CAPPASPORITES: A COMMON MIDDLE PENNSYLVANIAN PALYNOMORPH

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Abstract

Cappasporites L. Urban 1966, a Pennsylvanian spore genus, has been commonly overlooked or misidentified during descriptions of Pennsylvanian palynofloras. Numerous spores of this genus were found in the Middle Desmoinesian Croweburg coal of Oklahoma and subsequently in other Desmoinesian coals. The genus includes spores varying from 35μm to 90μm in longest dimension and ranging from broadly oval (polar) to spindle shaped (equatorial) in outline. The spore is further characterized by a thickened exine over the distal surface, generally ornamented with scattered blunt granules. Trilete laesurae are rarely evident. The spores are produced in cones of an arborescent lycopod, are most commonly associated with *Lycospora* and *Laevigatosporites*, and appear to be characteristic of the Pennsylvanian.

INTRODUCTION

The genus *Cappasporites* was described by Logan Urban in 1966 from the Bluejacket coal (Middle Pennsylvanian, Desmoinesian Series) of Oklahoma. At that time little was known about the distribution or botanical affinity of this spore. Recent work by Courvoisier and Phillips (1975) has revealed spores of identical morphology in a Pennsylvanian fructification of the genus *Achlamydocarpon*, now believed to be the cone of an arborescent lycopod (Phillips, 1979).

During a palynological study of an outcrop of Croweburg coal in Hughes County, Oklahoma, numerous specimens of this genus were encountered which prompted a reevaluation of the genus and an investigation of its occurrence in other Pennsylvanian coal palynomorph floras. An emended description of the genus is here given based upon extensive materials available and its presence is documented in Pennsylvanian coals of Oklahoma and elsewhere.

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SYSTEMATIC PALYNOLOGY

Genus *Cappasporites* Urban 1966 emend.

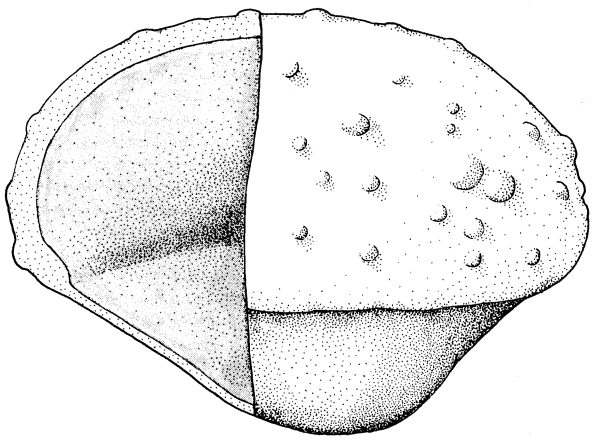
Cappasporites Urban, 1966, p. 112, pl. 1, figs. 1-2.

Type-species: *Cappasporites distortus* Urban, 1966, p. 114, pl. 1, figs. 1-2.

Emended Diagnosis. Spore broadly oval to roundly triangular in polar view; tapering ovoid in equatorial view. Proximal wall is thin and membranous (0.5 to 1μm), distal wall thicker (2-3μm). Trilete suture generally not seen but indicated by folds or triangular foramen on occasional specimens. Surface varies from minutely granular distally to mostly laevigate proximally. Additional ornamentation on the distal surface consists of a few to numerous irregularly distributed granules 1-2μm in diameter and occasional larger gemmae up to 5μm in diameter on the distal and proximal surfaces. Spores are commonly folded and torn. Dimensions vary from 35 to 90μm in maximum length with an average value of 68 $\pm$ 11μm for over 300 specimens. Spores frequently occur as loosely bound tetrads or fragments thereof.

Remarks. Many specimens obtained from coal macerates are torn and folded but very rarely do specimens exhibit any sign of a triradiate suture (Plate 1, figs. 4,5). This may be due in part to the positioning of the spores which are commonly flattened laterally (Plate 1, figs. 1-3). Although Courvoisier and Phillips (1975, pl. 1, fig. 17) illustrated a specimen from a sporangial macerate which exhibits a triradiate suture, in most dispersed specimens (99%) this feature is not apparent and its absence rather than its presence may be useful in diagnosis. The most obvious characteristics of the genus are the thickening of the exine on the distal surface and the

accompanying ornamentation on the distal and equatorial surfaces (Text-Figure 1).



Text-Figure 1. Three-dimensional reconstruction of *Cappasporites distortus* (Urban 1966) with cutaway illustrating differences in wall thickness. Composite based upon many specimens.

