87-J = 12½" coal
87-K = 6" seat rock

TABLE 3

GENERIC SUMMARY OF THE SMALL SPORES OF THE
UPPER BANNER COAL FROM THE TYPE LOCALITY

(0.9 mile ENE of Banner, Wise County, Toms Creek quad., Virginia. Sample cut by old adit on north side of road to Sandy Ridge. Alt. 2400 feet)

	104-A	104-B	104-C	104-D	104-E	104-F
AHRENSISPORITES	+	.4	2.8	+	.8	
ALATISPORITES			+			
CALAMOSPORA	+				.8	1.6
CAMPTOTRILETES			+			
CIRRATRIRADITES	+			.4	+	.4
CONVOLUTISPORA	.8	+	+			.4
CRASSISPORA						2.0
CRISTATISPORITES	.4	4.0	1.6	25.2	.8	
DENSOSPORITES	20.8	86.4	82.8	55.6	1.6	3.6
DICTYOTRILETES	1.6	.4	2.4	.4	+	.4
ENDOSPORITES	3.6	+	+	+		
FLORINITES	+	+		.8	.8	
GRANULATISPORITES	10.8	4.8	4.0	4.4	22.8	9.2
KNOXISPORITES		+	+			+
LAEVIGATOSPORITES	16.0	.8	+	8.0	34.0	11.2
LYCOSPORA	44.4	.4	.4	2.4	26.0	66.4
PUNCTATISPORITES	.4	1.6	.8	2.4	2.8	.4
RAISTRICKIA	.8		2.4	+	+	1.2
REINSCHOSPORA	.4		1.2			
RETICULATISPORITES	+	+	1.2	.4	.4	
SAVITRISPORITES	+				5.6	2.4
SCHULZOSPORA						+
SIMOZONOTRILETES		+				
TRIQUITRITES						.4
VESTISPORA	+					+
WILSONITES		.8			.4	
MONOSACCATE		.4	.4		3.2	+
ALL OTHER TAXA		+			+	.4
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

+ = present but not observed in statistical count. 1,500 specimens counted

104 A-F - 62.5" coal, sandstone, and clay
- 104-A = 16.0" coal, weathered
- 104-B = 7.0" coal
- 104-C = 1.5" Ss., carb., mic.
- 104-D = 16.5" coal + $\frac{1}{2}$" clay at base
- 104-E = 5.0" coal with clayey Ss. at base
  30.0 Ss., fn. grained, Mic., no sample
- 104-F = 16.5" coal (Upper Banner Leader)

TABLE 4

GENERIC SUMMARY OF THE SMALL SPORES OF THE LOWER BANNER COAL FROM THE TYPE LOCALITY

(0.7 mile ENE of Banner, Wise County, Toms Creek quad., Virginia. Sample cut on north side of road to Sandy Ridge. Alt. 2280')

	103-A	103-B	103-C
AHRENSISPORITES	.4	.8	
CALAMOSPORA	.8		
CIRRATRIRADITES		+	
CONVOLUTISPORA	+		
CRISTATISPORITES	+	20.4	.4
DENSOSPORITES	18.4	68.0	27.2
DICTYOTRILETES	+		
ENDOSPORITES	4.0		+
FLORINITES	.4		.4
GRANULATISPORITES	20.0	2.4	18.4
LAEVIGATOSPORITES	8.8	5.6	7.6
LYCOSPORA	39.6	.4	43.2
PUNCTATISPORITES	.4	.8	1.6
RAISTRICKIA	.4	1.2	.4
SAVITRISPORITES	+		
SCHULZOSPORA	1.6		
TRIQUITRITES	1.2		
WILSONITES	.8		
MONOSACCATE	3.2	.4	.8
ALL OTHER TAXA	+		
	100.0%	100.0%	100.0%

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

103 A-C = 3.5" clay and 29" coal
103-A = 3.5" clay, clay-shale
103-B = 14.0" coal
103-C = 15.0" coal

TABLE 7

GENERIC SUMMARY OF THE SMALL SPORES OF THE DOMAS COAL FROM THE TYPE LOCALITY
(12,000 feet S.48° of the gaging station at Elkhorn City, Elkhorn quad., Virginia)

