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# SCARCITY OF MIOSPORES FROM ALBIAN SECTION AT FOLKESTONE, ENGLAND

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The purpose of this paper is to record the miospore assemblage of an Albian section at Folkestone, Southern England and to account for their impoverished nature and similarity to Jurassic and Aptian microflora. The palynological study of the English Albian has attracted much interest because of the interesting and continuous record it presents of the rise of angiosperm pollen (see E.M. Kemp, 8) and because of its usefulness in stratigraphic correlation especially in confirmation and refinement of ages of otherwise unfossiliferous nonmarine deposits. Apart from that the middle and upper Albian rocks of England are well-dated and have been thoroughly studied on basis of macrofossils and the desire to compare palynological assemblages with other macro- and micropalaeontological assemblages such as ammonites, ostracods, and foraminifera was one of the initial objectives of the study. This was not possible again due to scarcity of spores and pollen.

One of the earliest studies of Mesozoic palynology in England and Scotland was made by R.A. Couper (3) who systematically described dispersed spores and pollen grains. G. Norris (11) published his descriptions of miospores assemblages from the Purbeck beds of Southern England and from the Upper Kimmeridgian and Portlandian marine sediments exposed on the Dorset coast. He further examined the stratigraphic value of miospores for zonation and correlation of strata developed close to the Jurassic – Cretaceous boundary in Southern England. The study of Aptian and Albian miospores of Southern England was made by E.M. Kemp (8). She emphasized the appearance of angiosperm pollen in Aptian and Albian and persistence of pre-Albian forms in the Gault Clay (Middle and Upper Albian).

Later J.F. Laing (10) made a description of angiosperm pollen from the Albian and Cenomanian strata of both Southern England and Northern France. He described twenty-two (22) species of angiosperm pollen assemblages and related them to the ammonite zones of the Albian stage. The above-mentioned works are not exhaustive of the enormous literature available now but they are

important to the present paper for the authors studied the palynology of areas nearest or inclusive of the present study area as will be shown later. E.M. Kemp (8), J.F. Laing (10) and M. Umenweke (25) contain a lot of references on Albian palynology in Britain.

## METHOD OF STUDY

The rock samples used in the study were macerated using standard palynological techniques which principally involved dilute hydrochloric acid (HCl) which was used to remove the carbonate while 10% HF was used to dissolve the silicates. Safranin O was used for staining. The samples were stored in the Palynology Laboratory of the Department of Geology, King's College, University of London, where the work was done. The sample number, the slide, the minimum size, the number of specimens measured, and the maximum sizes are stated against the palynomorphs. Samples were colected from each ammonite zone established for the section (see H.G. Owen, 16 and Fig. 2 of this study).

## STRATIGRAPHY AND GEOGRAPHICAL LOCATION OF SAMPLES

In England, the Lower Albian is represented within the top beds of the Lower Greensand and its junction with the overlying clays of the Gault. The Gault Clay is divided broadly into Lower Gault and Upper Gault which correspond respectively with the Middle and Upper Albian substages as shown in Fig. 2.

The samples were taken from each ammonite zone established by H.G. Owen (14, 16) of the Gault succession at Copt Point and East Wear Bay, Folkestone, Kent (Figs. 1, 2). The section is regarded as one of Albian standard sections since the work of F.G. Price (17). The classic section is included by A.D. d'Orbigny (1840–42) in his list of standard localities when defining the Albian stage. The section is also described in some detail by de C.E. Rance (19) in W. Topley's Memoir (24).

The Gault at Folkestone consists of Beds I to XIII. The section at Copt Point consists of Beds I to XI while, adjacent to the Coastguards Lock out below the Martello no. I Tower in East Wear Bay, the upper parts of Beds XII and XIII are exposed. Mobile landforms made sample collection from Beds XII and XIII rather very difficult.

