
Cauveridinium, a new Gv-type dinoflagellate cyst from Trichinopoly Formation, Cauvery Basin, India

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Khowaja-Ateequzzaman & Jain, K.P. 1990. *Cauveridinium*, a new Gv-type dinoflagellate cyst from Trichinopoly Formation, Cauvery Basin, India. In : Jain, K. P. & Tiwari, R. S. (eds)—*Proc. Symp. 'Vistas in Indian Palaeobotany', Palaeobotanist* **38** : 171-179.

Some lenticular dinoflagellate cysts with process ornamentation restricted to circumferential border zone, characterized by proximal process connections through ridges, have been recovered from the limestone unit of Trichinopoly Formation, Cauvery Basin. These Gv-cysts have been described under a new genus, *Cauveridinium*. Three new species, viz., *C. indicum*, *C. intermedium* and *C. longispinosum*, are proposed. A detailed comparison with other Gv-Cyst taxa has been attempted.

Key-words—Fossil dinoflagellate, Morphology, Cauvery Basin, Turonian-Santonian (India).

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सारांश

कावेरी द्रोणी (भारत) में त्रिचनापल्ली शैल-समूह से एक नई जी-वी० प्रकार की घूर्णीकशाभ पुटी : कावेरीडीनियम

खोवाजा-अतीकुज्जामाँ एवं कृष्ण प्रसाद जैन

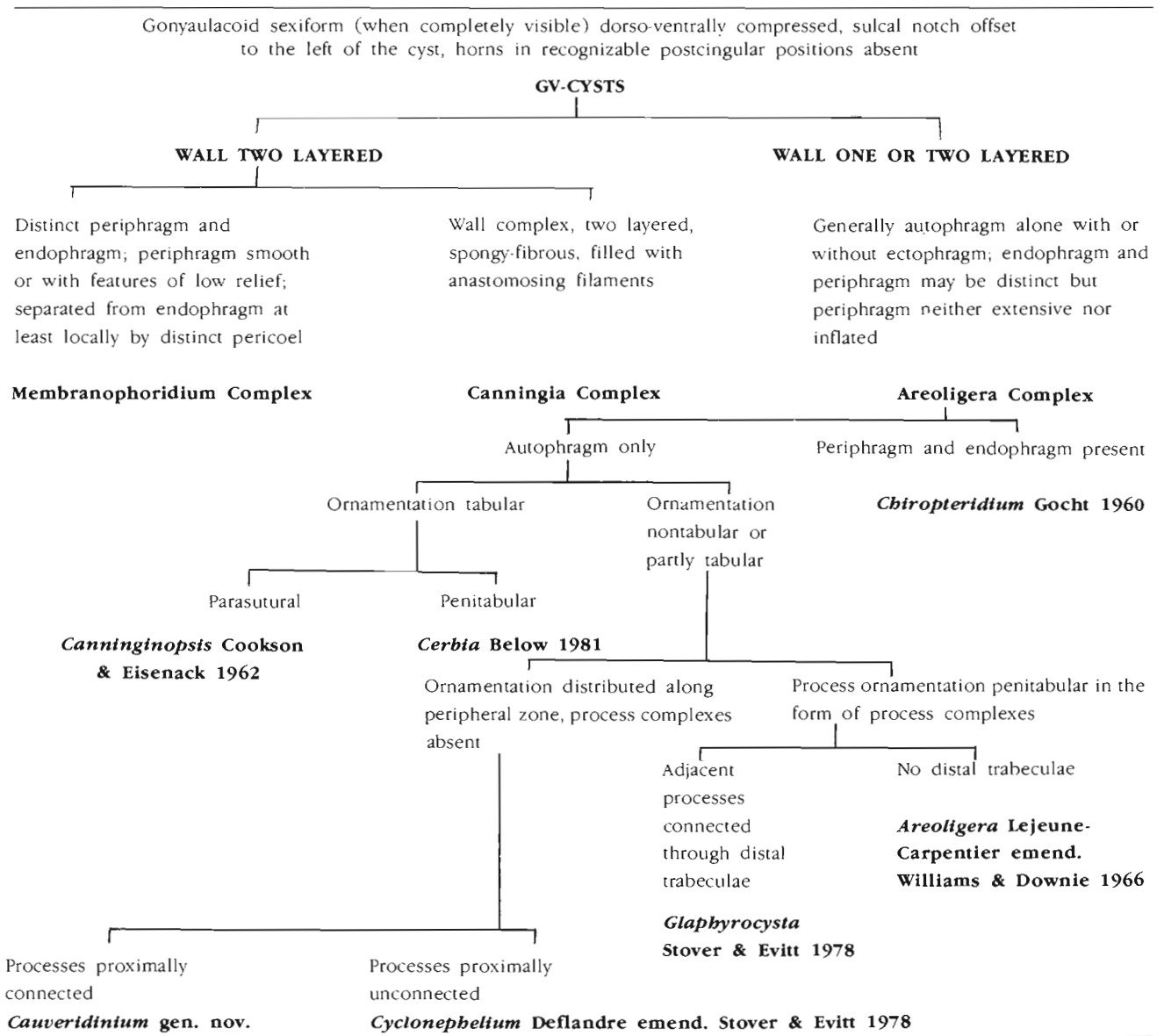
कावेरी द्रोणी की चूनापत्थर इकाई के परिवृत्तीय सीमा क्षेत्र, जो कि कटकें द्वारा निकटस्थ प्रवर्ध संयोजनों से युक्त है, से सीमित प्रवर्ध अलंकरण से युक्त कुछ मसुराकार घूर्णीकशाभ पुटीयों उपलब्ध हुई हैं। ये जी-वी० प्रकार की पुटीयाँ कावेरीडीनियम नामक नई प्रजाति के अन्तर्गत वर्णित की गई हैं। कावेरीडीनियम इंडिकम, क० इन्टरट्रेपियम एवं क० लॉपिस्याइनोसम नामक तीन नई जातियाँ प्रस्तावित की गई हैं। अन्य विदित जी-वी० प्रकार के वर्गकों से इनकी विस्तृत तुलना का प्रयास किया गया है।

