THE DISTRIBUTION OF MICROSPORES IN THE COALFIELDS LYING TO THE WEST OF THE PENNINES.

THESIS

presented for the Degree of

DOCTOR of PHILOSOPHY

in the

University of Edinburgh

by

Mavis A. Butterworth, B.Sc.

July, 1956.

THE DISTRIBUTION OF MICROSPORES IN THE COALFIELDS LYING TO THE WEST OF THE PENNINES.

By

Mavis A. Butterworth, B.Sc.

Figures 1 - 12

CONTENTS

I. INTRODUCTION.

The present investigation was carried out as part of a survey of the national coal resources of Great Britain undertaken by the Scientific Department (Coal Survey branch) of the National Coal Board. The work and its object were to study the microspore contents of sequences of seams from different areas in order to discover whether there might be any zonal features in the spore assemblages which remain constant when traced laterally within each area or even from one area to another.

In the course of the investigation some 612 samples of seams have been examined from the coalfields of Lancashire, Staffordshire, North Wales, Shropshire and Warwickshire. These coalfields, together with those of Yorkshire, Nottinghamshire, Leicestershire and South Derbyshire lying to the east of the Pennines, comprise the central group of English coalfields. This group was considered by Trueman (1947) to have formed a continuous area of deposition extending from the Craven block southwards to St. George's Land and the Midland land barrier. Fig. 3 is a map of the area covered by the present investigation and on it the sites from which samples have been taken are marked and numbered.

In recent years much detailed stratigraphical and palaeontological work has been done in these coalfields, mainly by officers of H.M. Geological Survey, and as a result the geology of the areas concerned is now known in considerable detail. Valuable datum lines are provided by the marine bands which occur in the modiolaris and similispulchra non-marine lamellibranch zones, and the limits of these zones have now been defined in most of the fields.

The National Coal Board's extensive boring programme has made available many seams hitherto unexposed and has provided complete sequences which previously had to be compiled from widely separated colliery workings. Inevitably the distribution of sampling points is uneven, the greatest amount of material being available from those areas for which the maximum development is foreseen.

It is hoped that the establishment of microspore successions in these coalfields will be an aid in the elucidation of coal-seam correlation problems, both in borehole sequences, to which this method is particularly applicable on account of the small quantity of coal required for the microspore analyses, and in colliery workings.

II. HISTORICAL INTRODUCTION.

Spores, both microspores and megaspores, from the Carboniferous sediments of Scotland were first recognised by Bennie and Kidston (1886) who examined samples collected from a thoroughly representative set of localities and horizons. They isolated the spores by alternately wetting and drying their material, although a maceration technique had been evolved earlier by Schulze (1855) who treated the coal with potassium chlorate and nitric acid (Schulze solution) followed by alkali. Very little was published by Kidston on the nature of the microspores found. Reinsch (1884) had previously described and figured many spores from Russia and Saxony but he interpreted them as belonging to the algae. Although he figured many microspores his descriptions are not valid taxonomically, as in many cases neither the source of his material nor the location of the type specimens is known.

The work of these pioneers was not followed up for many years and in the meantime attention was concentrated on the examination of megaspores in thin sections of coal. This technique was developed in America by Thiessen (1924) who described the vertical and lateral variations of megaspore distribution in several seams of the Pennsylvanian series.

He maintained that coals could be correlated by this method, arguing that the presence of certain distinctive spores at particular horizons in a seam was a feature which could be traced laterally and could therefore serve to differentiate one seam from another.

In England thin sections of coal were examined by Slater and his associates at the Sheffield Coal Survey Laboratory and on a basis of megaspore distribution the Arley Seam of Lancashire was correlated with the Better Bed of Yorkshire (Wray, Slater and Eddy, 1930).

The earliest systematic study of microspores was made by Potonié (1931) on assemblages from the Aegir and Bismarck seams of the Westphalian B of the Ruhr. Further studies of these seams were made by Ibrahim (1932) and Loose (1934) and as a result of these investigations Ibrahim (1933), with Potonié's guidance, devised a binomial system of spore nomenclature which has formed the basis of subsequent classifications. Zerndt (1934, 1937) made similar investigations on megaspores which he successfully extracted from coal.

Raistrick and Simpson (1933) and Raistrick alone (1934, 1939) in the same period examined microspores from the seams of Northumberland and Durham. The classification devised by Raistrick was one in which the spores were divided, on a basis of shape and ornamentation, into 7 groups lettered A - G, each of which was sub-divided numerically, e.g. A1, B3 etc. Raistrick had previously been engaged in pollen analysis of peats and the methods he used for correlating coal seams were a development of the techniques employed in the examination of peat. Samples of a seam were ground and reduced in bulk to 2gm. of finely powdered coal representative of the whole seam. This was macerated using the Schulze method. The proportions of the various spore types present were calculated from a count of several hundred spores and were recorded in the form of histograms. The spores were divided into 'common' and 'accessory' types and the individuality of the histograms depended on the differing proportions of the 'common' types A1, B1, B3, C1, D1, D3 and E2. Raistrick maintained that most seams had a characteristic histogram which remained fairly constant when the seam was traced laterally.

J. J. Walker (1942), who did a vast amount of work on microspores at the Sheffield Coal Survey Laboratory, the results of which, apart from a description of spores in the Pollington bore (Edwards, Walker and Wandless, 1938), were never published, has stated that in fact only three main types of histogram are possible, characterised by a dominance of A1, B1 or D1 respectively. Since B1 is only rarely the most common type present in a seam, it follows that in most cases there are only two main groups represented by the A and D type diagrams.

In his work on the North Staffordshire coalfields Millott (1938, 1946) showed that Raistrick's A-types are present for the most part only in black durain, a kind of dull coal, so that 'microspore analysis, in this instance, does not lead to any evidence which can be applied for the purposes of correlation beyond what is obvious from naked-eye inspection.'

Millott went on to investigate the vertical distributions of some of Raistrick's 'accessory' types in a sequence of seams from North Staffordshire. It was found that several of the rarer spores, notably C1, F1, G1 and Millott's type 5, had restricted ranges and were not present in the lower part of the sequence. In Yorkshire, meanwhile, Walker (1942) had noted that C1 was mainly confined to horizons above the Flockton seam and A7 to horizons below that seam.

Successions of seams from the Fife and Central coalfields of Scotland were examined by Knox (1942, 1946). The microspores used were numbered and prefixed by the letter K when they did not readily fit into Raistrick's classification.

The results obtained were substantially similar to those from North Staffordshire and Yorkshire. Investigations on the Limestone Coals of Fife (Knox, 1948) indicate that all of the 'common' spore types of Raistrick, excepting B1, are present in the lower coals but that the 'accessory' types are different.

In 1944 Schopf, Wilson and Bentall in America published a synopsis of Palaezoic spores and the definition of generic groups. In this work a binomial system of spore nomenclature was developed which incorporated all earlier descriptions of spores, including those of Ibrahim, Loose, Raistrick, Millott and Knox, and also spores described from the Carboniferous of America. 400 spore species were allocated among 23 genera. This system was amended by Knox (1950) who sub-divided the two largest genera of Schopf, Wilson and Bentall to form four smaller ones.

In 1950 Kosanke published a comprehensive account of the distribution of microspores in the Pennsylvanian of Illinois. The spore classification used was that of Schopf, Wilson and Bentall and five new genera were established.

Accounts of microspore studies which have been given since the present work was begun are discussed in the section of this paper dealing with microspore distribution in Britain, Europe and North America (Section VII, p.60).

III METHOD OF TREATMENT.

Most of the samples examined were taken from the cores of borings and are representative of the full seam thicknesses. In a few cases no whole seam samples were available and use was made of samples representing the marketable parts of the seams, or samples from which inferior or shaley coal had been omitted. Coals from collieries were obtained in the form of pillar-sections, whole seam samples of which were made up from representative portions of the various sub-sections. Material from trial pits on opencast sites was treated in a similar manner. Very occasionally seams were sampled at their outcrops, in which case a narrow channel section of the full seam thickness was taken when possible. Complete lists of the samples examined are recorded in the appendices relating to the various coalfields. (pp. i - xvi).

In the preparation of samples for microspore analysis the coal is crushed to pass through a 16 B.S. mesh sieve and a portion of this crushed material is ground so as just to pass through a 36 B.S. mesh sieve.

The maceration technique generally employed is essentially the same as that described by Raistrick (1934).

2gm. of the crushed coal are treated with Schulze solution (potassium chlorate and concentrated nitric acid) for periods varying from 6 to 48 hours and washed by decantation; the oxidised residue is then dissolved by a further 48 hours immersion in potassium hydroxide solution. The strength of the KOH solution appropriate to the purpose depends on the rank of the coal but is normally about 5%. The preparation is completed by repeated washings until the liquid holding spores, plant debris and unaltered coal particlss in suspension is clear.

Since the use of alkali tends to swell the spores slightly, the maceration technique described by Zetsche and Kalin (1932) is used when precise measurements of spores are to be made. In this method 0.2 gm. of coal are treated with 40 ml. fuming nitric acid for about 16 hours and then washed by filtration with successively weaker acid and finally with water. Usually Raistrick's method was used as it was found to be more convenient when dealingwith large batches of samples.

Permanent slides are made by warming a drop of the suspended material with a little glycerine jelly; the cover slips are sealed with gold size, although this does not always prevent their deterioration. For general purposes some

500 to 800 spores are counted and recorded from temporary water mounts. For this initial count the magnification used is 300. Large numbers of spores are subsequently examined and the occurrence of rare spore species recorded.

IV. CLASSIFICATION OF MICROSPORES.

The earliest system of spore nomenclature employed in this country was the numerical one of Raistrick (1934 etc.), modified forms of which were used by both Millott and Knox. At the present time a natural classification of microspores is impossible, as in the majority of cases the organic relationships between spores and parent plants are not known. The earlier generic names given to spores by Potonié (1931) and his associates were founded principally on the shape and ornamentation of the spores. A few of these genera, which are still being used, are _Granulatisporites_, _Punctatisporites_, _Alatisporites_, _Reticulatisporites_ and _Laevigatosporites_, all of which were described by Ibrahim (1933). The use of 'o' before 'sporites' in the last named genus indicates a monolete dehiscence slit as distinct from the trilete suture of genera whose names have an 'i' before 'sporites'.

The genus _Densosporites_ was proposed by Berry (1937) for certain thick-walled microspores occurring in the Pennington coal of Tennessee; this genus includes most of Raistrick's A-types.

In 1940 Wilson and Coe proposed three new genera - Cirratriradites, Endosporites and Triquitrites - for spores with equatorial flanges, enveloping bladders and triangular equatorial outlines with thickened apices respectively. Spores belonging to the genus Endosporites were thought to be related to the Cordaitales but recently they have been isolated from lycopod fructifications by Challoner (1953).

These genera, some of them in amended form, were all used by Schopf, Wilson and Bentall (1944) in their classification of Palaeozoic spores. In this system account was taken, where possible, of the known plant - spore affinities and new genera were created accordingly. The genus Calamospora was proposed for large thin-walled microspores known to be in part of Calamarian affinity (Hartung, 1933), and Lycospora for the most common of microspores, Raistrick's D1 types, which are believed to be related to the Lepidodendrales. The genus Raistrickia was proposed for microspores with parallel sided tubercles similar to Raistrick's E3 and E4, some of which have been identified as spores of Senftenbergia plumosa (Radforth, 1938; Remy, 1955) and are thought to be Filicean in origin. Pollen-like grains known from the work of Florin (1936, 1937) to be related to Cordaitales and other Palaeozoic gymnosperms were placed in the genus Florinites.

This classification of Schopf, Wilson and Bentall was adopted by subsequent Amercian spore workers and also by the British who however subsequently used the modifications suggested by Knox in 1950. The two largest genera in Schopf, Wilson and Bentall's classification, *Punctatisporites* and *Granulatisporites*, contain microspores with all types of exine ornamentation; they are separated from each other on the basis of their shape - species of *Punctatisporites* being round and species of *Granulatisporites* triangular. Knox's researches on the spores of existing lycopods indicate that the microspores of these plants tend to retain a similar form of ornamentation throughout their development; ornamentation therefore appears to be the most sound basis for classification. Four new genera were described - *Spinososporites*, *Planisporites*, *Verrucososporites*, and *Microreticulatisporites* which include spores with spinose, smooth, tuberculate and reticulate exospores respectively.

In his account of the Pennsylvanian spores of Illinois Kosanke (1950) recorded many new species and described the genera *Cadiospora*, *Schopfites* and *Schulzospora*. The first two are both restricted to the highest Coal Measures and Kosanke believes that *Cadiospora* may be a small megaspore. *Schulzospora* occurs only in the lower part of the succession; it is of interest that a species of this genus has recently been isolated from

<u>Simplotheca silesiaca</u>, a pteridosperm fructification, from Namur A of Niederschlesien (Remy, 1955). Notes on some of Kosanke's spores together with descriptions of three new species have been published by Butterworth and Williams (1954).

In 1954 Potonié and Kremp outlined a new spore classification based entirely on morphographic considerations and incorporating all previous descriptions of spores from the Palaeozoic of Europe (including Russia) and North America. The authors state that this classification has been devised for the use of spore workers engaged in Coal Measure correlations; theoretically it provides genera for all types of spores likely to be encountered. The probable plant affinities of each genus are given in a useful survey of work on this subject made by Potonie (1954). The details of the new classification are being published currently and only part is at present in print (Potonie and Kremp, 1955) but since it has been accepted on the continent and tentatively in North America (Hoffmeister, Staplin and Malloy, 1955) it has been thought advisable here to indicate the synonymy of the various spores used in so far as they can be ascertained at the present time.

In the following lists the synonyms are given of the 2 genera and 28 species used in the microspore distribution diagrams (Figs.4-12) and considered to be of stratigraphical value. These 30 types are illustrated in Figs. 1 and 2,

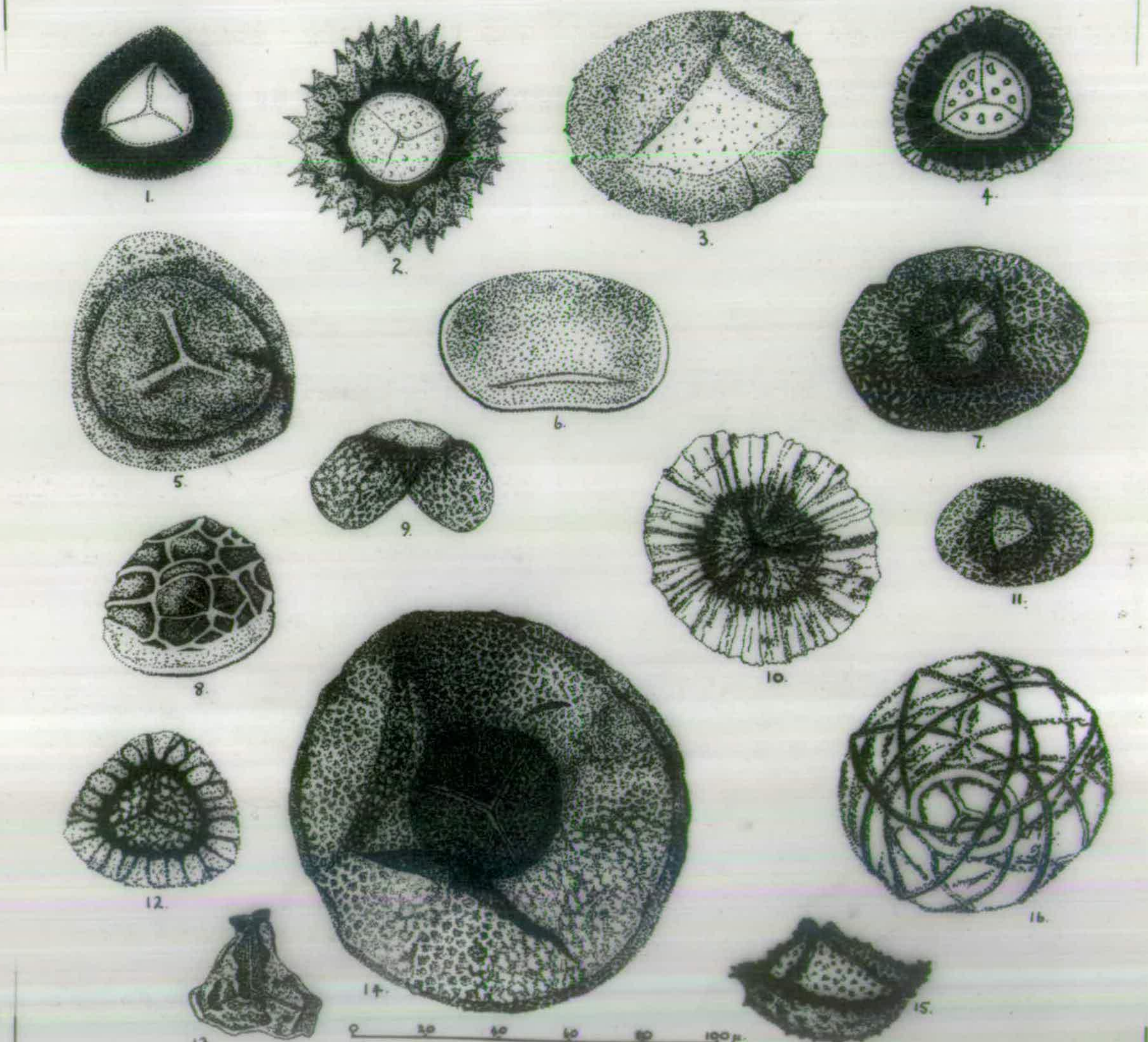


Fig. 1 Fossil Spores.

numbers 1 - 16 in Fig. 1 and 17 - 30 in Fig. 2. In the second part of the appendix (p.xviii et seq.) the percentages of a further 10 genera and 10 species are included; these consist of genera which would be of more practical value if split into a number of species, and also of ubiquitous species.

	NAMES USED	PROBABLE SYNONYMY
	Lycospora Schopf, Wilson & Bentall 1944	Lycospora S.W. & B.
(1)	Densosporites annulatus (Loose) S.W. & B.	Anulatisporites anulatus (Loose) Potonie & Kremp 1955.
(2)	D. indignabundus (Loose) S.W. & B.	Cristatisporites indignabundus (Loose) P. & K.
(15)	D. solaris Balme 1952	?C. solaris (Balme) P. & K.
	Calamospora S.W. & B.	Calamospora S.W. & B.
	Spinososporites Knox 1950	(Acanthotriletes (Naumova)P.& K. ? (Lophotriletes (Naumova)P.& K. (Apiculatisporites. Ibrahim
	S. sp. (Millott's type 4)	Anapiculatisporites spinosus (Kosanke) P. & K.
(3)	S. spinulistratus (Loose) Knox	Planisporites kosankei P. & K.
	Planisporites Knox	Planisporites (Knox) P. & K.
	Raistrickia S.W. & B.	Raistrickia (S.W. & B.) P. & K.
(26)	R. medusa Williams 1956	R. medusa W.
(4)	Cirratriradites striatus Knox	?Densosporites striatus (Knox) P. & K.
	C. sp.	Densosporites sp.
(12)	C. tenuis (Loose) S.W.& B.	?
(10)	C. aligerens Knox.	?

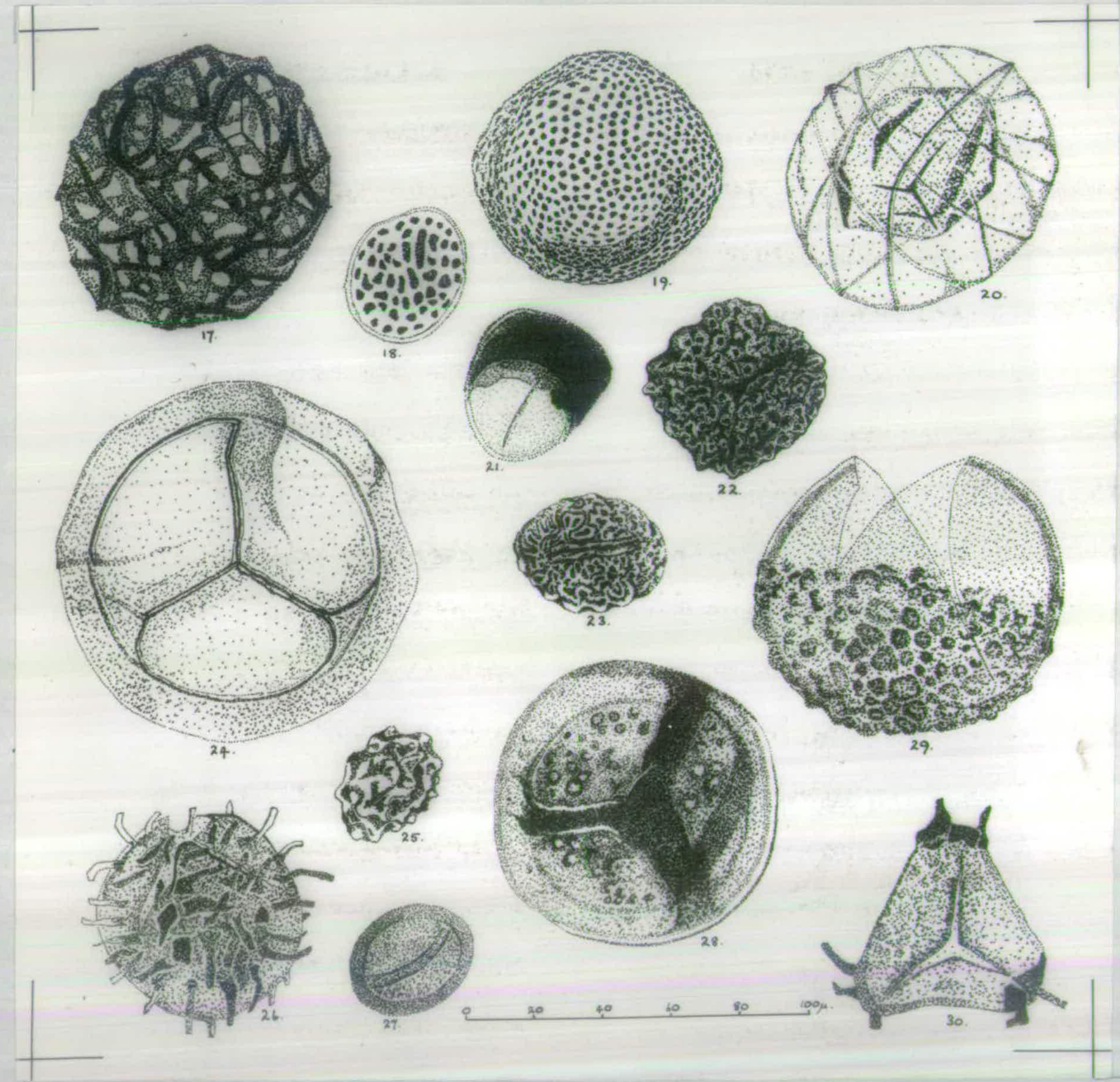


Fig. 2 Fossil Spores.

	NAMES USED	PROBABLE SYNONYMY
	C. saturni (Ibr.) S.W.& B.	C. saturni (Ibr.) S.W. & B.
(14)	Endosporites Wilson and Coe 1940	Endosporites Wilson and Coe
(5)	Schulzospora ovata (Balme)	Schulzospora ovata (Balme)
(20)	Endosporites costatus (Balme)	?
	Florinites S.W. & B.	Florinites S.W. & B.
(7)	F. antiquus Schopf	F. antiquus Schopf.
(11)	F. millotti Butterworth & Williams 1954	F. millotti B. & W.
(9)	Pityosporites westphalensis Williams 1955	P. westphalensis Williams
	Triquitrites Wilson & Coe	Triquitrites (W. & C.) P.& K.
(13)	T. sculptilis Balme	T. sculptilis Balme
(30)	T. inusitatus Kosanke 1950	T. inusitatus Kosanke
	Ahrensisporites P. & K.1954	Ahrensisporites P. & K.
(6)	Laevigatosporites (Ibr.) S.W. & B.	Laevigatosporites Ibr.
	L. minutus (Ibr.)S.W.& B.	Punctatosporites minutus (Ibr.) P. & K.
	L. minimus (W. & C.) S.W. & B.	?P. minimus (W. & C.) P. & K.
(23)	L. obscurus Kosanke	?Verrucososporites obscurus (Kos.) P. & K.
(27)	L. oculus Williams 1956	?Speciososporites oculus Williams
(25)	L. pseudothiessenii Kosanke	?Verrucososporites pseudothiessenii (Kos.) P.& K.
(8)	Reticulatisporites mediareticulatus Ibr.	Dictyotriletes bireticulatus (Ibr.) P. & K.
(16)	R. tortuosus Balme	?Reticulatasporites tortuosus (Balme) P. & K.
	R. facetus (Ibr.)S.W. & B.	Reticulatasporites facetus Ibr.
	Reticulatisporites (Ibr.) S.W. & B.	Reticulatisporites (Ibr.) S.W. & B.

	NAMES USED	PROBABLE SYNONYMY
(17)	*R. magnus* B. & W.	*Microreticulatisporites magnus* (B. & W.) P. & K.
	Verrucososporites facierugosus (Loose) B.& W.	*V. facierugosus* (Loose) B.& W.
	Alatisporites pustulatus Ibr.	*Alatisporites pustulatus* Ibr.
	Reinschospora S.W. & B.	*Reinschospora* S.W. & B.
(18)	*Microreticulatisporites quaesitus* (Kosanke) B.& W.	*Microreticulatisporites quaesitus* (Kosanke) B. & W.
(19)	*M. fenestratus* (Kosanke) B. & W.	*M. fenestratus* (K.) B. & W.
	M. parvipunctatus Williams	*M. parvipunctatus* W.
	M. reticulocingulum (Loose) Knox	*Dictyotriletes mediareticulatus* (Ibr.) P. & K.
(22)	*M. sulcatus* (Kosanke)	? *Converrucososporites sulcatus* (Kosanke) P. & K.
(21)	*Torispora securis* Balme	*Torispora securis* Balme
(24)	*Cadiospora magna* Kosanke	*Cadiospora magna* Kosanke
(28)	*Gravisporites sphaerus* (B.& W.) Bhardwaj 1954	
(29)	*Schopfites dimorphus* Kosanke	*Schopfites dimorphus* Kosanke

V. DISTRIBUTION OF MICROSPORES.

(i) Introduction.

A consideration of the microspore assemblages in the seams of the Upper Carboniferous of the central coalfields of England has indicated that whereas a few spore types, notably species of *Lycospora*, appear to persist throughout the sequence, others have restricted ranges. A number of types which fall into the latter category are so rare as to have little practical significance. The occurrence of such types is not discussed in the present paper but the ranges of some of them are given in the second part of the appendix (p.xviii et seq.). The microspores used in the tables (Figs. 4 - 12) are considered to be sufficiently distinctive in appearance and common in occurrence to be significant stratigraphically.

Earlier work (Balme and Butterworth, 1952) has shown that the microspores recognised in sequences of seams fall into assemblages; the change from one assemblage to another is not abrupt but tends to take place gradually, odd specimens of the new spores appearing as the earlier forms become less common. In the central coalfields of England Balme and Butterworth (loc. cit.) distinguished three microspore assemblages - S1, S2 and S3 - which occurred in zones having as their limits the marine bands in the <u>modiolaris</u> Zone and at the top of the Lower <u>similis-pulchra</u> Zone. Each of these marine horizons was found to be underlain by groups of seams having spore assemblages of a transitional nature.

Microspore studies carried out on more extensive sequences from Staffordshire and North Wales (Butterworth and Millott, 1954) indicated that three more assemblages could be distinguished, one from below S1, named SO, and two from above S3, named lower and upper S4. The SO assemblage was found in coals of <u>lenisulcata</u> Zone age and the S4 assemblages in the <u>phillipsii</u> and <u>tenuis</u> Zones.

The following account of microspore distribution in coalfields lying to the west of the Pennines embodies the previous findings; these have in some cases required modification by reason of evidence resulting from the examination of additional material.

The microspores most characteristic of each assemblage are shown in the following lists. Seams with assemblages S2, S3 and lower S4 are underlain by groups of seams having assemblages of a transitional nature.

Assemblage S0:-	Densosporites annulatus D. indignabundus Cirratriradites striatus Spinososporites spinulistratus Schulzospora ovata
Assemblage S1:-	As above plus Laevigatosporites
S1-S2 transition:-	S1 spores plus S2 spores plus Cirratriradites aligerens
Assemblage S2:-	D. annulatus D. indignabundus S. spinulistratus Laevigatosporites Florinites antiquus Pitycsporites westphalensis Reticulatisporites mediareticulatus Endosporites spp. R. tortuosus Cirratriradites tenuis (in part) Endosporites costatus (in part) Florinites millotti (in part) D. solaris (in part)

Assemblage S3:-

D. annulatus
D. indignabundus
S. spinulistratus
Laevigatosporites
F. antiquus
P. westphalensis
Endosporites spp.
R. tortuosus
C. tenuis
E. costatus
F. millotti
D. solaris
Triquitrites sculptilis
Reticulatisporites magnus

Lower S4 assemblage:-

Laevigatosporites
S. spinulistratus
F. antiquus
P. westphalensis
Endosporites spp.
R. tortuosus
E. costatus
F. millotti
T. sculptilis
M. sulcatus
Torispora securis
Microreticulatisporites quaesitus
M. fenestratus

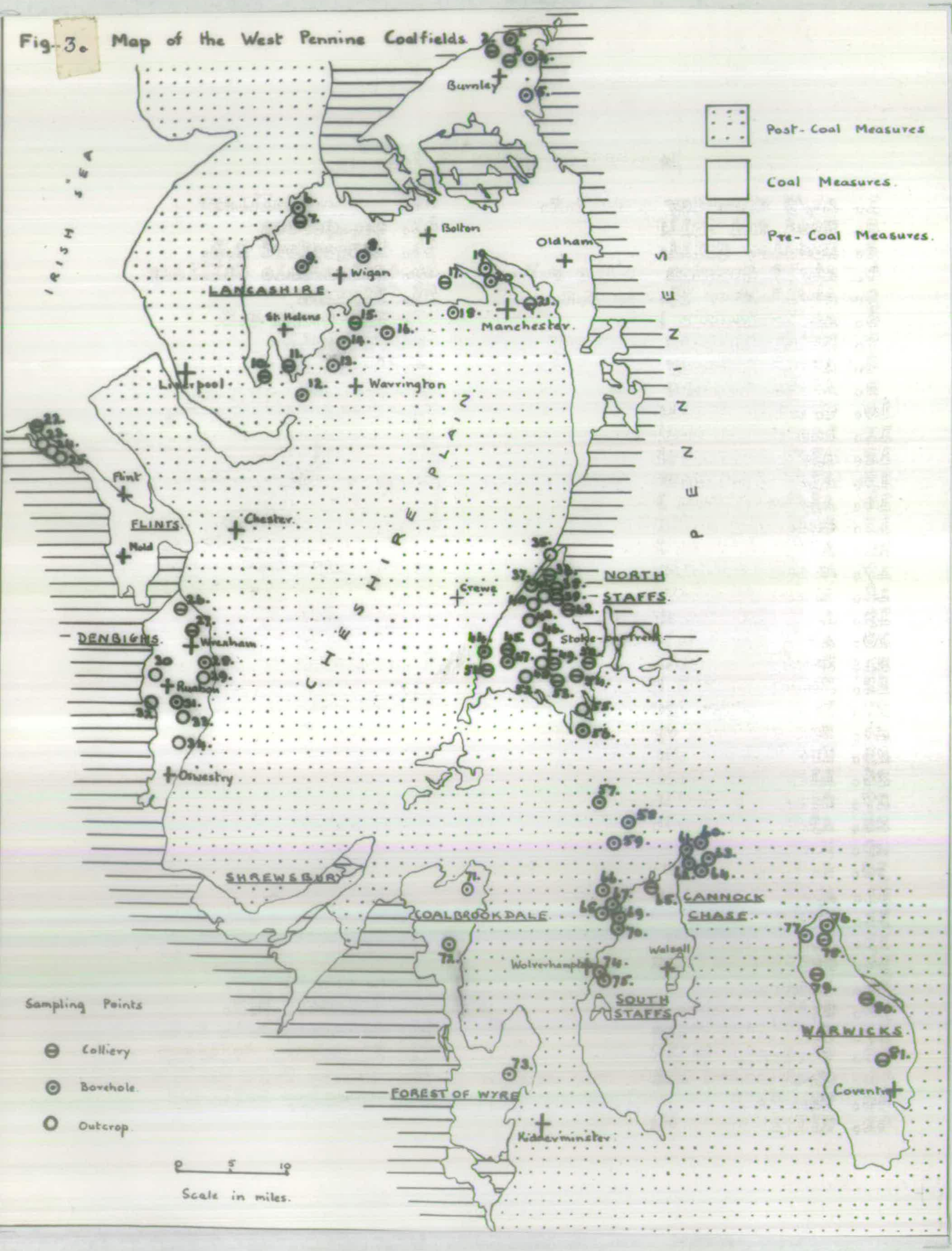
Upper S4 assemblage:-

Laevigatosporites
S. spinulistratus (rare)
F. antiquus (rare)
P. westphalensis
Endosporites spp.
R. tortuosus
E. costatus
F. millotti
T. securis
M. sulcatus
M. quaesitus
M. fenestratus
L. obscurus
L. pseudothiessenii

Upper S4
assemblage cont:- <u>Schopfites dimorphus</u>
<u>Gravisporites sphaerus</u>
<u>Cadiospora magna</u>
<u>Triquitrites inusitatus</u>
<u>Raistrickia medusa</u>
<u>L. oculus</u>

In the following descriptions of microspore assemblages in the various coalfields the numbers in brackets after boreholes and other sampling localities refer to the positions marked on the map in Fig. 3 and listed at the end of this section; these numbers are also shown (bracketed) beside the localities which are listed in the first part of the appendix (pp.i-xvi). The numbers in brackets after coal horizons refer to the stratigraphical positions indicated in the sections shown on Figs.4-12; these numbers are also given in the first part of the appendix, beside the coal horizons which are there listed under localities. In the sections in Figs. 4-12 seams of uncertain horizon have been indicated by numbers inserted between those representing known coal horizons. In those coalfields where more detailed work has been carried out on borehole sequences each sample examined has been tentatively assigned to a numbered coal horizon on the accompanying diagram. In general the correlations are those made by H.M. Geological Survey.

Fig. 3. Map of the West Pennine Coalfields



Localities given in Fig. 1.

1. A4/5 Wheatley Lane B.H.
2. Wood End Colliery
3. Reedley Colliery
4. A4/17 Cockden Bridge B.H.
5. A4/13 Mere Clough B.H.
6. A2/31 Heskin B.H.
7. Welch Whittle Colliery
8. A2/43 Hindley Deep B.H.
9. A2/92 Tontine B.H.
10. Cronton Colliery
11. Lea Green Colliery
12. A3/4 Farnworth B.H.
13. A3/6 Burtonwood B.H.
14. A3/10 Newton Park B.H.
15. Golborne Colliery
16. A2/57 Lowton B.H.
17. Moseley Common Colliery
18. A1/12 Patricroft B.H.
19. A1/1 Prestwich Asylum B.H.
20. A1/2 Drinkwater Park B.H.
21. Bradford Colliery
22. Point of Ayr Colliery
23. Felin Blwm opencast site
24. Hen-Dyfrydd opencast site
25. Tre Mostyn opencast site
26. Llay Main Colliery
27. Gresford Colliery
28. A5/1 Whitegate B.H.
29. Marchweil
30. Gardden Lodge opencast site
31. A5/6 Pen-y-Llan B.H.
32. Trevor
33. Dee & Ceiriog Junction
34. Criffin's Farm o/c site
35. Astbury
36. Gillow Heath Colliery
37. Congleton Edge
38. Victoria Colliery
39. Chatterley Whitfield Colly.
40. Tunstall
41. Wilkinson's Marl Pit.
42. Norton Colliery
43. Chesterton
44. Hungerford B.H.
45. Silverdale Colliery
46. Etruria
47. Pie Rough B.H.
48. Penkhull
49. Stafford Colliery
50. Adderley Green Colliery
51. Woodhouse Colliery
52. Trentham-Whitmore Road
53. Hem Heath Colliery
54. Florence Colliery
55. Moddershall
56. Holts Barn B.H.
57. Brancotegorse Covert B.H.
58. Devil's Dumble B.H.
59. Springslade Pool B.H.
60. Hawkesyard B.H.
61. Springs Farm B.H.
62. Hayes Wood No.2 B.H.
63. Brereton Cross B.H.
64. Giddywell B.H.
65. Wimblebury Colliery
66. Calf Heath B.H.
67. Saredon Hill B.H.
68. Moat Farm B.H.
69. Orchard Farm B.H.
70. Shareshill B.H.
71. Lilleshall No. 7A B.H.
72. Madeley No.1 B.H.
73. Alveley No. 1 B.H.
74. Baggeridge No.1 B.H.
75. Baggeridge No.5 B.H.
76. Statfold B.H.
77. Bolehall B.H.
78. Amington Hall B.H.
79. Kingsbury Colliery
80. Ansley Hall Colliery
81. Coventry Colliery

(ii) The Staffordshire Coalfields

(a) North Staffordshire. (Fig.4)

The coalfield of North Staffordshire is considered first because, of all the coalfields examined, it contains the most extensive and complete succession of Upper Carboniferous strata. There is, in fact, an unbroken sequence from the Astbury coal (64) occurring near to the Millstone Grit up to a seam (1) in the Keele Series, high in the *tenuis* Zone. The structure of the field is well known from the early work of Hind and Stobbs and of Walcot Gibson (1905, 1925) whilst the limits of the non-marine lamellibranch zones have been defined by R. V. Melville (1946). This is the only coalfield west of the Pennines in which an attempt has been made to define the plant zones (Dix, 1931); unfortunately the material examined by her was restricted to the Millstone Grit and Morganian strata so that the limits of the floral zones of the Middle Coal Measures are not known. The most recent structural and general account of the coalfield has been made by F.Wolverson Cope (in Trueman, 1954).

Samples of the seams examined were obtained from collieries, boreholes and outcrops. A seam (64) lying near to the base of the *Eumorphoceras* Zone of the Millstone Grit was sampled at its outcrop in Limekiln Wood, near Astbury (35).

The Sandrock Mine (First Grit Coal, 62) was also sampled where it outcrops above the Rough Rock near Mow Cop (37). Fragments of the Holcombe Brook Coal (Third Grit Coal, 63) were obtained from the old spoil heaps at Black Cobb (37) as the outcrop is no longer exposed.

Samples of seams from the Productive Measures are mostly from collieries but these have been augmented by two borehole sequences. Details of these samples are given in the first part of the appendix (pp.i-ii.) Several of the coals from the Etruria Marl and Newcastle-under-Lyme Groups were sampled at various marl pits. A thin coal (1) which outcrops in the wood near to Moddershall church (55) and which Gibson (1905, 1925) states may lie in the Keele Group, was also sampled at its outcrop.

Assemblage SO:- The lowest seam sampled from the North Staffordshire Coal Measures is the Crabtree (61) which lies below the extensive *Gastrioceras listeri* Marine Band in the Lower Coal Measures. The microspore assemblage obtained from this coal is poor in the number of types present but is represented by the genera *Lycospora*, *Densosporites*, *Calamospora*, *Spinososporites*, *Planisporites* and *Triquitrites*. Two species considered to be of stratigraphical significance, *Cirratriradites striatus* and *Schulzospora ovata*, are also present. The genus

Florinites is represented by a large, often ill-preserved form. This assemblage is found, with slight variations in the proportions of each genus present, in all coals of the Lower Coal Measures.

The Millstone Grit coals contain these spores along with other so far unidentified types. The thin seam outcropping at Astbury was examined with particular interest as it occurs below Kidston's floral break (Kidston 1923: Hester 1931). Although the coal contains a higher number of unidentified species than those from the upper part of the Millstone Grit it contains also most of the spores present in the SO assemblage. Since these are the only coal seams to be examined from the Namurian it has not been possible to make any critical comparisons.

Assemblage S1:- The next workable coal above the Crabtree is the King Seam (60) which lies in the *communis* Zone at the base of the Middle Coal Measures. Its microspore assemblage differs from those of the seams of the *lenisulcata* Zone in containing the genus *Laevigatosporites*, a monolete, bean-shaped spore which becomes one of the dominant genera of higher assemblages. The incoming of *Laevigatosporites* is taken as the base of the S1 assemblage. Balme and Butterworth (1952) defined S1 as characterised by the presence of *Cirratriradites aligerens* and

Schulzospora ovata (Endosporites ovatus) but subsequent work indicated that the former is found no lower in the succession than the spores characterising the overlying S2 assemblage whereas the latter occurs in all of the lower seams including those of the Millstone Grit. Odd specimens of the S2 types, along with Florinites antiquus, first appear in the Little Cannel Row (59) above the King and the seams from between this horizon and that of the Mid-modiolaris Marine Band constitute an S1 - S2 transitional zone. Cirratriradites aligerens is confined to this transition. The King is thus the only seam to have an S1 assemblage; formerly the overlying Little Cannel Row and Silver (58) Mines were included in the group of seams having an S1 assemblage but when it was discovered that in other coalfields only the lowest seam of the Middle Coal Measures had such an assemblage a further search was made and occasional S2 spores were found to be present in the Little Cannel Row and Silver Mines. S. ovata and C. striatus are still present in the transition zone and the latter reaches high proportions in the Winpenny Seam (56) and is also very abundant in the Bullhurst (55) and Brickiln (57) Seams.

Assemblage S2:- The species first appearing in the Little Cannel Row become constant members of the S2 assemblage in coals occurring above the Seven Feet Banbury Marine Band; they are

Endosporites spp. (including E. zonalis and E. globiformis) Reticulatisporites tortuosus and R. mediareticulatus. The species Cirratriradites aligerens, C. striatus and Schulzospora ovata are not found in seams from above the marine band.