	90-A	90-B	90-C	90-D	90-E
AHRENSISPORITES	+		+	+	.8
CALAMOSPORA	4.0		1.2	1.2	+
CAMPTOTRILETES				+	
CIRRATRIRADITES			+		
CONVOLUTISPORA					.4
CRASSISPORA				+	
CRISTATISPORITES		2.0	2.4	+	
DENSOSPORITES	+	57.2	39.2	11.6	.4
DICTYOTRILETES	.4	+			
ENDOSPORITES		.4			
FLORINITES	+		+	.4	3.6
GRANULATISPORITES	6.4	6.4	11.2	4.8	14.0
KNOXISPORITES				+	
LAEVIGATOSPORITES		1.6	4.0	3.2	.8
LYCOSPORA	69.6	30.8	37.2	66.0	4.8
PUNCTATISPORITES	10.0	1.2	1.2	2.0	2.0
RAISTRICKIA	2.8	.4	.4	.8	+
REINSCHOSPORA		+			
RETICULATISPORITES			.4	.4	+
SAVITRISPORITES				+	64.0
SCHULZOSPORA	3.2	+	2.8	2.0	
WILSONITES				2.4	.4
MONOSACCATE	3.2			4.8	6.8
ALL OTHER TAXA	.4			.4	2.0
	100.0%	100.0%	100.0%	100.0%	100.0%

+ = present but not observed in statistical count. 1250 specimens counted

Macerations 90 A-E = 6" roof Sh., 40" coal, and 4" underclay

90-A = basal 6 inches of roof shale
90-B = 0.0-14.0" coal
90-C = 14.0-27.0" coal
90-D = 27.0-40.0" coal
90-E = top 4" of underclay

TABLE 6

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

(2.1 miles north of Red Ash, Russell County, Virginia, Richlands quad. 100' off US 460 in cut bank on north side of truck trail leading to strip mines in Red Ash on Mudlick Creek)

	105-A	105-B	105-C
AHRENSISPORITES		+	+
CALAMOSPORA			+
CRISTATISPORITES	+	+	
DENSOSPORITES	+	+	+
GRANULATISPORITES	+	+	+
LAEVIGATOSPORITES	+	+	+
LYCOSPORA	+	+	+
PUNCTATISPORITES			+
RAISTRICKIA		+	+
RETICULATISPORITES	+	+	
SCHULZOSPORA	+	+	

+ = present in macerations as indicated. Statistical count not attempted.

105 A-C = 29.5" coal and 3.5" clay
105-A = 13.5" coal, weathered
105-B = 16.0" " " " "
105-C = 3.5" underclay

TABLE 5

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

(0.7 mile ESE of Banner, Wise County, Toms Creek quad., Virginia. In road cut on north side of US 58 alternate, in pass between Bull Run and Little Toms Creek)

	102-A	102-B	102-C	102-D	102-E	102-F	102-G	102-H	102-I
AHRENSISPORITES	+	+	1.2	.8			.4		+
CALAMOSPORA			.4			.4		+	+
CAMPTOTRILETES	+								
CIRRATRIRADITES			+					+	
CRASSISPORA								.4	
CRISTATISPORITES			+		1.6		+	1.2	
DENSOSPORITES	1.6	+	.8	+	14.8	.8	33.2	4.8	+
DICTYOTRILETES			4.0	2.8	1.2	1.6	1.6	.8	
ENDOSPORITES			.8	+		+		+	
FLORINITES								.4	+
GRANULATISPORITES	17.6	+	58.4	54.8	23.2	53.2	17.6	24.0	+
KNOXISPORITES									+
LAEVIGATESPORITES	.4	+	+	+	1.6		1.6	4.4	+
LYCOSPORA	49.6	+	33.6	38.4	57.6	40.8	43.2	62.0	+
PUNCTATISPORITES	20.8	+	.4	.8		.8	1.2	.8	+
RAISTRICKIA	1.6	+	.4	.4	+	.8		+	+
REINSCHOSPORA								.4	
RETICULATISPORITES			+						
SAVITRISPORITES	.8							+	
SCHULZOSPORA	3.6	+	+	.4				.8	+
TRIQUITRITES	.8	+				.8			
WILSONITES				.4					
MONOSACCATE	2.8			1.2		.8	1.2		
ALL OTHER TAXA	.4	+		+			+	+	
	100.0%		100.0%	100.0%	100.0%	100.0%	100.0%		

+ = present but not observed in statistical count. 1,750 specimens counted

Macerations 102 A-I = 92.5" shale, coal, and underclay
102-A = 4.0" shale, silty
102-B = 5.0" coal, impure at base
102-C = 14.5" coal
102-D = 14.0" coal
102-E = 11.5" coal
102-F = 19.0" coal
102-G = 15.0" coal
102-H = 5.5" coal, peacock color
102-I = 4.0" underclay

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