A GROUP of skolochorate type of lenticular dinoflagellate cysts lacking horns in recognizable postcingular positions and having an apical archaeopyle has been recovered from Shell Limestone unit of Trichinopoly Formation, exposed near Kunnam and Kullakkanatham villages in Cauvery Basin, southern India. On palaeontological evidence this formation has been assigned Turonian-Santonian age.

Recently Evitt (1985, p. 171) grouped the known dinoflagellate cyst genera into 17 major morphological categories. The criterion is based on consideration of morphological features of the cysts, for example, shape, wall relationship, wall features, paratabulation and archaeopyle. One of these is the Gv-Cyst category, mainly characterized by lenticular body, apical archaeopyle, sulcal notch offset to the left of the cyst and absence of horns. Keeping in

view the above characters, Evitt (1985) further recognized three complexes, viz., *Areoligera* complex, *Membranophoridium* complex and *Canningia* complex, distinguishing each other on wall structure and surface ornamentation (Table 1).

Out of these three complexes, the *Areoligera* complex is differentiated from the other two complexes in that smooth or low to high relief features of autophragm. In view of the above summary of Gv-Cysts, it is apparent that the present dinoflagellate cysts are assignable to *Areoligera* complex which at present consists of six genera, viz., *Areoligera* Lejeune-Carpentier emend. Williams & Downie 1966, *Canningopsis* Cookson & Eisenack 1962, *Cerbia* Below 1981, *Chiropteridium* Gocht 1960, *Cyclonephelium* Deflandre & Cookson emend. Stover & Evitt 1978 and *Glaphyrocysta* Stover & Evitt 1978.

Table 1—Key to identify Gv-Cyst genera of *Areoligera* Complex

All type and figured slides are housed in the Museum, Birbal Sahni Institute of Palaeobotany, Lucknow. All coordinates refer to Olympus (BH-2) microscope no. 02939.

SYSTEMATIC PALYNOLOGY

Cauveridinium gen. nov.

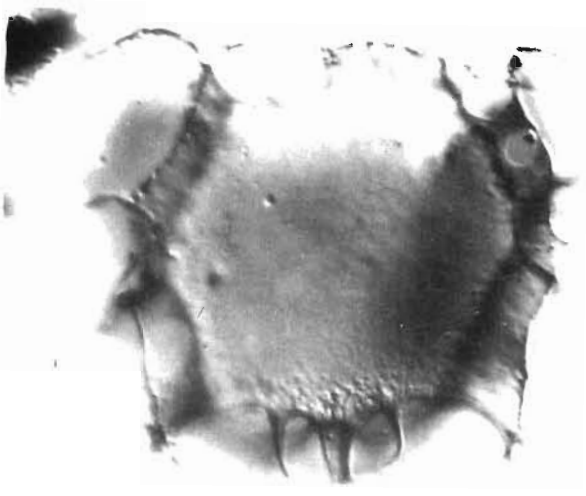
Type Species—*Cauveridinium indicum* sp. nov.