The junction of the Lower Albian and the Gault Clay is defined by presence of Sulphur Bands at the base of the Gault and current-bedded clayey sandstones of the Lower Greensand. The clay is bluish, sticky and contains many courses of phosphatic nodules. The Upper Gault Clay is very calcareous and in many other localities passes into a diachronous sandy facies called Upper Greensand. The Albian and Cenomanian boundary is defined by the Glauconitic Marl of the Lower Cenomanian.

The description of the section is as follows:

Bed XIII: fawnish grey marly clay 8.84 m mottled light grey and fawn grey 0.91 m. Highly glauconitic light grey clay highly glauconitic at base but diminish upward in size and number 3.95 m;

Bed XII: highly glauconitic light grey clay with scattered phosphatic nodules and a seam of them at base 0.99 m;

Bed XI: pale grey marly clay with phosphatic nodules bed at base 10.67 m;

Bed X: tough light grey marly clay with phosphatic nodules at the top and in a seam at 0.73 m below top 1.55 m;

Bed IX: light grey marly clay indurated at top which is marked by phosphatic nodules. Marlstone lenticles occur between 0.76 and 1.70 m above base, 2.85 m;

Bed VIII: (in part) grey clay, phosphatic nodules 0.6 m;

Bed VII: grey clay with pyritized fossils 2.6 m;

Bed VI: mottled clay, grey and glauconitic nodules 0.32 m;

Bed V: glauconitic nodules, dark 0.5 m;

Bed IV: grey clay, pyritic 0.16 m;

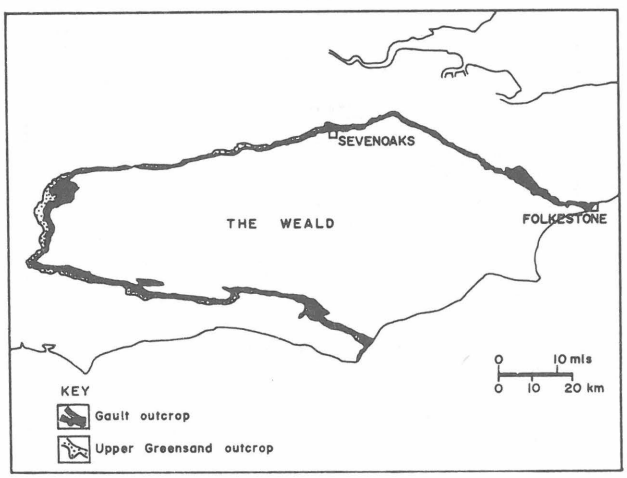


*Fig. 1. Map of the Weald showing positions of Folkestone and Gault outcrop*

*Ryc. 1. Obszar badań*

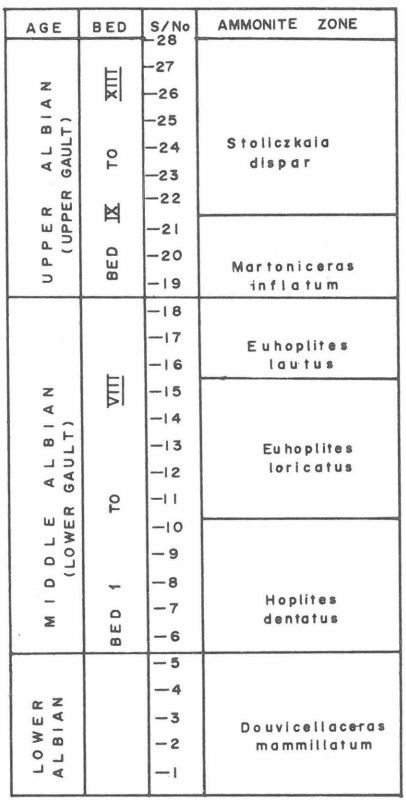


*Fig. 2. Generalized section showing Albian substages, sample points and Ammonite zones*

*Ryc. 2. Zgeneralizowany profil z podziałem albu, miejscem pobrania próbek i zonami amonitowymi*

Bed III: grey clay 2 m;
Bed II: grey clay 2.6 m;
Bed I: grey clay, sandy, base of the Gault 3.6 m.