Sculptural elements vary considerably from specimen to specimen. It has not yet been ascertained whether this variation represents one or more than one species. Phillips has indicated the potential for more than one species of *Achlamydocarpon* (pers. commun., [1979]) and a comparison of microspores from these parent sources may shed more light on this problem. For the present, all spores are being retained in one species. *Cappasporites* exhibits a general fine granular sculpture on the distal surface (Plate 1 and Courvoisier and Phillips, 1975, pl. 2, fig. 16). Additional ornamentation, when present, is helpful in identification of spores of this genus. Ornamentation is unlike that in most other forms in that it shows considerable irregularity in size, number and distribution from specimen to specimen within a given sample. Whereas the intermediate granules (1–2μm) are found only on the distal and equatorial surfaces of the cap, (Plate 1) the larger gemmae commonly occur on the proximal surface as well (Plate 1, figs. 1,4,5). Attempts to recognize distinct forms have been frustrated by an apparent continuum of variation between the more easily recognizable classes.

Specimens of *Cappasporites* range in size from 35 to over 90μm in longest dimension with a mean of $68 \pm 11\mu$m based upon or over 300 specimens. The mean value for my sample lies outside the range reported by Urban but is not significantly different from the average value of 64μm obtained by Courvoisier and Phillips. The spore frequently occurs in loosely bound tetrahedral tetrads (Plate 1, figs. 9,10) varying from 70 to over 100μm in diameter.

Distribution. When *Cappasporites* was originally recognized in the Bluejacket coal, Urban (1965) expressed the hope that it might have been limited to the Boggy Formation of which the Bluejacket coal is a member. During a study of the Hughes County Croweburg coal the occurrence of *Cappasporites* in significant numbers was noted. Subsequent examination of Pennsylvanian coals of Oklahoma, Kansas, Kentucky, and Illinois has revealed that this spore is present to some extent in nearly every Desmoinesian and equivalent coal surveyed (Table 1). This widespread occurrence suggests that *Cappasporites* should be considered a typical component of Desmoinesian floras. Peppers has recognized the occurrence of *Cappasporites* in coals of the Carbondale and Spoon Formations of Illinois. He states:

> "Spores resembling *C. distortus* were found in all Carbondale coals and in practically all the macerations studied and were classified as *Crassispora plicata*, because most of the samples were analyzed before 1966 (the date of Urban's publication)" (Peppers, 1970).

Subsequently Peppers (1979) and others (Ravn, 1979) have recognized the occurrence of this genus in various other coals. While this spore is absent from the lower Desmoinesian Hartshorne Coal and from the overlying Missourian strata of Oklahoma, it probably will prove to be present throughout the Pennsylvanian interval. For example, Ravn (pers. commun. [1980]) has recently noted the presence of *Cappasporites* in quantities up to 10% in Morrowan coal from Iowa.

The failure of numerous other authors to report the occurrence of *Cappasporites* as a distinct taxon must be attributed to its nondescript morphology and lack of trilete suture. It has probably also been confused with ruptured *Calamospora* or *Punctatisporites*, an error which is understandable in view of its characteristic appearance. Meyers (1967) did not identify the palynomorph and included *Cappasporites* in the genus *Punctatisporites* during his palynologic study of the Henryetta coal. Habib (1966, pl. 6, figs. 4,6) has identified grains of *Cappasporites* as *Granisporites medius* Dybova and Jachowicz 1957, in the Lower Kittanning Coal of Pennsylvania. Such an assignment is incorrect on the basis of Dybova and Jachowicz's (1957) description of the genus *Granisporites* which indicates the presence of

TABLE 1
OCCURRENCE OF *CAPPASPORITES* IN SOME COMMON DESMOINESIAN AND DESMOINESIAN EQUIVALENT COALS FROM OKLAHOMA AND ELSEWHERE

OKLAHOMA COALS	OCCURRENCE	COMMENTS
Oklahoma Coals	O Not Seen X Present (=1%) XX Common (−1%)	
Upper Dawson	X	Generally distributed
Lower Dawson	X	Generally distributed
Iron Post	XX	More common near top of bed (up to 5%)
Bevier	X	
Croweburg	XX	Present in all sections examined
Mineral	X	
Tebo	X	More frequent near top of bed
Weir Pittsburg	XX	Nearly all samples (up to 47%)
Secor	X	
Taft	XX	Most abundant near top of bed
Bluejacket	XX	Quantitative data from Urban 1965
Drywood	X	
Rowe	?	Insufficient data
McAlester	XX	Underclay 1% *Cappasporites*
Hartshorne	O	None seen in numerous slides examined
Other Coals		
Kentucky #12 Coal	XX	
Illinois #5 Coal	X	Exceeds 1% near top of seam
Illinois #2 Coal	XX	Up to 20% in some samples
Wheeler Coal (Kansas)	X	

a very clear trilete, a feature never seen as "very clear" in *Cappasporites*. The appearance of the trilete scar as seen on *Cappasporites* (Plate 1, figs. 4,5) is entirely dissimilar to that illustrated for *Granisporites* (Dybova and Jachowicz, 1957, Tab. X, fig. 1, 2; Tab. XI, fig. 3).