Cirratriradites tenuis, similar to C. aligerens but smaller and with a relatively narrower flange, is present in the Hard Mine (49) and adjacent seams; it also occurs at higher horizons but on the whole is comparatively rare in this coalfield. Endosporites costatus has not been noted below the Birches (42). In the Bellringer or Stoney Eight Feet Seam (44) at the top of the modiolaris Zone there is a considerable increase in the proportions of Spinososporites spinulistratus which remain at a high level up to the Granville (35).

Seams between the Moss (36) and the Gin Mine Marine Band form a transition between those having S2 and S3 assemblages. In 1954 Butterworth and Millott drew the lower limit of the S2 - S3 transition below the Birchenwood (Granville) Seam which was the lowest horizon at which Triquitrites sculptilis had been found but this species has since been noted in the Moss, and the boundary has been altered accordingly. Cope (in Trueman, 1954, p.233) states that the Moss and Birchenwood may be the same seam.

Assemblage S3:- This assemblage occurs in seams lying above the Gin Mine Marine Band. The characteristic species are Triquitrites sculptilis, Reticulatisporites magnus, Densosporites solaris, Florinites millotti and Microreticulatisporites sulcatus. Densosporites annulatus, which is common in the durain-rich seams of lower horizons, is comparatively rare.

Assemblage Lower S4:- Torispora securis and Microreticulatisporites fenestratus, which with M. quaesitus characterise this assemblage, are first noted in the Winghay Seam (24) which lies between the two highest marine horizons of the Coal Measures. Densosporites annulatus, D. indignabundus, D. solaris and Reticulatisporites magnus have not been found to occur above the Chalkey Mine (19). The seams from between these two horizons therefore represent a transitional zone. The lower S4 assemblage is present in all seams up to the top of the Black Band Group (8). Several unidentified species have been noted from seams occurring in the Black Band but these have not yet been described; the lack of correlatives to this group of seams in most of the other fields considered has prevented adequate checking of the use of these unidentified species as zonal indices.

Assemblage Upper S4:- There is a marked change in the spore assemblages of seams from the Etruria Marls and higher levels and, although this change was appreciated when the S4 assemblages were described (B. & M., 1954), the documentation of species was insufficient to warrant the establishment of a completely separate assemblage. Furthermore no transitional assemblage was noted; this may be due to the lack of coal seams in the higher measures. The general impression that in the upper S4 assemblage the spores are smaller and thinner-walled is in part due to the practical disappearance of the large species Spinososporites spinulistratus and Florinites antiquus, which formed a high proportion of the lower assemblages. There is also a marked increase in the numbers of small monolete spores of the genus Laevigatosporites - L. minutus and L. minimus become locally more common and L. obscurus, L. pseudothiessenii and L. oculus are present for the first time. The large species of Raistrickia of the lower coals are replaced by the small thin-walled R. medusa and similar types as yet unspecified.

Recent investigations made of samples from the Upper Coal Measures have indicated that Triquitrites sculptilis is not present in seams having an upper S4 assemblage. Re-examination of the Newcastle Group coals has confirmed this. The species of Triquitrites which were originally mistaken for T. sculptilis have not yet been identified but probably include T. protensus Kosanke, T. crassus Kosanke and T. spinosus Kosanke.

In addition to the changes already noted three new genera appear in the upper S4 assemblage - Schopfites, Gravisporites and Cadiospora. These are usually rare but sufficiently distinctive to be of use stratigraphically. Schopfites has been found only in seams of Etruria Marl age in North Staffordshire but in other coalfields it occurs in the equivalents of the Newcastle Group.

The highest seam (1) examined from North Staffordshire is that which outcrops at Moddershall (55) and which is presumed to lie in the Keele Group. This coal has an assemblage essentially similar to that present in the seams of the Newcastle Group but it contains in addition several rare spores which have also been noted in a seam in the Erbistock Beds of North Wales. One of these rare spores is thought to be conspecific with Guthörlisporites magnificus which has recently been described by Bhardwaj (1954) from the Stephanian of the Saar. Since this is the only seam to have been sampled from the Keele Group, and since its spore assemblage is very similar to that of seams from the Newcastle Group, no attempt has been made to define a separate assemblage.

(b) Cannock Chase (Fig. 5)

This is the part of the South Staffordshire coalfield lying to the north of the Bentley faults which extend westwards from Walsall towards Wolverhampton. An account of the geology of the coalfield (Mitchell and Stubblefield, (1945) plublished by the Geological Survey includes descriptions of the non-marine lamellibranch zones and suggests a standardised nomenclature for the seams of the coalfield which is now largely adhered to.

Most of the sequences considered here are from boreholes sunk in the north-eastern and north-western extensions of the exposed coalfield. The boring at Brancotegorse Covert (57) in the north-western area lies only about ten miles south of the nearest North Staffordshire bore (Holts' Barn, 56). A correlation between the two fields has recently been published by the Geological Survey (Calver, Earp and Hoare, 1953). The most extensive sequence was obtained from the area to the west of the exposed coalfield; the lower measures were encountered in the Moat Farm (68) and Calf Heath (66) bores and seams from the Halesowen Beds of the Upper Coal Measures in the Orchard Farm (69) and Shareshill (70) borings.

With the exception of a sample of the Mealy Greys (63) from Wimblebury Colliery (65) all of the Cannock Chase material has been obtained from borehole cores. Much emphasis has been laid on the seams of the Upper similis-pulchra Zone, particularly in the Brereton area to the north-east of the exposed coalfield. The relationships of this group of seams were formerly in doubt and most of the sequences were examined in an attempt at correlation.

A short account of microspore distribution in the Cannock Chase coalfield was given in a paper on the central coalfields (B. & B., 1952). This work was extended by B. & M. (1954) who recognised all of the spore assemblages excepting S0 and the lower S4. The absence of the S0 assemblage is a consequence of the absence of seams in the Lower Coal Measures, while that of the lower S4 assemblage results from the cutting out of strata from below the Halesowen Beds by an unconformity. The following description of the spore assemblages covers the same ground as the 1954 account referred to above but is based on the examination of a greater number of sequences; in particular four additional borehole cores from the western part of the field have been investigated.

The Mealy Greys seam (63) at the base of the sequence and the unnamed seam (62) below the Deep (61) each have an S1 assemblage. As Florinites antiquus and Cirratriradites aligerens are both present in the unnamed seam it might be expected that further searching would yield evidence of an S1 - S2 transition assemblage in this seam. The percentages of C. striatus are outstandingly high in the Deep Mine and to a lesser extent in the Upper Shallow (56). These horizons, lying towards the middle of the communis Zone, are roughly comparable with those of the Brickiln - Winpenny - Bullhurst seams in North Staffordshire. The Deep Mine in the Calf Heath Bore is peculiar in that it contains no C. striatus but has a high proportion of Densosporites indignabundus which is seldom common in whole seam samples. C. aligerens has not been seen above the Bass Mine (53) and Schulzospora ovata and C. striatus disappear at the horizon of the Stinking Marine Band which is considered to be the correlative of the Seven Foot Banbury marine horizon (Calver, etc., 1954).

The S2 assemblage is found in seams from the Stinking Marine Band up to the Brooch (34). Endosporites costatus and Cirratriradites tenuis occur at rather lower levels here than in North Staffordshire. The proportions of Spinososporites spinulistratus increase in the seam (39) below the Benches (38) and reach a maximum in a seam (37) below the Brooch. Above the latter seam occasional specimens occur of the S3 assemblage spores and the transition zone extends up to the seam above the Charles Marine Band, the Wyrley Yard (27), in some samples of which the odd specimen of Reticulatisporites mediareticulatus was noted. This distribution is unusual for the central coalfields; it is perhaps significant that more samples of the

Wyrley Yard have been examined than of seams at equivalent horizons in other coalfields. The occurrence of R. mediareticulatus above the Charles Marine Band is comparable with the appearance of the same spore above the Cefn Coed Marine Band in South Wales (Williams, in litt.).

The assemblage of the Wyrley Yard is characterised by high numbers of Densosporites solaris along with varying percentages of Cirratriradites tenuis and C. sp. - a type intermediate between C. tenuis and C. striatus.

The main seams in the group having an S3 assemblage are the Top and Bottom Robins. Excellent specimens of Reticulatisporites magnus have been recorded from the Bottom Robins (23) and this seam also contains considerable numbers of Densosporites solaris, but not so high a percentage as the Wyrley Yard. The Top Robins (19) has been distinguished from the two underlying seams by the comparative paucity of the types R. magnus and D. solaris and the generally higher percentages of Triquitrites sculptilis and Florinites antiquus in its assemblage.

The S4 assemblage spores are first apparent in the thin seam (18) lying above the Sylvester's Bridge Marine Band - there is no seam of comparable thickness to the Winghay of North Staffordshire at the equivalent horizon in Cannock Chase.

Densosporites annulatus, D. indignabundus and D. solaris are present above the highest marine band in most of the seams of the group including the Heath Hayes (12) and the Wimblebury Cannel (8). There are one or two seams above the latter horizon which may be said to have a lower S4 assemblage and to correspond to the seams above the Chalkey Mine level in North Staffordshire but there are no equivalents in Cannock Chase to the Great Row Measures and the Black Band Group of North Staffordshire owing to the earlier development in Cannock Chase of the Etruria Marl facies.

No coals have been encountered in the Etruria Marl Series of Cannock Chase and the only seams in which an upper S4 assemblage has been found are those of the Halesowen Beds, the equivalent of the Newcastle Group of North Staffordshire. The four Upper Coal Measure seams sampled in the western part of the coalfield all had typical upper S4 assemblages and the two lower ones (3,4) contained the rather rare spore Schopfites dimorphus.

(c) South Staffordshire (Fig. 6)

The part of the South Staffordshire coalfield lying to the south of Walsall and known as the Black Country is largely worked out but it has been possible to examine a sequence of seams from borings sunk on the western crop of the field near to Baggeridge (74,75). The Productive Coal Measures are less well developed than in the Cannock Chase area and many of the seams combine when traced southwards; thus the Benches, Wyrley Bottom and Old Park of Cannock Chase are represented by the Thick seam (4) in South Staffordshire; the Yard and Bass of Cannock are equivalent to the New Mine (8-10) and the Deep and Shallow Mines equal to the Bottom (13,14) of South Staffordshire, (Mitchell and Stubblefield, 1945). Coal-bearing strata of the Upper similis-pulchra Zone of Cannock Chase are replaced by barren red rocks of Etruria Marl facies in South Staffordshire.

The Baggeridge sequence is therefore short and with few seams. The lowest seam (16) present, correlative with the Mealy Greys of Cannock Chase, has a typical S1 assemblage and the seams between this horizon and that of the Stinking Marine Band form an S1 - S2 transition. The assemblage of the Bottom seam (13,14), like its correlative the Deep of Cannock Chase, is particularly rich in Cirratriradites striatus. Endosporites costatus occurs here in seams below the marine band suggesting perhaps that this spore appeared at an earlier horizon in the more southerly of the central coalfields than in those to the north.

The S2 assemblage is present in only four seams - the Lower Heathen (6) to the Flying Reed (3) inclusive. The latter contains high numbers of *Spinososporites spinulistratus*. The Brooch (2) contains occasional S3 types and constitutes an S2 - S3 transition zone but the seams of the Upper *similis-pulchra* Zone, which usually have an S3 assemblage, are not represented.

The highest seam examined, from the Halesowen Beds, contained representative spores of the upper S4 assemblage although *Schopfites dimorphus*, *Cadiospora magna* and *Triquitrites inusitatus* were not found.

(iii) The North Wales Coalfields.

The sequences in the two parts of this coalfield are considered separately. The most northerly, that of Flintshire, is now largely worked out but the lower part of the succession has been obtained from Point of Ayr (22), the only working colliery, and from neighbouring opencast sites. In the Denbighshire Coalfield to the south seams have been sampled from the base of the measures up to an horizon (1) in the Erbistock Beds. Both coalfields are fully described in the Memoirs of the Geological Survey (Wedd and others, 1923, 1924, 1928) and an account of the non-marine lamellibranch zones has been published by Wood (1937).

The microspore assemblages in the seams of the North Wales coalfields have already been described and published with those of Staffordshire (B. and M., 1954). In Flintshire no additional material has been available but a valuable sequence of seams from the Pen-y-Llan bore (31) in the Denbighshire field has helped to confirm the earlier conclusions which were based on the examination of samples from a fairly wide range of localities.

(a) The Flintshire Coalfield (Fig. 7)

All of the seams available from Point of Ayr Colliery (22), lying on the Dee Estuary, have been sampled together with two of the lower coals (8,9) which were exposed in trial pits on prospective opencast sites (23-25) to the south-east of the colliery.

The seams examined range from the base of the Coal Measures up to the Three Yard seam (1) in the modiolaris Zone. The Little Coal of Picton (9) at the base of the series has an SO assemblage comparable to that of the Crabtree of North Staffordshire. From the Bychton Three-quarters (8) up to the Durbog (3) there is an S1 - S2 transition which is consistent with the recently discovered Mid-modiolaris Marine Band in the measures between the Durbog and overlying Two Yard seam (2) at Point of Ayr Colliery, (D.Magraw, H.M.Geological Survey, in litt.).

Cirratriradites striatus is not very common at this locality but reaches a maximum percentage in the Bychton Three-quarters.

The Two Yard (2) and Three Yard (1) seams from above the marine band contain typical S2 assemblages.

The Bychton Three-quarters, which has been sampled both at the colliery and in a trial pit at its outcrop (25), occurs at approximately 100ft. below the Bychton Two Yard (7). In Wood (1937) this seam is shown in the Flintshire succession as the Queen and is placed towards the top of the *lenisulcata* Zone. Wood does not refer to any fossils collected from this horizon and as both of the samples examined in the present investigation have been found to have an S1 - S2 transition assemblage it appears likely that this seam is a correlative of the Queen or Wall and Bench of Denbighshire which occurs towards the base of the *communis* Zone.

(b) The Denbighshire Coalfield (Fig. 8)

In Denbighshire the Lower Coal Measures contain towards their base two seams, the Aqueduct (41) and Chwarelau (40), which were sampled at their outcrop in Australia Marl Pit, near Trevor (32). These seams both have an SO assemblage. About 200ft. higher in the succession is the Queen Series of coals in the *communis* Zone. These seams occurred in both the Whitegate (28) and Pen-y-Llan (31) bores and have been worked at several collieries. The Lower Queen (39) contains Laevigatosporites and is considered to have an S1 assemblage. There is apparently no workable coal at this horizon in the Flintshire sequence. Florinites antiquus, Cirratriradites aligerens and the S2 types occur in the Queen (38) or Wall and Bench, and in the Upper Queen (36) or Ruabon Yard, seams, and the S1 - S2 transition is considered to extend up to the Red Mine (32) above which the Mid-modiolaris Marine Band has recently been found in Llay Main Colliery (26) workings (Magraw, 1954). Cirratriradites striatus is common in the Ruabon Yard and in the overlying Nant seam (35) occurring at more or less similar horizons to the Winpenny of North Staffordshire and the Deep of Cannock which also contain high proportions of this species.

Seams from above the marine band have an undoubted S2 assemblage. Cirratriradites tenuis and Endosporites costatus are both occasionally present in the Fireclay seam (33) below the Marine Band; this distribution is similar to that of the same species in South Staffordshire. The Crank seam (23) sampled at Gresford Colliery (27) has a high percentage of C. tenuis; such concentrations of this species are found at various horizons in different coalfields (cf. the Wyrley Yard of Cannock Chase) and are thought to represent some particular ecological condition. As in the case of the Wyrley Yard, which lies at a considerably higher level, the Crank does not have this characteristic at all sampling points.

The S3 assemblage spores appear in the Smith seam (19) and since the S2 type Reticulatisporites mediareticulatus has not been seen above the Bottom Droughy (18) these two seams are considered to constitute an S2 - S3 transition. The marine band which occurs above the Bottom Droughy is believed to be the equivalent of the Gin Mine Marine Band of North Staffordshire, (Simpson, 1935). These two seams and the succeeding Warras (16) and John o'Gate (17) were sampled at Gardden Lodge Opencast Site (30) - they were faulted out of the Pen-y-Llan boring which otherwise yielded a complete succession.

As well as the Warras and John o'Gate the Wynnstay Five Feet (13) and associated seams occurring some 200 ft. higher in the sequence also have an S3 assemblage. In the Bersham Yard (9) group, a further 200 ft. higher, the lower S4 types are present along with occasional specimens of Densosporites. It is therefore thought possible that the horizon of the highest marine bands occurs somewhere in the measures separating these two groups of seams.

A coal (8) which outcrops near to the junction of the Rivers Dee and Ceiriog (33) was formerly thought, on account of its geographical position, to lie in the Ruabon Marl; the seam has a lower S4 assemblage and thus does not compare with that of the Etruria Marl coals of North Staffordshire, also several borings have passed through the Ruabon Marl without yielding any trace of coal. In the Denbighshire diagram, therefore, the position of this seam has been queried.

Good samples have been obtained from the Pen-y-Llan and other recent North Wales bores of coals occurring in the Coed-yr-Allt Group of the Upper Coal Measures. These seams have typical upper S4 assemblages including Schopfites dimorphus, a spore which in North Staffordshire has only been observed from seams of the Etruria Marl. The occasional presence of a spore similar to Densosporites annulatus in two of the seams was at first thought to be due to contamination but such isolated occurrences have since been noted elsewhere.

A coal (1) from the Erbistock Group outcrops on the banks of the Dee near Marchweil (29) and this yielded an assemblage comparable to that of the seams of the underlying Coed-yr-Allt Group. The Erbistock seam and the one sampled from the Keele Group of North Staffordshire however are the only coals in which the species Guthörlisporites magnificus has been found

(iv) The Lancashire Coalfield.

The compilation of a representative sequence for the Lancashire coalfield has presented certain difficulties as compared with other fields. The seam nomenclature varies considerably when traced laterally and the correlations are not always known with certainty. This is due mainly to the extensive faulting of the area and to the relative thinness and irregularity of some seams when compared with those of the Midlands.

The Geological Survey Memoirs on the Wigan, Manchester and Rossendale Anticline districts (Jones etc., 1938, Tonks etc., 1931, Wright etc., 1927) give descriptions of the various parts of the coalfield and the non-marine lamellibranch zones defined and sub-zoned by Wright (Manchester Memoir). Hickling (1927) has published a detailed list of shaft sections from localities extending across the field. In addition to the works listed above constant use has been made of the reports on boreholes by officers of H.M. Geological Survey; in the majority of cases the correlations inferred in these reports have been adhered to; the two occasions on which the naming of seams has been altered are indicated below.

Borehole material has been used whenever possible in order to ensure the correct naming of seams. In a previous account of microspores in the Lancashire coalfield (B. and B., 1952) the sequence examined was extremely piecemeal and consisted of samples from widely separated collieries. The deep boreholes used in the present work extend across the southern limit of the coalfield and include seams from the Upper Coal Measures down to the base of the modiolaris Zone. The lower part of the sequence has been collected from a number of shallow bores and from colliery workings. Samples from the Middle Coal Measures of Burnley are excluded as they have not been correlated with the sequence in the main part of the field. Unfortunately the number of samples available from seams of the communis Zone is restricted; more work is necessary before these can be correlated throughout the coalfield.

In Lancashire nine or ten seams occur in the lenisulcata Zone or Lower Coal Measures and many of these have been worked in the Burnley Coalfield and in drift mines on the slopes of the Pennines. Most of the Burnley samples are of too high rank to give satisfactory microspore separations but recent bores (9) sunk in the Rainford area near St. Helens yielded samples of Lower Coal Measure seams of relatively low rank which gave very good separations. These seams all have an SO assemblage.

No seams have been examined, in other coalfields of the central group, from horizons between that of the *Gastrioceras listeri* Marine Band (the Crabtree of North Staffordshire, the Lower Mountain (58) of Lancashire) and the base of the Middle Coal Measures at which level spores of the genus *Laevigatosporites* first appear. As the base of the Middle Coal Measures is an horizon of doubtful stratigraphical value and is not associated with any marine incursion it was thought that the examination of coals from strata towards the top of the Lower Coal Measures might indicate that this genus comes in at a slightly lower horizon, perhaps in association with Tonge's Marine Band. In the present investigation samples have been examined of the Cemetry (54) and Pasture (53) mines which lie between Tonge's Marine Band and the Arley Mine (52) at the base of the Middle Coal Measures; no species of *Laevigatosporites* was found in these samples and so the appearance of the S1 assemblage at the base of the Middle Coal Measures, also the base of the *communis* Zone, is confirmed.

The Arley Mine is the only seam from Lancashire to have an S1 assemblage and the seams from between this horizon and the Sutton Manor (*Midmodiolaris* Zone) Marine Band constitute an S1 - S2 transition. *Cirratriradites striatus* has not been found in great numbers in any of the seams considered; it is common in the Padiham Eleven Feet in the Burnley area and in the Reform of Poynton, lying to the north and south respectively of the main part of the coalfield, but unfortunately these seams have not been correlated.

The nomenclature of the seams between the Sutton Manor and Dukinfield Marine Bands varies; the synonyms occurring in the sample lists given in the appendix (pp.x-xiii) may be identified by referring to the numbers which are reproduced beside each coal horizon on the diagram (Fig.9). Thus the Pemberton Five Feet (35) and Bickershaw Seven Feet (36) are known as the Higher and Lower Florida seams in the western part of the field and as the Black and White Mines in the east. The Stone Delph (23), Binn (24), Crombouke (26), Brassey (28) and Rams (30) are called the Top Ince Yard (23), Ince Deep Yard (24), Ince Four Feet (26), Ince Seven Feet and Ince Furnace (30) respectively in the Wigan area. Radley (17), New Jet Amber (19) and Pottery (20) are names usually restricted to the Manchester coalfield; coals occurring at comparable horizons in other parts of the field are generally of no practical significance and are therefore not named.

As a result of the detailed examination of spore distribution in seam sub-sections the Crombouke and Brassey (Shuttle and 'Crombouke' of the Prestwich bores) have been re-correlated in the A1/18 B.H. and at Bradford Colliery (21), (B. and M., in the press). The amended correlation has been used in the construction of the diagram (Fig.9). The appendix nomenclature is, however, that of Poole and Whiteman (1954) whose correlation of other coal horizons in the Manchester coalfield is accepted and used here. The correlation of seams occurring at similar horizons in the St. Helen's part of the coalfield has also been slightly altered. The naming of the seams in the appendix (pp.x-xiii) is that of Trotter (1952) whilst the horizon numbering represents the amended correlation. The alterations concern the Crombouke and Earthy Delf seams in the Burtonwood bore (13), otherwise the correlations given by Trotter have been adhered to.

The S3 assemblage spores first appear at about the level of the Pottery (20). Reticulatisporites mediareticulatus is very rare above the Binn (24) but has been found in the seam (16) immediately underlying the Dukinfield Marine Band. A queried R. mediareticulatus was noted in the Parker Mine (15) above the marine band; this would be comparable to the distribution of the same spore in Cannock Chase where it is very occasionally found in the Wyrley Yard at an approximately equivalent horizon.

The only workable coal to have an S3 assemblage is the Worsley Four Feet (10). The top of the zone containing this assemblage cannot be clearly defined as no coals have been sampled from between the Prestwich Top and Lower Sankey Marine Bands which are the two highest marine horizons in the Coal Measures.

The next higher seams in the succession, known as the Bradford Series, contain S4 assemblage spores. These seams (3-6) have been correlated with those of the Black Band Group in North Staffordshire (Kidston, 1905) on account of the similarity of their respective floras. The seams of the Bradford Group of Lancashire have spore assemblages similar to those of the Black Band Series but an unexpected occurrence in the Lancashire field is the presence of _Densosporites solaris_ so high in the succession. A further peculiarity is that _D. solaris_ occurs only in samples from Bradford Colliery (21) and not in those from the Prestwich bores (19,20) situated a few miles to the north-west. Since the presence of the S4 type _Torispora securis_ precludes any suggestion of mis-correlation it can be inferred that the plant producing _D. solaris_ persisted in the Bradford area after it had become rare or extinct in the surrounding and more southerly districts. It is of interest that the Bradford Colliery sequence is very rich in coal of dominantly Densosporites-rich durain. Cronton Colliery (10) in the St. Helen's area and Point of Ayr in Flintshire are others similarly rich in dull coal. Furthermore the Bradford Upper Furnace seam (30), occurring towards the base of the Lower similis-pulchra Zone, has an assemblage complicated by the presence of large numbers of Cirratriradites tenuis and examination of the seam by sub-sections (B. and M., in the press) related this spore to certain dull bands of coal which could not be traced laterally to seams in adjacent collieries.

In other coalfields considered there are few Densosporites types above the horizon at which the lower S4 spores appear, i.e. at the top of the Upper similis-pulchra Zone. North Staffordshire and Lancashire are the only two coalfields of the central group which have a typical Coal Measure facies in this part of the Upper Coal Measures; in the Midlands the same horizons are represented by beds of Etruria Marl facies. In North Staffordshire the base of the lower S4 assemblage was drawn at the Chalkey Mine level before the coals of the Bradford Series of Lancashire were investigated and the fact that this series has an S3 - S4 transition assemblage does not necessarily indicate that it is of greater age than the Chalkey Mine; it is rather an indication that the limit drawn at that level between the S3 - S4 transition and the lower S4 assemblage is not entirely reliable, depending as it does on a group of spores known to be 'facies fossils'.

The seams (1,2) from the *tenuis* Zone were obtained from a boring (12) in the south-western part of the coalfield and these have typical upper S4 assemblages. *Schopfites dimorphus* is confined to a seam (2) in the Lower Group of the Upper Coal Measures (Trotter, 1952). The spores in these coals were somewhat difficult to separate and were found not to be so plentiful as in the equivalent coals in the Midland Coalfields.

(v) The Shropshire Coalfields.

Of the three Shropshire coalfields, Shrewsbury, Coalbrookdale and Forest of Wyre, only the two latter are now being worked. Borehole sequences have been examined from Lilleshall (71) and Madeley (72) in Coalbrookdale, and from Alveley (73) in Forest of Wyre. In both areas the sequence is interrupted by the Symon unconformity with the Productive Measures below and the Coalport or Highley Beds of the Upper Coal Measures above. A short account of the geology of these coalfields is given by Mitchell in Trueman (1954).

(a) Coalbrookdale (Fig.10)

The borings at Lilleshall and Madeley each cover the whole sequence of seams but the coals are thinner and often missing at Lilleshall in the northern part of the field. The correlation adopted between the two bores is that given by the Geological Survey (in borehole reports).

Generally the lowest seam found in Coalbrookdale is the Lancashire Ladies (28) but in the Madeley No. 1 bore (72) a 2ft. 7in. seam (29) was encountered 43ft. below that horizon. The assemblage of this unknown seam (29) has been queried as SO; it has, in addition to the usual SO types, occasional specimens of Reticulatisporites mediareticulatus and Endosporites spp. which generally occur in the S1 - S2 transition assemblage. It is likely that if the sample were contaminated there would also be odd specimens of Laevigatosporites, which is usually common in seams containing the other two species, but this is not the case.

The Lancashire Ladies seam has a typical S1 assemblage with species of Laevigatosporites and with no S2 types. The S1 - S2 transition extends from the Lower Big Flint seam (26) up to the Stinking Mine (18) below the Pennystone Marine Band. Cirratriradites striatus is particularly common in the Best, Randle and Clod (combined) seam (24). C. aligerens, a type characteristic of the S1 - S2 assemblage, is rare.

The S2 assemblage is found in seams up to the Blackstone Marine Band at which horizon the S3 types first appear. The S3 assemblage proper is not present as the Chance Pennystone Marine Band and succeeding measures (not shown in Fig.10) are cut out by the Symon unconformity in the sequences examined.

Four seams (1-4) from the Coalport Beds have upper S4 assemblages comparable with those of the Newcastle and Halesowen Beds of Staffordshire. Schopfites dimorphus is present in the two higher seams (1,2).

(b) Forest of Wyre (Fig.11)

The sequence in this coalfield is divided into the Highley and Kinlet Beds lying respectively above and below the Symon unconformity. The Alveley bore (73) went down to three seams below the Stinking Marine Band which is the equivalent of the Pennystone Marine Band of Coalbrookdale and of the Mid-modiolaris band elsewhere. The three lowest seams (19-21) have an S1 - S2 transition assemblage but Cirratriradites aligerens and C. striatus were not seen. C. tenuis and Endosporites costatus are both present in the lowest seam examined (21) which distribution is comparable to that of the same species in South Staffordshire.

The only named seam in the succession is the Highley Brooch (10) which marks the top of the zone having an S2 assemblage; Reticulatisporites mediareticulatus is present in the next two seams above (8,9) and these seams constitute an S2 - S3 transition.

The identity of the marine band occurring some 120ft. above the Highley Brooch is not certain and the evidence of the spores is not very helpful; the seams concerned are only a few inches thick and it would be rash to draw conclusions from their spore assemblages. The seam (7) below the marine band does not contain Reticulatisporites mediareticulatus and the seam (6) above has a fairly high percentage of Triquitrites sculptilis; these facts suggest a higher level than the Charles Marine Band of Cannock Chase. In Lancashire, on the other hand, R. mediareticulatus is frequently missing from the seams below the equivalent Dukinfield Marine Band. It is unfortunate that the seams associated with the Chance Pennystone Marine Band of Coalbrookdale are not available for comparison, for until they are no definite comparison is possible.

The seams sampled from the Highley Beds (1-4) have upper S4 assemblages. Schopfites dimorphus is confined to the two lower seams (3,4) but Laevigatosporites obscurus and Gravisporites sphaerus were not observed.

(vi) The Warwickshire Coalfield (Fig.12)

The geology of the Warwickshire coalfield has been described in detail by Mitchell and Stubblefield (1942); a shorter account is given by Mitchell in Trueman (1954).

Practically the whole of the exposed part of the coalfield consists of Upper Coal Measures but no seams have been sampled from strata higher than the similis-pulchra Zone. The longest sequence is that from the Amington Hall bore (78) in the north of the area where seams from above the Nuneaton Marine Band to below the Stanhope (33) were obtained. As in South Staffordshire there is a thinning of the measures when traced southwards and the coals of the lower part of the similis-pulchra Zone combine to form the Warwickshire Thick coal (5-16), parts of which were examined from Kingsbury (79) and Coventry (81) Collieries. All of the seams from the Two Yard (5) down to the Seven Feet (21) were sampled at Ansley Hall drift mine (80) in the eastern part of the coalfield. The Bolehall (77) and Statfold (76) bores in the northern part of the area provided seams from the Lower Coal Measures and Millstone Grit respectively.

The two seams (36,37) from Statfold and those from below the Stanhope coal in the Amington Hall bore all have an SO assemblage. The Stanhope (33) and Stumpy (32) seams each contain Laevigatosporites and Florinites antiquus; the presence of Cirratriradites aligerens in the Stumpy suggests that further search might show evidence of an S1 - S2 transition but until this is found both seams are placed in a zone having an S1 assemblage.

The Bench (31) is the first important seam in Warwickshire and it is the lowest horizon at which the S2 types have been noted. This coal and the lower leaf of the overlying Double (29,30) like seams from similar horizons in North Wales and Staffordshire, are remarkable for their high numbers of Cirratriradites striatus. Seams between this level and the Seven Feet Marine Band all have an S1 - S2 transition assemblage. C. tenuis and Endosporites costatus are both present in some seams from below the marine band as in other of the more southerly fields examined.

The S2 assemblage group is largely composed of seams rich in Densosporites which combine to form the Warwickshire Thick (5-16). Comparative studies of the component seams (Two Yard, Bare, Ryder, Ell and Nine Feet) from the localities listed above have tended to confirm the view of the officers of the Coal Survey Laboratory, Birmingham, that the High Main seam (18) joins the Nine Feet (14-16) to form part of the Thick coal. As in South Staffordshire an increase in the proportions of Spinososporites spinulistratus in the lower similis-pulchra

Zone is obscured by the high numbers of Densosporites present.

Very occasional specimens of the S3 types occur in the thin seam (2) below the Nuneaton Marine Band and the only seam to be sampled from above this horizon contains an S3 assemblage also.

VI. DISTRIBUTION OF MICROSPORES IN THE BRITISH COALFIELDS

The succession of microspore assemblages in the coalfields lying to the west of the Pennines has been outlined in the previous section. The changes from one microspore assemblage to another correspond broadly to the changes taking place in the non-marine lamellibranch succession. The lowest assemblage, S0, has been found in coals of the lenisulcata Zone and in the Millstone Grit coals of North Staffordshire which, however, have not been investigated in detail. The S1 assemblage is generally confined to the lowest seam of the communis Zone; most coals between this horizon and the Mid-modiolaris Marine Band contain occasional specimens of the S2 assemblage spores and so constitute an S1 - S2 transition zone. The S2 assemblage is present in seams from between the Mid-modiolaris Marine Band and the marine band at the top of the Lower similis-pulchra Zone. The S3 assemblage types appear at slightly varying levels in the seams below the top of the Lower similis-pulchra Zone and the assemblage is present from that level up to the marine band occurring at the base of the phillipsii Zone. Lower S4 assemblage types are present in the coal immediately below this marine band, which is the highest one in the Coal Measure succession. An S3 - S4 transition occurs from the marine band up to the Chalkey Mine level of North Staffordshire; this latter horizon is that at which Dix (1931,1933) placed the base of the Staffordian floral division. The upper S4 assemblage has been found in all coals of tenuis Zone age and also in seams which occur in the Etruria Marl of North Staffordshire.

Slight variations have been found in the ranges of certain spores; Endosporites costatus and Cirratriradites tenuis generally appear at about the top of the modiolaris Zone in the northern fields but in the Midlands they are frequently present in seams below the Mid-modiolaris Marine Band; Reticulatisporites mediareticulatus is rare in the higher part of the Lower similis-pulchra Zone in Lancashire but in the Midlands it has occasionally been found in a seam at the base of the Upper similis-pulchra Zone.

It is possible to compare the microspore distributions given with those found by workers in other British Coalfields. Knox (1942,1946) has described microspore assemblages from the Productive Coal Measures of the Fife and Central Coalfields of

Scotland. The presence is noted of Cirratriradites aligerens (A7) and Schulzospora ovata (6K) in coals of the pseudorobusta Zone (part of the communis Zone) and in the lower part of the modiolaris Zone. The types Endosporites spp. (C1), Reticulatisporites mediareticulatus (F2) and R. tortuosus (G1) are first recorded from coals immediately below the base of the modiolaris Zone. It seems probable, therefore, that the assemblages S1 and S2, with a transition zone, are present in the Scottish Productive Coal Measures. In a publication on the Limestone Coals of Fife (1948) Knox draws attention to the absence of spores of the genus Laevigatosporites (B1) from the Lower Carboniferous seams and to the presence in them of Schulzospora ovata (6K). The distribution of the same types in the lowest seams of the coalfields surveyed in the present investigations is in accordance with these results.

The microfloral successions in the South Wales, Forest of Dean, Bristol and Somerset, and Kent coalfields have been studied by R.W.Williams who has recorded the distributions of many spore species including most of those cited in the present work (in litt.).

The seams below the Amman Marine Band in South Wales i.e. the Mid-modiolaris Zone Marine Band, have an assemblage with Laevigatosporites, Florinites antiquus, Cirratriradites striatus, and C. aligerens, similar to the S1 - S2 transition;

Endosporites globiformis (included in Endosporites spp. in the present work) and Reticulatisporites tortuosus do not however appear below the marine band. C. tenuis and F. millotti occur in the seam immediately above the marine band - in the west Pennines coalfields C. tenuis appears sometimes below and sometimes above the marine band and F. millotti is confined to the S2 - S3 transition and higher horizons.

The S3 types Reticulatisporites magnus, Triquitrites sculptilis and Densosporites solaris come in above the Cefn Coed Marine Band, i.e. that at the top of the Lower similis-pulchra Zone, as compared with their appearance below that horizon in the central coalfields, whereas R. mediareticulatus is present up to an horizon between the Cefn Coed and Cwm Gorse (top of the Upper similis-pulchra Zone) Marine Bands and, in one instance, up to the latter marine horizon. This occurrence of R. mediareticulatus at comparatively high horizons in South Wales is perhaps a continuation of the trend noted in the central coalfields.

Of the S4 assemblage types, which appear immediately below the top of the phillipsii Zone in the central coalfields, Microreticulatisporites fenestratus occurs in the seam below the lower of the Cwm Gorse Marine Bands i.e. at a slightly lower horizon, and Torispora securis in a seam at the base of the phillipsii Zone i.e. at a rather higher level. M. quaesitus, in contrast to its appearance at the top of the Upper similis-pulchra Zone in the Midland coalfields, is present below the base of that zone in South Wales, but the M. quaesitus used in the present work is allied to M. fenestratus whereas the M. quaesitus of Williams is probably derived from Reticulatisporites cf. tortuosus. (See B. and W., 1954).

Densosporites and Reticulatisporites magnus disappear a short distance above the base of the phillipsii Zone in South Wales, as in the central English coalfields, and, as in North Wales, Staffordshire and Shropshire, species of the genus Densosporites are occasionally present in coals of tenuis Zone age. There is no occurrence of D. solaris in the upper part of the phillipsii Zone in South Wales to compare with that in the Bradford Series of Lancashire; there are, however, few coals in this part of the South Wales succession.

The higher coals in South Wales contain typical upper S4 assemblage spores but Cadiospora magna is apparently not present and Florinites antiquus and Spinososporites spinulistratus are more common in these coals than in those of comparable age in the central fields.

The distribution of microspores then is broadly comparable in the two areas; the differences tend to affect the positions of the transition zones rather than of the assemblages themselves. There does not seem to be any pattern in the variations - some species occur earlier in South Wales (Florinites millotti and perhaps Microreticulatisporites quaesitus) whereas others appear at a later stage (Reticulatisporites tortuosus, Endosporites globiformis and the S3 types).

In the south of England most of the sequences of coals on which microspore work has been carried out are of tenuis Zone age and younger, whereas in the central coalfields little has been done on coals of this age and, consequently detailed comparisons are not possible. It is interesting to note, however, that the species characterising the Newcastle - Halesown Beds of the Midlands are also present in the equivalent tenuis Zone coals in strata of different facies in the south.

V11. COMPARISON OF MICROSPORE DISTRIBUTION IN BRITAIN, EUROPE AND NORTH AMERICA.

Until recent years comparison of microspore distributions in Great Britain, Europe and North America was difficult on account of the numerous local divisions of the Upper Carboniferous strata and of the various classifications used for the microspores themselves. The publication of Schopf, Wilson and Bentall's synopsis of Palaeozoic spores in 1944 and the subsequent adoption of a modified form of the nomenclature in this country (Knox, 1950) facilitated comparison with the North American microfloras. Jongmans' (1952) division of the Coal Measures into Westphalian A-E and the definition of the zones in both Europe and North America has enabled broad comparisons of the ranges of spores to be made.

The most detailed record of microspore distribution in the United States is given by Kosanke in his account of the Pennsylvanian spores of Illinois (1950). The limits of Westphalian A given in this paper are at variance with those given at Heerlen (Cross and Schemel, 1951) but if the latter correlation is taken there is a considerable similarity among the ranges of several genera in Britain and America. Kosanke deals with four groups of measures - Caseyville, Tradewater, Carbondale and McLeansborough - which Cross and Schemel correlate broadly with the Westphalian A, B, C, and Westphalian D and Stephanian respectively. This sequence therefore corresponds with our Lower, Middle and Upper Coal Measures and with higher parts of the sequence which are unrepresented in Britain. The two main features of distribution in this country - the appearance of <u>Laevigatosporites</u> in Westphalian A and the virtual disappearance of <u>Densosporites</u> just above the base of Westphalian C - are paralled in Illinois. Other points of similarity are the absence of <u>Schulzospora</u> above Westphalian A, the restriction of Schopfites, Cadiospora and Laevigatosporites obscurus to higher parts of the sequence and the appearance of Florinites antiquus towards the top of Westphalian A. Raistrickia rubida, the occurrence of which is not noted separately in the appendix tables but which is present in the Black Band Group of North Staffordshire and in the Bradford Series of Lancashire, is also restricted to Westphalian C in Illinois. There are several differences in the distribution of species: Microreticulatisporites fenestratus, M. quaesitus and M. sulcatus all occur in Westphalian B in Illinois whereas they usually appear in Westphalian C in the British Coal Measures; Cirratriradites difformis, perhaps conspecific with C. aligerens, is found only in the lower part of Westphalian B of Illinois in contrast to its occurrence in the British Westphalian A.

Cross and Schemel (loc. cit.) compare the ranges of Laevigatosporites, Lycospora and Densosporites in the Western Interior, Eastern Interior and Appalachian basins of North America. In each district Laevigatosporites, although present in the Mississippian (Lower Carboniferous) becomes extremely rare in the Namurian and lower Westphalian A and becomes common only towards the top of Westphalian A. Densosporites disappears at a uniform level above the base of Westphalian C. There are no coals sufficiently high in the sequence in Britain to make comparison possible with the upper limits of Lycospora and Laevigatosporites which occur in the highest Westphalian and Stephanian respectively of North America.