## RESULTS

As shown in Fig. 2, the Albian standard section at Folkestone is zoned on basis of ammonites as follows (14–16):

*Stoliczkaia dispar* Zone Sample Nos 22–28
*Mortoniceras inflatum* Zone Sample Nos 19–21
*Euhoplites lautus* Zone Sample Nos 16–18
*Euhoplites loricatus* Zone Sample Nos 11–15
*Hoplites dentatus* Zone Sample Nos 6–10
*Douvicellaceras mammillatum* Zone Sample Nos 1–5

The Lower Albian is represented by *D. mammillatum* Zone, the Middle Albian by *H. dentatus*, *E. loricatus* and *E. lautus* and the Upper Albian is represented by *M. inflatum* and *S. dispar* Zones.

As shown in Fig. 3, the five samples taken from Lower Albian sediments yielded the following species named below:

*Podocarpidites radius, Araucariacites australis, Densoisporites perinatus, Gleicheniidites senonicus, Comcavissimisporites varirerrucatus, Alisporites elongatus, Classopollis torosus, Podocorpidtes minimus, Cengulitritetes* sp., *Microfoveolatosporites* sp., *Classopollis hamenii*, gymnosperm pollen and woody plant material.

The Middle Albian sediments (Samples No. 6–18) on the other hand yielded many species of which the following appear for the first time:

*Cyathides australis, Matonisporites equiexinus, Parvissaccites radiatus, Cyathides punctatus, Microreticulatisporites diatretus, Lycopodium austroclavatidites, Klukisporites* sp., *Classopollis classoides, Polypodiaceaesporites* sp., Cf. *Cicatricsisporites hallei, Lycopodiumsporites expansus, Todisporites major, Appendicisporites potomacensis, Pinuspollerites* sp., Cf. *Rubinella major* and palynological materials like foraminiferal shell linings and specimens of coccolith.

The Upper Albian on the other hand yielded most of the species already recorded for the Lower and Middle Albian but seem to be characterised by presence of triporate pollen and absence of the following species: *Gleicheniidites senonicus, Alisporites elongatus* and *Pinuspollenites* sp.

The state of preservation of the palynomorphs varied from one time–unit to the other. For instance the species in the Lower Albian were poorly preserved and some of them were mechanically damaged. In the Middle Albian, most of the species were very well preserved and were more abundant than those of the Lower Albian. The Upper Albian witnessed a decrease in specimen abundance of most of the species. Their preservation was good.

One of the most striking features of the palynomorphs was their state of preservation. Most of the palynomorphs were well preserved in the Gault Clay and morphological damage or deformation was rarely observed. Recycled or reworked spores and pollen were easily identified by their very dark colour. The palynomorphs of the Lower Albian (upper part of Lower Greensand) were not as well preserved as those of the Gault. Pyrite crystals were boldly emplaced on some specimens and quite a good number