Diagnosis—Cyst skolochorate, lenticular, subcircular; apex obtusely angular; antapex with two unequal prominences separated by a concavity; autophragm ornamentation elaborate with processes along circumferential border zone but modified on central dorsal and central ventral areas; processes solid or hollow, mostly connected proximally through ridges, rarely distally fused; archaeopyle apical, type (4A), operculum simple, polyplacoid, free.

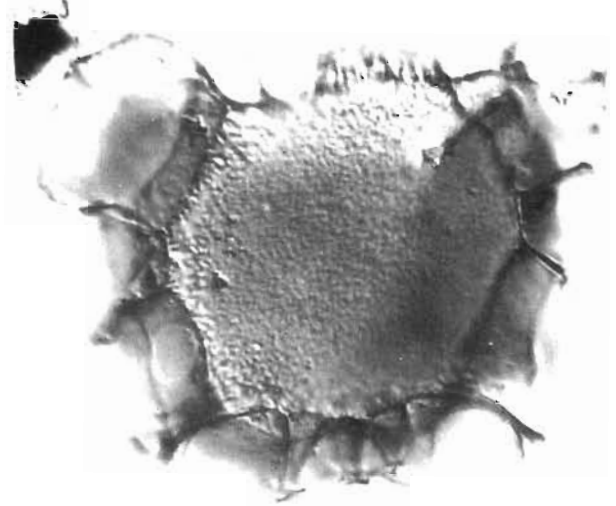
PLATE 1

(All photomicrographs in differential interference contrast, $\times 750$)
 1-6. *Cauveridinium indicum* sp. nov.
 1-3. In dorsal high to dorsal low views respectively.
 4,5. In ventral low and ventral high views respectively; slide no.

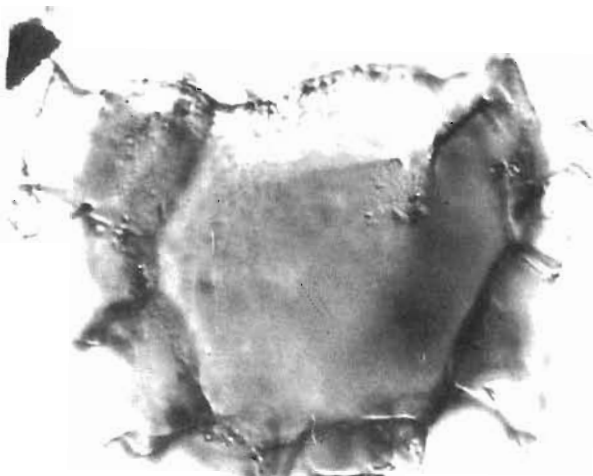
BSIP 10273; Coordinates: 3.0×146.9 (holotype).
 6. Detached operculum; slide no. BSIP 10273; Coordinates: 14.0×162.1 .