Recently a more comprehensive description of Palaeozoic spore genera in America has been given by Hoffmeister, Staplin and Malloy (1955) who have adopted, with modifications, the spore classification of Potonié and Kremp (1955). In this work the approximate distribution of 44 microspore genera are given for the whole of the American Carboniferous; there is also a useful summary of pre-Carboniferous spore occurrences with reference to the Devonian of Russia, Spitzbergen and America. Berry (1937) found Laevigatosporites in the Pennington Seam of Tennessee (Mississippian) but this is the only noted occurrence of the genus below the Pennsylvanian. In the tables appended to the paper (H., S. and M, loc. cit.) the lower limit of the genus Laevigatosporites is given as lower Westphalian. The upper limit of Densosporites is the same as that given elsewhere but it has a queried and isolated occurrence in the Stephanian. The scope of the work is too broad for detailed comparisons to be made within the Westphalian but in addition to the similarities in the distribution of Laevigatosporites and Densosporites it is noted that Schulzospora is restricted to the

Mississippian and Lower Pennsylvanian; this genus has also been recorded from the Lower Carboniferous of Russian (Luber and Waltz, 1938).

Spores present in the Namurian and Westphalian A of the Westoberschlesischen and Mahrisch-Ostrau regions of Germany have been described by Horst (1955) who uses the Potonié and Kremp system of nomenclature. In the Westoberschlesischen district, where the Hruschauer and Porubaer Beds of Namurian A and the Muldengruppe of Westphalian A are represented, the main point of interest is the presence of Laevigatosporites sp. and Dictyotriletes bireticulatus (Reticulatisporites mediareticulatus) in the Westphalian A and the top of the Namurian A whereas each of these appears towards the top of Westphalian A in Britain. A species of Schulzospora was found by Horst to be confined to the Namurian. In the Mahrisch-Ostrau region the Sattelgruppe (Namurian B) occurs between Namurian A and Westphalian A and here D. bireticulatus is rare and Laevigatosporites absent. This distribution of Laevigatosporites thus corresponds to that given by Schemel and Cross (loc. cit.) for North America; the presence of the genus in the Mississippian however is not confirmed by Hoffmeister, Staplin and Malloy.

Comparative studies of microspore distribution in the Ruhr and Saar coalfields have recently been carried out by Bhardwaj and Kremp (1955). This supplements the stratigraphical data in the paper outlining the spore classification devised by Potonié and Kremp (1954) in which the approximate limits for each genus are given. Much recent information is missing from these tables which include data from Europe, America and Russia, but there is a certain similarity in the generic distributions already discussed.

Kremp, in Bhardwaj and Kremp (1955), has divided the Westphalian B of the Ruhr into six zones and the Westphalian C into two, using only species of Lycospora, Densosporites and Anulatisporites. Comparisons in Britain are impossible until similar species are identified here.

Bhardwaj (loc. cit.) has divided the upper part of the Westphalian and the Stephanian of the Saar into four zones - the Densosporites (Westphalian C), Torispora (Westphalian D), Triquitrites (Stephanian A and B) and Lycospora (Stephanian C) Zones. If the Westphalian C - D boundary is taken according to Guthörl, as alternatively shown in Bhardwaj's diagram, then the limit between the Densosporites - Torispora Zones occurs below the base of Westphalian D, which is more comparable with the distribution of these genera in the British Coal Measures.

Bhardwaj shows no overlap between his zones, whereas in Britain there is a considerable group of seams containing both Densosporites and Torispora (S3 - S4 transition). The Torispora zone contains Microreticulatisporites fenestratus, M. quaesitus and Triquitrites sculptilis which compares with the lower S4 assemblage.

Bhardwaj has proposed that the junction of his Densosporites and Torispora Zones be taken into consideration in the definition of the Westphalian C - Westphalian D boundary. In Britain however, as indicated above, there is a considerable thickness of strata in which both genera are present, and, unfortunately, the range of Densosporites varies (cf. the Black Band Series of North Staffordshire and the Bradford Group of Lancashire.)

V111. COMPARISON OF THE PALAEONTOLOGICAL AND MICROSPORE SUB-DIVISIONS OF THE UPPER CARBONIFEROUS.

Marine bands serve as the most constant and valuable marker horizons in the Coal Measures of Great Britain. The occurrence of the marine bands affects both the plant and non-marine fauna distributions; in all published zoning schemes of the Upper Carboniferous, with the exception of that of Kidston (1894), some at least of the dividing lines have been drawn at marine horizons.

Although the marine bands at the middle of the *modiolaris* Zone, at the top of the Lower *similis-pulchra* Zone and at the base of the *phillipsii* Zone are all associated with the incoming of spore assemblages (S2, S3 and lower S4 respectively), there is no sharp break in the spore sequence; on each occasion the incoming species are present considerably in advance of the marine band and at the two higher horizons the types characterising the underlying assemblages persist above the marine level. This conforms with Jongmans' (1952) statement that the species representing the Westphalian A flora of north-western Europe are never found above the Catherina Niveau (mid-*modiolaris*) Marine Band whereas similar suites of plants are frequently found above and below the relatively more important Aegir Marine Band (the top of the Lower *similis-pulchra* Zone) which separates Westphalian B and Westphalian C on the continent.

The earliest sub-division of the Coal Measures of Great Britain was made by Kidston (1894) on the basis of plant distribution. Although this system was discredited by reason of the mis-naming of the Productive Coal Measures of Scotland as Lanarkian and of the transferance of the higher divisions from the type area of North Staffordshire, where they were said to have a lithological basis, to South Wales, it still remains a broadly serviceable zoning scheme in the central coalfields of England. The Radstockian strata are not considered here, but the Lanarkian, Yorkian and Staffordian are represented by the microspore assemblages SO, S1-3 and S4 (the base of the Staffordian in North Staffordshire was altered from the Bassey to the Chalkey Mine by Dix, 1931). Generally the limits of these three divisions of Kidston are defined by the incoming of Laevigatosporites at the base of the Yorkian and by the practical disappearance of Densosporites at the base of the Staffordian.

North Staffordshire is the only coalfield of the group considered here which is discussed in Dix's work on the sequence of Upper Carboniferous floras (1933). Apart from the base of the Millstone Grit (Flora A) her description is confined to strata of the Upper Coal Measures: Flora G is present from the Chalkey Mine up to the top of the Black Band Group (corresponding with the lower S4 assemblage): material from the Etruria Marl is limited but the overlying Newcastle-under-Lyme Beds are considered to have a Flora H (corresponding to the upper S4 assemblage). The lower floras can only be distinguished by comparison with those of South Wales where the full sequence was described. The base of Flora F, presumably present in the measures below the Chalkey Mine in North

Staffordshire, is drawn at an horizon somewhat lower than the top of the Lower similis-pulchra Zone i.e. perhaps at the base of the S2 - S3 transition. Flora E extends down to an horizon towards the top of the modiolaris Zone which is not of particular significance in the microspore sequence. The lower limit of Flora D occurs in the communis Zone, in the S1 - S2 transition, and Flora C includes the lower part of the communis Zone, all of the lenisulcata Zone and the top of the Millstone Grit. Thus Dix's floras do not coincide markedly with the microspore assemblages. If Flora C is taken as SO, Flora D as S1, Flora E as S2 and Flora F as S3 it can be seen that the spore assemblages generally appear in advance of the floras. However, as it has been shown that the spore assemblages of South Wales are slightly different from those of the central coalfields it is perhaps inappropriate to make such comparisons.

Jongmans' floral division of the Coal Measures into Westphalian A - D has been accepted by the IIième Congress of Carboniferous Stratigraphy at Heerlen (1951). According to Trueman (1946) Westphalian A extends from the base of the measures up to the Mid-modiolaris Marine Band; Westphalian B from that horizon to the marine band at the top of the Lower similis-pulchra Zone and Westphalian C from there to an horizon rather lower than the base of the _tenuis_ Zone. As was indicated in connection with the marine bands, the junctions of the Westphalian A - B and C - D coincide with those of the spore assemblages S1 - S2 and S2 - S3. Jongmans (1952) notes that 'the Westphalian B begins where the typical forms of A no longer persist' i.e. at the lower marine horizon, and this applies also to the S1 - S2 assemblages. Westphalian D coincides with the zone containing seams with an upper S4 assemblage excepting where coals of Etruria Marl age have been sampled, in which case the upper S4 limit has to be drawn at a lower level than that of Westphalian D.

It is interesting to find that the limits of the microspore assemblages, as defined in the present work, can be arrived at by combining the limits of Kidston's Lanarkian, Yorkian and Staffordian divisions and of Jongmans' Westphalian A, B, C and D.

The limits of the microspore assemblages have already been defined in terms of the non-marine lamellibranch succession (section V1, p.55). Briefly, assemblage S0 coincides with the _lenisulcata_ Zone; S1 and the S1 - S2 transition with the _communis_ Zone and the lower part of the _modiolaris_ Zone; S2 and the S2 - S3 transition with the upper part of the _modiolaris_ Zone and the Lower _similis-pulchra_ Zone;

S3 with the Upper <u>similis-pulchra</u> Zone; the S3 - S4 transition and the lower S4 assemblage with the <u>phillipsii</u> Zone and upper S4 with the <u>tenuis</u> Zone (plus the Etruria Marl of North Staffordshire).

The similarity in the distributions of microspores and non-marine lamellibranchs is largely due to the fact that both are affected by periodic marine incursions; thus, during the non-marine interphases edaphic conditions became favourable to both plants and non-marine lamellibranchs and they are brought into an apparent relationship with one another.

It is recognised that the zones containing the spore assemblages are, as Trueman (1946) has remarked concerning the non-marine lamellibranch zones, dependant 'mainly on the entry of new forms and the disappearance of earlier groups. They are not primarily based on evolutionary changes occurring within the genera.' It is for this reason that attention has been restricted in the course of the present work to easily distinguishable types. Further detailed examination of microspore assemblages may enable a more precise definition of zones to be drawn on the basis of the distribution of as yet undescribed species; before this can be done, however, it will be necessary to define the groups of spores which are associated with the various facies of the Coal Measures swamps and to distinguish between spores whose presence is dependant on ecological conditions and those due to evolutionary changes.

lX. SUMMARY.

1. The distributions of fifty microspores have been examined in sequences of seams from the Coal Measures of Staffordshire, North Wales, Lancashire, Shropshire and Warwickshire.

2. Six spore assemblages have been described and named S0, S1, S2, S3, lower S4 and upper S4.

3. The stratigraphical limits, in terms of non-marine lamellibranch zones, of the assemblages are as follows :-

S0 - in coals of the lenisucata Zone.

S1 - in coals from the base of the communis Zone to the Mid-modiolaris Zone Marine Band.

S2 - in coals from the Mid-moliolaris Marine Band to the top of the lower part of the similis-pulchra Zone.

S3 - in coals of the upper part of the similis-pulchra Zone.

Lower S4 - in coals of the phillipsii Zone.

Upper S4 - in coals of the tenuis Zone and in coals occurring in the Etruria Marl Group of North Staffordshire.

4. Three of the microspore zones are underlain by groups of seams having assemblages of a transitional nature :- the S1-S2 transition occurs in seams below the Mid-modiolaris Marine Band, in most cases only the lowest seam of the communis Zone having an S1 assemblage; the S2 - S3 transition occurs in seams just below the marine band marking the top of the Lower similis-pulchra Zone; the S3 - S4 transition is present in the seam below the marine band at the base of the phillipsii Zone and in North Staffordshire, where this part of the sequence is most complete, extends to the Chalkey Mine where Dix has placed the base of the Staffordian. In Lancashire the transition assemblage is also present in some of the coals of the Bradford Series which occur in the upper part of the phillipsii Zone.

5. The microspore distributions have been compared with those described from the coalfields of Scotland, South Wales, Southern England, North America and Germany. A broad similarity among these distributions has been noted.

6. Comparisons have been drawn between microspore distributions in the Coal Measures and the distributions of plants and non-marine lamellibranchs.

X. ACKNOWLEDGMENTS.

This research was carried out under the supervision of Dr. E. M. Knox for whose generous assistance and encouragement the author is very grateful. Thanks are also due to Professor A. Holmes, F.R.S., and to Dr. A. M. Cockburn of the Grant Institute of Geology for their help.

The work described forms part of the survey of National Coal Resources carried out by the Coal Survey organisation of the National Coal Board. Acknowledgment is made of the permission granted to reproduce the borehole logs given in the first part of the appendix. In the event of publication formal approval would be required from the National Coal Board to include these details. Thanks are due to Dr. J. O'N. Millott, Coal Survey Officer, Chester, for the guidance and help given in that part of the work relating to Lancashire, North Wales and North Staffordshire, and to Mr. E. Bradburn and Mr. K. G. Cope, Coal Survey Officer and Deputy Coal Survey Officer, of the Birmingham Coal Survey Laboratory for their assistance and co-operation in the work on the Midland coalfields. The author is grateful for helpful discussions with Mr. R. W. Williams and Mr. A. H. V. Smith of the Microscopy Section, Coal Survey Laboratory, Sheffield, and for the guidance afforded to her by their predecessor, Mr. B. E. Balme. Special thanks are due to Mr. R. W. Williams for permission to compare the present work with his unpublished data on the distribution of microspores in the coalfields of South Wales and the south of England.

Finally, acknowledgment is made of the use of numerous publications and reports by officers of H.M. Geological Survey.

XI. BIBLIOGRAPHY.

BALME, B.E., 1952, 'On some spore specimens from British Upper Carboniferous coals,' Geol.Mag., 89, 175.

BALME, B.E. & BUTTERWORTH, M.A., 1952, 'The stratigraphical significance of certain fossil spores in the central group of British coalfields', Trans.Inst.Min.Eng.,111, Pt.11, 3.

BENNIE, J. & KIDSTON, R., 1886, 'On the occurrence of spores in the Carboniferous formation of Scotland', Proc.Roy. Phys.Soc. Edin., 9, 82.

BERRY, W., 1937, 'Spores from the Pennington Coal, Rhea County, Tennessee', Am.Mid.Nat., 18, No.1, 155.

BHARDWAJ, D.C., 1954, 'Einige neue Sporengattungen des Saarkarbons', Neues Jb.Geol.Paläontol.Mb. No.11

_____________, & KREMP, G., 1955, 'Die Sporen fuhrung der Velener Schichten des Ruhrkarbons', Geol.Jb.,71, 51.

BUTTERWORTH, M.A. & MILLOTT, J.O'N., 1954, 'Microspore distribution in the seams of the North Staffordshire, Cannock Chase and North Wales coalfields', Trans.Inst.Min.Eng.,114, Pt.6, 501.

_____________, & _____________, (in the press), 'The Lancashire coalfields. The correlation by microspores of certain seams at Bradford and Wheatsheaf Collieries and in the Prestwich Boreholes', Ibid.

BUTTERWORTH, M.A. & WILLIAMS, R.W., 1954, 'Descriptions of nine species of small spores from the British Coal Measures', Ann.Mag.Nat.Hist., Ser.12, 7,753

CALVER, M.A., EARP, J.R. & HOARE, R.H., 1953, 'Correlation of the North and South Staffordshire Productive Coal Measures', Summary of Progress, Geol.Surv.Gt.Brit.,34.

CHALLONER, W.G., 1953, 'A new species of Lepidostrobus containing unusual spores', Geol.Mag., 90, 97.

CROSS, A.T. & SCHEMEL, M.P., 1951, 'Representative microfossil floras of some Appalachian coals', Extrait du Compte Rendu, 111ième Congres de Stratigraphie et de geologie du Carbonifiere, Heerlen, 1951.

DIJKSTRA, S.J., 1955, 'La correlation des reines de charbon par les megaspores', Publ.Ass.Etud.Paleont.Bruxelles, No.21, Hors Serie.

DIX, E., 1931, 'Flora of the upper portion of the Coal Measures of North Staffordshire', Q.J.G.S., 87, 160.

________, 1933, 'The sequence of floras in the Upper Carboniferous with special reference to South Wales', Trans.Roy. Soc.Edin., 57, Pt.111(No.33), 789.

EDWARDS, W., WALKER, J.J. & WANDLESS, A.M., 1938, 'A new interpretation of the Pollington boring, Yorkshire, Trans.Inst.Min.Eng., 95, Pt.2, 147.

FLORIN, R., 1936, 'On the structure of the pollen grains in the Cordaitales', Svensk.bot.tidsk., 30, No.3, 624.

_________, 1937, 'On the morphology of the pollen grains of some Palaeozoic Pteridosperms', Ibid., 31, No.3, 305.

GIBSON, W. & others, 1905, 'The geology of the North Staffordshire Coalfields', Memoir Geol.Surv.Gt.Brit., H.M.S.O.

_________ & others, 1925, 'Geology of the country around Stoke-on-Trent', Ibid. 1925.

HARTUNG, W., 1933, 'Die Sporenverhältnisse der Calamariaceen', Inst. Paläobot.u.Petrog. der Brennsteine Arb., 3 No. 3, 95.

HESTER, S.W., 1931, 'The Millstone Grit succession in North Staffordshire', Summ. of Prog., Geol.Surv. Gt.Brit., 1931,34.

HICKLING, G., 1927, 'Sections of strata of the Coal Measures of Lancashire', Andrew Reid, Newcastle, 1927.

HOFFMEISTER, F., STAPLIN, L. & MALLOY, R.E., 1955, 'Geologic range of Palaeozoic plant spores in North America', Micropalaeontology, 1 No.1, 9.

HORST, U., 1955, 'Die Sporae dispersae des Namurs von Westoberschlesischen und Mahrisch-Ostrau. Stratigraphischer vergleich der beiden Gebiete an Hand der Sporen-diagnose', Pälaontographica, 98 B.

IBRAHIM, A.C., 1931, 'Beschreibung von Sporenformen aus Flöz Agir', in Potonié, R., 1931.

_____________, 1933, 'Sporenformen des Agirhorizonts des Ruhrreviers', Dissertation, Berlin. Konrad Trilsch, Wurzburg, 1933.

JONES, R.C.B. & others, 1938, 'Wigan District', Mem.Geol.Surv. Gt.Brit. H.M.S.O.

JONGMANS, W.T., 1952, 'Some problems on Carboniferous stratigraphy', lllième Congr.Stratr.Carbonif. Heerlen.1951, C.R.1, 295.

KIDSTON, R., 1894, 'On the various divisions of the British Carboniferous rocks as determined by their fossil flora', Proc.Roy.Phys.Soc., 123, 183.

_____________, 1905, 'On the division and correlation of the upper portion of the Coal Measures with special reference to the Midland Counties of England', Q.J.G.S., 61, 308.

_____________, 1923-25, 'Fossil plants of the Carboniferous of Great Britain', Mem.Geol.Surv.Gt.Brit., H.M.S.O.

KNOX, E.M., 1938, 'The spores of the Pteridophyta with observations on the microspores in coals of Carboniferous age, Trans.Bot.Soc.Edin., 32, Pt.lll.

KNOX, E.M., 1939, 'The spores of Bryophyta compared with those of Carboniferous age', Ibid., 32, Pt.lV.

__________, 1942, 'Microspores in some coals of the Productive Coal Measures in Fife', Trans.Inst.Min.Eng., 101, Pt.l.

__________, 1946, 'Microspores in the Productive Coal Measures of the Central Coalfield of Scotland', Ibid., 105, Pt.lll.

__________, 1948, 'Microspores in coals of the Limestone Group in Scotland', Ibid., 107, Pt.lll.

__________, 1948, 'Spore development in the Archegoniates', Trans.Bot.Soc.Edin., 35, Pt.l.

__________, 1949, 'Microspores and their biological significance', Ibid., 35, Pt.ll.

__________, 1950, 'The spores of Lycopodium, Phylloglossum, Selaginella and Isoetes and their value in the study of microfossils of Palaeozoic age', Ibid., 35, Pt.lll.

KOSANKE, R., 1950, 'Pennsylvanian spores of Illinois and their use in correlation', Illinois State Geol.Surv., Bull. 74.

LOOSE, F., 1934, 'Sporenformen aus den Flöz Bismarck des Ruhrgebietes', Inst.Paläobot.u.Petrog.d.Brennsteine Arb., 4, No.3,127.

LUBER, A.A. & WALTZ, I.E., 1938, 'Classification and stratigraphic value of spores of some Carboniferous coal deposits in the U.S.S.R.', Russia, Central Geol.Prosp.Inst. Trans., fasc.105.

MAGRAW, D., 1954, 'Note on a marine band occurring above the Red Mine at Llay Main Colliery', Summ. of Prog. for 1953, Geol.Surv.Gt.Brit., 41.

MELVILLE, R.V., 1946, 'The non-marine lamellibranchs of the North Staffordshire Coalfield', Ann.Mag.Nat.Hist., 13, 289.

MILLOTT, J.O'N., 1938, 'The microspores of the coal seams of North Staffordshire, Pt.1 - The Millstone Grit - Ten Feet coals, Trans.Inst.Min.Eng., 96, 317.

_______________, 1946, 'The microspores in the coal seams of North Staffordshire, Pt.11 - the seams of the Cheadle coalfield', Ibid., 105, 91.

MITCHELL, G.H., STUBBLEFIELD, C.J. & CROOKALL, R., 1942, 'The geology of the Warwickshire coalfield', Geol.Surv. Gt.Brit., Wartime Pamphlet No.25.

MITCHELL, G.H., 1945, 'The geology of the northern part of the South Staffordshire coalfield (Cannock Chase region, with palaeontology by C.J.Stubblefield)', Ibid.,No.43.

MOORE, L.R., 1945, 'On the spores of some Carboniferous plants', Q.J.G.S., 102, 251.

POOLE, E.G. & WHITEMAN, A.J., 1954, 'Exploratory boreholes in the Prestwich area of the south-east Lancashire coalfield', Trans.Inst.Min.Eng., 114, Pt.4, 291.

POTONIÉ, R., 1931, 'Sporenformen aus den Flözen Agir und Bismarck des Ruhrgebietes', Neues Jahr., 67, Abt. B, 438.

__________, 1954, 'Stellung der paläozoischen Sporengattungen im natürlichen System', Palaönt. Zeit, 28, 103.

__________ & KREMP, G., 1954, 'Die Gattungen die paläozoischen Sporae dispersae und ihre Stratigraphie', Geol.Jb., 69, 111.

__________ & _____, 1955, 'Die Sporae dispersae des Ruhrkarbons, ihre Morphographie und Stratigraphie mit Ausblicken auf Arten andere Gebiete und Zeit abschnitte', Pälaontographica B.

RADFORTH, W.N., 1938, 'An analysis and comparison of the structural features of Dactylotheca plumosa and Senftenbergia ophiodermatica, Göppert sp.', Trans.Roy.Soc.Edin.,59.

RAISTRICK, A. & SIMPSON, J., 1933, 'The microspores of some Northumberland coals and their use in the correlation of soal seams', Trans.Inst.Min.Eng., 85, Pt.4, 225.

RAISTRICK, A., 1934, 'The correlation of coals by microspore content. Pt.1 - the seams of Northumberland', Ibid., 88, Pt.3, 142.

__________, 1939, 'The correlation of coal seams by microspore content, Pt.11 - The Trencherbone Seam, Lancashire and the Busty Seam, Durham', Ibid., 97, 425.

REINSCH, P.F., 1884, 'Micro-Palaeophytologia formationis Carboniferae, Vol.1, Continens Triletes et Stelidean,' Erlangae, Germania, Thomas Krische.

REMY, W., 1954, 'Monosaccate Pteridospermenpollen aus dem Karbon und Perm sowie eine allgemeine Betrachtung der palaozoischen Pollen mit Luftsack', Paläont Zeit, 28, 140.

________, 1955, 'Untersuchungen von kohlig erhaltenen fertilen und sterilen Sphenophyllen und Formen unsicherer systematischer Stellung', Abhandlungen der deutschen Akademie der Wissenschaften zu Berlin, 1955, No. 1.

REMY, R. & REMY, W., 1955, 'Mitteilungen über Sporen, die aus inkohlten Fruktifikationen von echten Farnen des Karbon gewonnen wurden', Ibid., No.1.

________ & ________, 1955, '_Simplotheca silesiaca_ n.gen. et sp.', Ibid, No.2.

REMY, W., 1955, 'Einige Grundzüge der Entwicklung von Pflanzen mit Pteridospermen Markmalen in Laufe der Erdgeschichte', Ibid, No.2.

SCHOPF, J.M., WILSON, L.R. & BENTALL, R., 1944, 'An annotated synopsis of Palaeozoic fossil spores and the definition of generic groups', Illinois State Geol. Surv. Report of Investig. 91.

SCHULZE, F., 1855, 'Uber das Vorkomeen wohlerhaltener Zellulose in Braunkohle und Steinkohle', Berlin K.Akad.Wiss. Berlin, 676.

SIMPSON, H.H., 1935, 'Notes on a marine band in the Denbighshire coalfield', Geol.Mag., 72, 165.

THIESSEN, R. & WILSON, F.E., 1924, 'Correlation of coal beds of the Allegheny Formation of Western Pennsylvania and Eastern Ohio', Coal Mining Investigations, Carnegie Inst., Tech. Bull. 10.

TONKS, L.H. & others, 1931, 'The geology of Manchester and the south-east Lancashire Coalfield', Mem.Geol.Surv. Gt.Brit., H.M.S.O.

TROTTER, F.M., 1952, 'Exploratory borings in south-west Lancashire', Trans.Inst.Min.Eng., 112, 268.

TRUEMAN, A.E., 1933, 'A suggested correlation of the coalfields of England and Wales', Proc.S.Wales Inst.Eng., 49, 63.

____________, 1946, 'Stratigraphical problems in the Coal Measures of Europe and North America', Q.J.G.S., 102, xlix.

____________, 1947, 'Stratigraphical problems in the coalfields of Great Britain', Ibid., 103, Pt. 2, lxv.

____________, 1954, 'Coalfields of Great Britain, London, Edward Arnold, 1954.

WALKER, J.J., 1942, 'The restricted time ranges of two types of fossil microspore in the Coal Measures of Yorkshire and Nottinghamshire', D.S.I.R. Coal Survey Report.

WEDD, C.B. & others, 1923, 'The geology of Liverpool with Wirral and part of the Flintshire coalfield', Mem.Geol. Surv.Gt.Brit., H.M.S.O.

WEDD, C.B. & KING, W.B.R., 1924, 'The geology of the country around Flint, Hawarden and Caergwrle', Ibid.

WEDD, C.B. & others, 1928, 'The geology of the country around Wrexham', Ibid.

WILLIAMS, R.W., 1955, 'Pityosporites westphalensis, sp.nov., an abietinious type pollen grain from the Coal Measures of Britain', Ann.Mag.Nat.Hist., Ser.12, 8, 465.

WILSON, L.R. & COE, E.A., 1940, 'Descriptions of some unassigned plant microfossils from the Des Moines Series of Iowa', Am.Mid.Nat., 23, No.1, 182.

WOOD, A., 1937, 'The non-marine lamellibranchs of the North Wales coalfield', Q.J.G.S., 93, 1.

WRAY, D.A., SLATER, L. & EDDY, G.E., 1930, 'The correlation of the Arley Mine of Lancashire with the Better Bed of Yorkshire', Summ.Prof.Geol.Surv.Gt.Brit., 1930, Pt.11, 1.

WRIGHT, W.B. & others, 1927, 'The geology of the Rossendale Anticline', Mem.Geol.Surv.Gt.Brit., H.M.S.O.

ZERNDT, J., 1934, 'Les Megaspores du bassin Nouiller Polonois', I. Acad. Pol. des Sci. et des Lett., Trav.Geol.,No.1.

__________, 1937, 'Les Megaspores du bassin Nouiller Polonois', 11. Ibid., No.3.

__________, 1938, 'Die Eignung von Megasporen als Leitfossilien', 11ième Congres de Stratigraphie Carbonifiere, Heerlen, 1935, C.R.3, 1711.

ZETSCHE, F. & KALIN, O., 1932, 'Untersuchungen uber die Membran der Sporen und Pollen', Helv.Chim.Acta., 15, 412.

XII. EXPLANATION OF FIGURES.

Fig. 1. Fossil microspores. Magnification x 500. Facing page 14.

1. Densosporites annulatus (Loose) S.,W. & B.
2. D. indignabundus (Loose) S.,W. & B.
3. Spinososporites spinulistratus (Loose) Knox.
4. Cirratriradites striatus Knox.
5. Schulzospora ovata (Balme)
6. Laevigatosporites desmoinensis (Wilson & Coe) S.,W. & B.
7. Florinites antiquus Schopf.
8. Reticulatisporites mediareticulatus Ibrahim.
9. Pityosporites westphalensis Williams.
10. Cirratriradites aligerens Knox.
11. Florinites millotti Butterworth & Williams
12. Cirratriradites tenuis (Loose) S.,W. & B.
13. Triquitrites sculptilis Balme.
14. Endosporites globiformis (Ibr.) S.,W. & B.
15. Densosporites solaris Balme
16. Reticulatisporites tortuosus Balme.

Fig. 2. Fossil microspores. Magnification x 500. Facing page 15.

17. Reticulatisporites magnus Butterworth & Williams
18. Microreticulatisporites quaesitus (Kosanke) B.& W.
19. M. fenestratus (Kosanke) B.& W.
20. Endosporites costatus Balme

(a) Sample localities.

NORTH STAFFORDSHIRE

Maceration Number	Number on Fig. 4	Colliery, Borehole or Opencast Site	Depth to base of seam (in case of borehole)	Name of Seam
K 1	7	Pie Rough B.H. (47)	729' 3"	
K 2	9	" " "	1003'10"	Red Shagg
K 3	10	" " "	1067' 0"	Red Mine
K 5	11	" " "	1097' 6"	Hoo Cannel
K 7	12	" " "	1264' 0"	Bassey
K11	13	" " "	1298' 6"	
K12	14	" " "	1322' 0"	Peacock
K15	15	" " "	1395' 0"	Spencroft Tops
K17	15	" " "	1450' 0"	" Btms
K19	16	" " "	1503' 0"	Great Row
K26	17	" " "	1564' 0"	Cannel Row
K27	20	" " "	1824' 6"	
K28	20	" " "	1873' 6"	
K29	24	" " "	2016' 0"	Winghay
K35	29	" " "	2343' 0"	Rowhurst
K36	31	" " "	2355' 0"	
K37	33	" " "	2438' 6"	Burnwood
K38	34	" " "	2455' 0"	Twist
K40	35	" " "	3038' 0"	Granville
K41	36	" " "	3152' 0"	Four Feet
K42	37	" " "	3162' 0"	Two "
K44	38	" " "	3233' 6"	Five "
K46	40	" " "	3313' 6"	Ragman
K47	43	" " "	3367' 0"	
K48	45	" " "	3496' 0"	
K49	45	" " "	3607' 6"	
K50	46	" " "	3624' 6"	Ten Feet
K55	47	" " "	3733' 0"	Bowling Alley
K56	48	" " "	3740' 0"	Holly Lane
K59	49	" " "	3861' 0"	Hard Mine
K61	52	" " "	3955' 0"	7 Ft. Banbury
494	18	Holts Barn B.H. (56)	1516'11"	
495	18	" " "	1521' 0"	
496	19	" " "	1538'10"	Chalkey
488	23	" " "	1681'11"	Bay
489	24	" " "	1711' 6"	Winghay
490	26	" " "	1742' 0"	
491	28	" " "	1789'10"	
492	28	" " "	1800' 9"	

NORTH STAFFORDSHIRE Continued ..

Maceration Number	Number on Fig.4	Colliery, Borehole or Opencast Site	Depth to base of seam (in case of borehole)	Name of Seam
661	1	Moddershall Churchyard (outcrop) (55)		? Keele Group
316	2	Downing's Marl Pit, Etruria " (46)		Newcastle Group
317	3	Trentham-Whitmore Rd. " (52)		" "
319	4	Marl Pit nr. Penkhull " (48)		" "
320	5	Downing's Marl Pit Chesterton" (43)		Etruria Marl
367	6	Hungerford B.H. (44)	988'0"	" "
323	8	Marl Pit nr. Tunstall (outcrop) (40)		" "
344	18	Silverdale Colliery (45)		Sheath
345	19	" "		Chalkey
346	21	Wilkinson's Marl Pit (outcrop) (41)		Bungilow
347	22	" " "		Unnamed 20' below
376	34	Stafford Colliery (49)		Twist
649	36	Hem Heath Colliery (53)		Moss
378	39	Florence Colliery (54)		Yard
324	41	Stafford Colliery (49)		Hams
325	42	" "		Birches
326	44	Chatterley Whitfield Colliery (39)		Bellringer
334	50	Adderley Green Colliery (50)		New
332	51	" " "		Little
382	53	Chatterley Whitfield Colliery (39)		Cockshead
337	54	Norton Colliery (42)		Whitehurst
335	55	" "		Bullhurst
381	56	Victoria " (38)		Winpenny
389	57	Gillow Heath Colliery (36)		Brickiln
390	58	" "		Silver
391	59	" "		Little Cannel Row
392	60	" "		King
393	61	Woodhouse Colliery (51)		Crabtree
394	62	Congleton Edge (outcrop) (37)		Sandrock Mine
448	63	" " "		Holcombe Brook
446	64	Limekiln Wood " (35)		Astbury Coal

CANNOCK CHASE.

Maceration Number	Number on Fig.5	Colliery, Borehole or Opencast Site		Depth to base of seam (in case of borehole)	Name of Seam
678	1	Shareshill B.H. (70)		486' 6")	Halesowen Beds
679	4	"	"	591'11")	
705	19	"	"	718' 6"	Top Robins
706	20	"	"	724' 1"	
707	23	"	"	797' 7"	Bottom Robins
708	26	"	"	815'10"	
709	27	"	"	831' 3"	Wyrley Yard
667	3	Orchard Farm B.H. (69)		482' 3")	Halesowen Beds
668	4	"	"	495' 0")	
669	16	"	"	582' 5"	
670	17	"	"	592' 6"	
710	18	"	"	602' 8"	
711	19	"	"	609' 9"	Top Robins
712	20	"	"	612' 3"	
714	?22	"	"	667'11"	
1012	1	Moat Farm B.H. (68)		1104' 9")	
1013	2	"	"	1108' 6")	Halesowen Beds
1014	4	"	"	1184' 9")	
1016	41	"	"	1257' 1"	
1017	42	"	"	1269' 6"	
1018	43	"	"	1286' 8"	Park
1019	44	"	"	1298' 5"	
1020	45	"	"	1322' 0"	
1021	46	"	"	1341' 3"	
1022	48	"	"	1360' 0"	
1023	50	"	"	1387' 6"	
1024	?58	"	"	1435' 3"	
1025	?59	"	"	1455' 6"	
1026	?60	"	"	1472' 0"	
1027	61	"	"	1508' 1"	Deep
1028	62	"	"	1531' 4"	
826	14	Saredon Hill B.H. (67)		1002' 4½"	
827	16	"	"	1033' 4"	
828	17	"	"	1043' 1"	
830	19	"	"	1061' 2"	Top Robins
831	20	"	"	1065' 6"	
832	21	"	"	1092' 8"	
833	22	"	"	1119' 1½"	
834	23	"	"	1170' 7"	Bottom Robins
835	27	"	"	1178' 6"	Wyrley Yard
836	28	"	"	1194' 6"	
829	18	"	"	1047' 8"	

CANNOCK CHASE Continued ..

Maceration Number	Number on Fig.5	Colliery, Borehole or Opencast Site		Depth to base of seam (in case of borehole)	Name of Seam
1411	38	Calf Heath B.H. (66)		1366' 9"	Benches
1412	39	"	"	1395'11"	
1413	40	"	"	1420'11"	Eight Feet
1414	41	"	"	1434' 0"	
1415	43	"	"	1479' 5"	Park
1416	44	"	"	1507' 8"	
1417	45	"	"	1539'10"	
1418	?46	"	"	1569' 4"	? Heathen
1419	53	"	"	1720' 9"	? Bass
1420	55	"	"	1766' 3"	? Cinder
1421	56	"	"	1782' 2")	Shallow
1422	57	"	"	1796' 6")	
1458	61	"	"	1838' 7"	Deep
1459	63	"	"	1931' 0"	Mealy Greys
991	5	Springslade Pool B.H. (59)		2050' 0"	
992	6	"	"	2054' 7"	
993	7	"	"	2065' 7"	
994	8	"	"	2076' 8"	? Wimblebury Cannel
995	10	"	"	2094' 7"	
996	11	"	"	2118'10"	
998)		"	"	2124' 4"	
999)	12	"	"	2141' 3"	
1000)		"	"	2154' 6"	
1001	14	"	"	2185' 3"	
1002	16	"	"	2222' 2"	
1003	18	"	"	2254' 1"	
1004	19	"	"	2267' 7"	Top Robins
1005	20	"	"	2274' 9"	
1006	21	"	"	2285' 5"	
1007	22	"	"	2293' 6"	
1008	23	"	"	2299' 4"	Bottom Robins
1009	27	"	"	2318' 7"	Wyrley Yard
1010	29	"	"	2396'11"	
1011	31	"	"	2441' 5"	
303	8	Devil's Dumble B.H. (58)		970' 5½"	
304	10	"	"	1055' 4"	
305	12	"	"	1082' 9"	Heath Hayes
306	14	"	"	1185' 1"	
307	15	"	"	1195' 1"	

CANNOCK CHASE Continued ..

Maceration Number	Number on Fig.5	Colliery, Borehole or Opencast Site		Depth to base of seam (in case of borehole)	Name of Seam
385	16	Devil's Dumble B.H. (58)		1216' 6"	
386	19	"	"	1233' 8"	Top Robins
387	20	"	"	1247'11"	
308	23	"	"	1361' 9"	Bottom Robins
309	27	"	"	1406' 9"	Wyrley Yard
310	29	"	"	1509'10"	
311	30	"	"	1520' 8"	
312	31	"	"	1533' 0"	
313	32	"	"	1580' 0"	
314	34	"	"	1621' 4"	Brooch
610	23	Brancotegorse Covert B.H.(57)		1558' 0"	Bottom Robins
611	24	"	"	1563'11"	
612	25	"	"	1578' 6"	
613	27	"	"	1609'10"	Wyrley Yard
614	29	"	"	1703' 6"	
615	31	"	"	1713' 3"	
616	32	"	"	1744' 4"	
617	33	"	"	1751'11"	
618	34	"	"	1791' 3"	Brooch
619	35	"	"	1812' 2"	
620	36	"	"	1830' 3"	
621	37	"	"	1837' 9"	
622	38	"	"	1921' 0"	Benches
623	39	"	"	1981' 7"	
624	40	"	"	2022' 6"	Eight Feet
625	41	"	"	2087' 6"	
626	43	"	"	2131'11"	Park
627	44	"	"	2148' 7"	
628	45	"	"	2174'11"	
629	46	"	"	2244' 6"	Upper Heathen
630	47	"	"	2254'11"	
631	48	"	"	2304' 2"	Lower Heathen
633	49	"	"	2400' 3"	Upper Stinking
634	50	"	"	2411' 5")	Lower Stinking
635	51	"	"	2414' 9")	
636	52	"	"	2464' 0"	Yard
637	53	"	"	2544' 0"	Bass
638	54	"	"	2566'10"	
639	55	"	"	2611' 4"	New
640	56	"	"	2632' 9"	Upper Shallow
641	57	"	"	2646' 3")	Lower Shallow
642	57	"	"	2649' 6")	

CANNOCK CHASE Continued ..

Maceration Number	Number on Fig.5	Colliery Borehole or Opencast Site		Depth to base of seam (in case of borehole)	Name of Seam
643	58	Brancotegorse Covert B.H.(57)		2698' 0"	
644	59	"	"	2723' 2"	
647	60	"	"	2741' 9"	Top Deep
645	61	"	"	2800'10"	Deep
646	62	"	"	2855' 0"	
425	11	Springs Farm B.H. (61)		645' 6"	
426	12	"	"	654' 9"	Heath Hayes
427	14	"	"	672' 9"	
428	16	"	"	719' 6"	
429	17	"	"	739' 0"	
430	18	"	"	748' 9½"	
431	19	"	"	758' 3½"	Top Robins
432	23	"	"	820' 6"	Bottom Robins
433	27	"	"	867' 7"	Wyrley Yard
434	7	Hayes Wood No. 2 B.H. (62)		857' 2"	
435	8	"	"	864' 7"	
436	9	"	"	870' 6"	
437	10	"	"	899' 5"	
438	11	"	"	918' 8"	
439	12	"	"	935' 4"	Heath Hayes
440	14	"	"	957' 3"	
441	18	"	"	997' 5"	
442	19	"	"	1008' 3"	Top Robins
443	20	"	"	1025' 1"	
444	21	"	"	1054' 7"	
445	23	"	"	1108'10"	Bottom Robins
978	5	Giddywell B.H. (64)		1384' 8"	
979	6	"	"	1422' 9"	
980	7	"	"	1435' 7"	
981	8	"	"	1446' 7"	
982	10	"	"	1470' 3"	
983	12	"	"	1498' 5"	
984	13	"	"	1509' 1"	
985	14	"	"	1532' 0"	
986	18	"	"	1564' 1"	
987	19	"	"	1574' 0"	Top Robins
988	23	"	"	1580' 0"	
989	27	"	"	1597'10"	
990	28	"	"	1607' 9"	

CANNOCK CHASE Continued ..

Maceration Number	Number on Fig. 5 & 6	Colliery, Borehole or Opencast Site	Depth to base of seam (in case of borehole)	Name of Seam
575)		Brereton Cross B.H. (63)	519' 9"	
576)	8	" "	521' 3"	
577)		" "	525'10"	
578)		" "	528' 8"	
579	11	" "	563' 6"	
580	12	" "	590' 0"	Heath Hayes
581	14	" "	609' 0"	
582	15	" "	612' 1"	
583	18	" "	642' 9"	
584	19	" "	659'11"	Top Robins
585	23	" "	728' 0"	Bottom Robins
586	24	" "	735' 5"	
587	25	" "	741' 0"	
588	26	" "	746' 3"	
589	27	" "	771' 7"	Wyrley Yard
424	20	Hawkes Yard B.H. (60)	489' 2"	
423	21	" "	496' 8"	
422	22	" "	512'11"	
421	23	" "	552' 7"	Bottom Robins
420	27	" "	615' 6"	Wyrley Yard
673	63	Wimblebury Colliery (65)		Mealy Greys

SOUTH STAFFORDSHIRE

1432	1	Baggeridge No.1 B.H. (74)	2034'10½"	Halesowen Beds
1339	2	" "	2128' 7"	Brooch
1433	14	" "	2410'11"	
1434	15	" "	2423' 3"	Mealy Greys
732	3	Baggeridge No.5 B.H. (75)	2190'10"	Flying Reed
733	4	" "	2288' 4½"	Thick
734	5	" "	2302' 3"	Upper Heathen
735	6	" "	2315' 6"	Lower "
736	7	" "	2338' 1"	Stinking
737	8	" "	2367'10"	New
738	9	" "	2376' 1"	"
739	10	" "	2379' 6"	"
740	11	" "	2387' 8"	
741	12	" "	2406'10"	

SOUTH STAFFORDSHIRE Continued ..