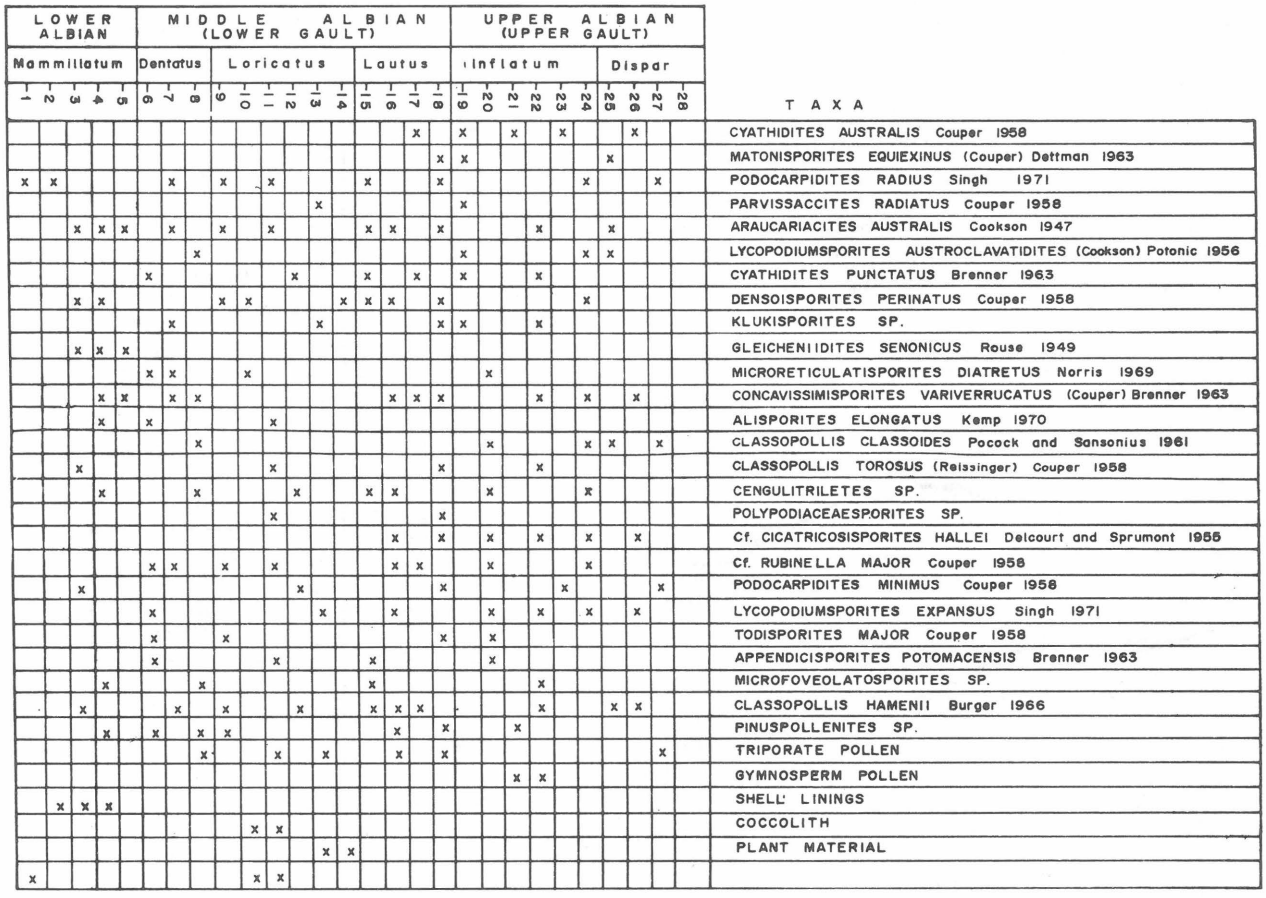


*Fig. 3. Distribution of palynomorphs in the Albian of Southern England*

*Ryc. 3. Występowanie palynomorfów w albie*

were mechanically damaged and corroded. The poor preservation of the palynomorphs of the top of the Lower Greensand was probably due to the sandy facies of the Lower Greensand. The good preservation afforded by the Gault Clay was expected due to the fact that it is a marine clay and offered a cushion effect on the specimens which prevented not only microbial attack but mechanical damage.

The greatest concentration of the number of specimens and species was in the Middle Albian (Lower Gault). Both the Upper Albian and Lower Albian showed considerable drop in the number of specimens of each species.

The area covered in the study is too narrow to warrant any generalization. The poor preservation of the Lower Albian (Lower Greensand) and the increased water depth in the Upper Albian (16) were perhaps contributory factors to their scarcity. Even though shelf assemblages can easily be swept by contemporaneous marine currents into deeper water as remarked by D. Habib (6), the Middle Albian (Lower Gault) sea was probably nearer the land and vegetational source than the Upper Albian hence more palynomorphs occur in the latter.