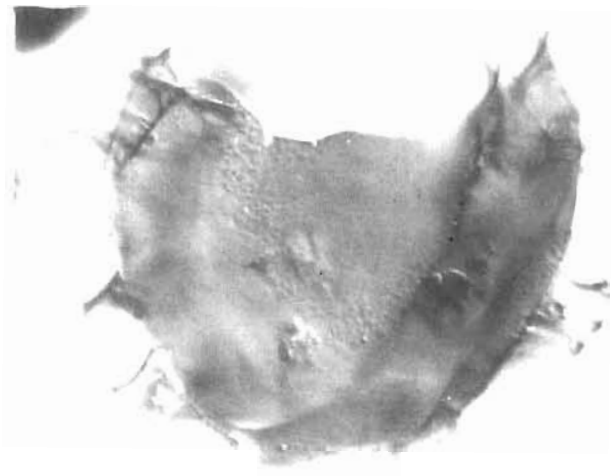
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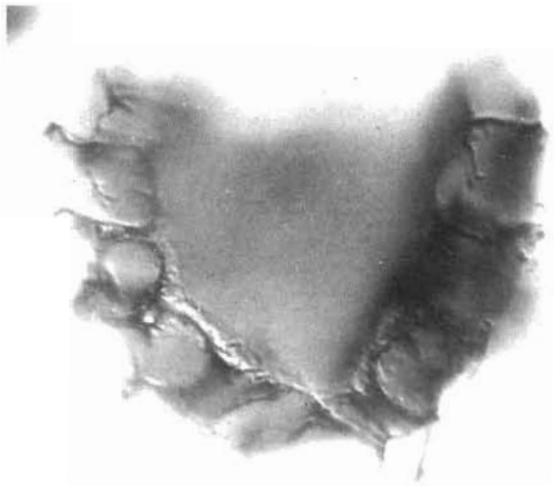
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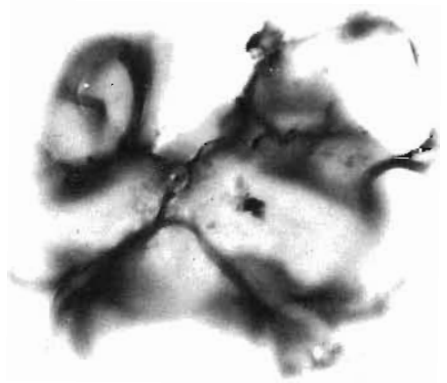
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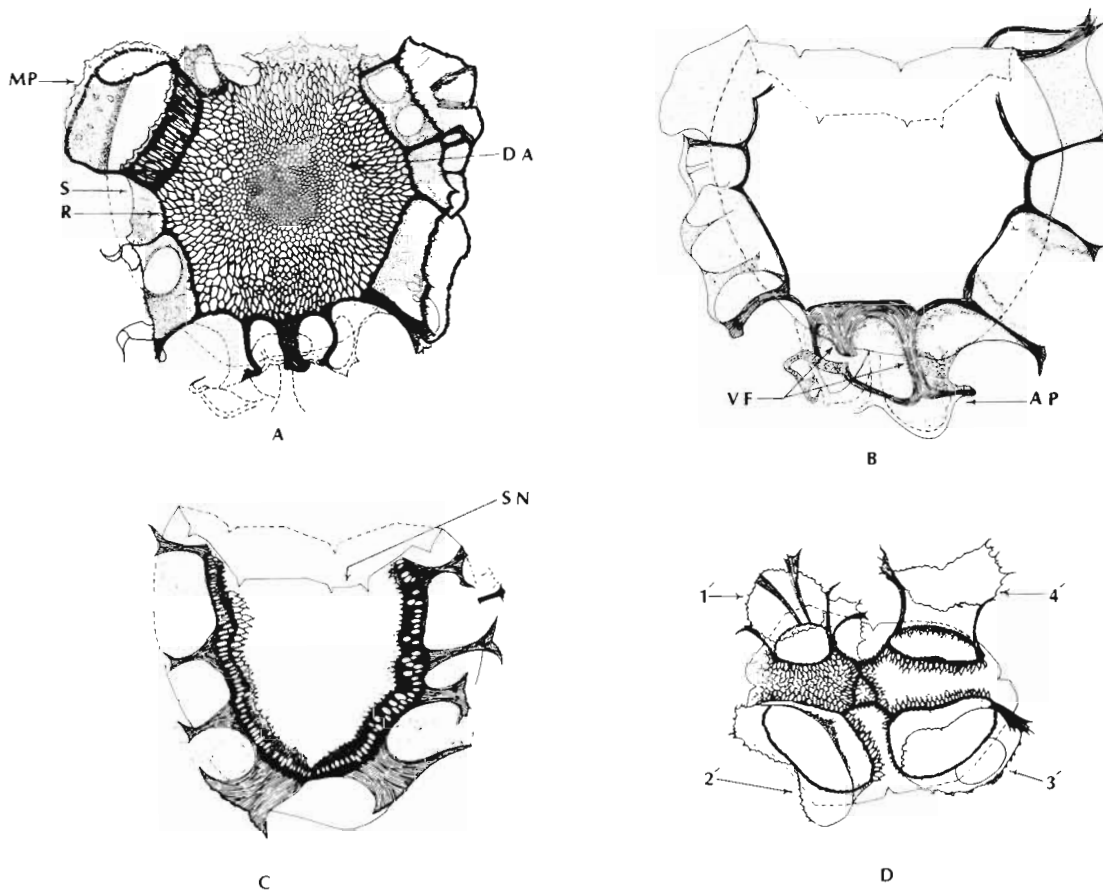
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Text-figure 1—*Cauveridinium indicum* sp. nov. : **A**, Dorsal high view showing differentiated autophragm (DA), membranous processes (MP), ridge (R) and septum (S) connecting adjacent processes; **B**, Ventral high view showing vertical fibres (VF) of antapical process (AP); **C**, Ventral low view showing sulcal notch (SN) offset to the left of the cyst and process distribution; **D**, Detached operculum showing proximal connections of apical processes in a definite pattern; all \times ca. 1000.