Maceration Number	Number on Figs.6,7 & 8	Colliery, Borehole or Opencast Site	Depth to base of seam (in case of borehole)	Name of Seam
742	13	Baggeridge No.5 B.H. (75)	2414'10")	Fireclay or
743	14	" "	2418'11")	Bottom
744	15	" "	2429' 3"	
745	16	" "	2442' 1"	

NORTH WALES (FLINTSHIRE)

153	1	Point of Ayr Colliery (22)		Three Yard
154	2	" "		Two Yard
155	3	" "		Durbog
156	4	" "		Stone
157	5	" "		Hard Five Quarter
158	6	" "		Badger
533/4	7	" "		Bychton Two Yd.
535	8	" "		" 3/4.
666	8	Tre Mostyn o/c (25)		" "
692	9	Felin Blwm o/c (23)		Little of Picton
676	9	Hen Dyffryd o/c (24)		" "

NORTH WALES (DENBIGHSHIRE)

704	3	A5/6 Pen-y-Llan B.H. (31)	366' 4½"	
725	4	" "	580' 5½"	
726	5	" "	604' 1"	
858	6	" "	802' 3"	
727	7	" "	855' 1"	
852	9	" "	1766' 0"	
853	10	" "	1794' 1½"	
854	11	" "	1878' 1½"	
855	12	" "	2101' 4½"	
859	13	" "	2165' 6"	
856	14	" "	2197' 5"	
857	15	" "	2221' 5"	
860	20	" "	2531' 4")	Powell and
861	21	" "	2538' 1")	Drowsell
862	24	" "	2658' 6"	Two Yd.& ?Crank
864	25	" "	2724'11"	Quaker
865	30	" "	2803' 0"	Main, Pin & Crown
866	31	" "	2864' 9"	Ruabon Crank

NORTH WALES (DENBIGHSHIRE) Continued ..

Maceration Number	Number on Fig.8	Colliery, Borehole or Opencast Site		Depth to base of seam (in case of borehole)	Name of Seam
868	32	A5/6 Pen-y-Llan B.H. (31)		2909' 0"	Unnamed
893	33	"	"	2931'10")	Half Yard,
889	34	"	"	2942' 8")	Benches & Firecla
891	37	"	"	3016' 4"	Nant & Lr.Yard
892	38	"	"	3078' 6"	Wall and Bench
399	2	A5/1 Whitegate B.H. (28)		232' 0"	
400	9	"	"	1397' 0"	Bersham Yard
401	10	"	"	1430' 0"	
501	22	"	"	2031' 0"	Two Yard
402	23	"	"	2056' 6"	Crank
403	25	"	"	2082' 6"	Quaker
404	27	"	"	2204' 6"	Main
405	29	"	"	2279' 0"	Crown
406	32	"	"	2335' 0"	
407/10	33	"	"	2359' 0"	Fireclay
411	34	"	"	2416' 0"	Stone
412	35	"	"	2456' 6"	Nant
413	36	"	"	2514' 0"	Ruabon Yard
546	13	Gardden Lodge O/C (30)			Wynnstay 5ft.
545	16	"	"		Warras
608	17	"	"		John o' Gate
164	18	"	"		Bottom Droughy
548	19	"	"		Smith
549	20	"	"		Drowsell
290	19	Gresford Colliery (27)			Smith
551	21	"	"		Powell
180	22	"	"		Two Yard
169	23	"	"		Crank
552	25	"	"		Quaker
553	26	"	"		Black Bed
554	27	"	"		Main
555	28	Llay Main Colliery (26)			Pin
556	29	"	"		Crown
175	33	"	"		Fireclay
557	34	"	"		Stone
559	36	"	"		Ruabon Yard
566	38	"	"		Wall and Bench
609	39	"	"		Lower Queen
497	1	Lwyn-onn Mill, Marchweil(outcrop)(29)			
694	3	Criffin's Farm O/C (34)			
596	8	Dee & Ceirog Junction (outcrop)(33)			
485	40	Australia Clay Pit,Treror(outcrop)(32)			Chwarelau

LANCASHIRE

Maceration Number	Number on Fig.9	Colliery, Borehole or Opencast Site		Depth to base of seam (in case of borehole)	Name of Seam
151	1	A3/4 Farnworth B.H. (12)		717' 2"	
152	2	"	"	997' 8"	
190	10	"	"	1696' 1"	
191	15	"	"	1716' 2"	
192	21	"	"	2047' 8"	Fiery Delph
201	?23	"	"	2159' 5"	Felcroft - Pasture
202	?24	"	"	"	" "
203	?26	"	"	"	" "
224	30	"	"	2356' 0"	Furnace
225	35	"	"	2485'11"	Higher Florida
226	36	"	"	2500' 5"	Lower Florida
227)	37	"	"	2549' 6"	Hr.Pigeon House
228)		"	"	2577' 2"	Lr.Pigeon House
283	38	"	"	2682' 0"	Park
284	39	"	"	2688' 9"	
285	41	"	"	2722' 5"	Hr.Ravenhead
286	42/43	"	"	2759' 5"	Ravenhead Main Delf & Bastions
287	44	"	"	2823' 5"	Trencherbone
204	21	A3/6 Burtonwood B.H. (13)		2414' 1"	Fiery Delph
205	?23	"	"	2466'10"	Crombouke
206	?24	"	"	2484' 2"	
207	?26	"	"	2532' 8"	Earthy Delf
208	?25	"	"	2542' 5"	
209	?28	"	"	2554' 6"	
210	29	"	"	2600' 5"	Yard
211	30	"	"	2643' 5"	Furnace
212	32	"	"	2660' 5"	New
213	34	"	"	2700' 5"	
214	35	"	"	2742' 5"	Higher Florida
215	36	"	"	2752' 4"	Lower Florida
229	15	A3/10 Newton Park B.H. (14)		639' 8"	
230	?17	"	"	920' 8"	
231	26	"	"	1194' 9"	Crombouke
232	30	"	"	1356' 6"	Furnace
233	32	"	"	1399' 5½"	New
234	33	"	"	1424' 3"	
235	34	"	"	1454' 7"	
236	35	"	"	1480' 0"	Higher Florida
237	36	"	"	1505' 8"	Lower Florida
238	41	"	"	1778'11"	Hr.Ravenhead
239	42	"	"	1849' 6"	Ravenhead Main
240	43	"	"	1855'10½"	Bastions (Delf

LANCASHIRE Continued ..

Maceration Number	Number on Fig.9	Colliery, Borehole or Opencast Site	Depth to base of seam (in case of borehole)	Name of Seam
1361	15	A2/57 Lowton B.H. (16)	1944' 7"	Parker
1362	22	" "	2395' 9"	Park Yard
1363	23	" "	2417' 9"	Top Ince Yard
1364)	24	" "	2438' 3"	Bot. " "
1365)		" "	2442' 8"	Ince Deep Yard
1366	26	" "	2495' 2"	Ince 4 ft.
1367	30	" "	2637' 6"	Rams
1368	35	" "	2762' 8"	Pemberton 5 ft.
1369	36	" "	2794' 4"	Bickershaw 7'
1370	?37	" "	2856' 5"	
1371	42	" "	3010'10"	Wigan 4ft.
1372	45	" "	3102' 0"	Peacock
1307	4	A1/12 Patricroft B.H. (18)	1075' 3"	
1308	5	" "	1110' 7"	
1310	10	" "	1861' 1"	Worsley 4 ft.
1311	11	" "	1884' 9"	
1312	19	" "	2454' 6"	
1313	20	" "	2461' 7"	
1314	24	" "	2616' 3"	Binn
1315	26	" "	2677'11"	Crombouke
1316	27	" "	2696' 3"	
1317	28	" "	2707' 6"	Brassey
1318	30	" "	2859' 4"	Rams
1319	31	" "	2863' 7"	Little Rams
1075	3	A1/2 Drinkwater Park B.H.(20)	481' 0"	Bradford 4ft.
1076	4	" "	641' 8"	" Yard
1077	5	" "	681' 6"	" New
1078	10	" "	1671' 0"	Worsley 4ft.
1080	11	" "	1684' 2"	
1057	19	" "	2342' 9"	
1056	20	" "	2350' 7"	
1055	21	" "	2391' 1"	
1058	23	" "	2456' 0"	Stone Delph
871	24	" "	2536' 6"	Binn
872	26	" "	2637' 9"	Shuttle
873	28	" "	2647' 3"	Crombouke
874	30	" "	2779' 1"	Rams
288	7	A1/1 Prestwich Asylum B.H.(19)	284' 2"	
289	8	" "	308' 6"	
244	9	" "	419' 1"	
294	10	" "	571'10"	Worsley 4ft.
295	12	" "	601' 7"	

LANCASHIRE Continued ..

Maceration Number	Number on Fig.9	Colliery, Borehole or Opencast Site		Depth to base of seam (in case of borehole)	Name of Seam
245	13	A1/1 Prestwich Asylum B.H.(19)		627' 0"	
246	14	"	"	729' 6"	
296	15	"	"	756'10"	Parker
1059	16	"	"	932'10"	
1048	18	"	"	1314' 7"	
1047	20	"	"	1350' 3"	
1046	21	"	"	1390' 4"	Ashclough
1050	?22	"	"	1408' 5"	
1049	23	"	"	1464' 6"	Stone Delph
875	24	"	"	1529'11"	Binn
876	25	"	"	1550' 5"	
877	26	"	"	1622' 7"	Shuttle
879	28	"	"	1636'10"	Crombouke
880	30	"	"	1831' 9"	Rams
1060	35	"	"	2005' 0"	Windmill
1062)		"	"	2250'11"	White
1063)	36	"	"	2276' 7"	
1064)		"	"	2294' 7"	
1065)		"	"	2341' 7"	Black
1066	?38	"	"	2483' 0"	
1067/9	40	"	"	2568' 0"	Doe
1070	41	"	"	2583' 3"	Three-quarters
1071	42	"	"	2704' 5"	Victoria
1072	44	"	"	2855' 8"	Trencherbone
1073	45	"	"	2884'10"	Dyehouse
1074	46	"	"	3053' 2"	Cannel
1336	52	A2/31 Heskin B.H. (6)		586'10"	Arley
417	60	"	"	2075' 1"	Six Inch
1480	58	A2/92 Tontine B.H. (9)		643' 9"	Lower Mountain
1481	59	"	"	670' 4"	Rambler
1510	61	"	"	1005'11"	Sandrock
1476	?48	A4/13 Mere Clough B.H. (5)		45' 9"	China
1477	?49	"	"	80' 0"	Crackers
1478	?51	"	"	146' 8"	Dandy
1506	54	A4/17 Cockden Bridge B.H. (4)		428' 5"	Cemetry
1507	55	"	"	615' 4¼"	Cannel
1511	56	"	"	632' 6"	Upper Mountain
1509	58	"	"	737' 6"	Union
1380	42	Cronton Colliery (10)			Wigan Four Ft.
1381	44	"	"		Trencherbone
1379	49	"	"		Haigh Yard
1378	51	"	"		Rushy Park

LANCASHIRE Continued ..

Maceration Number	Number on Fig.9	Colliery, Borehole or Opencast Site	Depth to base of seam (in case of borehole)	Name of Seam
1321	52	Lea Green Colliery (11)		Arley
1323	44	Golbourne Colliery (15)		Trencherbone
1041	48	" "		Plodder
1153	40	Moseley Common Colliery (17)		Doe
1234	45	" "		Peacock
85	52	" "		Arley
302	53	" "		Pasture
1387	47	A2/43 Hindley Deep B.H. (8)	343' 5"	King
1388	48	" "	443' 5"	Ravine
1489	50	Welch Whittle Colliery (7)		Bone
87	55	A4/5 Wheatley Lane B.H. (1)	460' 0"	Cannel
89	57	" "	504' 0"	Inch
86	53	" "	270' 0"	Pasture
189	3	Bradford Colliery (21)		Bradford 4ft.
1104	4	" "		" Yard
1174	6	" "		" 2ft.
1044	10	" "		Worsley 4ft.
1045	11	" "		Unnamed
1109	15	" "		Parker
1110	17	" "		Radley
1152	19	" "		New Jet Amber
216	20	" "		Pottery
1054	23	" "		Top
870	24	" "		Middle
887	26	" "		Crombouke
888	28	" "		Roger
446)	30	" "		Upper Furnace
886)		" "		Lower Furnace
1151	?35	" "		Mary
1486	47	Reedley Colliery (3)		King
1508	49	Wood End Colliery (2)		Arley Yard

SHROPSHIRE (COALBROOKDALE)

Maceration Number	Number on Fig.10	Colliery, Borehole or Opencast Site		Depth to base of seam (in case of borehole)	Name of Seam	
782	1	Madeley No.1 B.H. (72)		1032'11"	Coalport Beds	
783	2	"	"	1035'11"	"	"
784	3	"	"	1113' 4"	"	"
785	4	"	"	1131' 1"	"	"
786	7	"	"	1219' 3"	Foot	
787	8	"	"	1229' 7"	Deep	
788	9	"	"	1232' 8"	Gur	
789	10	"	"	1309' 8")	Top	
790	11	"	"	1312' 4")		
791	13	"	"	1321' 0"	Three-quarters	
792	14	"	"	1332' 9"	Double	
793	15	"	"	1343' 4"	Yard	
794	16	"	"	1365' 5"	Upper Flint	
795	17	"	"	1378' 4"	Lower "	
796	19	"	"	1415' 3"	Upper Vigars	
797	20	"	"	1450' 0"	Lower "	
798	21	"	"	1463' 7"	Clunch	
799	22	"	"	1471'10"	Upper Two Feet	
800	23	"	"	1477'10"	Lower " "	
801	24	"	"	1506'11"	Best, Randle & Clod	
802	25	"	"	1523' 9"	Upper Little Flint	
803	26	"	"	1529' 2"	Lower " "	
804	28	"	"	1552' 6"	Lancashire Ladies	
805	29	"	"	1609' 4"		
837	2	Lilleshall 7a B.H. (71)		877' 2"	Coalport Beds	
838	5	"	"	1031' 9"		
839	6	"	"	1055' 0"	Marquis	
840	8	"	"	1081' 6"	Deep	
841	12	"	"	1144' 5"	Top	
842	14	"	"	1178' 9"	Double	
843	15	"	"	1193' 2"	Yard	
844	16	"	"	1219' 0"	Upper Big Flint	
845	18	"	"	1296' 2"	New or Stinking	
846	21	"	"	1323' 3"	Clunch	
847	?24	"	"	1375' 5"		
848	27	"	"	1396' 2"	? Little Flint	
849	28	"	"	1446' 6"	Lancashire Ladies.	

SHROPSHIRE (FOREST OF WYRE)

Maceration Number	Number on Figs. 11 & 12	Colliery Borehole or Opencast Site		Depth to base of seam (in case of borehole)	Name of Seam
1340	1	Alveley No.1 B.H. (73)		511' 0"	Highley Beds
1341	2	"	"	720' 8"	" "
1342	3	"	"	737' 0"	" "
1343	4	"	"	739'10"	" "
1344	5	"	"	1102' 6"	
1345	6	"	"	1124' 3"	
1346	7	"	"	1236' 3"	
1347	8	"	"	1269' 5"	
1348	9	"	"	1282' 0"	
1349	10	"	"	1294' 3"	Highley Brooch
1350	11	"	"	1301' 5"	
1351	12	"	"	1316' 1"	
1352	13	"	"	1325' 0"	
1353	14	"	"	1349' 9"	
1354	15	"	"	1377' 0"	
1355	16	"	"	1396'11"	
1356	17	"	"	"	
1357	18	"	"	1407' 8"	
1358	19	"	"	1431' 3"	
1359	20	"	"	1445' 6"	
1360	21	"	"	?	

WARWICKSHIRE

746	1	Amington Hall B.H. (78)		1318' 6"	
747	2	"	"	1384' 6"	
748	3	"	"	1414' 6"	
749	4	"	"	1436' 0"	
750	14	"	"	1455' 0")	Nine Feet
751	15	"	"	1460' 6")	
752	17	"	"	1476' 2"	
753	18	"	"	1521' 4"	High Main
754	19	"	"	1542' 9"	Smithy
755	20	"	"	1607' 8"	Seven Ft.Thin
756	21	"	"	1614' 4"	Seven Feet
757	22	"	"	1632' 3")	
758	23	"	"	1635' 6")	Trencher Series
759	24	"	"	1637' 8")	
760	26	"	"	1673' 6"	Yard of Tamworth
761	27	"	"	1710' 3")	Deep Rider
762	28	"	"	1715'10")	

WARWICKSHIRE Continued ..

Maceration Number	Number on Fig.12	Colliery, Borehole or Opencast Site	Depth to base of seam (in case of borehole)	Name of Seam
763	29	Amington Hall B.H. (78)	1724' 6")	Double
764	30	" "	1731' 1")	
765	31	" "	1778' 9"	Bench
766	32	" "	1830' 6"	? Stumpy
767	33	" "	1866'10"	Stanhope
768	34	" "	1988' 0"	
769	35	" "	1992' 9"	
1305	5	Ansley Hall Drift (80)		Two Yard
1304	6	" "		Bare
1303	7	" "	)	Ryder
1302	8	" "	)	
1301	12	" "		Ell
1424	16	" "		Nine Feet
1300	18	" "		High Main
1299	19	" "		
1298	20	" "		Seven Ft. Thin
1297	21	" "		Seven Feet
1466	7	Kingsbury Colliery (79)	)	Ryder
1467	8	" "	)	
1468	9	" "	)	
1469	10	" "	)	Ell
1470	11	" "	)	
1471	14	" "	)	Nine Feet
1472	15	" "	)	
1473	18	" "		High Main
817	5	Coventry Colliery (81)		Two Yard
818	6	" "		Bare
819	13	" "		Ryder and Ell
820	16	" "		Nine Feet
1265		Bolehall B.H. (77)	c.1015'	
1266	20	"	c.1025'	Seven Ft.Thin
1180	21	"	1032' 0"	Seven Feet
1181	25	"	1046' 0"	Trencher
1182	26	"	1074' 3"	Yard
1267	31	"	1115'10"	Bench
1268	32	"	1162' 1"	Stumpy
1269	33	"	1198' 0"	Stanhope
1029	36	Statfold B.H. (76)	857' 0"	? Millstone Grit
1030	37	"	926' 6"	? " "

(b) Microspore percentages.

The numbers along the tops of the tables refer to the maceration numbers given in the first part of the appendix.

SPORE TYPES	K 1	K 2	K 3	K 5	K 7	K11	K12	K15	K17	K19	K26	K27	K28	K29	K35	K36	K37	K38	K40	K41	K42	K44	K46	K47
Lycospora spp.	32.2	45.5	15.7	63.1	72.0	65.5	74.8	60.0	61.2	63.9	19.5	60.3	56.9	42.5	28.7	45.0	40.0	36.4	32.6	26.9	47.8	33.2	32.3	51.8
Densosporites annulatus														0.1	0.5	0.4	0.2		32.5	41.0	1.5	23.7	1.0	
D. indignabundus														*					0.3	0.4	0.2	1.0	2.8	0.4
D. solaris												0.6		0.9	0.2	0.1	0.2	0.8						
Calamospora spp.	9.0	9.7	8.9	4.5	5.1	7.5	5.4	5.8	3.2	4.0	12.5	6.5	9.3	6.3	12.9	13.4	11.7	13.0	1.3	2.2	9.3	2.3	12.2	6.5
Spinososporites spp.	1.5	1.6	4.2	1.8	0.6	0.8	0.6	0.9	0.7	0.9	0.9	2.1	0.7	1.5	2.0	1.7	1.1	1.2	0.2	0.6	1.9	0.9	2.0	2.7
S. sp. (Millott's type 4)			*							0.1				0.1	0.4		0.2	0.3	*	0.2	0.2	0.1	0.3	0.4
S. spinulistratus	0.2	1.9	1.0	0.4	0.3	0.5	1.8	2.6	3.2	0.7	8.9	1.1	0.8	3.4	0.7	0.7	1.4	4.7	o.5	1.3	10.9	0.4	1.6	2.1
Planisporites spp.	1.3	0.6	4.0	0.8	0.7	0.4	0.7	2.7	1.8	2.4	1.7	0.8		1.8	1.4	1.7	3.0	1.7	1.0	0.9	1.3	0.3	1.0	3.1
Raistrickia spp.	0.4	0.5	1.7	1.0	0.5	0.4	0.6	0.2	0.6	0.6	0.2	0.4	0.2	0.6	0.4	0.1	0.6	0.5	0.8	0.4	0.6	1.3	0.4	1.0
R. medusa	*																							
Cirratriradites striatus																								
C. sp.															0.5	0.3	0.2		1.2	0.4		0.6	0.7	
C. tenuis																		0.3						
C. aligerens																								
C. saturni	0.6		*		*		*		0.2	0.1	0.2			*		0.1				0.4	0.8	0.1	0.2	*
Endosporites spp.	22.9	0.8	9.2	1.4	0.2	0.2	0.4	0.4	1.3	0.2	0.1	*	0.6	4.1	2.3	1.2	0.6	0.5	1.2	0.7	1.0	0.2	1.0	0.2
Schulzospora ovata																								
Endosporites costatus	0.2								*			*	0.1	0.4	0.4	0.3	0.2	0.7	0.2		0.2		*	
Florinites spp.	0.3								0.1															
F. antiquus	*	3.1	2.7	5.3	2.3	1.9	3.0	2.6	3.7	7.2	9.6	1.9	2.7	12.8	6.3	4.1	3.7	4.9	0.5	1.1	3.2	1.5	5.1	4.0
F. millotti	0.3		*	0.3	0.2		*		0.2	*				*	*			*						
Pityosporites westphalensis	*					*			*									*						
Triquitrites spp.	1.8								*										0.5			0.1		
T. sculptilis		1.5	9.5	5.1	1.3	2.6	1.1	0.9	3.9	0.4	0.7	0.5	1.0	0.4	0.5	0.5	0.4	0.8						
T. inusitatus																								
Ahrensisporites spp.																								
Laevigatosporites spp.	20.0	29.1	37.5	11.6	12.0	18.2	9.2	17.0	18.7	13.0	42.5	23.5	25.9	24.3	39.9	28.7	30.1	29.2	25.7	23.2	20.0	33.8	36.6	26.2
L minutus	4.0	3.4	1.0	2.7	1.9	0.8	1.0	3.0	0.1	3.5	0.5	0.6	0.2	0.1		0.7	0.4	0.3					0.2	
L. minimus	3.9	1.5	4.1	1.2	1.8	0.7	0.8	2.9	0.1	2.7	2.0	1.1	1.0	0.2		0.3			0.3		0.5	0.1	0.7	0.8
L. obscurus																								
L. oculus	*																							
L. pseudothiessenii	*																							
Reticulatisporites mediareticulatus																		*	0.8	*	0.4	0.3	0.7	0.4
R. tortuosus	*	0.2			0.2	0.2	0.2		0.1	0.2	0.1	0.4	0.6	0.8	1.4	0.1	5.4	4.2			0.2	0.1	0.4	
R. facetus	0.2				*	*	*	0.2		0.1	0.1	0.2		0.4	0.7	0.4	0.6	0.3					0.2	
R. spp.		*	*				*							0.1	0.2	0.1		0.2	*	0.2		*		0.4
R. magnus														*				*						
Verrucososporites facierugosus	*				*																			
Alatisporites pustulatus		0.1		0.2		*			0.1															
Reinschospora spp.						*																		
Microreticulatisporites quaesitus	0.2	*	*	*	*	*	*	*			*													
M. fenestratus	0.8	0.3	*	*	0.3	*	*	*	*	*	*	*												
M. parvipunctatus			*	*	*		*																	
M. reticulocingulum														*					0.3				0.2	
M. sulcatus	0.2		0.2																					
Torispora securis	*	*	0.3	0.4	0.4	0.3	0.4	0.8	0.3		0.2			*										
Cadiospora magna	*																							
Gravisporites sphaerus																								
Schopfites dimorphus	*																							
Remainder		0.2		0.2	0.2				0.5		0.3			0.1	0.6	0.1			0.1	0.1			0.4	

* Not noted in original count but subsequently observed to be present.

SPORE TYPES	K48	K49	K50	K55	K56	K59	K61	494	495	496	488	489	490	491	492	364	363	362	361	360	359	358	357	356
Lycospora spp.	36.0	47.5	36.8	51.1	66.1	59.0	60.3	78.0	44.5	56.5	60.0	40.6	41.0	46.9	53.1	72.0	58.8	74.4	65.1	40.9	55.0	52.8	61.5	25.9
Densosporites annulatus	17.0	3.6	32.8	10.4	5.9	2.8	9.5					*		0.5						*		0.2	0.1	*
D. indignabundus	3.3	5.6	1.0		0.5	0.6	1.4						*				*					*	*	
D. solaris									*			1.3									1.4	0.2		*
Calamospora spp.	7.6	5.6	5.0	3.1	1.9	5.2	3.5	3.7	19.0	8.3	11.6	12.7	19.9	19.2	11.8	6.8	4.3	2.2	5.9	6.9	2.3	9.8	5.6	13.8
Spinososporites spp.	0.6	2.6	1.3	2.6	0.9	0.6	1.2	1.2	0.8	9.2	8.1	12.9	5.4	4.5	9.1	1.7	1.2	1.1	0.8	1.0	2.3	0.7	1.0	2.2
S. sp. (Millott's type 4)	0.4	0.2	*	0.2	0.1		0.2										0.2			0.2	0.6			*
S. spinulistratus	1.2	3.6	2.5	0.8	1.3	1.5	2.0	2.0	8.3	4.7	1.1	2.1	12.3	1.2	7.1	1.0	3.2	4.8	0.4	5.5	2.3	1.1	6.9	5.7
Planisporites spp.	1.6	0.8	1.0	0.8	0.6	1.4	0.3	1.3	1.9	1.7	0.7	2.3	1.3	1.4	0.9	0.6	0.4	0.6	0.3	1.1	1.3	2.0	1.3	1.0
Raistrickia spp.	0.4	0.4	0.7	1.0	0.6	0.3	1.1	0.5		0.2	1.3	0.1	*	0.8		0.7	0.2	0.3	0.2	0.4	0.2	0.9	0.4	0.4
R. medusa																								
Cirratriradites striatus																								
C. sp.	3.1	1.3	0.1		0.2	0.3	0.4							0.1								0.1		
C. tenuis				*	*	0.3						*												
C. aligerens							1.2																	
C. saturni			*			0.3	0.3		*	0.6	*		*	0.2	0.3		0.4		*	*	*	0.1		*
ndosporites spp.	0.7	1.1	0.3	1.0	0.4	1.1	0.2	2.0	0.3	0.4	2.7	3.1	0.3	1.4	0.8	1.0	1.1	*	*	6.1	1.9	*	0.6	*
chulzospora ovata							*																	
ndosporites costatus	0.2	0.2						*	0.3	0.2				0.2		0.9	0.2	1.1		0.8	0.4	0.9	0.3	0.4
lorinites spp.								0.2			*			0.5	0.6							*		
. antiquus	1.0	1.8	0.4	1.5	1.0	1.1	1.2	0.6	1.3	4.3	0.5	5.9	3.3	2.9	2.7	0.7	2.4	1.4	1.0	3.5	5.1	2.3	3.6	4.2
. millotti									*			*					*			*				
ityosporites westphalensis										*														
riquitrites spp.	0.2	0.3	*		0.2	*			0.3													0.1		
. sculptilis								*	8.0	0.6	0.2	0.6		0.5		0.4	0.8	1.0	0.2	1.3	1.4	1.0	*	*
. inusitatus																								
hrensisporites spp.																								
aevigatosporites spp.	24.5	22.8	16.1	26.0	19.6	24.0	16.2	2.2	5.9	6.0	6.8	10.4	14.5	16.3	9.8	9.2	23.6	11.4	24.7	29.6	22.2	27.3	18.3	42.4
. minutus		0.2		0.2			0.2									2.8	1.8	0.3	1.0	0.8	1.4	0.2		1.1
. minimus		1.1	0.2	0.2	0.1	1.5	0.1	6.3	7.0	4.3	4.2	6.8	0.3	0.5	0.8			0.4				0.1		
. obscurus																								
. oculus																								
. pseudothiessenii																								
Reticulatisporites mediareticulatus	1.4	0.7	0.5	0.7	0.3	*	0.1																	
R. tortuosus		0.2	0.3		0.2	*		1.3	1.3	2.6	2.1	1.1	1.4	2.2	2.6	1.8	0.4	1.0	0.2	1.1	1.4	0.1	0.1	1.9
R. facetus			*				0.1	0.2		0.2	0.2		*	*	0.2	0.4	0.4		0.2	0.8	0.4		*	0.5
R. spp.	0.4	0.2					0.1			*			0.3	0.2					*				*	
R. magnus									*	*	*	*	*	*	*					*		*	*	*
Verrucososporites facierugosus												*									*			
Aatisporites pustulatus					*							*										0.1	*	
Rinschospora spp.																								
Microreticulatisporites quaesitus									*								*							
M. fenestratus								0.3	*	*		*					*				0.2			
M. parvipunctatus									*												*		*	*
M. reticulocingulum	0.4	0.2	0.1		0.1																			
M. sulcatus										*		0.1						*				*		
Torispora securis									*	*	*						0.2		*	*		*		
Cadiospora magna																								
Clavisporites sphaerus																								
Schopfites dimorphus																								
Remainder			0.9	0.4			0.4	0.2	1.1	0.2	0.5			0.5	0.2		0.4				0.2		0.3	0.5

SPORE TYPES	355	354	353A	353	352	351	350	349	661	316	317	319	320	367	323	344	345	346	347	376	649	378	324	325
Lycospora spp.	20.9	37.0	18.0	69.6	36.0	29.7	48.3	37.2	78.3	48.8	61.3	35.3	58.5	38.6	46.6	59.7	23.8	75.0	32.2	37.0	65.7	22.9	66.1	37.2
Densosporites annulatus	0.5		1.9	0.2	0.2	2.3	0.8											*	0.4	6.4	2.3	13.8	*	11.7
D. indignabundus		*	0.4	*																	0.3	3.2		*
D. solaris		0.4		*	*	1.4	*	0.9									0.2		0.6	0.2	0.5			
Calamospora spp.	10.2	10.3	7.8	6.8	4.0	6.1	11.6	12.4	7.0	7.6	5.0	6.6	5.4	2.4	7.3	7.1	10.4	4.4	11.8	10.8	10.1	4.7	3.6	6.0
Spinososporites spp.	3.4	3.5	0.3	0.2	0.3	0.8	0.6	0.9	0.6	6.5	2.3	30.0	5.5	0.3	0.6	1.1	2.3	0.6	0.4	0.2	1.2	1.9	1.1	0.3
S. sp. (Millott's type 4)		0.2			0.2					*		*		0.3							0.1	0.3		
S. spinulistratus	0.9	4.7	0.4	0.5		0.9	1.1	0.3	*	0.4	0.2	*	0.8	0.1	7.1	1.2	2.4	1.2	0.9	0.2	0.5	6.9	6.1	3.8
Planisporites spp.	1.0	1.0	1.3	1.2	1.1	0.7	0.9	1.6	1.5	0.5	1.2	*	0.4	1.7	1.3	1.5	1.5	0.5	4.6	0.9	0.4	2.2	0.4	0.7
Raistrickia spp.	0.4	0.4	0.5	0.3	*	0.4	0.2		0.4	0.7	0.8	0.2		0.2	0.4		1.5	0.1	0.6	0.4	0.1	0.7	0.4	0.7
R. medusa										*														
Cirratriradites striatus																								
C. sp.	0.2		2.3	*	0.3	1.1	0.8	0.6													*	0.3	*	1.0
C. tenuis			*				*														0.5			
C. aligerens																								
C. saturni	0.4		0.1	0.1			0.2	0.2					*	0.2	0.4			0.1	*		0.3	0.3	0.4	0.3
Endosporites spp.	0.5	1.5	0.1	0.3		0.3	0.2	0.3	0.6	1.6	4.4	1.6	*	36.9	1.4	0.2	7.8	0.8	0.3		1.2	0.7	0.5	1.0
Schulzospora ovata																								
Endosporites costatus	0.5	*		0.2			0.2	0.2	*						*	*	0.4	0.2	0.2		*	0.3		0.2
Florinites spp.		*		*							0.8													
F. antiquus	2.4	3.9	1.1	1.0	0.2	0.6	0.2	1.9	*	0.1		*			5.4	6.1	8.2	1.9	3.0	1.5	1.5	4.4	0.9	1.5
F. millotti				*			*		0.2	0.4		0.4	0.1	0.6	0.5		*							
Pityosporites westphalensis							*			*		*	*		*									
Triquitrites spp.	0.2					0.3			1.2	4.4	1.0	9.3	1.8	0.9	0.2							0.7		0.2
T. sculptilis	0.4	0.2	0.1	0.2	0.3	0.3	*	3.2							0.7	2.8	3.1	0.7	4.4	0.4	*			
T. inusitatus									0.3															
Ahrensisporites spp.																								
Laevigatosporites spp.	55.6	35.6	63.7	18.5	57.0	54.6	33.9	40.0	1.8	9.1	20.0	8.0	24.2	13.5	26.3	18.0	31.2	12.8	38.2	41.6	14.6	30.1	18.4	34.9
L. minutus	0.2	0.4		0.1		0.2	0.2		2.4	1.9		0.5	0.6	3.5	0.2	0.7	0.4	0.6	0.1			0.6	0.2	
L. minimus		0.4					0.2		4.3	2.4	0.6	1.7	0.8	0.2	0.2			0.2	0.3		0.3	1.5	1.1	
L. obscurus										6.7	1.0	5.4	1.8		0.4									
L. oculus									0.5															
L. pseudothiessenii									0.3	7.0	0.8	0.3		*										
Reticulatisporites mediareticulatus																				0.2	*	3.0		0.1
R. tortuosus	1.9	0.5	0.1	0.2	*	0.2	*		0.4	0.7	0.4					0.5	4.7	0.6		*	0.1	0.6	0.2	*
R. facetus	0.4	*	*	*	*												1.1						0.2	
R. spp.		*	*	0.2																	*		0.2	*
R. magnus	*	*		*			*														0.3			
Verrucososporites facierugosus														*										
Alatisporites pustulatus				*											0.2			0.1	0.2					
Reinschospora spp.	*																							
Microreticulatisporites quaesitus									*	*	*				*	0.5								
M. fenestratus									0.2	*	*	0.3			0.2	*								
M. parvipunctatus																								
M. reticulocingulum			1.5		0.2	0.1	0.2															0.6		*
M. sulcatus													*	0.1			0.2	0.1				0.3		
Torispora securis									*	0.5		0.4	0.1	0.2	0.4	0.4	0.4	*	1.6					
Cadiospora magna									*		*			*										
Gravisporites sphaerus													*	*										
Schopfites dimorphus												*	*	*										
Remainder			0.4	0.4	0.2		0.4	0.3		0.7	0.2			0.3	0.2	0.2	0.4	0.1	0.2	0.2			0.2	0.4

	NORTH STAFFORDSHIRE Continued ..															CANNOCK CHASE								
SPORE TYPES	326	334	332	382	337	335	381	389	390	391	392	393	394	448	446	678	679	705	706	707	708	709	667	668
Lycospora spp.	24.2	52.0	54.3	40.1	55.5	68.4	53.6	61.8	81.7	90.6	48.4	13.4	91.5	68.0	82.0	34.0	56.3	42.9	42.9	18.8	35.8	50.4	54.9	78.0
Densosporites annulatus	2.3	1.7	1.0	5.1	8.0		0.3	9.0	0.8		2.2	52.8	0.2	3.9	1.0							1.2		
D. indignabundus	7.8		1.7	4.0	0.9			3.5			0.5													
D. solaris																				3.1	1.8	8.7		
Calamospora spp.	5.1	7.5	9.0	5.5	3.6	7.0	4.2	1.2	3.7	3.7	14.3	12.4	2.2	7.5	5.0	15.2	16.2	16.8	12.2	25.7	20.2	11.0	13.6	8,3
Spinososporites spp.	2.2	1.8	0.2	0.8	0.5	1.3	1.5	0.4	0.2	*	2.2	0.4	0.2	0.6	1.6	16.8	6.8	8.5	2.4	1.0	2.8	2.4	1.7	1.9
S. sp. (Millott's type 4)	0.2	0.3	*	1.5	0.2		0.3	*			*							0.2		0.1				
S. spinulistratus	9.2	8.1	3.3	5.8	1.9	1.3	4.5	1.6	0.4	0.7	24.0	7.7		5.2	*			0.4	6.5	5.9	2.1	1.1	0.3	0.9
Planisporites spp.	3.7	0.7	1.2	2.2	3.8	0.4	0.2	0.6	0.4	1.0	1.9	0.5	*	3.9	0.6	1.3	1.0	3.7	2.4	1.5	1.5	1.5	0.4	0.9
Raistrickia spp.	0.4	1.6	1.4		0.3	1.9	0.3	2.0	1.0	1.0	1.2	7.2	2.4	2.6	4.0	0.1		0.3	0.6	0.5	0.4	0.6		0.3
R. medusa																	0.2						0.1	0.1
Cirratriradites striatus				0.9	1.0	*	16.1	6.8	*	*	0.5	0.5		1.0	*									
C. sp.	1.6		0.8	0.9					0.8		0.7			2.6				*				6.3		
C. tenuis																					*	*		
C. aligerens				0.4	0.2	0.5	0.3																	
C. saturni	0.4	0.2	0.2	0.4	*		*	*			0.2									0.7	0.2	0.2		
Endosporites spp.	0.6	0.2	0.2	0.1	0.5		*	*		*						4.4	4.1	2.2		0.8	1.0	0.4	0.1	
Schulzospora ovata			*	0.4			*	*	*	*	*	0.9	*		1.0									
Endosporites costatus																0.6	*	1.0		0.4	0.7	0.2	*	0.2
Florinites spp.								*	*	*	0.7	2.9		1.6	0.6	0.1	1.0	0.5	0.7	0.4			1.1	
F. antiquus	4.1	5.5	*	4.0	2.0	1.6	*		0.2	*								1.9	0.9	4.4	2.8	1.1		0.2
F. millotti																*	0.2	0.1	0.2	0.3	0.3		0.1	
Pityosporites westphalensis																*				*			*	
Triquitrites spp.		*	*		0.2	0.2					0.3	0.5	*	1.3		3.4	2.2	0.3				0.2	4.9	0.9
T. sculptilis																		3.3	0.6	0.7	1.3	0.9		
T. inusitatus																							*	*
Ahrensisporites spp.																								
Laevigatosporites spp.	31.7	19.0	23.8	26.5	21.4	16.7	18.1	12.5	10.8	3.0	2.9					2.6	5.4	14.4	24.3	29.3	24.8	13.4	14.3	4.9
L. minutus	0.4	0.6	0.4													12.2	2.4				1.1		1.5	1.1
L. minimus	0.8	0.4	0.2			0.7										9.1		2.2			1.0		5.5	1.7
L. obscurus																	1.5							
L. oculus																*	*							
L. pseudothiessenii																	2.0						0.6	
Reticulatisporites mediareticulatus	4.1	0.2	0.2			*	*																	
R. tortuosus	*	0.2	1.5														0.5	0.8	3.4	1.9	0.5		0.3	0.2
R. facetus			0.2															0.1	0.2	0.7	0.5	0.2		
R. spp.		*	*				0.2	*	*									0.3	1.7	0.4	*			
R. magnus																		0.1	0.4	3.2	0.5	0.2		
Verrucososporites facierugosus																	0.2						0.1	
Alatisporites pustulatus			*																0.2					
Reinschospora spp.					*			*	*															
Microreticulatisporites quaesitus																*							0.1	0.2
M. fenestratus																0.1							0.1	0.2
M. parvipunctatus																								
M. reticulocingulum	0.8		*					*	*												0.2			
M. sulcatus																*								
Torispora securis																								
Cadiospora magna																*	*							*
Gravisporites sphaerus																0.1							0.1	
Schopfites dimorphus																							0.1	
Remainder	0.4		0.4	1.4			0.4	0.6				0.8	3.5	1.8	4.2				0.4	0.2	0.5		0.1	

SPORE TYPES	669	670	710	711	712	714	1012	1013	1014	1016	1017	1018	1019	1020	1021	1022	1023	1024	1025	1026	1027	1028	826	827
Lycospora spp.	53.4	48.1	60.4	23.0	46.1	12.0	48.0	70.3	75.4	60.0	75.7	1.7	58.9	59.8	32.6	65.9	43.1	72.1	62.5	61.9	41.9	85.3	11.5	50.0
Densosporites annulatus					*					0.2	0.1	90.2	0.4	2.7	3.2			0.1	1.6	0.3	0.8			
D. indignabundus			0.1							0.3	0.1			0.4				3.3	2.2	2.5	1.8		0.2	
D. solaris																							*	
Calamospora spp.	6.4	10.0	14.2	16.7	18.0	15.4	11.1	8.8	4.3	14.8	9.6	1.8	20.2	11.9	23.2	8.6	18.0	11.6	14.2	14.5	11.1	8.7	9.1	5.5
Spinososporites spp.	2.7	1.7	4.3	5.0	2.4	7.7	8.3	9.8	8.5	0.7	0.3	0.1	*	0.5		9.2	0.4	0.4		1.4	1.0	0.3		2.3
S. sp. (Millott's type 4)													*							0.2		*		
S. spinulistratus	12.5	14.0	0.1	2.5	0.8		0.8		0.2	6.6	0.5	0.1	*	1.3	6.2	3.9	0.9	0.8	6.2	4.6	0.8	0.4	32.7	18.3
Planisporites spp.	3.4	1.0	2.5	2.5	2.5	4.0	2.2	0.2	0.2	0.5	1.0	0.1	0.6	1.5	0.1	3.6	0.3	0.1	0.5	0.2	3.6	0.3	2.3	2.1
Raistrickia spp.	0.5	0.5	0.5	0.4	0.7		0.3	0.2	0.2	1.6	0.1		1.1	1.9	0.3	1.3	1.3	1.3	1.0	1.1	4.1	0.9	1.2	0.9
R. medusa																								
Cirratriradites striatus																			0.4		24.4			
C. sp.										0.7			0.9	9.4	3.0	0.4		0.1	0.4			*		
C. tenuis																								
C. aligerens																		0.3	1.5			0.1		
C. saturni	0.7	0.6			0.1					*			*			0.1	0,4		0.2	0.3	*	*	0.4	0.9
Endosporites spp.	1.2	2.7	2.0	0.2	0.8	2.4	9.3	2.0	0.7	0.7	4.1	0.1	0.4	0.1	0.1	1.0	0.4	*	0.4		0.2		1.1	1.2
Schulzospora ovata																	*	0.3	*			0.3		
Endosporites costatus	0.2		0.7	5.1	2.5	4.0								0.1										
Florinites spp.		0.6	0.3	1.2	0.8		0.3		0.4				0.4	0.5		0.2	0.3	0.1	0.4			0.3		0.6
F. antiquus	5.4	1.3	0.1	13.9	0.8	31.5				0.4	0.5		0.1	0.1	0.1	0.7	1.4	0.4	1.1		0.4		0.6	6.0
F. millotti			*				0.2																0.2	0.2
Pityosporites westphalensis				*					*								*						0.2	
Triquitrites spp.			0.1				8.3	1.3	3.6		0.1	0.1		0.4		0.3			0.1	0.2	0.3		0.2	0.2
T. sculptilis	2.1	1.3	4.4	2.8	3.0	1.2																	1.3	0.6
T. inusitatus																								
Ahrensisporites spp.																		*	*		*			
Laevigatosporites spp.	10.1	11.4	8.1	18.7	17.3	20.6	1.5	1.3	1.5	13.3	7.8	5.6	16.7	9.1	30.1	4.4	32.3	8.8	7.1	12.8	8.8	3.3	29.8	7.6
L. minutus	0.3	0.6		5.8	1.6	1.2																		
L. minimus	0.7	3.7	0.8	1.6	0.3		7.1	4.5	4.4														8.6	2.3
L. obscurus									0.2															
L. oculus								*																
L. pseudothiessenii							1.3		0.2															
Reticulatisporites mediareticulatus										*	*	*	*	*	0.4		*				0.4			
R. tortuosus	0.2	1.0	0.8		1.5			0.4		0.2			*			0.4		*					*	0.8
R. facetus	0.2		0.1		*																			
R. spp.			0.1		0.3					*			0.2	0.2			0.5	0.1			0.2			
R. magnus	*	1.0	0.4	0.2	0.4																		0.4	0.2
Verrucososporites facierugosus				0.2													0.3							
Alatisporites pustulatus															0.7		0.2							
Reinschospora spp.													0.1											
Microreticulatisporites quaesitus							0.2	0.4	0.2															
M. fenestratus							1.1	0.8															0.1	
M. parvipunctatus																								
M. reticulocingulum										*	*	0.1									0.2			
M. sulcatus																							*	0.2
Torispora securis		*																					0.1	
Cadiospora magna								*	*															
Gravisporites sphaerus									*															
Schopfites dimorphus								*																
Remainder		0.5		0.2	0.1						o.1	0.1		0.1			0.2	0.2	0.2			0.1		0.1

CANNOCK CHASE continued ..