Another striking feature of these Albian miospores is its similarity with spores and pollen from the Cat Island, North Atlantic in Bahamas and Jurassic forms in Britain. D. Habib (5) described some spores and pollen of Albian age recovered from abyssal depth (5200 km) in submarine outcrops near Seismic Reflector Horizon Beta in Cat Island, Bahamas. Most of the species described by E.M. Kemp (8) and this study bear close resemblance or are identical to those of D. Habib (5). Apart from confirming the Albian age of the Gault, the following species are common to both areas: *Todisporites major, Gleicheniidites*

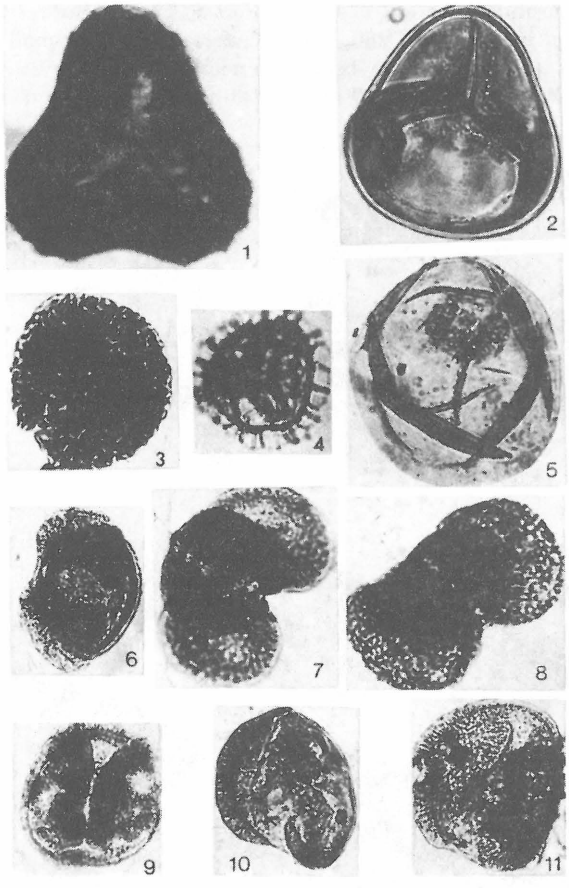

*Fig. 4. All figures magnified × 250. The order of recording is: species name, size (minimum, number of specimens, maximum), sample number and slide in bracket plus microscope coordinates*

1 – *Cyathidites punctatus* Brenner 1963 40 (15) 55 microns F10 (6) 113–12.50; 2 – *Matonisporites equiexinus* (Couper) Dettman 1963 48 (11) 58 microns F9 (5) 112.7–12.7; 3 – *Klukisporites* sp. 40 (30) 54 microns F3 (8) 94–32.00; 4 – *Lycopodiumsporites austroclavatidites* (Cookson) Potonie 1956 38 (17) 45 microns F8 (1) 150–26.50; 5 – *Araucariacites australis* Cookson 1947; 6, 9, 10, 11 – *Parvissaccites radiatus* Couper 1958 40 (28) 60 F10 (4) 113–45.00; 7, 8 – *Podocarpidites radiatus* Singh 1971 overall size 60 (30) 70 microns F10 (2) 115–44.50

*Ryc. 4. Wszystkie okazy są powiększone 250×. W opisie podano: nazwę gatunkową, wielkość (minimalną, liczbę okazów, maksymalną), numer próbki i – w nawiasie – numer preparatu oraz współrzędne mikroskopowe*