Remarks—A perusal of dinoflagellate cyst literature indicates that the development of ridges, septa or trabeculae, connecting processes, is an important character for generic identification. A few examples supporting the above statement are the distinction between *Glaphyrocysta/Cyclonephelium*, *Peridictyocysta/Prolixosphaeridium*, *Distatodinium/Tanyosphaeridium*, *Hystrichosphaerina/Perisseiasphaeridium*, *Emmetrocysta/Systematophera*, *Achomosphaera/Spiniferites*, etc.

Dinoflagellate cysts described under a new genus *Cauveridinium* are, in general, of *Cyclonephelium* morphology but are distinguished

from the latter in characteristic development of ridges connecting the adjacent processes proximally. The other genera of *Areoligera* complex are compared and differentiated here (Table 1).

Cauveridinium indicum sp. nov.

Pl. 1, figs 1-6; Pl. 2, fig. 6; Pl. 3, figs 5, 6; Text-fig. 1A-D

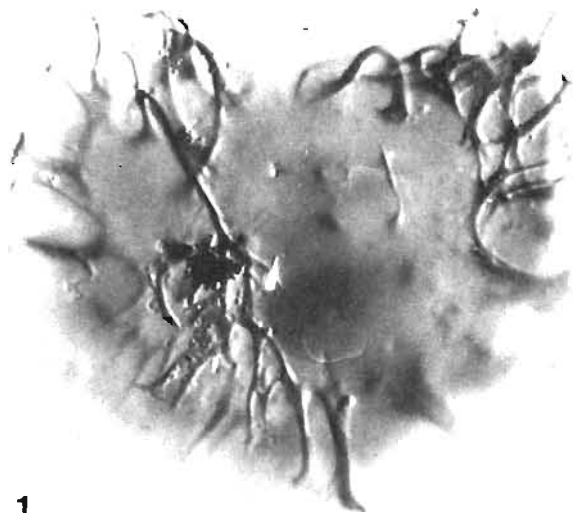
Holotype—Pl. 1, figs 1-5; Text-fig. 1A-C; Slide no. BSIP 10273; Coordinates: 3.0×146.9 ; Trichinopoly Formation, Kunnam, Cauvery Basin, Turonian-Santonian.

Diagnosis—Cyst skolochorate, lenticular,

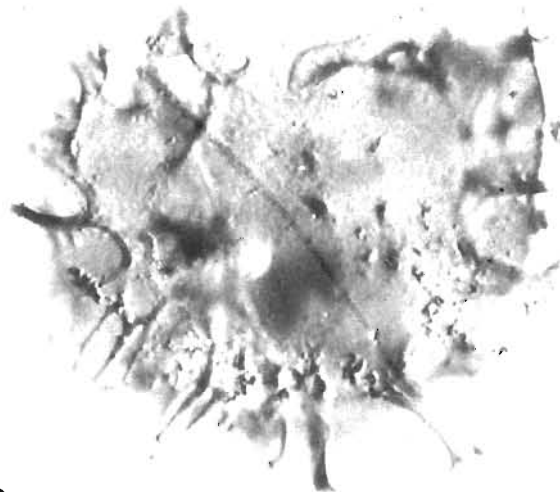
PLATE 2

(All photomicrographs in differential interference contrast, \times 750)
1-5. *Cauveridinium intermedium* sp. nov.
1-3. In dorsal high to dorsal low views respectively.
4,5. In ventral low and ventral high views respectively; slide no.

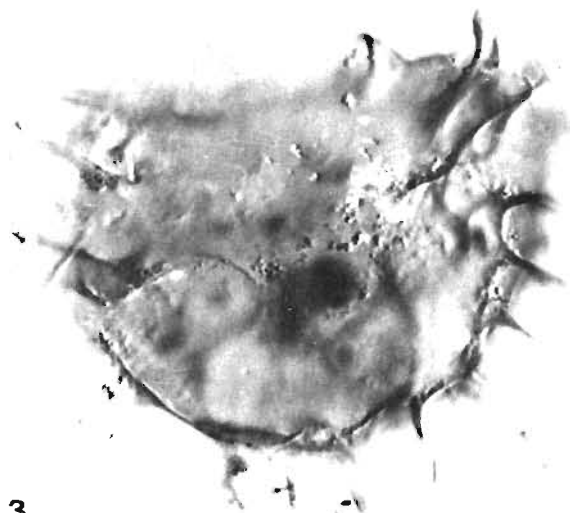
BSIP 10274; Coordinates: 17.6×159.1
6 *Cauveridinium indicum* sp. nov.—detached operculum; slide no. BSIP 10273; Coordinates: 2.1×162.5 .