SPORE TYPES	828	829	830	831	832	833	834	835	836	1411	1412	1413	1414	1415	1416	1417	1418	1419	1420	1421	1422	1458	1459	991
Lycospora spp.	49.8	36.8	35.4	20.3	32.5	25.8	48.4	53.2	76.0	59.1	76.8	4.2	74.1	8.0	50.8	43.0	11.6	64.0	33.7	1.7	90.0	39.2	68.0	56.4
Densosporites annulatus		*					0.6	0.1				87.4	4.6	75.5	0.3	16.4	63.2	*	12.2	88.0		6.4		
D. indignabundus							0.3	0.3	0.1	0.7	0.1	0.5	0.4	1.7		5.1	2.4	1.9	12.8	1.9	0.7	11.0	*	
D. solaris						*	2.9	2.0	0.7															
Calamospora spp.	7.4	9.2	21.3	12.8	15.8	41.4	18.1	20.4	9.6	6.4	7.8	2.8	3.9	5.3	21.7	6.0	2.9	8.3	9.9	2.1	3.8	13.2	11.2	3.1
Spinososporites spp.	9.4	4.6	3.6	3.6	1.7	0.9	0.8	0.7	0.4	2.7	1.5	0.5	0.4	0.8	1.0	0.9	1.7	1.0	1.8	0.2	1.1	1.8	5.4	1.1
S. sp. (Millott's type 4)		o.1	*			*	0.3				0.1	0.1			0.3		0.1					*		
S. spinulistratus	4.4	0.4	4.4	0.8	32.7	6.7	2.3	2.1	0.5	4.4	1.8	0.1	0.7	0.1	0.3	*	0.4		2.9	0.1	*		7.3	23.5
Planisporites spp.	3.1	3.7	3.5	5.5	2.2	1.5	2.5	2.1	0.8	1.0	0.4	0.8	0.9	0.8	0.4	0.9	1.0	0.3	0.5	1.3		8.5	3.9	1.4
Raistrickia spp.	0.2	0.9	0.6	0.2	0.5	0.7	0.3	0.4	0.2	1.9	1.3	0.1	1.2	0.3	2.0		0.5	6.7	5.4	0.8	1.1	5.0	2.1	*
R. medusa																								
Cirratriradites striatus																				0.1				
C. sp.							0.8	0.8		5.5	0.1		0.7	0.8	0.2	1.8	*	1.0	2.9	0.6		0.7	0.6	
C. tenuis							0.5	*	*		*	0.1		0.3		*	0.2							
C. aligerens																		0.3	0.5		0.1			
C. saturni	1.2	0.3	0.2	0.2	*	0.1	0.3		*		0.5		0.2					0.6	0.5	0.6			*	
Endosporites spp.	2.1	2.7		0.8	1.9	0.1	1.3	0.9	4.6	0.6	0.6	0.1	4.7		*	1.8	3.4	*	0.5	*				1.3
Schulzospora ovata																		*						
Endosporites costatus	0.2	0.6	0.6	2.6		0.4	0.5	0.9	0.1	0.3	0.1													
Florinites spp.	0.9	0.6		2.0	1.5	0.6	0.7			0.2		0.1	0.2								*			1.3
F. antiquus	3.9	0.4	6.3	18.0	1.9	4.1	4.1	2.0	0.5	0.4	0.1		2.4				*							1.6
F. millotti			*		0.1	*																		
Pityosporites westphalensis						0.1							0.2				*	*						
Triquitrites spp.	0.7	0.7	0.2	0.3		0.6	0.1	0.1				0.4					0.4	2.5		0.6		0.7		
T. sculptilis	1.9	8.4	0.3	1.3	0.3	*	1.2	1.0	*															0.9
T. inusitatus																								
Ahrensisporites spp.																							0.3	
Laevigatosporites spp.	11.0	25.5	20.2	29.3	5.8	14.0	11.3	12.3	6.4	15.6	6.6	2.7	5.4	6.3	22.3	24.1	10.4	12.8	14.6	1.9	3.2	11.0	0.6	8.8
L. Minutus		4.6		1.8	1.5					0.2	1.5							0.6	1.4					
L. minimus	3.0		2.5																					0.1
L. obscurus																								
L. oculus																								
L. pseudothiessenii																								
Reticulatisporites mediareticulatus										0.4	0.1	0.1				*	*	*		0.1		1.4		
R. tortuosus	0.4		0.2		1.0	1.7	1.2	0.3	0.1		0.3				0.2		*							*
R. facetus					0.1	0.4	0.1	0.1																
R. spp.			0.7			0.8	0.3	0.1		0.6	0.2			0.1	0.2				0.2					
R. magnus					0.3	0.1	0.7	*																
Verrucososporites facierugosus											*						0.1							
Alatisporites pustulatus																			*					
Reinschospora spp.																								
Microreticulatisporites quaesitus		0.1																						
M. fenestratus		*																						0.1
M. parvipunctatus																								
M. reticulocingulum									*						0.3		0.1							
M. sulcatus																								
Torispora securis	0.2																							0.4
Cadiospora magna																								
Gravisporites sphaerus																								
Schopfites dimorphus																								
Remainder	0.2	0.4		0.5	0.2		0.4	0.2			0.1						1.6		0.2			1.1	0.6	

CANNOCK CHASE continued ..

SPORE TYPES:	992	993	994	995	996	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	303	304	305	306	307
Lycospora spp.	70.7	64.8	83.2	74.0	70.0	36.1	77.5	63.0	47.9	74.0	74.3	54.5	75.0	73.5	48.5	53.3	68.2	56.0	42.2	69.5	60.4	55.0	52.0	32.6
Densosporites annulatus				0.2			*								0.2			0.7				*		*
D. indignabundus																			1.2					
D. solaris							*	0.2			*	0.3	0.5	0.1		0.4	0.3	0.8	1.2	*		*		1.0
Calamospora spp.	4.9	5.0	3.0	3.7	2.5	37.8	3.2	15.6	7.1	11.2	4.2	5.6	8.7	7.6	6.8	12.4	10.4	14.8	16.8	4.1	4.1	5.3	12.1	6.2
Spinososporites spp.	1.1	0.8		1.5	5.6	0.7	1.1	1.1	1.5	0.3	2.3	0.9	0.6	0.8	0.8	0.7	0.7	0.6	0.3	0.3	0.7	0.4	1.1	0.2
S. sp. (Millott's type 4)																		0.1						
S. spinulistratus	0.8	1.6	1.4	1.7	2.5	1.0	6.1	3.3	9.0	3.8	0.4	2.1	1.1	2.9	9.3	7.6	1.3	5.4	4.4	2.5	6.1	3.9	0.9	7.5
Planisporites spp.	1.9	2.5		1.9	0.7	1.0	0.4	1.2	1.7	0.5	1.5	3.6	1.0	1.1	1.9	0.5	0.2	1.0	1.6	1.1	0.7	0.8	1.1	1.0
Raistrickia spp.	0.5	0.8	*	0.2	0.7	0.2	0.2	0.6	0.8	0.2	0.2	0.6	0.5	0.5	0.2	0.4	0.3			*	0.3	0.4	0.7	0.8
R. medusa																								
Cirratriradites striatus																								
C. sp.		0.2										0.1	0.3			0.5	0.2	1.0	10.0	*				
C. tenuis							*							0.1			0.2		2.0					
C. aligerens																								
C. saturni			0.1				*	*	0.2	0.2		0.3				0.4					0.3	0.2	*	0.2
Endosporites spp.		4.0	0.1	1.7	4.4	*	0.5	0.2	2.1	0.2	2.2	4.5	0.9	0.5	1.4	2.1	*	1.0	1.2	0.7	0.4	1.8	0.9	1.9
Schulzospora ovata																								
Endosporites costatus								0.3				*		0.1	0.6					*		*	*	*
Florinites spp.	0.2	1.1	0.3	0.6	0.7	0.2		0.2		0.2	0.2	1.6		0.6	0.8	0.2	0.2	0.2	0.4)	1.6	2.2	0.4	2.2	4.0
F. antiquus	1.4	3.4	1.3	0.3		2.9	1.3	0.9	3.8	1.2	4.4	5.8	0.9	0.9	5.4	1.4	0.3	3.3	2.4)					
F. millotti							*	*			1.0	0.7	0.3	0.6	0.2	0.2					*	*	*	*
Pityosporites westphalensis									0.2				0.2											
Triquitrites spp.		0.3		0.1							*	0.1	0.3		0.8						*			
T. sculptilis	0.3	1.8	0.5	6.0	1.3	2.2	1.3	1.5	1.9	0.9	1.3	2.7	2.8	0.8	1.2	0.2	*	*		0.5	0.3	1.2	1.5	5.4
T. inusitatus																								
Ahrensisporites spp.																								
Laevigatosporites spp.	17.6	12.5	9.5	7.8	9.6	17.4	6.7	9.0	18.9	6.0	5.1	11.4	6.6	8.0	17.2	14.2	15.2	13.7	14.2	18.8	21.0	28.2	26.6	36.1
L. minutus	0.3						*				1.8	2.0				1.1				*	0.4	0.4	0.7	
L. minimus		0.3			0.7				0.8							1.2				0.5	0.4	0.4		0.6
L. obscurus																								
L. oculus																								
L. pseudothiessenii																								
Reticulatisporites mediareticulatus																								
R. tortuosus	0.1		0.6		1.3	0.5	0.7	1.1	3.6	0.6	0.9	2.0	0.2	1.5	3.5	2.5	2.1	0.7	1.2	*	0.4	0.4	0.2	1.5
R. facetus							0.2	0.2	0.2		*		0.1	0.1	1.0	0.2	*			0.2	0.3	*		0.2
R. spp.	0.1	0.2							0.3						0.2				0.3	*	*			
R. magnus							0.2	0.2	*	0.2		1.2		0.3		0.5	0.3	0.6		*			*	*
Verrucososporites facierugosus																				*	*	*	*	
Alatisporites pustulatus																		0.1						
Reinschospora spp.																								
Microreticulatisporites quaesitus		0.2		*		*	0.2	0.3		0.3										*	*	*		
M. fenestratus	0.1		*				*	0.5		0.2	0.2									*		*		
M. parvipunctatus							*			*	*													
M. reticulocingulum																								
M. sulcatus						*	0.2	0.3														*		*
Torispora securis	*					*			*											0.2	1.3	1.2	*	0.8
Cadiospora magna																								
Gravisporites sphaerus																								
Schopfites dimorphus																								
Remainder		0.5		0.3			0.2	0.3									0.1		0.6		0.7			

SPORE TYPES	385	386	387	308	309	310	311	312	313	314	610	611	612	613	614	615	616	617	618	619	620	621	622	623
Lycospora spp.	51.8	42.2	55.7	39.0	42.3	47.0	69.4	20.2	24.4	35.0	53.2	59.4	53.8	49.4	71.5	31.4	25.3	42.8	56.1	41.6	67.0	43.1	41.0	49.3
Densosporites annulatus				3.0	2.7	0.5	0.5	4.6	29.7	25.6	0.5	0.8	1.2	1.4	0.2	0.8	29.6	0.2	0.8	1.3			4.4	1.7
D. indignabundus					2.2			1.0	0.2	0.8							1.9		1.9			*	0.7	
D. solaris		*		1.6	1.0	*					2.3	0.8	0.2	1.4		0.2	0.2		*					
Calamospora spp.	4.9	11.5	12.6	11.6	6.8	8.7	4.7	6.1	1.6	4.7	9.9	8.8	8.9	14.3	6.5	14.6	11.8	9.4	9.2	8.6	6.6	12.9	9.6	9.7
Spinososporites spp.	4.3		1.0	1.7	0.7	1.5	0.5	1.9	1.0	2.0	3.6	2.5	3.9	3.0	2.6	4.8	4.6	3.4	2.9	9.4	4.1	5.7	9.4	5.6
S. sp. (Millott's type 4)				0.2				0.4	*	*	*			0.2		0.2			*	0.3	*	0.2		
S. spinulistratus	4.6	1.9	3.2	3.0	0.9	0.2		1.8	1.4	0.8	4.4	1.4	4.1	1.6		0.2	1.5	1.0	1.0	7.6	6.0	18. 6	9.4	5.6
Planisporites spp.	3.4	0.6	1.5	1.4	1.1	0.2	0.5	2.2	0.6	0.3	1.3	1.7	1.2	1.4	0.9	2.9	1.5	1.3	1.6	2.9	1.6	0.3	3.2	1.4
Raistrickia spp.	0.3		0.2	0.6	0.9	0.5	0.8	0.9	0.6	0.3	0.7		0.6	0.6	1.4	1.2		1.1	o.4	1.0	0.4	1.4	1.0	1.6
R. medusa																								
Cirratriradites striatus																								
C. sp.		*	*	1.4	1.1	0.3		1.7		*	*	*	1.2	2.0		2.1	0.6	11.1	2.9	0.5				1.2
C. tenuis											*	*		*	*				*	0.3				
C. aligerens																								
C. saturni	0.3			0.3	0.2			0.7	0.3	0.1	*		1.0	0.2		1.0	0.4	0.2	*	1.9	0.1	0.3	0.2	0.6
Endosporites spp.	8.0	0.5	6.1	0.5	0.5	0.3	0.7	1.0	0.2	0.5	1.2	0.2	1.2	1.2	5.8	1.7		3.2	1.0	0.3	0.6	0.5	1.1	1.9
Schulzospora ovata																								
Endosporites costatus	1.4	*	1.0	0.1	*	0.2	0.1	0.2			*	0.4	0.4	0.2	*	0.4	*	1.0	*	0.8		*		
Florinites spp.	13.4	2.3	5.3	2.4	5.0	0.2	0.4	9.1	0.6	1.9	(	0.2	0.2	0.4	*	0.6	0.2		1.0	0.3	0.1	0.5	0.7	0.4
F. antiquus											(0.9	0.5	1.5	0.6	0.2	2.9	0.8	1.8	1.6	1.3	1.6	0.3	0.9	0.8
F. millotti	*	*															*							
Pityosporites westphalensis																					*		*	
Triquitrites spp.	*												*			0.2	0.2	0.4	0.2			0.2	1.1	0.2
T. sculptilis	0.3	*	0.2	0.3	0.5	0.2		0.4	*		0.2	1.1	0.2	0.8	*	0.2		0.2						
T. inusitatus																								
Ahrensisporites spp.																								
Laevigatosporites spp.	4.0	40.3	10.0	31.4	33.7	40.0	21.5	44.7	38.0	26.7	17.6	20.8	18.2	15.5	8.9	33.0	19.8	21.0	15.1	18.3	8.9	8.0	10.2	19.0
L. minutus	1.4		0.2	0.5	0.2			0.2		0.3	3.0	0.4		4.6	1.0	0.8	0.4	0.2	2.5	0.3	2.2	3.9	1.4	
L. minimus				0.2				0.2	0.5	0.1					1.0	0.2				1.6	0.3	3.9	1.4	0.4
L. obscurus																								
L. oculus																								
L. pseudothiessenii																								
Reticulatisporites mediareticulatus						0.2	*	0.2	0.1	0.1						0.2	*		0.4	0.3			3.0	0.2
R. tortuosus	0.9	0.2	1.2	0.1	0.2		0.5	0.2	0.3	0.5	0.7	0.4	0.6	0.2	*	0.2		0.2	0.4	0.3	0.5	0.2	1.1	0.4
R. facetus	0.5	0.2	0.4	0.1	*		0.1	0.2				*	0.6	0.2				0.2	*			*		
R. spp.		*	0.2	0.3	*	*	0.1	1.6	0.5	0.3	0.5	0.2				0.2	0.4	0.7	0.4		*		0.2	
R. magnus	*		1.2	0.2								*	1.0	*				*						
Verrucososporites facierugosus	*											*			*	*		0.2						
Alatisporites pustulatus				*			*	*			*							0.2						
Reinschospora spp.																								
Microreticulatisporites quaesitus																								
M. fenestratus																								
M. parvipunctatus																								
M. reticulocingulum								0.5												*				
M. sulcatus																								
Torispora securis	0.5																							
Cadiospora magna																								
Gravisporites sphaerus																								
Schopfites dimorphus																								
Remainder		0.3		0.1			0.2					0.4		0.8			0.8	0.2	0.6	1.1				

SPORE TYPES	624	625	626	627	628	629	630	631	633	634	635	636	637	638	639	640	641	642	643	644	647	645	646	425
Lycospora spp.	54.8	87.6	12.1	72.4	76.3	55.0	76.0	50.3	67.2	56.0	63.4	30.3	69.8	66.4	63.8	39.7	86.6	76.1	77.2	83.0	84.6	48.5	71.2	63.0
Densosporites annulatus	7.6	0.1	64.1	0.7		1.6	0.2		*	4.8	0.3	21.6	0.5		1.9	9.4	0.3	0.6		0.6	0.3	0.6	4.0	
D. indignabundus	0.2			0.2	*	0.2	*	0.4		5.0		8.6	0.5	0.7	0.2	3.8	0.3			0.8	0.7	1.1	0.5	
D. solaris																								
Calamospora spp.	9.4	3.8	2.9	5.9	8.5	9.8	6.9	10.0	8.5	7.2	7.5	6.6	5.8	12.0	8.0	11.3	4.8	9.4	9.8	2.3	3.0	7.9	3.4	8.4
Spinososporites spp.	6.5	2.1	2.2	9.5	6.0	3.9	4.1	7.6	5.4	4.5	5.3	0.8	7.3	3.0	2.4	2.8	2.6	6.7	8.0	5.5	3.8	6.0	4.5	3.2
S. sp. (Millott's type 4)			0.3		*	0.2	*	0.2	0.3			0.5	0.2		0.2							0.2	0.2	
S. spinulistratus	3.0	0.3	1.3	0.4	0.7	14.0	1.0	7.6	2.8	3.5	4.7	2.4	0.5	0.6	6.6	0.9	1.0	2.7		0.5	0.2	2.6	4.3	1.9
Planisporites spp.	3.1	1.1	0.7	3.1	1.6	1.9	0.7	1.0	1.4	3.0	3.1	2.2	2.0	2.1	1.0	4.7	1.6	0.6	*	0.8	0.7	2.5	1.2	0.5
Raistrickia spp.	0.8	0.5	1.2	1.6	0.3	1.0	0.7	3.9	1.1	2.0	2.4	0.5	1.6	1.3	1.0	6.6	0.9	0.2	0.9	0.9	0.9	2.9	1.2	0.6
R. medusa																								
Cirratriradites striatus										0.3		0.9	0.7		1.7	5.7	*			0.5	0.2	21.6	1.2	
C. sp.	0.9	0.3	2.6	0.2			0.4	*					0.2	0.7		2.8	0.1							
C. tenuis										0.3			*											
C. aligerens													1.3		0.3		0.1	0.2	0.2	2.3	0.3	0.2	*	
C. saturni	0.2		0.2		0.3	0.6	*	1.5	*	0.3		0.2						*						0.1
Endosporites spp.	0.9	0.5	0.2	0.2	0.3	0.6	2.7	1.5	*	*	*	*	*	*					0.2					2.8
Schulzospora ovata									*	*		*		0.6	0.2				*			*	0.4	
Endosporites costatus												*		0.4										0.4
Florinites spp.	0.2		0.3			1.4		0.4	0.6	0.3	0.2	0.4	0.4	0.6	0.5		0.1	*		*	0.2	*	0.8)	)2.2
F. antiquus	0.2	0.2	0.2	0.2	0.9	1.2	0.2	2.4	0.6	1.3	1.0	1.3	1.0	0.4	0.2			0.2	0.2		0.2	*	*)	
F. millotti																								
Pityosporites westphalensis								*	*								*							
Triquitrites spp.											0.2	0.5	*	0.2										
T. sculptilis																								0.4
T. inusitatus																								
Ahrensisporites spp.																								
Laevigatosporites spp.	9.6	2.4	10.4	4.0	3.5	6.8	4.5	10.0	8.5	9.8	11.1	20.7	7.8	9.9	11.4	11.3	1.4	2.7	3.3	1.9	4.9	5.5	5.8	15.1
L. minutus	1.0	0.6				0.7														0.3				1.3
L. minimus	1.2		1.0		1.0		2.4	2.7	1.5	1.3	0.2	0.4		1.1	0.6			0.2	0.2	0.3		*	0.2	
L. obscurus																								
L. oculus																								
L. pseudothiessenii																								
Reticulatisporites mediareticulatus	0.2		0.3	0.4		*	0.2	*	*	*	*	0.9	*				*					0.4		
R. tprtuosus	0.2	0.3		1.0	0.3	0.7		0.5	0.8	0.2	0.3	0.4	*									*		0.1
R. facetus												0.2												
R. spp.		*		*			*		*	*		0.2	0.2				0.1					*	0.2	*
R. magnus																								
Verrucososporites facierugosus																								
Alatisporites pustulatus																								
Reinschospora spp.												0.2												*
Microreticulatisporites quaesitus																								
M. fenestratus																								
M. parvipunctatus																								
M. reticulocingulum							*						0.2									*		
M. sulcatus																								
Torispora securis																								
Cadiospora magna																								
Gravisporites sphaerus																								
Schopfites dimorphus																								
Remainder		0.2		0.2	0.3	0.4			1.3	0.2	0.3	0.2				1.0	0.1	0.4		0.3			0.9	

CANNOCK CHASE continued ..

SPORE TYPES	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	978	979	980	981
Lycospora spp.	41.4	51.3	50.5	37.3	46.3	44.8	23.1	54.3	56.4	67.1	70.0	57.2	67.4	59.2	52.9	48.5	53.1	52.9	55.8	36.0	59.3	83.3	43.0	38.7
Densosporites annulatus									*									0.6	0.3	0.2				
D. indignabundus					0.3						*	*		*	0.2				*					
D. solaris	*			0.8	0.3	0.3	6.2	13.9			*		*		*			11.8		1.5	*	0.1	0.7	0.5
Calamospora spp.	20.7	7.5	16.8	8.5	13.3	8.5	12.2	6.3	8.2	4.5	4.0	8.5	2.9	6.1	3.6	12.9	8.1	6.8	8.3	15.9	12.3	1.5	8.1	21.6
Spinososporites spp.	2.7	1.9	2.6	0.6	2.0	1.0	0.5	0.4	0.4	0.4	1.0	o.8	1.0	0.7	1.3	0.1	0.2	0.4	0.7	0.7	1.5	0.5	1.6	0.2
S. sp. (Millott's type 4)	*			*		0.2	0.2				*		0.2	0.1	0.2	0.3	0.2			*				
S. spinulistratus	2.8	0.5	0.7	6.4	0.7	5.2	12.0	0.2	5.2	4.0	6.2	4.9	10.0	5.9	4.1	3.4	5.1	0.5	8.8	8.9	1.5	3.5	2.0	4.1
Planisporites spp.	1.4	3.8	1.5	1.3	3.6	1.7	2.2	0.7	0.5	0.6	0.5	1.4	0.9	1.3	3.1	1.2	1.9	1.6	3.6	1.5	1.3		2.2	0.8
Raistrickia spp.	0.1	0.2	0.6	0.4	0.3		0.2	0.7	0.2	0.2	0.3	0.2	1.2		0.2	0.1	0.3	0.2	0.2	0.3	0.4	0.4	2.1	0.9
R. medusa																								
Cirratriradites striatus																								
C. sp.	*						*	1.6	*				*					2.2	*				*	0.2
C. tenuis				*				*							*				0.3					
C. aligerens																								
C. saturni	*	0.3	0.3	1.0		0.2	0.7	0.2	0.1		0.3	0.4		0.1	0.5	0.3	0.2	0.3	0.6	0.2		0.3		0.2
Endosporites spp.	1.8	1.4	1.2	1.8	1.7	0.4	1.1	0.5	7.6		0.2	3.0	2.2	1.6	2.0	2.3	0.2	0.5	1.0	0.9	5.3	0.4	7.9	3.8
Schulzospora ovata																								
Endosporites costatus	0.5	1.2	0.6	0.2	0.1	0.4	0.3					*	*	1.0	0.3	0.7	0.8	*	0.3	0.1			0.3	
Florinites spp.	5.5	9.6	1.5	14.2	2.5	4.2	6.4	1.4	4.6	2.3	2.9	3.6	3.6	3.6	9.9	6.5	9.4	2.5	4.8	6.4	(0.3	0.1	1.5	0.4
F. antiquus																					(1.0	0.4	0.7	7.9
F. millotti									*					*	*	*					0.2		*	0.2
Pityosporites westphalensis													*											
Triquitrites spp.				0.2						*	0.2		*	0.1	0.2				0.6		0.3		0.4	0.2
T. sculptilis	0.6	1.5	1.5	1.3	3.3	2.9	0.2	0.4	1.6	2.2	1.0	0.2	0.7	2.1	0.7	1.9	2.4	0.2	1.1	0.2	2.1	0.4	2.7	0.2
T. inusitatus																								
Ahrensisporites spp.																								
Laevigatosporites spp.	19.2	16.8	19.6	17.5	22.6	28.1	31.5	19.0	13.5	14.7	11.6	17.8	7.5	12.8	16.4	17.4	15.2	19.0	11.5	25.6	12.6	6.7	22.0	19.8
L. minutus	2.0	0.2	1.8	1.8	1.5	0.8	0.9	0.2	0.7	2.5	1.3	0.4	1.1	1.5	0.2	2.4	1.0		1.8					
L. minimus	0.6	0.9		1.2	0.4									1.7	0.3						1.7	2.0		
L. obscurus																								
L. oculus																								
L. pseudothiessenii																								
Reticulatisporites mediareticulatus																								
R. tortuosus	0.5	2.4	0.8	2.8	0.8	0.4	1.0	0.2	0.7	1.0	*	1.4	1.1	1.7	3.6	1.3	1.6	*	*	0.6		0.1	0.2	0.3
R. facetus	*	0.1		0.8	0.1	0.3	0.5		0.2	0.1		*		0.4	0.3	0.7			*	0.4				
R. spp.	*			0.4	0.1	0.4	0.5	*		0.2		0.2				*	0.1	0.3	*	0.3			0.2	
R. magnus	*			1.0		*	0.3									*	*		0.3	0.3		*	*	
Verrucososporites facierugosus									*												0.2		0.2	
Alatisporites pustulatus	0.2																	*		*				
Reinschospora spp.	*																							
Microreticulatisporites quaesitus									*	*			*	*	*						*		0.2	
M. fenestratus										*			*	*		*								
M. parvipunctatus														*										
M. reticulocingulum						*					0.2									*				
M. sulcatus										*														
Torispora securis									*	*	0.3			*	*							0.3	3.7	*
Cadiospora magna																								
Gravisporites sphaerus																								
Schopfites dimorphus																								
Remainder		0.4		0.5	0.1	0.2			0.1	0.2			0.2	0.1			0.2	0.2					0.3	

CANNOCK CHASE Continued ..

SPORE TYPES	982	983	984	985	986	987	988	989	990	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589
Lycospora spp.	68.5	59.1	83.0	79.2	66.0	57.2	55.9	19.8	47.9	62.1	23.6	51.9	38.9	61.2	58.4	42.4	55.1	50.5	54.7	25.1	64.5	69.9	15.7	37.5
Densosporites annulatus		*				0.2		6.5	0.9											0.2			0.2	1.4
D. indignabundus		*			0.2			1.2					*											
D. solaris		0.4	0.3	0.2		0.2	0.3	7.7	8.3				0.2				*			3.8	0.7	0.4	0.3	12.1
Calamospora spp.	4.0	5.5	2.3	2.0	5.4	7.8	9.9	5.0	15.8	6.5	13.8	9.8	15.7	2.2	6.1	5.5	5.5	14.1	12.1	20.5	5.0	10.9	7.5	16.1
Spinososporites spp.	4.1	3.7	0.2	0.8	3.1	1.6	2.3	0.9	0.2	2.5	5.1	2.2	2.9	2.3	2.6	3.0	0.2	3.8	0.8	4.4	3.7	2.0	3.9	3.2
S. sp. (Millott's type 4)					0.2			*			0.2				0.1						*			
S. spinulistratus	1.4	4.5	2.6	2.0	0.8	2.6	0.9	1.2	0.5	6.1	2.0	6.8	2.5	8.5	4.6	4.4	9.4	1.2	3.4	4.9	3.6	2.4	11.4	0.6
Planisporites spp.	1.4	0.7	0.2	0.7	1.0	1.6	2.3	1.9	1.3	0.7	7.0	1.5	1.6	1.6	2.1	2.7	3.2	1.5	0.5	2.0	2.9	1.3	2.9	0.8
Raistrickia spp.		0.1	0.3	0.2	0.3	0.2	0.2	*	0.2	0.2	0.7	2.5	0.4	0.3	0.4	0.6	0.2	0.5	0.4	1.3	0.2		0.2	*
R. medusa																								
Cirratriradites striatus																								
C. sp.		0.1		0.2		0.2		17.0	0.7				0.2							0.4				0.4
C. tenuis							0.3	21.7	0.3												*	*	*	
C. aligerens																								
C. saturni	0.3	0.4	*		*		0.2	0.7	0.3	0.1	*			*	*	0.2	0.4			0.2	*			*
Endosporites spp.	6.2	0.4	0.8	1.2	1.0	0.8	1.3	1.9	0.3	0.3	17.4	1.5	*	1.4	3.0	8.0	*	4.0	0.5	2.0	1.0	0.2	3.4	1.4
Schulzospora ovata																								
Endosporites costatus		0.4				0.2	0.4				0.7	0.2		0.1	0.5	0.6	0.6	0.5	*	0.9	*		0.2	0.6
Florinites spp.	0.8		0.3	0.7			1.3		0.2	0.3	0.7	0.3	0.2	0.5	0.1	1.9		0.3		0.4				0.6
F. antiquus	1.2	4.3	0.3	2.7	4.6	3.5	2.5	0.6	0.9	0.3	0.3	0.5	5.7	1.2	3.7	9.5	0.4	3.6	4.2	7.9	1.5	0.8	3.9	1.8
F. millotti		0.8	0.5	0.2	0.3	0.2	0.5								*			*						
Pityosporites spp.						0.2	0.2														*			
Triquitrites spp.	0.3	0.4				0.3			0.3	0.1	0.7	0.2					0.2		0.5		*	0.2		*
T. sculptilis	0.6	1.1	2.0	0.2	1.0	1.8	4.0		0.2	1.4	3.8	1.2	2.3	0.2	2.2	1.0	11.3	0.8	1.1	0.4	0.9	1.3		0.4
T. inusitatus																								
Ahrensisporites spp.																								
Laevigatosporites spp.	9.3	12.4	3.9	8.9	9.2	17.8	11.2	13.0	21.2	15.2	21.7	18.0	24.4	11.0	11.4	12.8	9.4	13.0	20.3	21.8	13.8	9.6	48.1	22.3
L. minutus					1.5		1.3			1.7	0.2	0.8	1.2	9.3	4.2	6.1	3.3	3.2	0.5	1.6	1.2	0.4	1.7	0.6
L. minimus		2.1	1.1		0.4	0.4				1.7	1.3	1.3	2.1											
L. obscurus																								
L. oculus																								
L. pseudothiessenii																								
Reticulatisporites mediareticulatus																								0.2
R. tortuosus	1.7	2.9	1.4	0.6	4.1	2.5	2.3			0.3	0.2	1.2	0.9	0.2	0.3	1.1	*	3.0	0.2	0.6	0.2		*	*
R. facetus	0.2	0.1	0.2		0.2		0.5					*				*			0.3		0.2			
R. spp.									0.5		0.2	0.1					*	*	0.5	0.9	0.2		0.3	*
R. magnus		0.1	*		0.5	0.3	2.2	0.3			*	*		*		*			*	0.5	*	0.2		*
Verrucososporites facierugosus											*	*												
Alatisporites pustulatus															*	*		*		*	*			
Reinschospora spp.																								
Microreticulatisporites quaesitus		0.1	0.2																					
M. fenestratus		*	0.2	0.2	*										*	*								
M. parvipunctatus																	*							
M. reticulocingulum								0.6		0.1														
M. sulcatus			*											*	0.3		0.4	*	*		*			
Torispora securis		0.4	*							0.3	0.2					*	*							
Cadiospora magna																								
Gravisporites sphaerus																								
Schopfites dimorphus																								
Remainder			0.2		0.2	0.4				0.1	0.2		0.8			0.2	0.4			0.2	0.4	0.4	0.3	

	CANNOCK CHASE Continued ..						SOUTH STAFFORDSHIRE																	
SPORE TYPES	424	423	422	421	420	673	1432	1339	1433	1434	732	733	734	735	736	737	738	739	740	741	742	743	744	745
Lycospora spp.	46.0	55.0	36.6	40.1	52.2	68.1	71.4	66.7	69.4	79.0	61.8	47.5	39.8	59.9	52.8	32.8	13.5	68.0	40.2	69.8	76.2	59.9	75.0	81.6
Densosporites annulatus				0.2		0.4	*	*	0.3	2.4	*	11.3	0.1	0.2		3.6	55.4	1.5	4.2	0.9	0.5	0.7	0.4	
D. indignabundus				*		0.6		3.1		0.2		1.3		*	*	10.5	3.6		2.4	0.2	1.1	2.0		*
D. solaris				2.0	2.0																			
Calamospora spp.	20.5	15.9	14.4	11.9	10.6	8.8	13.0	18.7	7.6	5.2	9.9	11.9	24.9	15.1	14.9	14.4	8.4	15.6	17.5	7.3	10.4	11.4	7.7	5.1
Spinososporites spp.	1.0	1.6	0.5	1.1	0.1	2.4	2.6	0.2	0.2	0.6	2.2	0.2	0.3	0.7	2.4	2.5	0.2	2.0	1.9	2.6	0.2	0.5	1.7	2.3
S. sp. (Millott's type 4)		*			*							0.2	0.3		*	0.1			*	0.2	0.2	0.1	*	
S. spinulistratus	0.4	4.3	1.5	5.7	1.0	10.2	*	1.8	1.0	5.5	7.4	1.2	3.9	2.6	0.9	4.6	0.8	3.5	9.9	0,3	1.2	6.8	9.3	4.3
Planisporites spp.	1.5	1.0	3.4	2.1	1.4	3.0	0.2	0.4	0.7	1.6	1.5	1.2	0.1	0.3	0.4	1.4	0.8	0.2	0.9	0.9	0.4	1.6	0.4	1.2
Raistrickia spp.	0.6	0.2	2.1	0.2	0.3	2.0	0.2	0.2	1.2	2.4	*	0.5	0.5	0.4	0.4	0.4	0.8	1.0	1.6	0.5	1.2	1.5	1.1	1.9
R. medusa							*																	
Cirratriradites striatus						0.2			16.5	0.5						1.0	2.7	1.7	1.2		*	8.8	2.6	0.2
C. sp.	0.5		0.2	1.0	0.8	0.4					0.2	4.2	3.6	1.6	*	7.1		0.5	0.5					*
C. tenuis	0.2			*				*				1.3												
C. aligerens																			*	1.4	0.2	*		
C. saturni	*	*	0.8	*	0.1	0.6	0.2	0.3	*	*	0.3	*		0.1	0.2	*	*		0.3			0.3	*	*
Endosporites spp.	1.7	0.5	1.0	0.8	3.2		3.4	0.3	*		1.5	0.9	0.3	0.2	*	*				*				
Schulzospora ovata						*			*	*					*	*					0.2		*	
Endosporites costatus	0.5	0.6	0.5	*	1.2			0.2						*	*									
Florinites spp.)	2.5	2.9	4.8	3.8	1.0)		0.4		0.7	0.2	0.3	0.2	0.3	0.3	0.2	0.1	*	0.2	1.2	0.3	0.2	*	0.1	*
F. antiquus)							0.2	0.8		*	2.1	0.5	0.4		1.1	0.4	*		*					
F. millotti							*	*																
Pityosporites westphalensis								*	*						*									
Triquitrites spp.				0.3	0.3	1.1	0.7			0.5	0.3	0.2	*		*	0.4	0.2		*		*			0.5
T. sculptilis	3.0	0.5	0.7	*	0.1																			
T. inusitatus																								
Ahrensisporites spp.									*															
Laevigatosporites spp.	20.7	15.9	31.8	27.5	25.0	2.0	4.0	5.4	2.1	1.7	6.4	16.6	24.5	17.1	25.5	19.7	13.2	5.5	16.8	15.6	7.8	5.9	1.7	1.0
L. minutus			0.2				0.3				4.1				0.5				0.3		*	0.3		
L. minimus	0.5	0.5	0.2	1.8			0.9	0.5			1.6			0.7		0.6								
L. obscurus							1.1																	
L. oculus							0.6																	
L. pseudothiessenii							0.4																	
Reticulatisporites mediareticulatus					0.3			0.2		0.2	*	*	0.1	0.2	0.2	0.4								
R. tortuosus		0.3	0.5		0.3			1.0			0.2	*		0.2	0.2	*								
R. facetus	0.2	0.2	0.3	*	0.1										*									
R. spp.	*	0.3		0.8	*			0.2	0.3		*	0.2	0.5	0.2	0.3	*	0.3	0.3	0.6	*		0.2	*	*
R. magnus	*	0.3	0.5	0.7				*			0.2													
Verrucososporites facierugosus													0.3		*									
Alatisporites pustulatus												0.2	*	0.1	*	*							*	
Reinschospora spp.	*																*							
Microreticulatisporites quaesitus																								
M. fenestratus							0.2																	
M. parvipunctatus																								
M. reticulocingulum	0.2											0.2		*										
M. sulcatus							0.2																	
Torispora securis																								
Cadiospora magna																								
Gravisporites sphaerus							*																	
Schopfites dimorphus																								
Remainder						0.2						0.2	0.1	0.1			0.1		0.5		0.2			1.9

SPORE TYPES	NORTH WALES (FLINTSHIRE)											NORTH WALES (DENBIGHSHIRE)												
	153	154	155	156	157	158	533/4	535	666	692	676	704	725	726	858	727	852	853	854	855	859	856	857	860
Lycospora spp.	13.0	39.4	24.1	30.7	20.3	68.8	74.0	42.7	64.5	81.2	79.0	32.4	39.4	45.9	34.4	61.9	62.2	44.8	30.2	15.7	34.7	49.0	79.1	66.6
Densosporites annulatus	56.2	14.6	15.8	35.0	50.0		2.8	26.3	0.2	6.0	0.6		0.4										*	0.9
D. indignabundus	0.9	0.8	1.3	0.4	1.0			7.5									*		0.5					0.2
D. solaris																				0.2	0.3	*		
Calamospora spp.	5.5	9.7	10.4	18.6	14.2	6.9	17.1	9.4	10.5	3.0	10.8	29.9	20.2	21.3	20.3	6.4	11.9	5.2	23.2	16.7	21.2	28.1	9.3	9.2
Spinososporites spp.	2.2	2.5	1.5	2.7	2.5	11.3	0.6	0.9	1.7	0.2	1.9	3.1	2.3	5.5	7.3	11.9	2.9	5.3	9.6	4.5	2.5	0.2	0.6	0.6
S. sp. (Millott's type 4)	0.1		0.5		0.1		0.1														0.6			0.2
S. spinulistratus	0.3	1.9	4.8	0.7	1.0	0.4	0.8	2.6	0.9	5.4	2.1	2.9	0.5	0.4	0.5	0.2	2.7	7.1	1.2	4.7	1.2	2.4	0.3	2.8
Planisporites spp.	0.8	1.0	1.8	1.5	0.7	1.9	0.9	1.9	0.2	0.4	1.3	0.3	0.7	1.0	0.8	0.2	2.2	4.6	1.5	9.3	2.2	0.4	1.7	0.6
Raistrickia spp.	1.3	1.7	2.8	1.2	1.6	1.7	0.9	0.4	1.1	2.6	2.8	0.7	1.7	0.6	*	0.9	0.2	1.2	1.2	1.4	0.4	0.7	0.6	1.5
R. medusa													0.6											
Cirratriradites striatus							0.9	1.0	0.9	0.4	1.3													
C. sp.	0.3	0.1	0.2		1.1			5.2	0.2				0.2	*										0.4
C. tenuis																					*			
C. aligerens			*	1.3	1.0	3.5	0.2																	
C. saturni		*	0.1	*		0.2		*	0.6			*	0.2	0.2	*			0.2	1.2	2.9	*	*		0.2
Endosporites spp.	*	1.6	0.5		0.1				0.2			12.1	1.4		5.2	0.2	1.1	*	0.5	1.6	3.1	0.2	0.3	*
Schulzospora ovata			0.2		*	*	0.1		0.2	0.4	0.1													
Endosporites costatus													0.5	0.6	0.7					0.8	*			*
Florinites spp.							0.2			*		0.5	0.2	0.2	1.1		0.6	0.4	1.2	7.4	0.8	0.3	*	0.2
F. antiquus	0.3	1.1	0.7	0.7	0.6	0.5	0.1	*	0;6				0.2				0.9	10.0	1.8	9.5	9.0	0.3	0.9	0.6
F. millotti												1.1	1.8		0.7	0.2	0.2	2.5	0.4	1.9	0.4		*	*
Pityosporites westphalensis												*			*	*							*	
Triquitrites spp.	*			*						0.4		6.5	8.0	4.4	7.8	2.3		0.4	0.4	0.4	0.6			
T. sculptilis																	1.8	0.4	3.1	0.2	*	0.2	*	
T. inusitatus																								
Ahrensisporites spp.		*					*	*																
Laevigatosporites spp.	17.3	23.0	32.8	5.6	4.1	2.3	1.0	1.9	16.6			5.3	6.9	5.9	0.9	3.4	8.6	15.7	16.1	9.9	16.2	15.2	7.2	11.2
L. minutus												0.7	4.3	5.3	2.0	5.5	0.6		1.8	4.5				3.3
L. minimus	0.7	1.1	0.5	1.6	1.6	2.0						0.6	5.5	6.5	5.9	6.2	0.4				1.0			0.7
L. obscurus												*			9.3	0.3								
L. oculus												*			1.4									
L. pseudothiessenii												0.7	*		1.1	0.2								
Reticulatisporites mediareticulatus	0.4	0.7	1.3					*	0.6															*
R. tortuosus		0.3	0.5											0.4	0.3	0.2	1.1	1.0	3.1	2.3	3.7	3.0	*	0.4
R. facetus																	0.2				0.4			
R. spp.		*	0.1			0.2			0.6												0.7		*	0.2
R. magnus																			0.4	4.9	0.3		*	*
Verrucososporites facierugosus												*	0.5	*	0.3									
Alatisporites pustulatus			*					*																
Reinschospora spp.					*		*																	
Microreticulatisporites quaesitus												0.6	1.1	0.6		*	1.1	0.2	0.4					
M. fenestratus												1.3	2.8	1.2			1.3	0.2	1.8					
M. parvipunctatus																								
M. reticulocingulum	0.6	0.3			*																			*
M. sulcatus																								
Torispora securis													0.4						0.4					
Cadiospora magna												*												
Gravisporites sphaerus												*												
Schopfites dimorphus														?										
Remainder	0.1	0.2	0.1		0.1	0.3	0.3	0.2	0.4		0.1	1.3	0.2					0.8		1.2	0.7			0.2

NORTH WALES (DENBIGHSHIRE) Continued ..