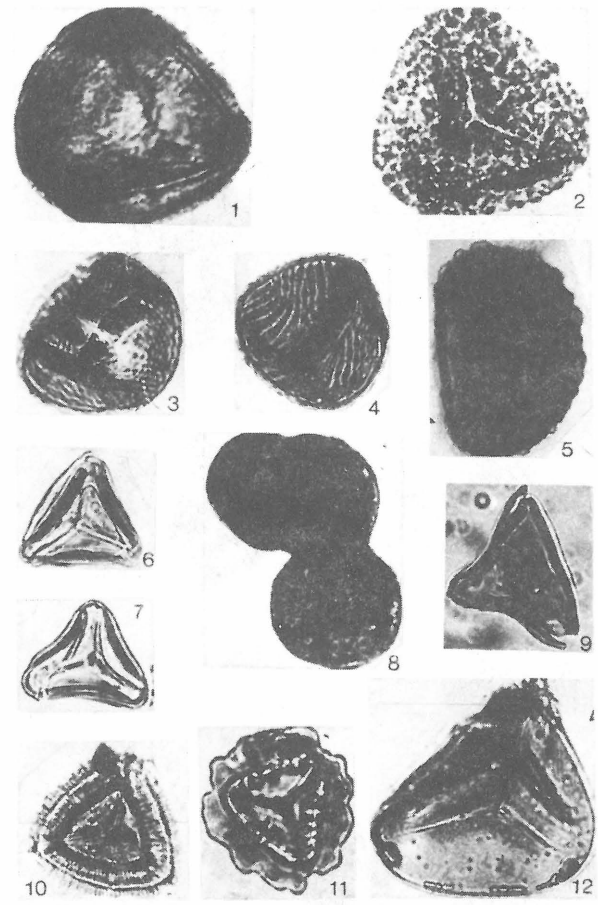

*Fig. 5. All figures magnifies × 250. Explanations as given in Fig. 4*

1 – *Densoisporites perinatus* Couper 1958 48 (6) 60 microns F (1) 118–11.00; 2 – Cf. *Rubinella major* Couper 1958 (11) 50 microns F9 (3) 112–10.00; 3, 4 – *Cicatricosisporites* Cf. C. *hallei* Delcourt and Sprumont 1955 40 (21) 55 microns F15 (5) 112–39.00; 5 – *Microfoveolatosporites* sp. F4 (6) 109–35.50; 6, 7, – *Gleicheniidites senonicus* Rouse 1949 40 (18) 50 microns F7 (2) 110–9.7; 30 (15) 40 microns F2 (3) 118–38.00; 8 – *Classopollis hammerinii* Burger 1966 F6 (8) 113–32.00; 9 – *Triporate* pollen 20 (13) 30 microns F6 (8) 120–21.00; 10 – *Cingulitritetes* 28 (11) 35 microns F7 (2) 122–44.00; 11 – *Lycopodiumsporites expansus* Singh 1971 40 (13) 60 F8 11–32; 12 – *Cyathidites australis* Couper 1958 45 20) 60 microns F14 (1) 105–48.00

*Ryc. 5. Wszystkie okazy są powiększone 250×. Objaśnienia jak dla ryc. 4*

*senonicus, Cicatricsiporites australiensis, Parvissaccites radiatus*, and *Cyathidites australis*.

In Britain, G. Norris (11) studied miospores from the Purbeck Beds and marine Upper Jurassic of Southern England. The species which are observed in both the Jurassic and Albian are as follows: *Araucariacites australis, Microreticulatisporites diatretus, Parvissaccites radiatus, Appendicisporites potomacensis, Gleicheniidites senonicus, Classopollis torosus, Concavissi miosporites variverrucatus* and *Lycopodiumsporites expansus*. Apart from these, many of the spores described by G. Norris were also recorded by E.M. Kemp (8) from various Aptian and Lower Albian sections in England. It does appear that there was no marked difference between the flora of the Jurassic and the overlying the Lower Greensand and Gault. The most notable difference was the emergence of the angiosperm pollen in Aptian and their increase in Albian.