The spore is differentiated from *Crassispora* on the basis of type and distribution of ornamentation. In *Cappasporites* ornamentation is mostly blunt granules scattered randomly across the distal surface. In *Crassispora*, the ornamentation is coni which appear concentrated in the equatorial region of the compressed spore and more or less uniformly distributed across the distal surface.

Botanical Affinity. Leisman and Phillips (1979) have isolated *Cappasporites*-type microspores from microsporangia of a new species of *Achlamydocarpon, A. varius*. The heterosporous cone which contains the megaspore *Cystosporites varius* as well as *Cappasporites* microspores, has recently been

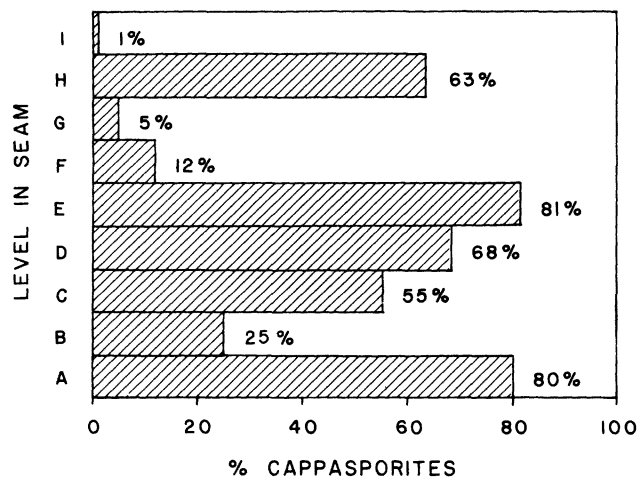
found in organic connection with vegetative foliage assigned to *Lepidodendron dicentricum* Felix (Phillips, pers. commun., [1979]). If this assignment is correct and if *Cappasporites* is a monotypic genus one might anticipate the presence of the relevant megafossils in coals with high proportions of *Cappasporites* microspores. The stratigraphic range reported by Winslow (1959, fig. 9) for *Cystosporites varius* megaspores (Morrowan and Desmoinesian) is consistent with that of the microspore.

Paleoecology. Cappasporites occurs in great abundance in three of the coals of Table 1. In the Bluejacket coal this spore comprises as much as 26 percent of the assemblage in the underclay in association with *Lycospora, Laevigatosporites* and *Leschikisporis* (Urban, 1966, p. 114). Within the coal itself, *Cappasporites* is present in only a few percent with a peak occurring midway through the seam.

The Croweburg coal from Hughes county also displays peak abundances in the underclay (up to 80%) and about midway through the seam (Text-Figure 2). Associated genera are primarily species of *Lycospora* and *Laevigatosporites*. Unusual in this coal is the persistence of this genus throughout the seam in relatively high abundance.

The Porter and Henryetta coals were found to have *Cappasporites* present in significant quantities. In the Porter coal the peak abundance occurs low in the seam (up to 47% *Cappasporites*) in association with *Laevigatosporites, Florinites* and *Cirratriradites*.

Like the Croweburg to which it is equivalent, the Henryetta coal contains numerous *Cappasporites* near the base and about midway through the seam where this spore is the most abundant component. Associated genera in this coal are *Laevigatosporites* and *Lycospora* near the base and additionally, saccate forms, predominantly *Florinites* higher in the section.



Text-Figure 2. Distribution of *Cappasporites* in the Hughes County Croweburg coal. Percentages based upon total counts in excess of 300 spores per sample. A was from underclay, H was a sandy clay in contact with seam top, and I was overlying shale. B through G were successive intervals through the eight inch seam.

The association of *Laevigatosporites, Lycospora,* and *Cappasporites* in several coals suggests that the parent plants may have grown under similar conditions. In the Hughes County Croweburg coal, *Cappasporites* abundance is more strongly correlated with *Laevigatosporites* than with *Lycospora*, a trend that is also apparent in the other coals.

Wilson (1976) suggested that the *Laevigatosporites-Lycospora* association is an element in the pioneer vegetation of coal accumulating areas. He also finds an association between thick pioneer palynological stages and high sulfur content in coals. If these suggestions are correct, *Cappasporites* may also be considered an early colonizer and thus may be useful in estimating paleoecological conditions and possible coal quality.