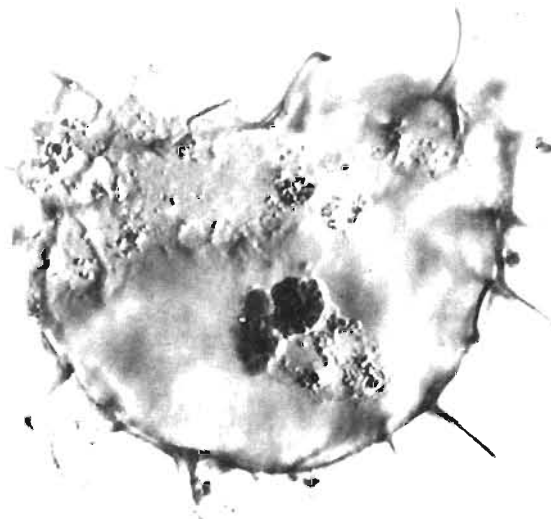
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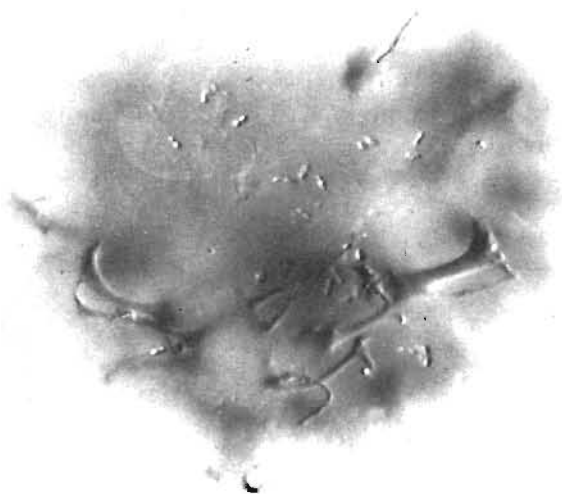
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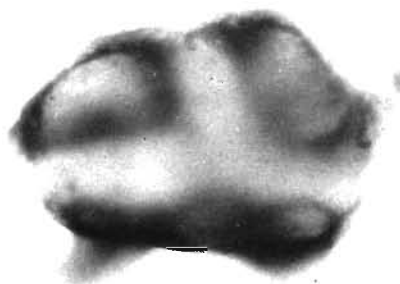
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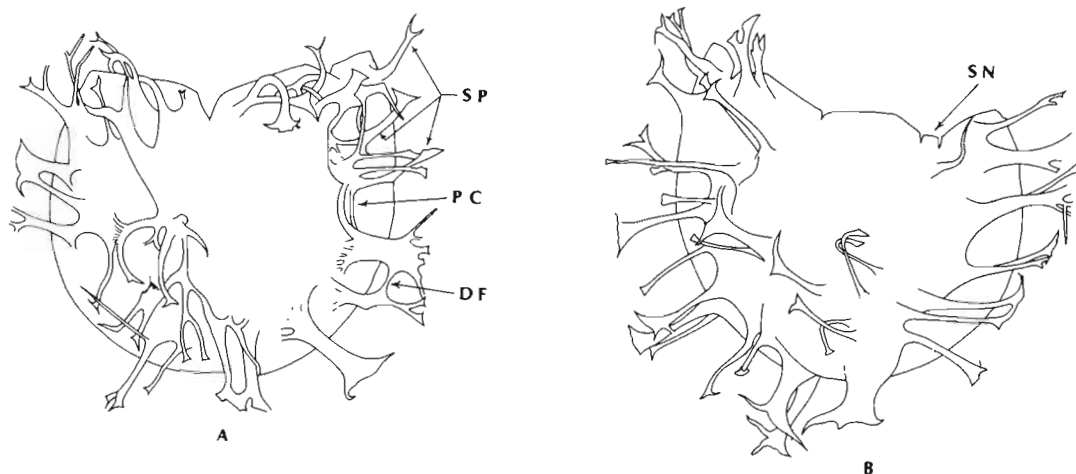
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Text-figure 2—*Cauveridinium intermedium* sp. nov. : **A**, Dorsal view showing general distribution, shape, proximal connections (PC) and distal fusions (DF) of solid processes (SP); **B**, Ventral view showing sulcal notch (SN) offset to the left of the cyst and process distribution: all \times ca. 1000.