SPORE TYPES	861	862	864	865	866	868	893	889	891	392	399	400	401	501	402	403	404	405	406	407/10	411	412	413	546
Lycospora spp.	46.4	69.6	60.1	52.4	68.4	60.9	38.8	58.8	62.0	63.9	34.4	78.8	73.1	74.9	61.7	46.6	42.5	65.0	54.0	70.1	85.3	72.7	71.0	26.9
Densosporites annulatus	16.0	0.9	2.3	3.4	0.7	*	26.2		8.7	4.4		0.2	0.2	0.2	6.2	2.5	9.4	1.1	1.2	7.2	0.5	4.2	12.4	
D. indignabundus	1.4		0.8	0.5	0.5		0.2		0.9	0.2				0.7	1.9	1.6	2.2	0.3	0.7		0.7		0.2	
D. solaris																								0.2
Calamospora spp.	16.2	11.0	15.7	20.2	15.2	14.8	14.9	13.0	9.4	15.4	11.6	4.8	6.4	8.3	5.2	13.6	13.6	8.2	10.6	6.1	5.9	5.0	6.0	18.4
Spinososporites spp.	0.8	2.0	1.0	0.8	0.2	3.0	0.6	4.5	0.2	0.4	21.4	1.6	1.0	0.2	0.2	1.6	0.7	0.2	0.9	0.1	0.5	0.2	0.4	8.1
S. sp. (Millott's type 4)	0.2	*		0.2	*	*				0.6		*			0.2	*	0.2		*	*	0.2		*	0.2
S. spinulistratus	3.4	3.5	1.7	2.1	1.2	1.0	0.6	4.8	1.5	5.3	*	*	1.0	3.7	4.1	3.0	2.2	3.2	1.7	2.3	0.4	2.1	0.8	7.5
Planisporites spp.	0.8	0.9	0.6	0.5	0.1	2.3	0.6	1.4	1.7	0.9	2.3	0.3	2.0	0.7	1.3	0.7	1.1	0.7	2.1	0.3	0.7	0.9	0.5	4.5
Raistrickia spp.	0.6	0.9	0;6	1.0	1.5	1.4	2.4	2.6	2.8			0.5	0.6	*	0.4	1.3	1.4	0.6	1.5	1.0	0.4	1.4	0.8	0.3
R. medusa											*													
Cirratriradites striatus							7.6		7.0	1.8										0.5		7.4	1.3	
C. sp.	1.0	*	1.3	0.6	1.0	*	0.8			0.2		*	0.2	0.4	2.0	1.8	4.6	2.2	0.7	0.5				
C. tenuis	*	0.5												*	4.0	1.6				*				
C. aligerens								1.0	*	0.2										*	1.2	0.2	0.2	
C. saturni	*	0.4	0.2	*		*	*				0.3	*	*	0.3	0.2	0.4	*		0.2	*	*	*		0.5
Endosporites spp.	0.8	*	2.7	0.6	0.1	*	*	0.4	0.2	0.2	6.6	0.8	1.6	0.7	0.2	0.7	0.6	0.2	0.5	*	0.2		*	2.2
Schulzospora ovata						*	*	0.9	*	0.2									0.4	*			*	
Endosporites costatus	*	*		*			*				*			0.2			*		*	*				
Florinites spp.	0.2	0.2	0.2	0.2	*	*	0.3	1.0		0.2	0.2	1.8					0.2				0.8	*	*	0.5
F. antiquus	0.6	1.3	1.1	1.1	0.2	0.6	1.0	0.2	0.4	0.2	*	*	1.0	0.8	1.5	3.0	1.7	0.2	2.0	0.2	0.2	0.2	0.2	15.2
F. millotti											0.1	*												
Pityosporites westphalensis					*		*																	
Triquitrites spp.	0.6	*		0.4	0.1		*	0.4	0.2		3.4	0.2	0.2	*	0.2	*	0.2	0.2	0.5	*				
T. sculptilis											1.3	0.2	1.0											0.5
T. inusitatus											*													
Ahrensisporites spp.						*									*									
Laevigatosporites spp.	9.4	8.4	11.5	15.0	10.7	15.4	6.0	10.8	4.6	5.9	3.5	7.6	9.9	7.4	10.3	20.9	18.5	16.4	21.8	11.4	3.0	5.7	6.2	8.5
L. minutus	0.6	0.2									3.3	1.2		1.0					0.1					0.3
L. minimus	0.4	0.2		0.6							8.9	1.2	0.2			0.2		0.2	0.9	*				1.2
L. obscurus																								
L. oculus																								
L. pseudothiessenii											0.8													
Reticulatisporites mediareticulatus	*	*	*	0.2	*	0.2			0.2					*		0.5	0.5	0.6	0.1	0.2		*		
R. tortuosus	0.2	*	*	*	0.1	0.2	*				1.0	0.5	1.4	0.2	*	*	*	0.2	0.1	0.1				2.5
R. facetus				*							*	*		*					*					0.7
R. spp.	0.2		0.2	0.2	*	*								0.2	*		0.2	0.3	*	*				0.5
R. magnus																								1.0
Verrucososporites facierugosus				*		*	*				*								*					
Alatisporites pustulatus				*	*	*									0.2	*	*							
Reinschospora spp.						*																		
Microreticulatisporites quaesitus											0.5													
M. fenestratus											*													
M. parvipunctatus																								
M. reticulocingulum				*														*		*				
M. sulcatus																								
Torispora securis											*	0.3	0.2											
Cadiospora magna											*													
Gravisporites sphaerus																								
Schopfites dimorphus																								
Remainder	0.2					0.2		0.2	0.2		0.3			0.1	0.2		0.2	0.2						0.3

NORTH WALES (DENBIGHSHIRE)

SPORE TYPES	545	608	164	548	549	290	551	180	169	552	553	554	555	556	175	557	559	566	609	497	694	596	485	486
Lycospora spp.	38.6	51.4	30.7	16.3	62.7	70.2	38.5	60.9	28.6	55.0	38.2	47.0	82.8	52.2	69.0	66.6	62.3	73.1	53.3	55.4	74.9	47.4	66.6	83.5
Densosporites annulatus		0.2	0.2	0.4	0.3	0.5	0.8	0.9	2.1	1.9	3.4	10.5	0.7	0.9	2.8	0.6	4.4	8.9	7.4				25.2	3.7
D. indignabundus			0.2				0.2	0.2	0.6	0.6	1.3	1.5			2.0		0.4	*	1.2					
D. solaris	0.2	0.2	*				0.6																	
Calamospora spp.	13.1	15.5	15.8	31.8	11.4	7.5	12.1	3.9	9.3	10.2	13.7	11.4	4.7	11.9	8.8	9.5	8.1	3.5	11.3	11.6	10.7	22.3	3.9	3.6
Spinososporites spp.	11.7	8.4	11.6	18.2	0.5	3.5	14.0	5.7	6.0	3.2	6.8	1.2	2.5	2.5	2.2	4.8	5.0	1.7	5.4	3.5	3.7	2.8	0.4	1.5
S. sp. (Millott's type 4)	0.1		0.2		*			0.2		0.3		0.2					0.2							*
S. spinulistratus	0.8	1.6	3.0	3.3	4.2	2.9	8.4	5.4	4.9	2.6	15.6	0.8	0.7	1.7	2.6	2.9	0.4	1.8	7.4	*	0.5	*	1.0	2.3
Planisporites spp.	1.6	3.3	4.1	5.8	0.9	1.1	2.7	1.7	2.0	1.9	0.8	0.4	0.6	2.5	1.0	2.3	0.4	0.4	4.6	0.4	0.2	3.4	0.6	2.5
Raistrickia spp.	0.6	3.1	0.3	2.7	1.8		1.4	1.3	1.7	0.8	0.8	1.2	0.4	2.5	1.4	1.5	2.4	0.6	2.0	0.2		1.1	2.1	1.8
R. medusa																				0.2	0.1			
Cirratriradites striatus															0.3		10.6	2.2	0.6				*	
C. sp.				0.6	0.7		0.8	0.7	4.7	2.1	2.6	4.4		1.9	0.3				1.5					
C. tenuis			1.7					0.2	10.6	*														
C. aligerens															*	0.8	*	*	0.2					
C. saturni	0.1		0.6	0.2	0.2		1.9	0.2	1.7						*					*				
Endosporites spp.	2.4	1.0	0.9	0.4	0.2	0.4	1.5	0.6	0.5	0.9	0.2	0.4	2.0	2.2	*					3.2	1.2	2.9		
Schulzospora ovata															*	0.5	*	*						0.2
Endosporites costatus	1.1	0.4	0.3	0.4		*		0.2												0.2		*		
Florinites spp.	1.1	0.2	0.6	0.4	0.3		0.8	0.4			0.4			0.2	0.2	0.2	0.2	*	0.2		0.2		0.2	0.2
F. antiquus	8.5	2.3	7.6	4.0	3.7	0.4	2.7	1.8	1.3	0.9	0.4	1.3	0.2	1.2	*	0.2			0.2	*		9.8		
F. millotti			*	*																0.4				
Pityosporites westphalensis																								
Triquitrites spp.				0.2					0.2					0.2					0.2	1.7	0.3			0.5
T. sculptilis	1.1	0.4	0.8																		0.5	4.7		
T. inusitatus																				*	0.2			
Ahrensisporites spp.			0.6					0.2							*									
Laevigatosporites spp.	11.6	8.9	15.4	11.4	10.3	10.9	11.3	10.3	22.4	17.9	13.7	18.1	5.0	19.5	9.4	9.7	4.8	5.9	2.6	2.5	2.7	1.7		
L. minutus	3.2		0.3					1.8		0.2										3.8	2.7			
L. minimus	1.8	1.9	0.2	2.5	1.2	2.0	1.5	2.2	1.7	0.3	1.5	0.4	*	0.2			0.2	0.3	1.1	16.0	1.7	3.5		
L. obscurus																				*	*			
L. oculus																				*				
L. pseudothiessenii																				0.7	0.1			
Reticulatisporites mediareticulatus			0.2					0.4	0.2	0.3	0.2	0.8					0.2							
R. tortuosus	1.4		1.9	0.4	1.0	0.2	0.2	0.4			0.2											0.1		
R. facetus	0.2	0.2	0.2	0.6		0.2	0.2	0.4																
R. spp.	*				0.4	*			0.6	*	0.2						0.2	0.2	0.2					
R. magnus	0.1	0.2	1.5	0.4	0.2																			
Verrucososporites facierugosus																								
Alatisporites pustulatus			0.3						*	0.2		0.2	0.2											
Reinschospora spp.			*																0.4					
Microreticulatisporites quaesitus																				0.2	*	*		
M. fenestratus																				*	0.3	*		
M. Parvipunctatus																								
M. reticulocingulum										0.7		0.2												
M. sulcatus	*		*																					
Torispora securis																								
Cadiospora magna																				*				
Gravisporites sphaerus																					*			
Schopfites dimorphus																					?			
Remainder	0.7	0.8	0.8			0.2	0.4		0.9				0.2	0.4		0.4	0.2	0.4	0.2			0.3		0.2

LANCASHIRE

SPORE TYPES	151	152	190	191	192	201	202	203	224	225	226	227	228	283	284	285	286	287	204	205	206	207	208	209
Lycospora spp.	63.9	68.1	52.7	47.8	72.0	39.6	53.5	70.4	63.0	59.9	51.6	62.4	68.4	60.5	66.6	71.4	75.3	72.0	65.5	31.0	67.6	83.0	76.1	81.2
Densosporites annulatus				0.3		25.7	1.0	0.5	0.9	1.9	2.9	4.4	0.1			0.4	0.9	0.2	0.2	21.8	2.2	0.2	0.4	0.3
D. indignabundus				1.1	0.1	1.0	0.6		1.0		0.5	0.4			0.2	0.1	*	1.4	0.3	0.4	0.3	0.2	0.4	*
D. solaris			0.5	1.0																				
Calamospora spp.	12.9	16.8	21.5	14.5	8.3	6.1	12.5	6.1	10.6	13.1	14.6	10.7	8.2	14.6	8.8	14.1	13.7	9.5	9.3	9.0	7.7	7.1	10.1	5.9
Spinososporites spp.	4.4	2.1	2.0	2.2	7.9	5.5	3.5	4.0	3.0	0.4	1.2	0.8	4.8	0.7	4.0	1.0	1.1	1.3	0.5	1.0	1.0	0.8	0.7	0.6
S. sp. (Millott's type 4)						*			*		0.4							*		0.4				*
S. spinulistratus	0.6	0.2	1.0	10.0	2.2	3.5	9.2	5.2	1.4	0.4	2.8	0.7	4.9	1.1	5.9	1.8	1.9	4.5	8.7	11.0	2.2	1.2	2.1	4.8
Planisporites spp.	0.2	0.6	2.3	1.6	1.0	0.5	3.1	0.9	1.1	1.3	0.8	1.1	0.8	1.3	1.1	0.5	0.9	2.1	2.8	0.4	2.4	0.8	2.0	2.0
Raistrickia spp.		0.4	*	0.9	0.8	0.9	0.3	0.9	0.6	0.7	0.9	1.7	1.1	1.0	0.4	0.1	0.8	1.7	1.1	1.4	2.2	0.6	0.4	0.2
R. medusa	*																							
Cirratriradites striatus														0.2	0.2	0.2	0.3	0.2						
C. sp.	*		0.1	1.2		2.2	1.2	0.5	0.7	1.1	1.2	2.2				0.1		0.2	0.2	3.2		0.2	0.4	
C. tenuis				1.0	0.1				0.3	0.7														
C. aligerens																	1.9	1.1						
C. saturni			0.1	0.1	0.2	0.2	*	*	0.2	*	0.1	0.2		0.5			*	*	*	0.2			0.4	0.3
Endosporites spp.	1.3	0.5	0.8	0.3	1.0	0.2	0.2	*	1.1	2.1	2.4	0.8	0.5		*	0.4	*	0.3	0.8	1.0	0.4	0.4	*	0.2
Schulzospora ovata															0.2	*	0.2	0.3						
Endosporites costatus	*	0.4	*	*	0.2		*		0.2															
Florinites spp.	*	0.2	0.1	0.9	0.2	0.2	0.2		0.3	0.2	0.4	0.2	0.1	0.2	0.3	0.1	*	0.2	0.3	0.6	0.2	0.2	0.4	0.2
F. antiquus			4.1	2.3	1.1	0.8	2.7	1.1	1.1	1.3	2.0	0.1	2.1	2.6	1.6	0.8	*		2.5	1.6	2.0	0.8		0.4
F. millotti			*		0.2														0.2					
Pityosporites westphalensis	*				*		0.2									*			0.3	0.2			0.1	0.4
Triquitrites spp.	1.3	0.9				0.2	*		0.2		*	0.4		0.2				0.3	0.5	0.4	0.2		*	
T. sculptilis			1.4	0.1																				
T. inusitatus																								
Ahrensisporites spp.																			*					
Laevigatosporites spp.	5.1	7.1	12.2	13.2	3.1	12.1	9.6	6.7	12.5	15.8	17.4	13.5	6.9	16.4	8.3	8.5	3.0	4.5	5.2	15.4	10.3	4.1	4.6	3.5
L. minutus	4.5	0.4		0.6	0.2		0.3		0.3															
L. minimus	5.6	1.7			1.0			2.8	0.6				1.1		1.2									
L. obscurus	*	*																						
L. oculus	*																							
L. pseudothiessenii	0.1																							
Reticulatisporites mediareticulatus						0.5	0.3	*	*	0.9	0.4	0.1			0.2	*			*	0.2	*	0.2	0.9	
R. tortuosus	0.1	0.2	0.9	0.3	0.3	*	0.8	0.7			0.1	0.2	0.5	0.7	0.7	0.4	*		1.3	0.2	0.7	0.2	0.9	
R. facetus			*				0.2													0.4				
R. spp.				0.3		*			0.2		0.1	*	0.1		*						0.2			
R. magnus			0.3	*																				
Verrucososporites facierugosus									*										*					
Alatisporites pustulatus									*	0.2		*												
Reinschospora spp.																								
Microreticulatisporites quaesitus	*																							
M. fenestratus	*	*																						
M. parvipunctatus																								
M. reticulocingulum				*		*		0.2				0.1												
M. sulcatus	*	*																						
Torispora securis																								
Cadiospora magna		*																						
Gravisporites sphaerus	*	*																						
Schopfites dimorphus		0.2																						
Remainder		0.2		0.3	0.1	0.8	0.6		0.7		0.2		0.4		0.3	0.1		0.2	0.3	0.2	0.4		0.1	

SPORE TYPES	210	211	212	213	214	215	229	230	231	232	233	234	235	236	237	238	239	240	1361	1362	1363	1364	1365	1366
Lycospora spp.	58.0	65.1	49.6	78.1	52.9	31.5	28.4	63.1	69.3	52.4	63.1	73.3	83.6	65.7	33.2	68.9	71.0	77.0	35.5	61.8	69.7	68.5	60.8	80.0
Densosporites annulatus	5.0	1.4	9.9	1.2	4.1	7.9	1.1		0.5	2.5	0.3		0.2	0.6	8.7	0.4	2.7			1.2	0.4	0.2	0.4	0.2
D. indignabundus	1.1	0.8	0.5		0.5	3.8				0.2		0.3	1.0	0.6	3.9		1.0		1.4	0.3	0.2	*	0.1	
D. solaris							1.6	*											0.2					
Calamospora spp.	12.5	8.4	9.4	6.9	6.7	10.7	18.2	19.5	9.8	15.6	12.2	10.0	7.6	11.3	12.7	10.3	10.0	11.7	21.8	2.8	6.3	10.4	9.6	5.4
Spinososporites spp.	0.8	0.8	1.6	0.7	0.5	0.9	0.7	1.4	0.2	3.4	1.2	2.8	2.0	1.0	3.2	1.3		0.5	0.7	1.7	0.8		1.1	0.5
S. sp. (Millott's type 4)	0.2	0.2			0.1		*				0.2			0.3										
S. spinulistratus	3.1	4.7	1.6	0.6		3.1	0.2	3.1	5.4	3.6	0.6	1.7	0.2	0.6	0.9	3.1	4.4	0.4	0.8	3.7	11.2	5.8	7.4	4.6
Planisporites spp.	2.0	2.0	2.0	1.0	1.7	0.6	1.6	3.1	1.8	3.4	1.1	2.4	0.5	1.4	2.6	0.6	1.0	1.0	0.7	0.8	0.7	0.5	1.6	0.3
Raistrickia spp.	0.2	1.0	1.5	1.3	0.9	2.9	0.2	0.4	1.3	1.3	2.2	0.8	0.9	0.8	3.1	2.4	1.2	0.4	0.9	0.5	0.5	1.1	0.5	0.5
R. medusa																								
Cirratriradites striatus																	0.3	0.2						
C. sp.	0.9	0.9	7.9	4.0	5.0	6.0	3.0	*	0.2	1.3	1.9	0.5		0.5	2.3		0.3	0.4	2.5	0.8	1.3	2.7	0.1	0.3
C. tenuis	0.4	0.2			0.7	0.9	9.6						0.3		0.4		0.2		1.4					0.2
C. aligerens																	0.5	2.0						
C. saturni	0.4	0.2			0.4		*	0.1			0.2	0.3			0.3		0.2		0.1	0.1		0.9	0.9	0.3
Endosporites spp.	1.6	1.6	0.9	0.8	1.8	5.0	0.7	1.2	4.4	1.8	0.2	0.3	0.2	1.8	5.5	0.6	*	0.4	0.4	13.1	1.9	0.5	2.6	2.6
Schulzospora ovata																0.6	*							
Endosporites costatus								0.8	0.2			0.3		0.6										
Florinites spp.	0.5	0.5		0.6	0.1	0.9	0.2				0.4	0.2	0.3	0.3	0.4			0.4	0.1	0.6	0.1	0.4	1.4	0.5
F. antiquus	1.6	0.6	0.1	1.2	1.2	1.9	0.9	1.2	1.9	2.5	2.8	1.0	0.2	1.1	1.8	1.7	*	1.1	3.0	1.7	1.0	1.5	3.0	0.8
F. millotti							0.2													0.1				
Pityosporites westphalensis					0.1	0.4	0.2		0.2	0.2				*		0.2					*	*		*
Triquitrites spp.			0.1				*					*		0.3			0.2	0.2	*	*				0.2
T. sculptilis							*																	
T. inusitatus																								
Ahrensisporites spp.																								
Laevigatosporites spp.	9.4	11.2	12.8	3.2	23.2	21.8	31.0	5.3	4.8	11.2	12.8	5.4	2.3	12.2	18.2	8.6	6.8	4.3	29.7	10.4	5.4	6.8	10.4	3.2
L. minutus																								
L. minimus																				0.2	0.2			
L. obscurus																								
L. oculus																								
L. pseudothiessenii																								
Reticulatisporites mediareticulatus	2.3	*	1.3	0.1	0.1	0.6					0.4			*	1.8	0.2	0.2		*	0.2			*	
R. tortuosus		0.4	0.4	0.2		*		0.6		0.4	0.2	0.5	0.5	0.6	0.4	0.9			0.4		0.3	0.4	0.1	0.2
R. facetus										0.2						0.2			0.1			0.3	*	
R. spp.				0.1		0.3	1.3						0.2	0.3					0.1					
R. magnus																			*					
Verrucososporites facierugosus					*														0.1					
Alatisporites pustulatus								*			0.2													
Reinschospora spp.																								
Microreticulatisporites quaesitus																								
M. fenestratus																								
M. parvipunctatus																								
M. reticulocingulum			0.1				*							*										
M. sulcatus							*																	
Torispora securis																								
Cadiospora magna																								
Gravisporites sphaerus																								
Schopfites dimorphus																								
Remainder			0.3			0.8	0.9	0.2				0.2			0.6				0.1					0.

LANCASHIRE Continued ..

SPORE TYPES	1367	1368	1369	1370	1371	1372	1307	1308	1310	1311	1312	1313	1314	1315	1316	1317	1318	1319	1075	1076	1077	1078	1080	1057
Lycospora spp.	62.5	74.5	66.0	74.8	91.2	83.7	90.3	71.1	53.0	76.1	63.5	61.2	46.5	79.5	78.1	50.4	29.8	71.2	75.6	78.4	58.7	30.5	73.0	52.4
Densosporites annulatus	0.9	0.7	1.5	0.3		0.3			0.5				3.0	0.2	0.5	0.2	9.6	0.7				0.1		*
D. indignabundus	1.1	0.5	3.8	0.4							*		0.5		0.3	6.7	4.6	0.5				0.1		
D. solaris											*											*	0.1	
Calamospora spp.	10.2	7.8	7.1	5.0	3.2	4.0	1.9	11.4	3.9	4.9	2.9	7.4	4.6	5.4	4.4	5.2	8.3	6.1	5.1	6.5	25.3	28.4	8.8	5.1
Spinososporites spp.	2.5	0.8	1.3	3.6	0.3	0.7	1.8	1.3	3.6	1.2	0.8	0.2	2.7	1.2	1.3	0.9	2.5	2.9	3.1	1.9	0.2	1.8	1.2	0.5
S. sp. (Millott's type 4)	0.2	0.1	0.5						0.2		0.2								*	*		0.1		0.2
S. spinulistratus	5.8	0.6	1.3	5.0	0.2	1.3	0.3	0.2	0.7	3.8	15.6	19.8	9.7	6.5	3.1	11.6	10.1	1.8	0.1	*	0.3	1.4	0.9	17.8
Planisporites spp.	1.1	0.8	1.3	0.4	1.1	1.2	0.1	1.0	4.3	1.0	0.8	0.9	1.8	0.6	0.6	1.7	1.4	1.4	0.5	0.3	1.7	3.5	1.2	1.3
Raistrickia spp.	0.8	0.2	1.0	0.4	0.4	0.8	*	0.2	1.4	0.6	1.0	0.5	2.1	0.6	0.4	2.1	1.3	1.8	0.2	0.4	0.1	0.6	0.5	0.7
R. medusa																								
Cirratriradites striatus					*																			
C. sp.	1.4	1.4	0.3	0.4					2.4		0.2		7.1		0.5	0.5	2.1	4.5				2.2		*
C. tenuis		0.1											0.2			0.2								
C. aligerens					0.5	2.0																		
C. saturni		0.1	0.2						0.3	*	0.8	0.5	0.7			0.5		0.5			0.1	0.1		0.4
Endosporites spp.	1.2	3.7	2.3	0.7	*		1.0	1.1	2.6	1.1	2.0	1.1	1.2	1.3	0.3	0.5	1.8		0.7	0.4	2.1	3.1	2.0	3.4
Schulzospora ovata					*	0.2																		
Endosporites costatus											0.3								0.1					
Florinites spp.	1.2	0.4	0.2	0.2	0.1	0.3	0.1	0.7	0.7		0.5	0.5	0.9		0.5	0.7	0.5	0.2	0.1	0.2	0.3	0.4	0.3	0.3
F. antiquus	0.9	0.6	2.8	0.3	*	0.3	0.4		4.6	2.0	3.2	0.7	2.3	0.2	0.8	0.8	2.1	1.1	2.9	*	2.4	6.4	3.2	6.4
F. millotti							0.1	*	0.9	0.1	0.2	0.2							0.1		*		0.1	
Pityosporites westphalensis	0.4			*	*	0.3	*	*	0.3	*			0.2	0.4			0.2	0.2	0.1		*			
Triquitrites spp.				0.2					0.2				0.7			0.3		0.2	0.6	0.5	0.5	0.1		
T. sculptilis							0.6	1.2	1.9	1.2									0.5	0.3	0.3	1.8	1.2	
T. inusitatus																								
Ahrensisporites spp.			*										*											
Laevigatosporites spp.	8.7	7.6	9.9	8.1	2.9	4.7	3.4	5.9	16.0	6.8	6.8	6.3	12.0	3.5	8.9	12.4	21.1	5.1	9.5	6.5	5.7	18.1	6.8	10.0
L. minutus								2.8			0.3		0.5	0.4				0.7	0.1	3.2				
L. minimus								2.1	0.2				0.2					0.5	0.4	1.4	1.8			
L. obscurus																								
L. oculus																								
L. pseudothiessenii																								
Reticulatisporites mediareticulatus	0.6		0.3	*									0.9		0.3	4.5	3.9	0.2						
R. tortuosus	0.5	0.1	*	0.2				0.2	1.7	0.5	0.3	0.7	0.7			0.4	0.5	0.4	*	*	0.3	1.0	0.7	0.9
R. facetus									0.2	0.5	0.2		0.7	0.2		0.4						0.1		0.2
R. spp.									0.2				0.6									*		
R. Magnus									0.2	0.1												*	*	
Verrucososporites facierugosus																					*			
Alatisporites pustulatus																								
Reinschospora spp.																								
Microreticulatisporites quaesitus								*											0.1		0.1			
M. fenestratus								*											0.2	*	*			
M. parvipunctatus																								
M. reticulocingulum								0.2									0.2							
M. sulcatus								*		0.1														
Torispora securis							*												*	*				
Cadiospora magna																								
Gravisporites sphaerus																								
Schopfites dimorphus																								
Remainder			0.2		0.1	0.2		0.6			0.4		0.2								0.1	0.2		0.[illegible]

LANCASHIRE Continued ..

SPORE TYPES	1056	1055	1058	871	872	873	874	288	289	244	294	295	245	246	296	1059	1048	1047	1046	1050	1049	875	876	877
Lycospora spp.	56.5	77.7	53.1	62.1	72.4	22.6	44.1	63.0	30.9	31.2	25.9	59.7	68.3	70.0	53.8	68.6	56.1	55.7	78.5	64.5	40.8	57.0	68.4	65.0
Densosporites annulatus		*	0.6	0.8	0.3	56.7	6.5	0.2		0.2	0.7	0.1			0.2		0.1	0.1		0.1		2.5	0.4	0.[illegible]
D. indignabundus			0.6	0.2	0.2	1.4	0.7								0.1					0.1			*	
D. solaris								*			0.2	*	0.2		0.2	*	0.3							
Calamospora spp.	6.0	2.6	5.9	5.2	4.4	2.3	10.9	7.1	21.4	15.0	23.6	10.2	11.5	14.1	16.6	17.5	3.7	6.5	3.9	14.8	9.9	7.9	14.4	8.[illegible]
Spinososporites spp.	0.8	1.9	4.1	1.1	2.7	0.7	4.3	4.1	3.8	6.6	0.2	3.5	2.7	2.0	0.8	4.6	1.7	0.9	3.8	0.4	2.3	0.5	2.6	4.[illegible]
S. sp. (Millott's type 4)	0.1		0.2	*								0.1		0.2			0.1				0.1		0.2	
S. spinulistratus	22.5	9.4	18.6	12.2	8.3	2.5	4.6	0.6	3.2	4.4	1.8	1.5	1.0	0.2	0.2	1.3	15.2	19.3	5.2	5.6	21.6	13. 2	1.6	10.[illegible]
Planisporites spp.	1.8	1.1	1.4	1.8	1.3	1.3	0.9	3.6	2.8	3.5	3.4	1.5	1.6	1.1	2.4	0.6	2.5	1.3	0.5	3.0	1.7	1.0	0.4	0.[illegible]
Raistrickia spp.	0.6	0.9	1.3	1.5	1.3	1.1	0.5	0.8	0.5	0.4	0.9	0.1	0.2	0.4	0.8	1.1	0.8	0.4	0.5	0.5	0.9	1.8	0.7	1.[illegible]
R. medusa																								
Cirratriradites striatus																								
C. sp.			0.2	1.2	0.3		1.2	*		0.2	1.1				*		0.1				0.1	2.2	0.2	0.[illegible]
C. tenuis				0.2	*	0.3																0.2	*	0.[illegible]
C. aligerens																								
C. saturni	0.1		0.5	0.2	*	*	0.5	0.3	0.5		*	0.1	0.5				0.6	0.5			0.9	0.2	*	1.[illegible]
Endosporites spp.	0.5	3.0	1.5	0.4	0.8	*	3.4	0.9	12.7	4.2	4.3	1.7	1.2	1.7	2.7	0.6	2.5	1.6	2.2	0.3	0.9	1.2	1.0	1.[illegible]
Schulzospora ovata																								
Endosporites costatus					*			0.2		*	0.4			*	0.3	0.3				0.1			*	
Florinites spp.	0.6		0.3	0.9	0.2	0.3	0.5	0.6	1.0	0.7	0.7	0.4	0.4		0.3	0.2	0.9	0.1		0.1	0.1	0.2		
F. antiquus	1.5	0.1	3.0	2.7	2.5	0.3	2.6	3.9	3.2	9.8	9.5	4.6	1.8	0.6	3.2		4.2	2.0	0.7	2.0	5.5	1.0	0.6	1.[illegible]
F. millotti								0.2	*		0.4	0.1					0.1							
Pityosporites westphalensis	*						0.1			*													*	
Triquitrites spp.				0.5		0.4	0.7						0.2					0.2		0.1				0.[illegible]
T. sculptilis								1.5	2.3	1.4	1.1	1.7	0.8	*	1.0									
T. inusitatus																								
Ahrensisporites spp.																			0.1					
Laevigatosporites spp.	6.9	3.0	7.6	7.6	3.8	8.9	15.6	8.2	13.8	11.3	24.0	8.8	7.6	8.0	15.9	4.2	7.5	6.4	1.8	7.9	10.1	10.0	8.4	3.[illegible]
L. minutus					0.5			3.2		4.7		1.7		0.8										
L. minimus				0.4	0.8					3.8		1.1					2.0	3.2	2.7		4.0		0.3	1.[illegible]
L. obscurus																								
L. oculus																								
L. pseudothiessenii																								
Reticulatisporites mediareticulatus			*	0.2	0.2	0.8	1.7									*						0.5	0.2	
R. tortuosus	1.4	0.2	0.5	0.2	*	*	0.9	0.6	2.2	0.3	1.4	2.8	1.2	0.5	0.7	0.3	0.7	1.3	0.1	0.3	0.9	0.2	0.2	0.[illegible]
R. facetus	0.6		0.2	*				*	0.7	0.2		0.1	0.4	*	0.3	0.2	0.3	0.4					*	
R. spp.				0.2		0.2			0.3	*	0.4			*	0.2		0.1					0.2	*	
R. magnus								0.6	0.3	2.1	*	*	0.2			0.3								
Verrucososporites facierugosus						0.2	0.1				*	*		0.2							0.1		*	
Alatisporites pustulatus							0.1	0.2			*											*	0.2	
Reinschospora spp.																			*				*	
Microreticulatisporites quaesitus																								
M. fenestratus																								
M. parvipunctatus																								
M. reticulocingulum							0.1							*										
M. sulcatus											*				*									
Torispora securis																								
Cadiospora magna																								
Gravisporites sphaerus																								
Schopfites dimorphus																								
Remainder	0.1	0.1	0.4	0.4				0.2	0.4			0.2	0.2	0.2	0.3	0.2	0.5	0.1		0.2	0.1	0.2	0.2	0.[illegible]

LANCASHIRE Continued ..

SPORE TYPES	879	880	1060	1062	1063	1064	1065	1066	1067/9	1070	1071	1072	1073	1074	1336	417	1480	1481	1510	1476	1477	1478	1506	1507
Lycospora spp.	38.3	41.2	56.1	74.1	91.4	62.1	63.4	62.4	66.0	75.0	62.5	60.8	67.1	75.1	87.1	90.5	49.5	79.0	83.9	74.8	84.0	82.9	86.9	73.0
Densosporites annulatus	39.9	4.2	1.0	0.8		5.8		0.3	0.3		0.9	1.1	*		0.2	3.1	40.5	10.1	3.7	7.8	4.9		0.7	19.7
D. indignabundus	0.9	2.6	0.3			1.0	0.3	*	*	*		0.7	*	0.1	0.2					3.0		0.2		
D. solaris																								
Calamospora spp.	4.3	12.9	11.6	8.4	5.7	9.5	5.8	13.4	8.0	7.9	12.9	13.1	12.1	15.6	4.2	0.5	6.4	5.5	4.5	6.9	3.3	7.5	4.9	5.5
Spinososporites spp.	1.3	3.3	5.4	1.0	0.5	1.6	0.6	3.3	1.2	3.6	3.4	0.3	0.8	0.6	0.9	0.3	0.1	0.2		0.2	2.4	3.1	1.2	
S. sp. (Millott's type 4)		0.2										*		*	0.2					*				
S. spinulistratus	3.4	4.0	2.5	5.6	0.2	1.3	17.8	4.9	15.0	6.2	6.0	6.4	6.5	1.0	1.6	4.1	2.0	2.0	4.9	1.0	0.6	0.3	2.1	0.1
Planisporites spp.	0.7	1.0	1.1	2.1	0.5	0.6		1.4	1.3	1.3	0.7	1.3	1.2	0.6	0.3	0.1	0.3	0.2	0.5	1.2	1.6	1.2	1.5	0.5
Raistrickia spp.	0.1	0.8	2.5	1.9	0.1	1.0	0.3	0.6	1.8	0.2	4.8	1.6	1.0	1.0	1.7	1.3	0.7	1.3	1.5	2.3	1.6	1.5	2.0	1.1
R. medusa																								
Cirratriradites striatus									*					0.3	*			0.2	0.7	0.2		0.3		
C. sp.		1.9	2.0	1.7	*	1.8	0.3			*		0.1			0.2	0.1				1.2				
C. tenuis	0.4																							
C. aligerens											0.2	2.1	0.9	0.1								*		
C. saturni	0.4	*	0.4	0.1		0.1	0.6	0.1	0.3					*	0.2			0.2						
Endosporites spp.	0.6	1.2	1.8	0.9	0.1	0.1	0.3		0.4	0.4		0.7	0.1											
Schulzospora ovata								*	*	*	*	*	0.1	0.1	0.4		0.5	0.6	0.1	*			0.2	0.1
Endosporites costatus	0.1																							
Florinites spp.	0.4	0.8	1.1	0.4	*		0.6	0.8	0.1	0.6		0.7	0.3	0.6	*		*			0.2		1.2	0.5	
F. antiquus	0.3	3.1	3.4		0.1	1.4	1.3	0.6	1.0	0.2		1.3	1.2	0.6						*		0.1		
F. millotti																								
Pityosporites westphalensis		0.3						*	*															
Triquitrites spp.	0.3	0.6	0.1	0.1	0.2		0.3	0.1	0.1		0.2	*		0.2		*			0.1					
T. sculptilis																								
T. inusitatus																								
Ahrensisporites spp.											*	*						0.5						
Laevigatosporites spp.	6.7	18.9	7.8	2.4	0.7	12.0	4.5	8.9	3.8	2.7	8.0	9.1	8.2	4.0	2.6					1.2	1.6	1.7		
L. minutus																								
L. minimus		0.2	2.3			1.5	3.6	2.2		1.3	0.2		0.3											
L. obscurus																								
L. oculus																								
L. pseudothiessenii																								
Reticulatisporites mediareticulatus	1.4	1.7				0.1		0.1	*	0.1				*										
R. tortuosus	0.3	0.6	0.4	0.4	0.2	*		*	0.6	0.4		*	0.1											
R. facetus									0.1															
R. spp.		*						0.1				*				*			0.1					
R. magnus																								
Verrucososporites facierugosus																								
Alatisporites pustulatus																								
Reinschospora spp.																								
Microreticulatisporites quaesitus																								
M. fenestratus																								
M. parvipunctatus																								
M. reticulocingulum																								
M. sulcatus																								
Torispora securis																								
Cadiospora magna																								
Gravisporites sphaerus																								
Schopfites dimorphus																								
Remainder	0.2	0.5	0.2	0.1	0.3	0.1	0.3	0.8		0.1	0.2	0.7	0.1	0.1	0.2			0.2						

LANCASHIRE Continued ..