PLATE 1

Interference contrast light photomicrographs of characteristic forms of *Cappasporites distortus* (Urban 1963) from the Hughes County Croweburg Coal. Scale bar represents 20μm.

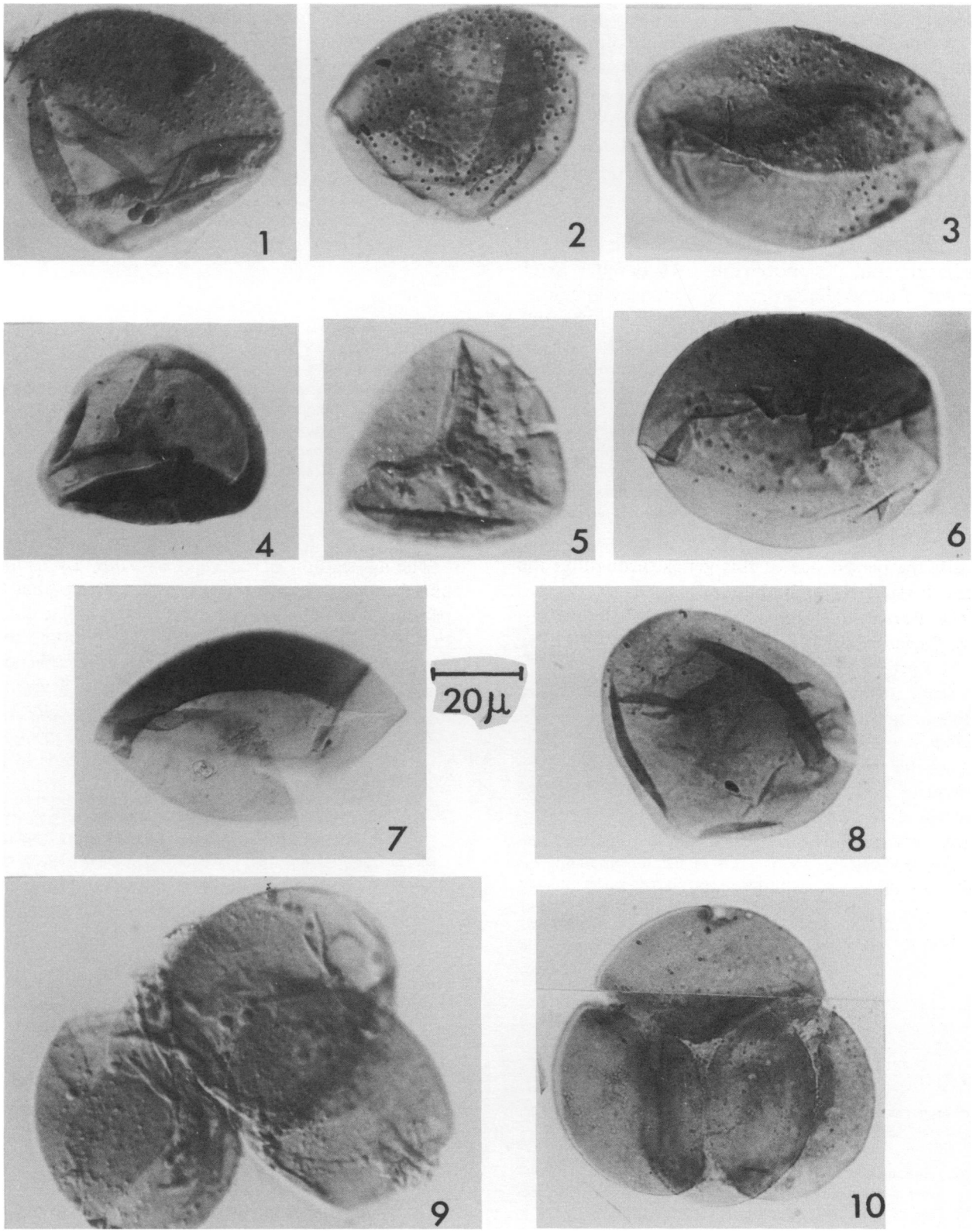
1,2 Equatorial view showing thinning of exine proximally and two distinct ornamentation sizes. Note characteristic folding of exine.

3,6,8 Polar to equatorial views illustrating the range of ornamentation from common to absent.

4,5 Rare polar views of spores with trilete folds on proximal surface. Note particularly the abundant large size gemmae on the proximal surface in 5.

7 Equatorial view of spore with a distinct distal cap.

9,10 Tetrads of *Cappasporites* spores. Note the prominent cap displayed by the spores in 10.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