subcircular; apex obtusely angular; antapex with two unequal prominences separated by a concavity; autophragm differentiated (*sensu* Evitt, 1985); processes restricted to circumferential border zone, absent on central dorsal and central ventral areas, short, broad, membranous, fenestrate, supported by vertical fibres; processes proximally connected through thick ridges and a few mostly on dorsal surface also laterally connected through septa; archaeopyle apical, type (4A), operculum simple, polyplacoid, free; apical processes four, one per paraplate, proximally connected to a triangular structure formed at pre-apical paraplate position through ridges.

Description :

Shape—Cyst dorso-ventrally compressed, subcircular, sulcal notch offset to left of cyst (Text-fig. 1B,C); apical margin obtusely angular, antapex with two unequal prominences separated by a concavity.

Wall relationship—Autophragm only.

Wall features—No parasutural features; fibrous, spongy, fibre-like elements arise from process bases and ridges which merge with others, packing density of these elements increases inwardly, becoming quite continuous, homogeneous and less spongy towards center (Text-fig. 1A); ornamented with

processes; processes restricted to circumferential border zone, covering more areas on ventral than dorsal side (Text-fig. 1C), central dorsal and central ventral areas free of processes; processes short, broad, membranous, fenestrate, distal margins irregular, serrate, supported by vertical fibres, adjacent processes on each side proximally connected through a ridge, some laterally connected through septa (Text-fig. 1A); apical processes proximally connected through ridges to a triangular structure at pre-apical paraplate position in a definite pattern, processes of 2' and 3' directly connect but of 1' and 4' first join together and then connect through a common ridge (Text-fig. 1D).

Paratabulation—Indicated by archaeopyle alone.

Archaeopyle—Apical, type (4A), operculum simple, polyplacoid, free (Text-fig. 1D).

<i>Dimensions</i>	<i>Holotype</i>	<i>Range</i>
Size of body	70 \times 80 μ m	70-80 \times 65-82 μ m
Length of processes	6-12 μ m	6-20 μ m

Remarks—The details of apical processes and operculum type mentioned for *C. indicum* sp. nov. are based on two well preserved dispersed specimens which possess identical differentiated autophragm and process type characteristic of the cyst.

PLATE 3

(All photomicrographs in differential interference contrast, \times 750)

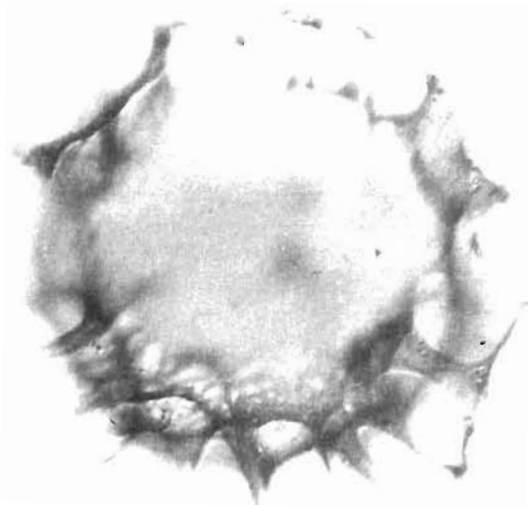
1-4. *Cauveridinium longispinosum* sp. nov.

1,3. In dorsal high to dorsal low views respectively.

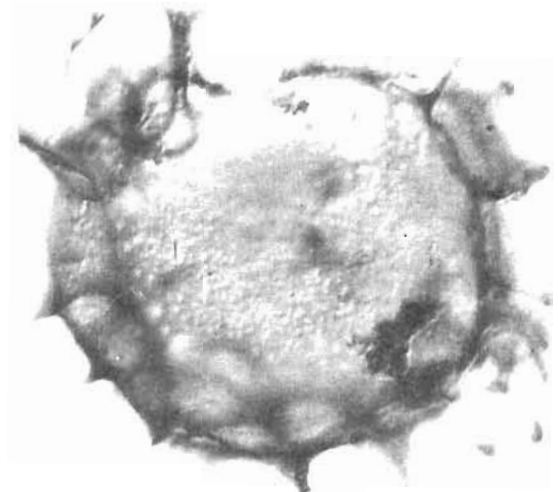
4. In ventral view; slide no. BSIP 10275; Coordinates: 13.0 \times