The impoverished nature of the assemblage in this study merits special mention. The Gault and its arenaceous facies, the Upper Greensand, are relatively poor in plant megafossils although drifted wood is abundant (see 8, p. 134). J.M. Stopes (23) described a cone of probable bennettitalean origin from an unspecified Gault Horizon at Folkestone. The scarcity of the spores and pollen could therefore probably be a reflection of the environment of deposition rather than a reflection of the bulk composition of flora living in Gault times. The Lower Gault was deposited in about 150–200 m water depth (7) and the Upper Gault was much deeper (25). The presence of woody remains (see this study Fig. 7, specimens 2, 6) in the Lower Greensand (Lower Albian) and absence of fern foliage has been attributed to a large extent to the destruction of leaves and more delicate organs before burial and to the long period of transportation suffered by remains deposited under marine conditions (20, 8, 9, 23). It can therefore be safely stated that the impoverished nature of spores and pollen in the section under study is related directly to the distance of the sea from land or vegetational source and environment of deposition. The angiosperm pollen which are more common in the Gault and Lower Greensand are so small in size (on the average below 35 microns) as observed by E.M. Kemp (8) and J.F. Laing (10) that they can be trans-

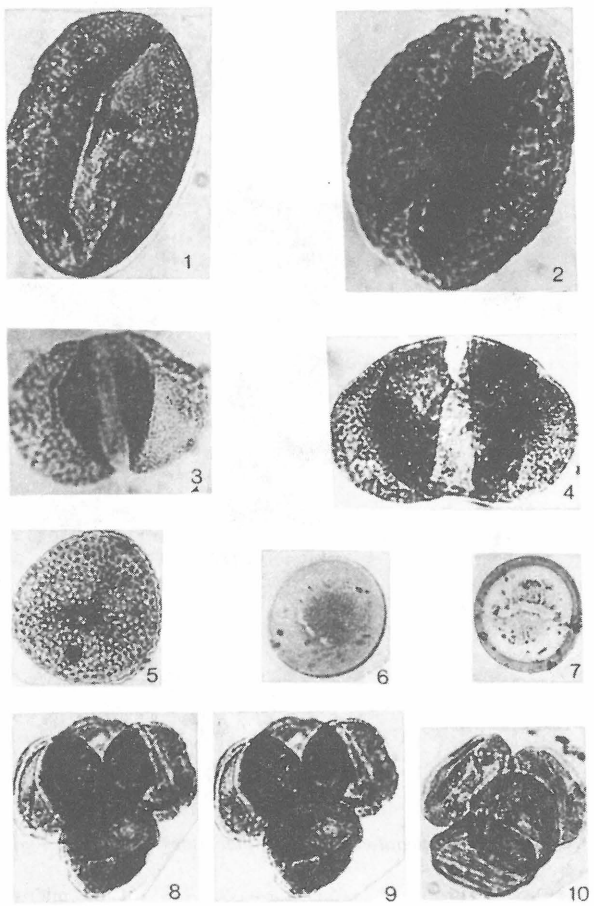

*Fig. 6. All figures magnified ×250. Explanations as given in Fig. 4*

1 – *Gymnosperm* pollen F3 (4) 110–00; 2 – *Alisporites elongatus* Kemp 1970 60 (15) 80 microns F9 (6) 110–25.00; 3 – *Pinuspollenites* sp. F (8) 120 11.00; 4 – *Podocarpidites minimus* (Couper) 1958 40 (11) 50 microns F11 (4) 110–33.00; 5 – *Microreticulatisporites diatretus* Norris 1969 30 (8) 40 microns F9 (5) 110–34.00; 6, 7 – *Classopollis classoides* Pocock and Jansonius 1961 30 (12) 40 microns F6 (8) 102–34.00; 8, 9, 10 – *Classopollis torosus* (Reissinger) Couper 1958 35 (11) 45 microns F10 (3) 109–38.00