SPORE TYPES	1511	1509	1380	1381	1379	1378	1321	1323	1041	1153	1234	85	302	1387	1388	1489	87	89	86	189	1104	1174	1044	1045
Lycospora spp.	75.2	81.0	64.9	32.4	83.6	74.5	43.4	70.2	71.2	59.0	64.7	89.0	87.1	90.5	71.2	83.8	42.3	92.3	88.4	64.2	22.6	64.8	45.6	47.9
Densosporites annulatus	15.2	7.0	1.3	5.0	0.1	2.2	11.0		0.1	0.2	0.5	0.4	0.9		0.2	1.8	41.8	1.2	4.7			*		
D. indignabundus		0.4	2.3	4.7	*	0.3	4.6	0.7	0.6		0.1	0.2		*	0.2	0.7		0.1						
D. solaris																				*	7.7	*	0.1	0.1
Calamospora spp.	4.7	5.9	11.0	15.1	7.5	11.4	6.8	6.4	8.9	13.5	15.9	1.8	3.5	2.5	9.2	6.0	11.5	2.2	2.7	19.6	25.0	12.9	19.6	26.5
Spinososporites spp.	0.8		1.0	1.7	1.8	0.6	5.0	0.8	1.3	0.5	3.2	0.6	1.1	3.8	5.3	1.8	0.1	1.2	1.2	0.4	2.8	1.2	1.1	3.7
S. sp. (Millott's type 4)				0.2		0.2				0.2					0.4						0.2		0.1	0.1
S. spinulistratus	0.2	2.4	2.8	1.9	0.3	1.3	10.8	2.8	3.6	16.6	2.0	2.5	2.1	0.5	0.4	1.2	0.5	0.7	0.2	1.3	5.7	6.6	2.6	0.1
Planisporites spp.	0.8	0.3	1.2	3.0	1.4	0.6	2.7	1.3	1.7	1.0	1.3	0.7	0.7	0.5	0.4	0.7	0.3	0.2	0.2	2.2	2.7	1.4	4.3	1.3
Raistrickia spp.	2.7	0.8	0.8	5.0	3.0	1.2	3.7	2.6	5.0	1.0	0.3	2.3	3.4	0.4	1.8	0.8	1.3	1.7	1.9	0.3	0.8	0.5	0.6	0.4
R. medusa																								
Cirratriradites striatus	0.2	0.3	0.2			0.7	1.8	0.1	0.1			0.6	*	0.3		0.4	0.1	*	*					
C. sp.			0.1	0.2		0.6	0.5		0.1			0.2				0.4	0.7		0.1		*		0.1	
C. tenuis																								
C. aligerens			3.1	0.2				2.9	0.6		2.4													
C. saturni			0.1	0.6			0.7		0.4	0.2	0.1	*								0.2	0.9	0.1	0.3	
Endosporites spp.			0.2	0.2	0.3			0.6	0.1	0.2	*					*				1.5	2.4	2.5	0.8	3.4
Schulzospora ovata	*	1.3	0.2	0.4	*	0.2	0.3	0.1	0.4	*	0.4	0.2	0.6	*		0.1	0.3	0.2	0.1					
Endosporites costatus																					*	*	0.1	*
Florinites spp.	0.2	0.3	*		0.1	0.3	1.3	0.4	0.4	0.2	2.3		0.6	0.5	0.4			0.2	0.5	0.2	0.8	1.3	0.4	
F. antiquus				0.5		0.2		0.3	0.4	3.4	0.6			*	0.4	*				1.2	6.1	0.8	6.7	1.1
F. millotti																					*	*	0.1	
Pityosporites westphalensis			*	0.2			0.3	0.1		0.2	*			0.2	0.5						*			
Triquitrites spp.		0.3		0.5							*	*					1.1	*		0.2	0.1	*		
T. sculptilis																				0.5	0.3	1.1	2.8	0.6
T. inusitatus																								
Ahrensisporites spp.		*										*												
Laevigatosporites spp.			10.6	27.3	1.5	5.4	6.0	10.6	5.0	2.7	6.1	1.5		0.8	9.4	2.3				5.9	18.3	5.3	10.5	14.0
L. minutus																					0.3		2.4	
L. minimus																				1.5	0.7	0.8		
L. obscurus																								
L. oculus																								
L. pseudothiessenii																								
Reticulatisporites mediareticulatus				0.2						0.2														
R. tortuosus				0.2						0.7	*									0.6	1.0	0.5	1.3	0.3
R. facetus																				0.2	0.1	0.1	0.1	
R. spp.						*	0.7								0.2						0.3			0.1
R. magnus																					0.3	*	0.3	
Verrucososporites facierugosus										0.2	0.1											*		0.3
Alatisporites pustulatus																		*			*			
Reinschospora spp.																								
Microreticulatisporites quaesitus																					*	*		
M. fenestratus																				*	0.1	*		
M. parvipunctatus																				*	*	0.1		
M. reticulocingulum										*														
M. sulcatus																								
Torispora securis																				*	0.2	*		
Cadiospora magna																								
Gravisporites sphaerus																								
Schopfites dimorphus																								
Remainder			0.2	0.5	0.4	0.3	0.4	0.1	0.1												0.6		0.1	0.1

SPORE TYPES	LANCASHIRE Continued .. 1109	1110	1152	216	1054	870	887	888	446	886	1151	1486	1508
Lycospora spp.	51.3	67.0	61.1	57.8	47.5	51.1	70.1	20.3	47.3	56.3	51.8	95.1	86.7
Densosporites annulatus		0.3	*	0.1	0.7	0.3	0.2	47.1	0.1	0.3	1.6		3.3
D. indignabundus				0.1	3.0	0.1		1.1	0.5	0.8	1.6		1.0
D. solaris	0.5	*											
Calamospora spp.	28.9	13.1	6.7	7.4	6.9	14.4	7.5	3.1	16.9	12.7	11.3	2.4	4.0
Spinososporites spp.	0.2	1.0	0.6	1.3	3.7	3.2	3.2	3.0	1.5	5.9	5.0	0.1	0.5
S. sp. (Millott's type 4)					0.1	0.1		0.2	0.1		0.2		
S. spinulistratus	0.1	2.6	16.6	19.4	16.3	6.4	6.2	5.9	9.1	7.3	1.6		0.3
Planisporites spp.	0.7	2.6	1.5	0.5	0.5	2.5	1.0	3.3	2.2	3.3	1.8	0.9	0.8
Raistrickia spp.	0.4	1.6	1.7	1.3	1.3	0.4	0.9	1.0	0.5	1.4	2.1	0.6	1.0
R. medusa													
Cirratriradites striatus													0.5
C. sp.	0.4	0.2		*	0.8		0.2		0.8	0.6	0.6		0.3
C. tenuis						*		0.2	1.0				
C. aligerens												0.1	0.2
C. saturni	0.1		0.5	0.4	0.1	0.1	0.6	0.3	0.4	0.3	0.6		
Endosporites spp.	0.9	1.2	2.5	1.2	1.0	0.5	2.0	0.2	*	1.0	0.6		
Schulzospora ovata													
Endosporites costatus		0.1	*	0.1		*	0.2						
Florinites spp.	0.8	0.6	0.5	0.1	0.3	0.6	0.6	0.2	0.1	0.4	0.5	0.5	0.2
F. antiquus	0.8	2.0	0.9	1.3	2.6	2.3	1.4	0.6	1.3	1.6	3.1	0.1	0.2
F. millotti		0.3											
Pityosporites westphalensis	0.1						0.2			0.3			*
Triquitrites spp.			*			0.6		0.3		0.2			
T. sculptilis	0.1												
T. inusitatus													
Ahrensisporites spp.													
Laevigatosporites spp.	13.9	5.9	6.4	7.4	11.9	15.9	4.2	10.1	16.2	5.1	16.8	0.1	1.0
L. minutus													
L. minimus					2.1	0.9	1.5	1.1		2.3	0.6		
L. obscurus													
L. oculus													
L. pseudothiessenii													
Reticulatisporites mediareticulatus						0.1		1.3	1.9	*	0.1		
R. tortuosus	0.5	1.4	0.7	1.2	0.4	0.3		0.3		*	*		
R. facetus	*	0.1	0.3	0.3	0.1								
R. spp.					0.6	0.1		*					
R. magnus	*												
Verrucososporites facierugosus								*					
Alatisporites pustulatus								0.2					
Reinschospora spp.								0.2					
Microreticulatisporites quaesitus													
M. fenestratus													
M. parvipunctatus													
M. reticulocingulum		*				*							
M. sulcatus													
Torispora securis													
Cadiospora magna													
Gravisporites sphaerus													
Schopfites dimorphus													
Remainder	0.3			0.1	0.1	0.1			0.1	0.2	0.1	0.1	

SPORE TYPES	SHROPSHIRE (COALBROOKDALE) 782	783	784	785	786	787	788	789	790	791
Lycospora spp.	46.4	56.7	63.1	52.5	57.2	48.4	59.8	24.0	65.6	19.
Densosporites annulatus					0.4	7.4	0.3	58.2		11.
D. indignabundus					*	0.3	0.3	0.7		2.
D. solaris										
Calamospora spp.	9.7	5.9	10.2	3.6	12.4	9.0	9.8	4.8	15.2	14.
Spinososporites spp.	17.1	21.7	9.2	21.1	2.6	3.0	1.4	0.9	0.9	0.
S. sp. (Millott's type 4)							*			0.
S. spinulistratus	[illegible]	0.1	0.4		7.1	6.6	5.4	1.5	5.3	8.
Planisporites spp.	0.3	0.8	1.1	0.8	1.1	2.6	2.9	0.8	2.0	2.
Raistrickia spp.	0.2	0.3	0.2		1.0	0.5	1.1	0.2	1.5	1.
R. medusa	0.2									
Cirratriradites striatus										
C. sp.					0.7	0.5	0.6	0.2	0.1	3.
C. tenuis						0.2		0.2		0.
C. aligerens										
C. saturni	*		*		0.2	0.2	0.3	0.4	*	0.
Endosporites spp.	5.4	0.5	1.8	11.4	0.7	2.1	1.3	1.6	0.6	1.
Schulzospora ovata										
Endosporites costatus	0.2	*			0.2		*			
Florinites spp.	*	0.3	0.4	*	0.4	0.8		0.2	0.1	0.
F. antiquus					2.2	2.6	3.5	0.4		1.
F. millotti		*	0.4							
Pityosporites westphalensis							0.5			
Triquitrites spp.	0.4	2.1	2.4	3.1		0.2	0.6			0.
T. sculptilis										
T. inusitatus										
Ahrensisporites spp.						*				
Laevigatosporites spp.	1.9	2.0	2.2	2.3	8.7	10.9	10.5	5.5	7.5	22.
L. minutus	17.8	9.2	8.2	4.9	(	1.0				
L. minimus					(2.9	0.3	0.2		1.0	
L. obscurus			0.2							
L. oculus		*								
L. pseudothiessenii	*									
Reticulatisporites mediareticulatus					*	1.6	*	0.4		6.
R. tortuosus	*	0.3			0.5	0.6	0.8		0.1	
R. facetus	*	0.1			0.4	0.2	0.5			
R. spp.					0.4	0.2		*	0.1	0.
R. magnus										
Verrucososporites facierugosus										
Alatisporites pustulatus					*					0.
Reinschospora spp.										
Microreticulatisporites quaesitus	*	*	*							
M. fenestratus	0.2	*	0.2	0.3						
M. parvipunctatus										
M. reticulocingulum					0.2	*				0.
M. sulcatus						*				
Torispora securis										
Cadiospora magna			*	*						
Gravisporites sphaerus		*								
Schopfites dimorphus	0.2									
Remainder					0.7	0.8	0.2			0.

SPORE TYPES	792	793	794	795	796	797	798	799	800	801	802	803	804	805	837	838	839	840	841	842	843	844	845	846
Lycospora spp.	58.6	54.9	59.6	59.4	22.1	22.8	68.4	60.5	66.4	34.8	57.8	41.7	72.1	54.5	76.8	20.2	54.6	76.9	14.8	53.2	69.9	34.5	25.9	41.8
Densosporites annulatus	6.6	2.1	1.4	1.3	0.2	45.8	1.2	0.8	1.2	5.2	16.9	25.7	3.7	10.8		0.2	4.6	0.1	62.2	5.7	0.3	9.3	9.9	7.3
D. indignabundus	0.9	0.8	1.3			3.1	0.4	0.9	1.2	9.8			2.2			0.2	1.4	0.1	0.9	1.4	0.5	2.5	6.5	5.4
D. solaris																0.2	0.5							
Calamospora spp.	9.2	14.5	16.3	15.9	8.2	7.3	14.7	17.2	14.3	11.1	13.0	17.5	6.3	18.3	9.4	36.0	10.1	5.0	5.6	11.4	10.9	16.0	8.4	11.0
Spinososporites spp.	0.7	2.0	4.1	2.3	5.4	0.3	1.8	2.3	0.4	0.5	0.4	5.0		2.9	2.2	0.8	*	0.2	1.1	1.5	1.5	3.4	0.4	1.4
S. sp. (Millott's type 4)	*	*		0.3					0.2	0.5	0.2	0.2		0.4		*	*	0.3			0.3			
S. spinulistratus	0.9	0.3	1.6	2.7	0.3	1.9	0.7	4.1	3.7	3.0	1.0	0.2	1.5	0.2	0.3	0.2	2.5	3.3	1.0	1.9	0.5	6.2	1.6	4.0
Planisporites spp.	1.3	0.5	2.1	1.1	1.3	0.6	0.6	1.2	1.4	1.0	0.4	1.6	0.4	2.1	0.1	0.4	1.8	1.2	2.1	1.0	2.1	1.0	1.1	1.9
Raistrickia spp.	0.9	1.1	0.5	0.1	0.5	0.9	0.4	0.8	1.0	1.2	0.8	1.0	0.2	2.2	0.1	1.3	0.5	1.2	0.8	2.6	2.2	1.6	0.6	3.5
R. medusa																								
Cirratriradites striatus							*	0.2		24.4	5.0	1.7	8.6	5.9									1.0	1.6
C. sp.	1.1	4.6	0.3	0.9	0.3		1.8	0.6	2.3			0.7	0.5	1.0		22.6	0.4	0.1	0.1	2.5	2.7	1.1	2.0	7.6
C. tenuis	0.2															0.3	0.1	*	*			0.3		
C. aligerens							*	0.5	0.5															*
C. saturni	0.2	*		0.7	0.3	0.2	*	0.2	0.2	*							0.4	0.7	0.1	1.0	0.3	*	0.6	*
Endosporites spp.	1.0	0.3	0.2	1.4	1.3	*	*	*						0.2	1.6	*	0.8	0.5	1.0	0.3	0.3	0.6	0.3	0.1
Schulzospora ovata					0.2	*	*		*			0.1	*	0.2									0.2	0.1
Endosporites costatus																0.7	0.1				0.5	0.3	0.3	
Florinites spp.	0.3	0.3		0.6	0.3		0.2	0.2	0.2	0.5			0.5	0.5	0.5	0.2	0.1	0.1		0.3			0.3	0.3
F. antiquus	2.6	1.5	0.6	3.3	1.3	0.6	*	0.3	0.2							0.3	2.5	2.0	0.4	1.4	1.2	2.5	1.1	0.1
F. millotti															*									
Pityosporites westphalensis			*																					
Triquitrites spp.		0.1	0.2		0.2		0.4			0.5		*		0.2	2.1	*							0.5	0.3
T. sculptilis																								
T. inusitatus																								
Ahrensisporites spp.					*														0.1			0.3		0.5
Laevigatosporites spp.	14.6	16.1	9.3	9.2	53.0	15.6	8.8	9.6	6.5	7.1	4.1	4.6	4.0		0.8	15.3	16.0	5.6	8.9	14.6	6.3	18.8	36.6	11.8
L. minutus					4.6										3.4									
L. minimus		0.5	1.3												1.3		2.8	2.1						1.0
L. obscurus															0.8									
L. oculus															0.3									
L. pseudothiessenii															0.1									
Reticulatisporites mediareticulatus	0.2	*	*	0.4	0.3	0.6								0.4		*	*	0.1	0.1	0.4	0.3	1.0	0.5	
R. tortuosus	0.3	0.1	*	0.4	*	*		*			0.2					0.2	0.6	0.1			0.1	0.4	0.6	
R. facetus																*		*				*		
R. spp.	*	0.1	0.4			*		0.6		0.2	*	*	*	*	*	*	*		0.1	0.5	0.1	0.1	0.7	0.1
R. magnus																0.3	*	0.4						
Verrucososporites facierugosus																	*		0.3					
Alatisporites pustulatus	*		*			*																0.1	0.3	
Reinschospora spp.			0.2			*																	0.2	
Microreticulatisporites quaesitus																								
M. fenestratus															0.1									
M. parvipunctatus																								
M. reticulocingulum								*									0.1			0.1			0.2	*
M. sulcatus																								
Torispora securis															0.1									
Cadiospora magna															*									
Gravisporites sphaerus																								
Schopfites dimorphus																								
Remainder	0.4	0.2	0.6		0.2	0.3	0.6		0.3	0.2	0.2			0.2		0.6	0.1		0.4	0.2			0.2	0.2

	COALBROOKDALE Cont.			FOREST OF WYRE																				
SPORE TYPES	847	848	849	1340	1341	1342	1343	1344	1345	1346	1347	1348	1349	1350	1351	1352	1353	1354	1355	1356	1357	1358	1359	1360
Lycospora spp.	32.1	56.0	78.1	21.0	61.0	18.7	66.1	24.0	70.0	40.6	33.0	51.9	37.5	61.0	33.3	38.8	67.5	54.0	48.0	38.8	57.0	38.5	17.5	44.0
Densosporites annulatus	0.9	29.5	0.4							*		0.1	0.2	0.9	3.1	1.4	0.2		4.9	2.1	1.1		3.5	1.6
D. indignabundus	1.9				1.5			0.5	0.2		3.0	*	22.8	0.2	1.1	9.1	1.8	0.2	3.3	0.3	0.7		2.0	5.8
D. solaris								*	*	*	2.6													
Calamospora spp.	11.8	5.4	10.7	17.5	15.0	26.6	14.7	12.4	2.5	25.4	21.0	8.7	11.8	21.0	20.6	11.3	6.9	10.3	12.2	19.4	14.6	12.2	23.5	14.1
Spinososporites spp.	0.7	0.6	1.2	1.9	4.9	4.9	3.1	3.1	0.7	0.7	0.5	0.8	0.2	2.1	0.4	3.2	1.2	3.3	1.2	0.3	2.7	0.1	7.5	0.2
S. sp. (Millott's type 4)			0.1		0.2						0.2	0.1	0.2			0.1			0.2		0.2			0.2
S. spinulistratus	3.9	0.7	2.0		0.3	0.2	0.7	26.6	0.5	11.4	8.1	15.2	5.1	2.3	5.0	14.1	13.2	19.4	6.1	18.2	2.4	2.1	2.0	12.8
Planisporites spp.	1.4	0.6	0.5		1.1	1.4	0.2	6.5	5.8	3.7	1.7	3.5	1.0	0.5		2.0	0.5	2.5	1.2	0.8	2.3	0.1	12.5	0.3
Raistrickia spp.	1.3	0.4	1.6	1.2	0.5	1.0	0.3	0.5	0.4	1.5	1.2	1.6	*	0.2	0.4	1.0	1.5	2.9	1.6	0.3	1.6	0.4	6.0	0.7
R. medusa				*		0.2																		
Cirratriradites striatus	35.3	3.3	0.7																					
C. sp.		0.3	0.2						0.2	*				1.5	21.5	0.8	0.5		7.0	4.7	4.5	*	0.5	0.2
C. tenuis								0.3		*			1.9			*			0.4		1.0			0.2
C. aligerens																								
C. saturni			0.1	2.5	0.6		0.2	0.2	0.5	0.6	0.8	0.5	0.4	0.2		0.5	0.2	0.3	0.8	0.2	*	*		0.3
Endosporites spp.		0.3		10.1	1.5	13.3	8.6	4.3	1.9	0.6	1.8		0.4	0.9	0.2	1.7	0.5	0.5	0.5	*	0.9	*		*
Schulzospora ovata		*	*																			*		
Endosporites costatus				0.6	0.8	0.3	0.4	0.7		0.2	0.2	0.5	0.2			*	0.2		0.2			*		*
Florinites spp.			0.2	0.6	0.5	0.2		1.0	0.2	1.0		0.9		0.2		0.5		0.2	0.5	0.6	0.4	0.1	5.0	0.2
F. antiquus							0.2	6.2	8.1	3.0	2.3	8.5	1.7	0.2	0.4	1.1	*	0.3	1.1	0.6	0.4	*	0.5	
F. millotti				1.3	0.2			0.5	*	*														
Pityosporites westphalensis				0.4	0.2						*	*	*				*		*		0.2		0.5	
Triquitrites spp.			*	6.1	2.3	2.2	1.7			*				0.3			*	0.2	0.4				1.0	
T. sculptilis								3.6	4.7	*		*												
T. inusitatus				0.3																				
Ahrensisporites spp.										*		0.1				*					*	*	0.5	0.2
Laevigatosporites spp.	9.9	2.9	4.2	21.1	3.8	4.5	0.8	6.0	3.9	6.1	16.0	6.4	13.7	8.1	13.4	12.4	4.2	4.3	9.0	11.3	9.0	45.9	1.0	17.5
L. minutus				1.5	0.8	0.8	1.8																	
L. minimus				4.4	1.4	2.1	0.5						1.3				1.1	1.4	0.3	0.8				
L. obscurus																								
L. oculus				4.0	0.3		0.5																	
L. pseudothiessenii				4.0	2.4	23.6	0.2																	
Reticulatisporites mediareticulatus	0.2	*									*		*	*		*			*	*	*	0.2		0.7
R. tortuosus					0.2					1.4		0.9	0.2	0.2	0.4	0.2		*	0.2	0.6	0.2	0.4	2.5	*
R. facetus								1.0		0.2		*											0.5	
R. spp.			*		0.1					2.6	7.4	0.3	1.2		0.2	1.2	0.5		0.5	0.8	0.6			1.0
R. magnus								2.6	0.4	0.2		*												
Verrucososporites facierugosus					*																*			
Alatisporites pustulatus										*			*				*				*			
Reinschospora spp.										*	*								*		*			
Microreticulatisporites quaesitus					0.2		*																	
M. fenestratus					0.2																			
M. parvipunctatus																								
M. reticulocingulum	0.2									*	0.2			0.2		0.2								
M. sulcatus							*	*	*															
Torispora securis																								
Cadiospora magna						*																		
Gravisporites sphaerus																								
Schopfites dimorphus						*																		
Remainder	0.4			1.5						0.8			0.2			0.4		0.2	0.4	0.2	0.2		13.5	

WARWICKSHIRE

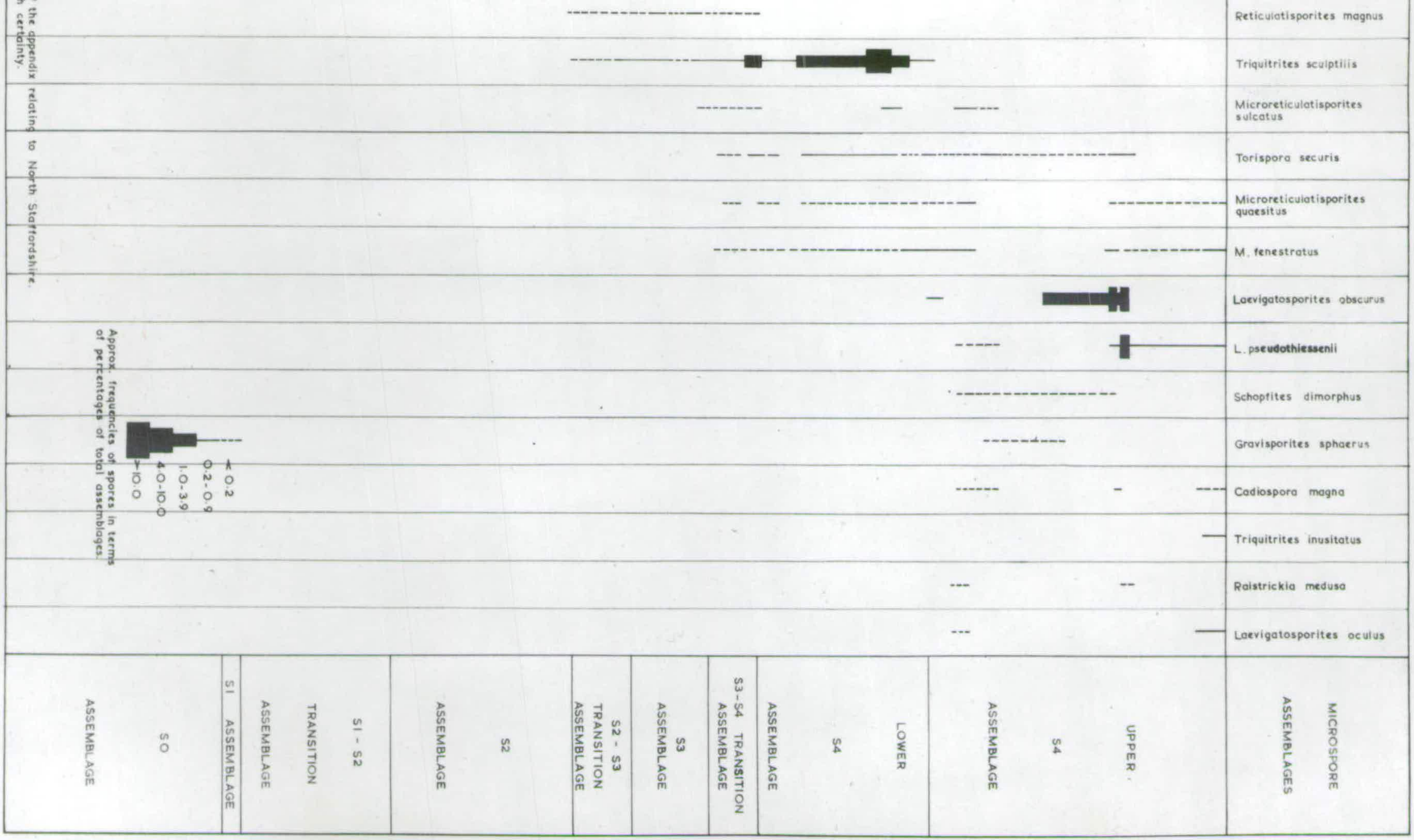
SPORE TYPES	746	747	748	749	750	751	752	753	754	755	756	757
Lycospora spp.	84.1	66.0	73.5	80.5	35.2	25.2	6.4	52.0	67.9	37.2	23.9	19.5
Densosporites annulatus	0.1	*			8.2	42.2	68.9	0.3	0.2	6.5	46.0	3.9
D. indignabundus	*				3.0			1.1		2.7	0.9	2.0
D. solaris	*	0.2										
Calamospora spp.	5.5	23.3	11.6	5.7	14.5	3.0	4.0	17.9	10.6	14.5	7.9	23.0
Spinososporites spp.	0.1	0.2	0.9	0.8	0.2	0.6		2.8	1.2	3.5	1.5	2.2
S. sp. (Millott's type 4)											0.4	
S. spinulistratus	2.5	0.4	1.5	5.7	2.2	1.6		6.1	3.7	1.7	1.7	10.9
Planisporites spp.	0.4	1.0	0.1	2.2	0.5	1.9	0.5	0.2	1.7	2.1	1.3	1.7
Raistrickia spp.	0.1	*	0.1		1.1		0.1	1.1	0.9	1.2	0.2	1.3
R. medusa												
Cirratriradites striatus										*	*	*
C. sp.			0.8		8.7	5.1	1.1	1.4	0.3	0.6	1.1	0.8
C. tenuis			0.1	0.1	1.4		0.5				*	
C. aligerens												
C. saturni				*		0.1		0.3	*	0.5	0.4	*
Endosporites spp.	0.7	0.2	1.1	0.2	1.2	0.3	1.9	0.8	0.7	0.6	0.2	
Schulzospora ovata										*	*	
Endosporites costatus	0.1	0.2			0.2					0.5	0.2	
Florinites spp.		0.4	0.1	0.1	0.3	0.1	0.1	0.3	0.3	0.8	0.2	0.3
F. antiquus	0.1	0.2	1.4	0.6	0.7	0.4			0.9	2.1	2.6	0.5
F. millotti												
Pityosporites westphalensis												
Triquitrites spp.		0.2		0.2	0.2	0.1					*	1.2
T. sculptilis	2.0	*										
T. inusitatus												
Ahrensisporites spp.												
Laevigatosporites spp.	4.0	6.5	6.7	3.4	19.7	18.1	16.2	14.9	11.1	25.1	8.1	30.8
L. minutus			1.4								1.1	0.5
L. minimus			0.1									
L. obscurus												
L. oculus												
L. pseudothiessenii												
Reticulatisporites mediareticulatus		0.2	0.1	*	2.1	0.7	0.1	0.4	0.2	0.2	1.7	
R. tortuosus		*	0.1	0.5	0.2	0.1			0.3	0.2	0.4	0.3
R. facetus	0.1		0.4									
R. spp.								0.2	*		*	*
R. magnus	*	0.2		*								
Verrucososporites facierugosus								0.1	*		*	*
Alatisporites pustulatus		0.2		*	0.2			0.1		*	*	
Reinschospora spp.						0.1					*	*
Microreticulatisporites quaesitus												
M. fenestratus												
M. parvipunctatus												
M. reticulocingulum					0.2	0.1	0.1					
M. sulcatus												
Torispora securis												
Cadiospora magna												
Gravisporites sphaerus												
Schopfites dimorphus												
Remainder	0.2	0.6				0.3	0.1				0.2	1.1

SPORE TYPES	758	759	760	761	762	763	764	765	766	767	768	769
Lycospora spp.	58.1	87.0	39.6	51.3	36.2	16.4	52.5	59.7	73.1	51.7	57.8	62.0
Densosporites annulatus	2.2		25.2	4.4	3.1	60.0	6.7	4.2	0.4	0.3	16.3	20.7
D. indignabundus	4.4	0.7	4.2	0.9	0.8	3.3	1.4	2.1	1.3	3.2	6.2	1.2
D. solaris												
Calamospora spp.	12.6	10.0	8.7	12.3	10.6	7.1	7.7	8.4	6.2	10.8	3.6	7.8
Spinososporites spp.	2.8	0.3	1.3	4.0	1.3	0.7	0.6	0.3	2.3	4.1	0.5	2.3
S. sp. (Millott's type 4)			*					*	0.4			
S. spinulistratus	1.5		1.9	4.6	8.4	0.8	4.3	1.1	2.5	9.7	7.4	
Planisporites spp.	1.0	0.5	0.2	1.4	2.5	1.5	1.0	2.6	2.5	1.9	1.3	1.7
Raistrickia spp.	4.0	0.5	2.5	3.9	3.3	2.0	2.6	0.9	1.0	3.9	3.1	0.3
R. medusa												
Cirratriradites striatus					2.0	0.5	14.5	10.4	4.4	0.3	0.2	0.2
C. sp.	0.7		2.1	0.7	4.7		0.5	0.5	0.4		1.7	2.3
C. tenuis					*	*	*					
C. aligerens	*	0.3	*	1.7	3.1	*	*	*	*			
C. saturni	0.3		*	0.2	0.2	0.2	0.2	*	*	*		
Endosporites spp.	*		*	1.4	0.2		0.4					
Schulzospora ovata					0.2		*	0.2	*			
Endosporites costatus	*											
Florinites spp.	*	0.2		0.2		0.2			0.4	0.3	0.2	0.3
F. antiquus				0.3	0.2		0.2	0.2	0.2	0.2		
F. millotti												
Pityosporites westphalensis									0.2			
Triquitrites spp.	1.0		0.4	0.9		0.2	0.2	0.2	*	0.7	0.6	0.3
T. sculptilis												
T. inusitatus												
Ahrensisporites spp.	1.0		0.4		0.2	0.1						*
Laevigatosporites spp.	10.4	0.3	12.5	9.6	22.2	6.4	6.6	8.2	4.5	6.0		
L. minutus							0.4			0.5		
L. minimus				1.4						0.3		
L. obscurus												
L. oculus												
L. pseudothiessenii												
Reticulatisporites mediareticulatus			*				*	*				
R. tortuosus			*									
R. facetus												
R. spp.	*		*		0.2	0.2		0.2	*	0.3	0.2	
R. magnus												
Verrucososporites facierugosus				*								
Alatisporites pustulatus	*		*		0.2	*		0.2	*	*		
Reinschospora spp.												
Microreticulatisporites quaesitus												
M. fenestratus												
M. parvipunctatus												
M. reticulocingulum			0.2		0.2		0.2					
M. sulcatus												
Torispora securis												
Cadiospora magna												
Gravisporites sphaerus												
Schopfites dimorphus												
Remainder		0.2	0.8	0.8	0.2	0.4		0.6	0.2	5.8	0.9	0.9

WARWICKSHIRE Continued ..

SPORE TYPES	1305	1304	1303	1302	1301	1424	1300	1299	1298	1297	1466	1467	1468	1469	1470	1471	1472	1473	817	818	819	820
Lycospora spp.	16.3	2.8	3.8	69.3	32.4	6.7	54.9	27.8	17.8	3.2	70.6	44.7	57.8	6.2	0.9	4.8	18.9	55.2	15.2	13.2	28.3	45.6
Densosporites annulatus	62.4	75.9	87.1	0.3	20.1	73.4	8.3		0.2	65.1	2.3	7.6	2.8	58.9	85.5	67.8	43.5	2.4	62.0	35.7	40.6	12.9
D. indignabundus	0.2	0.2	*		2.1	0.7	2.3	0.2			0.1	0.2		2.1	0.9	1.8	1.9	0.3	0.2	8.6	0.3	2.2
D. solaris																						
Calamospora spp.	4.6	6.4	3.2	8.2	8.3	3.8	8.7	29.7	27.0	7.2	5.7	9.7	14.4	3.9	2.8	4.5	9.9	14.4	5.5	8.7	9.6	12.9
Spinososporites spp.	1.0	0.6	0.5	1.7	0.6	0.3	1.6	4.4	8.0	1.3	0.1	1.0	0.9	0.2	0.3	1.2	0.5	1.0	1.8	0.7	0.7	0.7
S. sp. (Millott's type 4)					*			0.2								0.1	0.1		0.3	0.3		0.1
S. spinulistratus	0.2	0.8	0.7	0.6	0.5	0.4	2.7	3.0	0.2			0.2	0.9	0.7		1.7	0.9	3.5	0.5	1.6	0.4	1.9
Planisporites spp.	1.3	0.2	0.7	2.1	1.0	0.4	0.2	0.5	3.1	1.5	1.3	0.2	2.6	0.6	1.3	0.7	0.4	1.0	1.8	1.8	1.2	0.7
Raistrickia spp.	0.7		0.4	1.6	2.8	0.5	2.4	3.8	4.0	1.5	0.7	0.4	2.5	0.4	0.6	0.6	1.8	2.4	0.8	1.0	0.3	0.9
R. medusa																						
Cirratriradites striatus										0.2												
C. sp.	0.2			0.9	8.9	0.9	1.8	2.0		0.2	5.6	13.3	2.8	18.3	2.5	6.5	4.2	1.2	2.1	2.0	0.3	1.0
C. tenuis		0.3	*						0.4		0.1					0.3						
C. aligerens																						
C. saturni	0.2				*	*	0.7	1.0							0.3		0.1	1.4	0.2	0.4		0.1
Endosporites spp.	0.3		0.1	0.1	0.2	0.7	1.0	0.4	*	0.2	0.1	1.5	2.1	0.4	*	0.5	0.4	1.5	0.2	0.7	0.4	0.7
Schulzospora ovata									0.2													
Endosporites costatus				0.1		*	0.1	1.8	0.2									0.8				
Florinites spp.	0.4			0.1	0.3		0.1	1.0	3.1			0.2	0.5		0.2	0.1	0.5	0.3			0.4	0.1
F. antiquus	0.5			0.4	0.9	*	0.7	3.8	4.8	1.1	0.1	0.7	0.9	0.4	0.2	0.5	1.2	2.6	0.5	0.9	1.0	0.7
F. millotti																						
Pityosporites westphalensis			*			0.2		*	0.7	0.2			0.3					0.5				
Triquitrites spp.		0.2		0.1	0.9	*	0.1	0.2		0.6				0.4	0.3		0.6		0.3			
T. sculptilis																						
T. inusitatus																						
Ahrensisporites spp.					*				*					*								
Laevigatosporites spp.	10.4	12.6	3.5	14.1	20.8	11.9	13.9	20.0	30.1	16.9	13.2	20.1	10.9	7.3	3.8	8.3	14.5	10.0	5.7	22.6	15.1	19.3
L. minutus																						
L. minimus																			0.2	0.3		
L. obscurus																						
L. oculus																						
L. pseudothiessenii																						
Reticulatisporites mediareticulatus	0.8			0.3	*	*	0.4	0.2	*	*	*	0.2	0.3		0.1	0.3			2.3	1.1	0.4	*
R. tortuosus											0.1		0.3					0.9	*		0.3	
R. facetus			*																			
R. spp.				0.1	*	0.1	0.1		0.2					0.2				0.2	0.2			0.1
R. magnus																						
Verrucososporites facierugosus					*																	
Alatisporites pustulatus						*			*	0.2							0.1					0.1
Reinschospora spp.																						
Microreticulatisporites quaesitus																						
M. fenestratus																						
M. parvipunctatus																						
M. reticulocingulum										0.2					*		0.1					
M. sulcatus																						
Torispora securis																						
Cadiospora magna																						
Gravisporites sphaerus																						
Schopfites dimorphus																						
Remainder	0.5				0.2					0.4					0.3	0.3	0.4	0.4	0.2	0.4	0.7	

SPORE TYPES	1265	1266	1180	1181	1182	1267	1268	1269	1029	1030
Lycospora spp.	32.0	54.2	10.8	47.0	15.6	83.9	80.9	57.8	53.2	81.4
Densosporites annulatus	48.0	21.4	71.0	3.7	26.0	0.2	2.2	2.0	24.8	1.1
D. indignabundus	0.5	1.3	0.3	4.4	18.2	1.1		3.1	6.4	
D. solaris										
Calamospora spp.	6.0	10.7	2.8	16.2	15.8	6.7	5.6	9.0	9.5	4.9
Spinososporites spp.	0.3	0.5	0.7	1.1	1.7	0.7	0.7	0.3	0.3	0.8
S. sp. (Millott's type 4)				0.2			*			
S. spinulistratus	0.5	0.8	1.6	3.4	1.2	1.8	2.8	8.5	0.8	6.3
Planisporites spp.	0.2	0.4	0.5	1.7	1.2	0.2	0.3	1.4	1.5	1.0
Raistrickia spp.	0.5	1.0	0.3	1.3	2.2	0.7	0.5	4.0	1.4	2.6
R. medusa										
Cirratriradites striatus	0.5	0.2	0.7	0.3	1.1		0.9	7.3	0.5	0.7
C. sp.	2.1	0.6		0.8	2.1		1.7	0.3		
C. tenuis	0.2			*						
C. aligerens			0.2					0.3		
C. saturni	*	0.2	*	*	0.1			0.3		
Endosporites spp.	*	*	*		0.1					
Schulzospora ovata		*	*	0.2	*	0.9	0.6	0.3		0.3
Endosporites costatus										
Florinites spp.		0.8	0.3	0.2		0.2	0.2	0.3	0.1	0.3
F. antiquus	*	0.5	1.0							
F. millotti										
Pityosporites westphalensis			*	*						
Triquitrites spp.	*	*		0.2	0.1			0.3	1.4	0.6
T. sculptilis										
T. inusitatus										
Ahrensisporites spp.									*	
Laevigatosporites spp.	8.5	7.1	7.3	17.0	14.6	3.4	3.6	4.0		
L. minutus										
L. minimus										
L. obscurus										
L. oculus										
L. pseudothiessenii										
Reticulatisporites mediareticulatus	0.3	0.3	1.4	*		0.2				
R. tortuosus			0.5							
R. facetus			0.2							
R. spp.	0.2			1.7						
R. magnus										
Verrucososporites facierugosus	*	*								
Alatisporites pustulatus	*	*	0.2	*						
Reinschospora spp.				0.2						
Microreticulatisporites quaesitus										
M. fenestratus										
M. parvipunctatus										
M. reticulocingulum										
M. sulcatus										
Torispora securis										
Cadiospora magna										
Gravisporites sphaerus										
Schopfites dimorphus										
Remainder	0.2		0.2	0.4				0.8	0.1	



the appendix relating to North Staffordshire.
certainty.
Reticulatisporites magnus
Triquitrites sculptilis
Microreticulatisporites sulcatus
Torispora securis
Microreticulatisporites quaesitus
M. fenestratus
Laevigatosporites obscurus
L. pseudothiessenii
Schopfites dimorphus
Gravisporites sphaerus
Cadiospora magna
Triquitrites inusitatus
Raistrickia medusa
Laevigatosporites oculus
Approx. frequencies of spores in terms of percentages of total assemblages.
< 0.2
0.2-0.9
1.0-3.9
4.0-10.0
> 10.0
S0 ASSEMBLAGE
S1 ASSEMBLAGE
S1 - S2 TRANSITION ASSEMBLAGE
S2 ASSEMBLAGE
S2 - S3 TRANSITION ASSEMBLAGE
S3 ASSEMBLAGE
S3-S4 TRANSITION ASSEMBLAGE
LOWER S4 ASSEMBLAGE
UPPER S4 ASSEMBLAGE
MICROSPORE ASSEMBLAGES