*Ryc. 6. Wszystkie okazy są powiększone 250×. Objaśnienia jak dla ryc. 4*

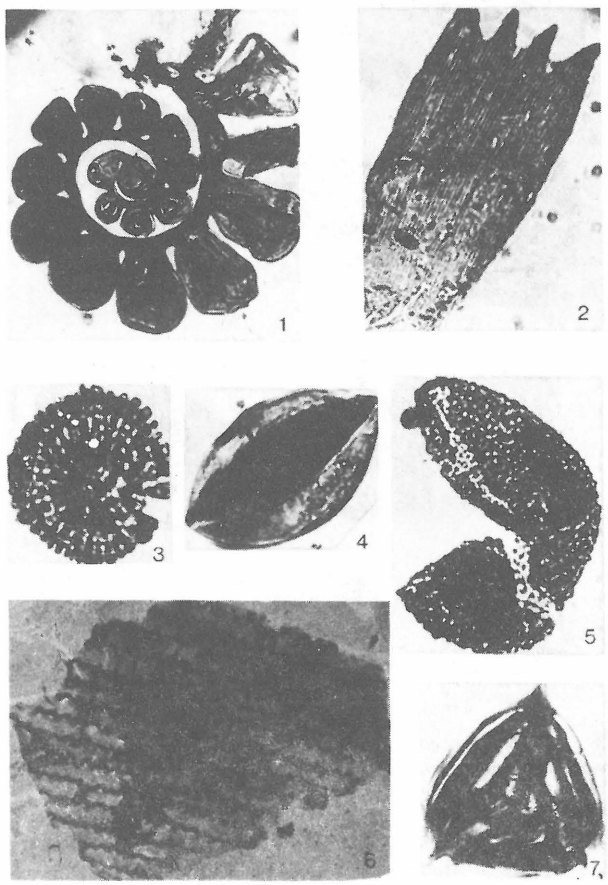

*Fig. 7. All figures magnified ×250. Explanations as given in Fig. 4*

1 – Shell Linings of a trochoid foraminifera F10 (11) 109–27.00 Middle Albian; 2 – Plant material F11 (3) 117–42.00; 3 – *Coccolith* sp. F13 (8) 110–13.00; 4 – *Todisporites major* Couper 1958 40 (11) 50 F8 (3) 110–32.00; 5 – *Concavissimisporites variverrucatus* (Couper) Brenner 1963 45 (30) 65 F11 (7) 110–36.00; 6 – Plant material F6 (4) 110–28.00; 7 – *Appendicisporites potomacensis* Brenner 1963 45 (20) 60 F7 (3) 110–108

*Ryc. 7. Wszystkie okazy są powiększone 250×. Objaśnienia jak dla ryc. 4*

ported long distances in the open sea without much difficulty.

On the French side of the Anglo-Paris Basin, J.C. Foucher and Ph. Taugourdeau (4) recorded only fourteen (14) undescribed and unnamed spores and pollen plus other microfossils from Albian section in Wissant in France. The forms they figured are trilete spores and conifer pollen. The scarcity of spores and pollen in the Albian sediments is therefore not just a local feature peculiar to Folkestone (England) but is true of the neighbouring French Albian section.

The study of some Albian section in Folkestone has shown that spores and pollen are impoverished and well preserved except in the top part of the Lower Greensand below the base of Gault. The spores and pollen composition bear close identity to pre-Albian Jurassic and Aptian miospores suggestion similarity in plant composition between the Albian plants and Jurassic and Aptian ones. The impoverished nature of spores and pollen is attributed to distance of the depocentre (the Gault Sea) from the vegetational source and to a little extent water depth for D. Habib (6) found similar forms in abundance in very deep water in Bahamas. Even though the age of the section is not doubt, the study has shown that similar palynological assemblage are present in Albian abyssal deposits in Bahamas and Wissant in France.

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## STRESZCZENIE

W utworach albu południowej Anglii stwierdzono występowanie 27 gatunków spor i pyłków. W pracy przedyskutowano zubożałość palynomorfów albu i porównano je z formami jurajskimi i apckimi. Występowanie sporów i pyłków skorelowano z zonami amonitowymi ustanowionymi w profilu Folkestone.

## РЕЗЮМЕ

В альбских отложениях южной Англии было определено присутствие 27 типов спор и пыльцы. В статье рассматривается обеднение палиноморфов альба и проводится их сравнение с юрскими и аптскими формами. Распространение спор и пыльцы коррелируется с аммонитными зонами установленными в разрезе Фолькстон.