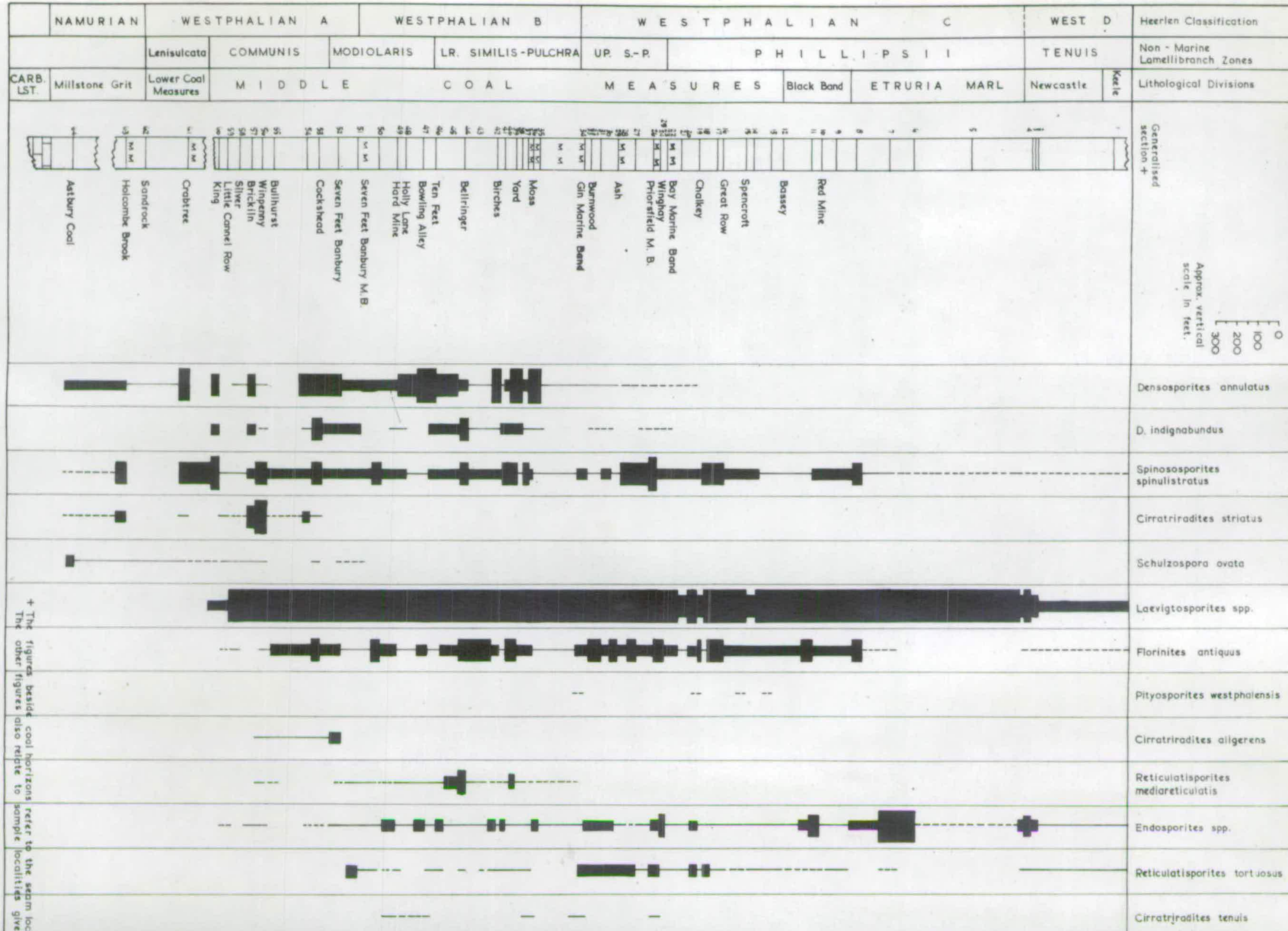
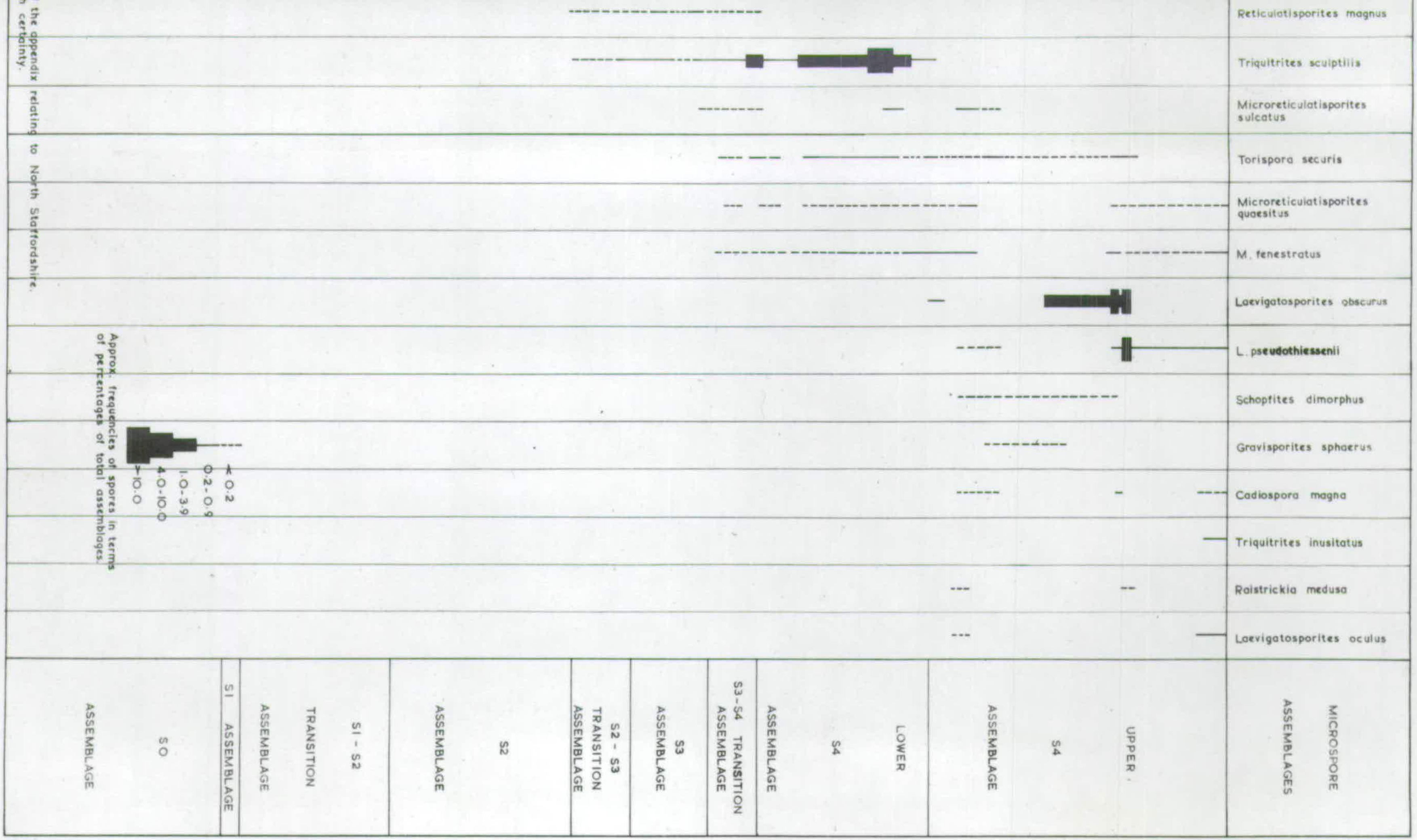


FIG. 4. MICROSPORE DISTRIBUTION IN THE NORTH STAFFORDSHIRE C



the appendix relating to North Staffordshire.
certainty.
Reticulatisporites magnus
Triquitrites sculptilis
Microreticulatisporites sulcatus
Torispora securis
Microreticulatisporites quaesitus
M. fenestratus
Laevigatosporites obscurus
L. pseudothiessenii
Schopfites dimorphus
Gravisporites sphaerus
Cadiospora magna
Triquitrites inusitatus
Raistrickia medusa
Laevigatosporites oculus
Approx. frequencies of spores in terms of percentages of total assemblages.
<0.2
0.2-0.9
1.0-3.9
4.0-10.0
>10.0
SO ASSEMBLAGE
SI ASSEMBLAGE
SI - S2 TRANSITION ASSEMBLAGE
S2 ASSEMBLAGE
S2 - S3 TRANSITION ASSEMBLAGE
S3 ASSEMBLAGE
S3-S4 TRANSITION ASSEMBLAGE
LOWER S4 ASSEMBLAGE
UPPER S4 ASSEMBLAGE
MICROSPORE ASSEMBLAGES

FIG. 5. MICROSPORE DISTRIBUTION IN THE CANNOCK CHASE COALFIELD

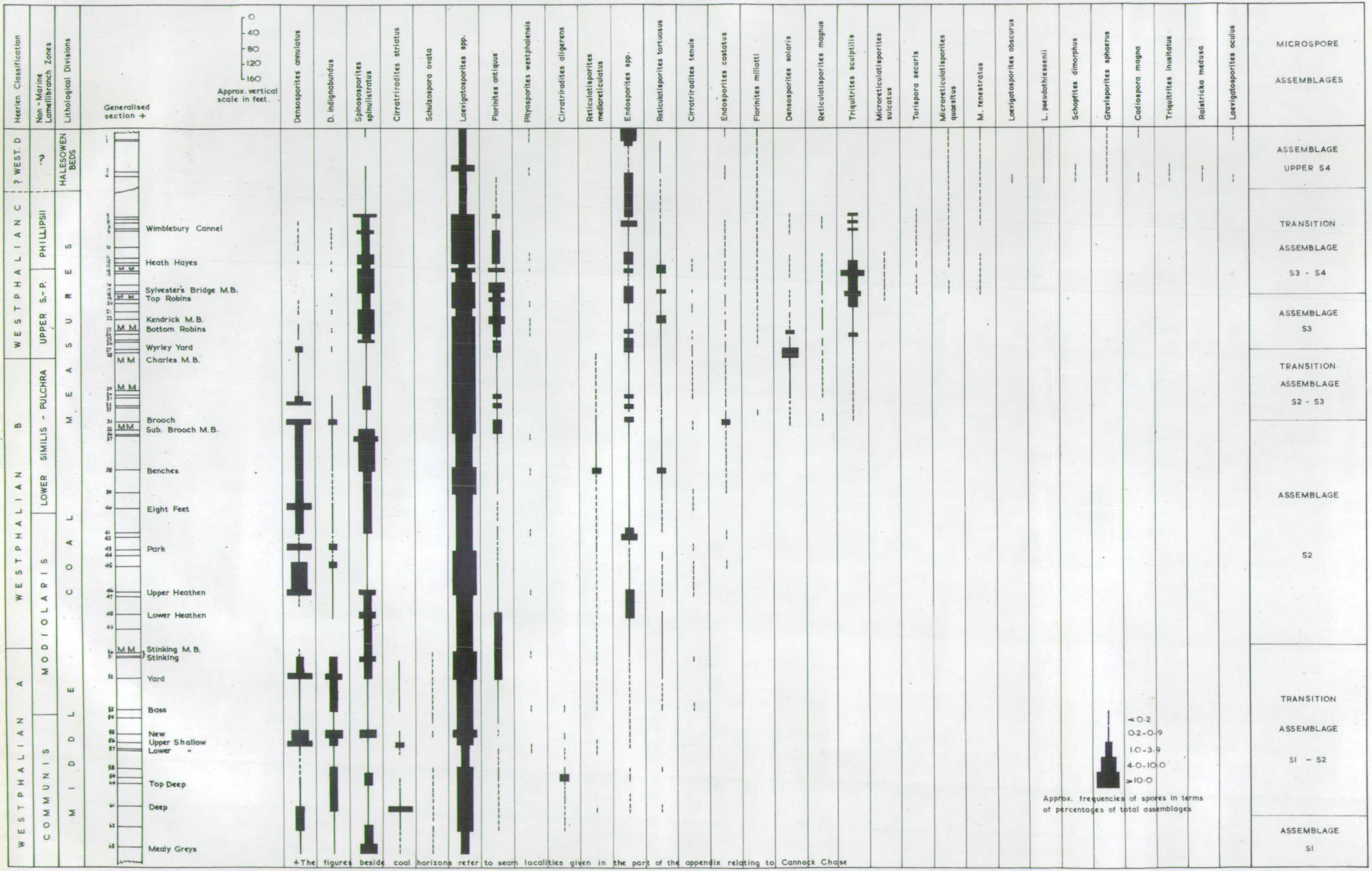
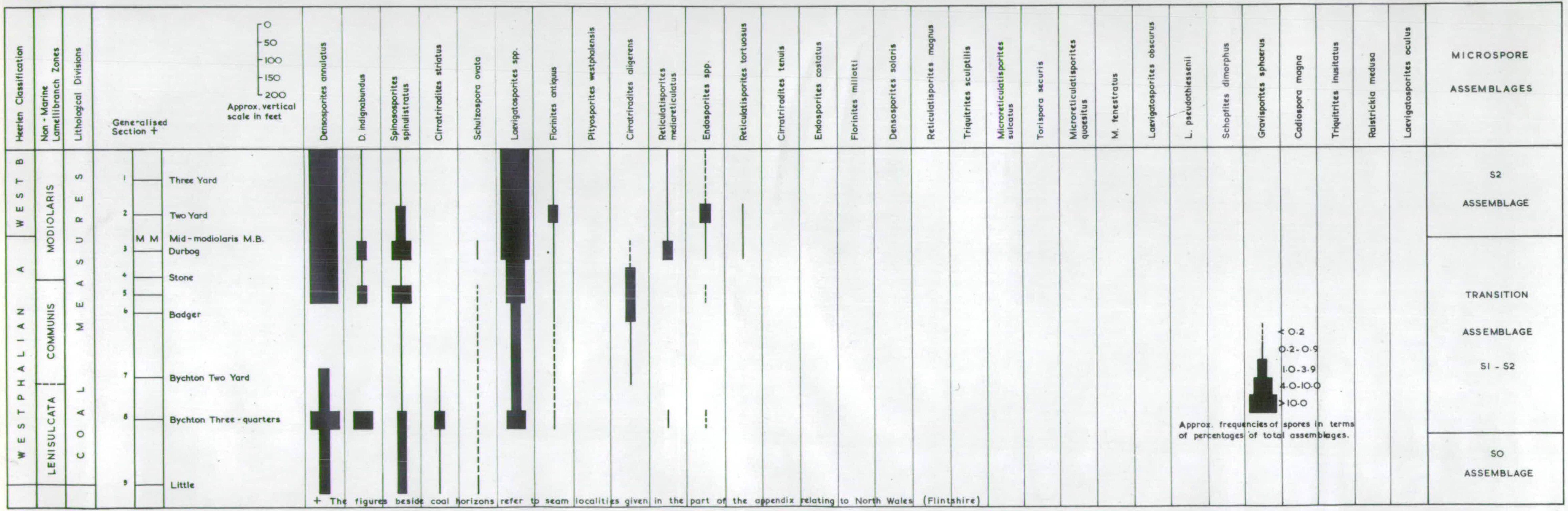


FIG. 7. MICROSPORE DISTRIBUTION IN THE FLINTSHIRE COALFIELD



IG. 6. MICROSPORE DISTRIBUTION IN THE SOUTH STAFFORDSHIRE COALFIELD

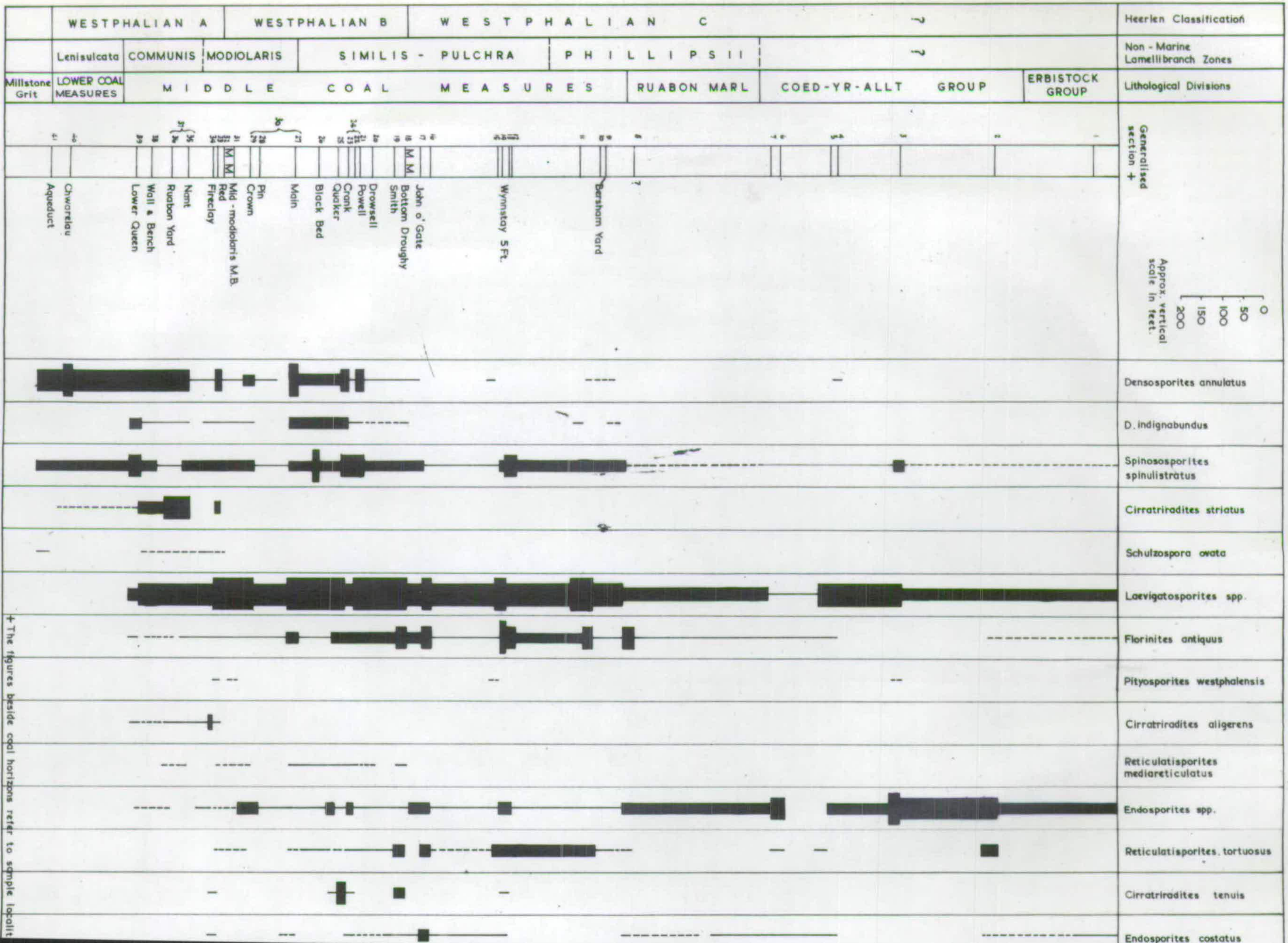
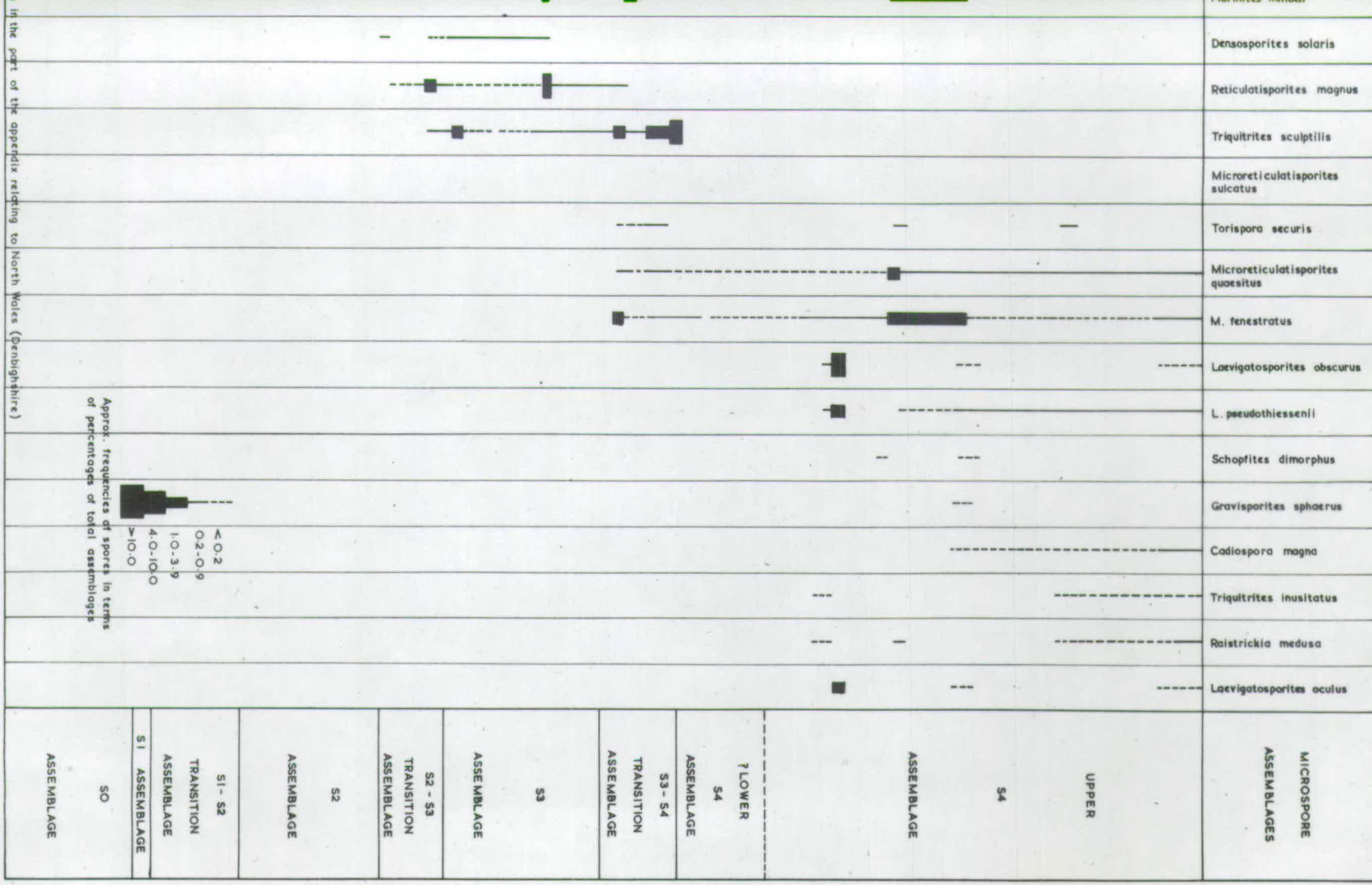


FIG. 8. MICROSPORE DISTRIBUTION IN THE NORTH WALES (DENBIGHSHIR

COALFIELD



in the part of the appendix relating to North Wales (Denbighshire)
Densosporites solaris
Reticulatisporites magnus
Triquitrites sculptilis
Microreticulatisporites sulcatus
Torispora securis
Microreticulatisporites quaesitus
M. fenestratus
Laevigatosporites obscurus
L. pseudothiessenii
Schopfites dimorphus
Gravisporites sphaerus
Cadiospora magna
Triquitrites inusitatus
Raistrickia medusa
Laevigatosporites oculus
Approx. frequencies of spores in terms of percentages of total assemblages
<0.2
0.2-0.9
1.0-3.9
4.0-10.0
>10.0
SO ASSEMBLAGE
S1 ASSEMBLAGE
S1 - S2 TRANSITION ASSEMBLAGE
S2 ASSEMBLAGE
S2 - S3 TRANSITION ASSEMBLAGE
S3 ASSEMBLAGE
S3 - S4 TRANSITION ASSEMBLAGE
?LOWER S4 ASSEMBLAGE
UPPER S4 ASSEMBLAGE
MICROSPORE ASSEMBLAGES

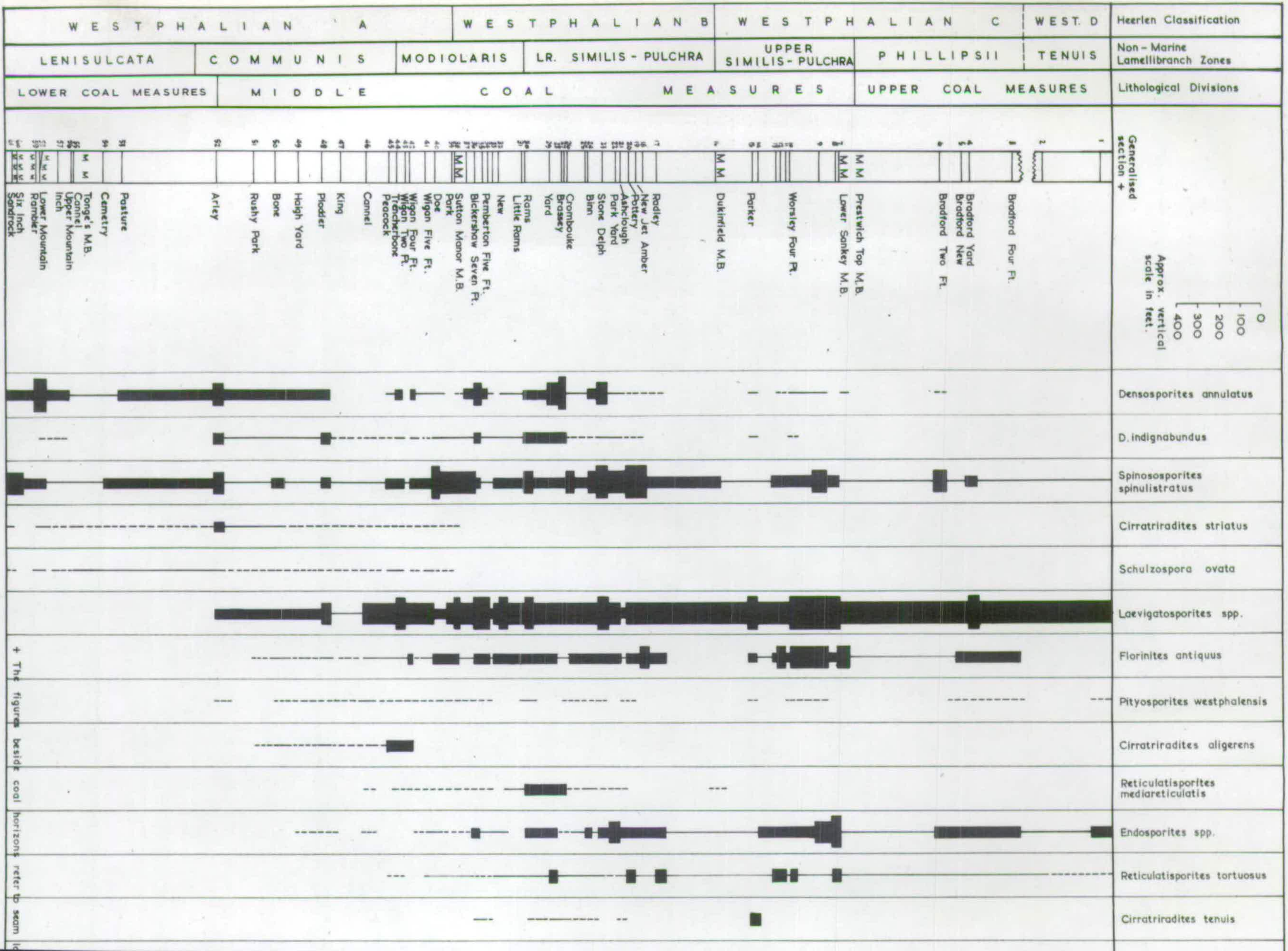
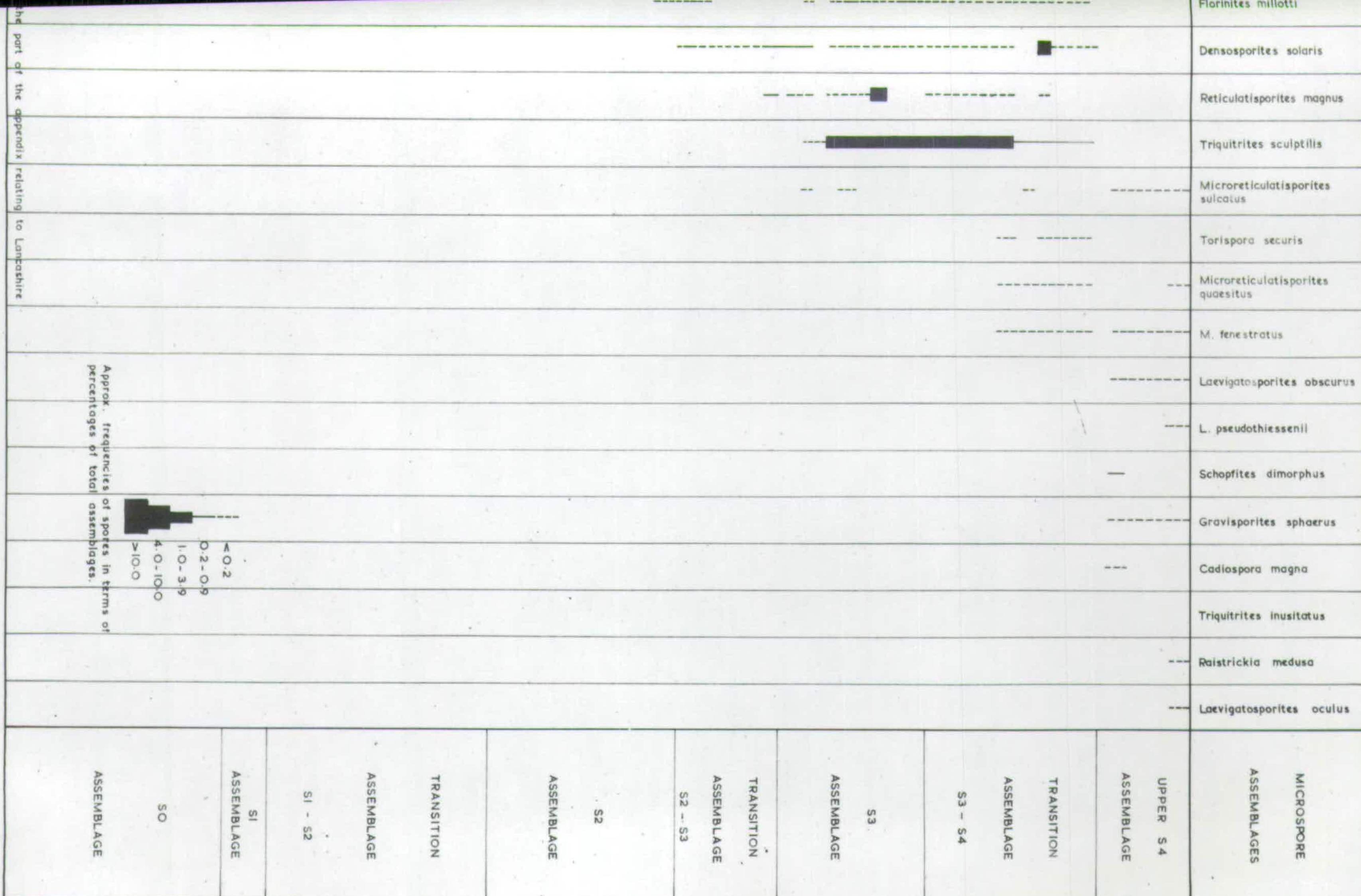


FIG. 9. MICROSPORE DISTRIBUTION IN THE LANCASHIRE COALFIELD



Florinites millotti
Densosporites solaris
Reticulatisporites magnus
Triquitrites sculptilis
Microreticulatisporites sulcatus
Torispora securis
Microreticulatisporites quaesitus
M. fenestratus
Laevigatosporites obscurus
L. pseudothiessenii
Schopfites dimorphus
Gravisporites sphaerus
Cadiospora magna
Triquitrites inusitatus
Raistrickia medusa
Laevigatosporites oculus
...he part of the appendix relating to Lancashire
Approx. frequencies of spores in terms of percentages of total assemblages.
<0.2
0.2 - 0.9
1.0 - 3.9
4.0 - 10.0
>10.0
SO ASSEMBLAGE
SI ASSEMBLAGE
SI - S2 TRANSITION ASSEMBLAGE
S2 ASSEMBLAGE
S2 - S3 TRANSITION ASSEMBLAGE
S3 ASSEMBLAGE
S3 - S4 TRANSITION ASSEMBLAGE
UPPER S4 ASSEMBLAGE
MICROSPORE ASSEMBLAGES

FIG. 10. MICROSPORE DISTRIBUTION IN THE SHROPSHIRE (COALBROOKDALE) COALFIELD

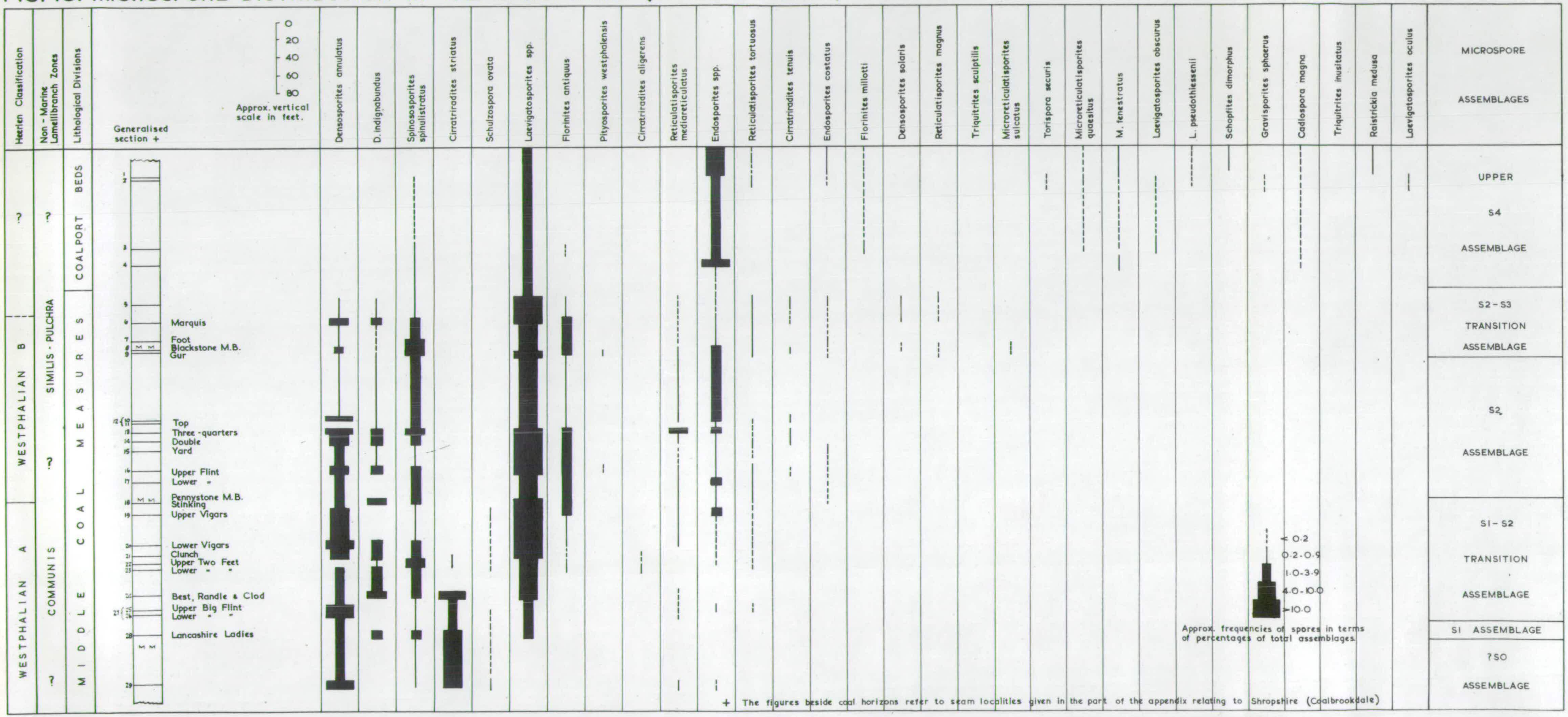


FIG. 11. MICROSPORE DISTRIBUTION IN THE SHROPSHIRE (FOREST OF WYRE) COALFIELD

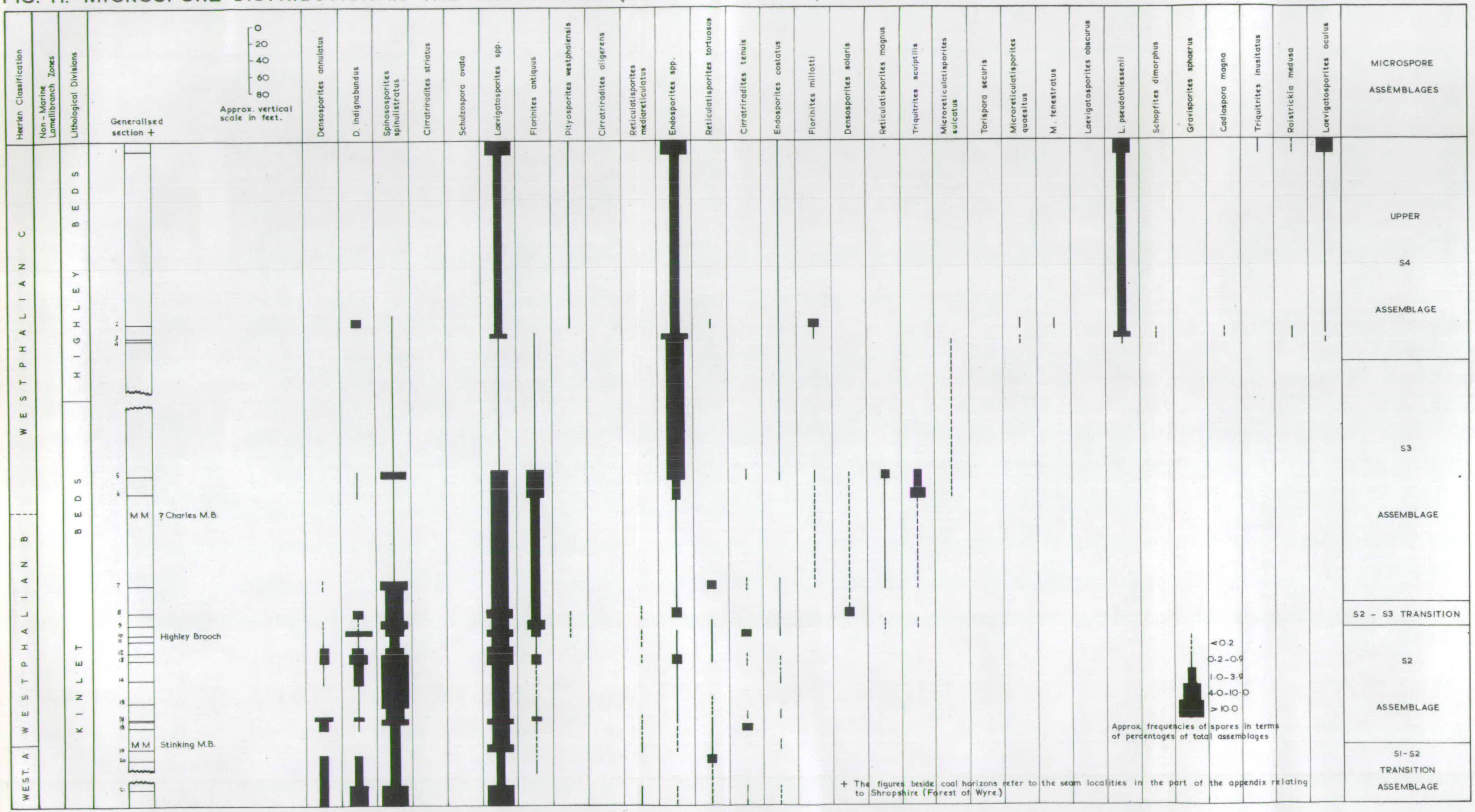


FIG. 12. MICROSPORE DISTRIBUTION IN THE WARWICKSHIRE COALFIELD