159.5 (holotype)

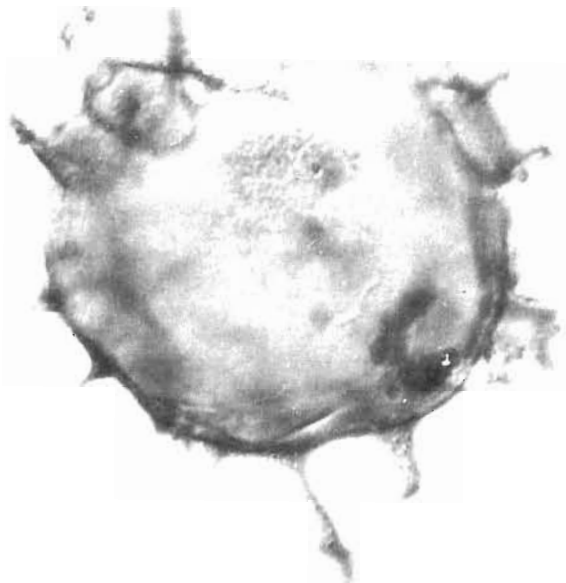
5,6. *Cauveridinium indicum* sp. nov.—detached opercula; slide no. BSIP 10273; Coordinates: 14.0 \times 162.1 and 2.1 \times 162.5 respectively.



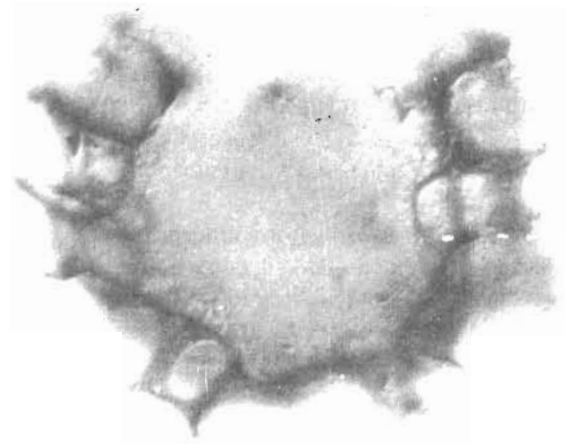
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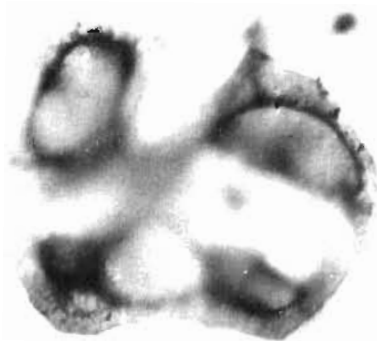
2



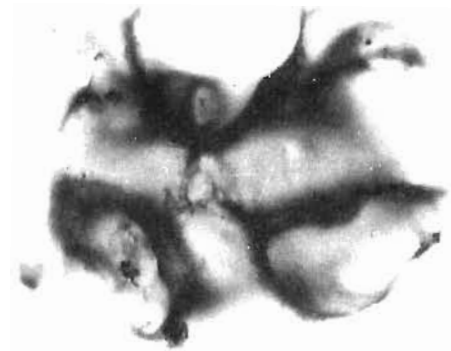
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Cauveridinium intermedium sp. nov.

Pl. 2, figs 1-5; Text-fig. 2A-B

1962 *Cyclonephelium distinctum* Deflandre & Cookson—In Cookson & Eisenack, p. 494; pl. 5, figs 8-11.

1978 *C. distinctum* Deflandre & Cookson—In Morgan, p. 923; pl. 10, fig. 3.

1978 *C. distinctum* sub sp. *longispinatum* Davey, p. 894; pl. 3, figs 4, 7, 8.

Holotype—Pl. 2, figs 1-5; Text-fig. 2A-B; Slide no. BSIP 10274; Coordinates: 17.6 × 159.1; Trichinopoly Formation, Kullakkanatham, Cauvery Basin, Turonian-Santonian.

Diagnosis—Cyst skolochorate, lenticular, subcircular; apex obtusely angular; antapex with two reduced, unequal prominences, separated by a concavity; autophragm smooth, ornamented with processes; processes restricted to circumferential border zone, absent on central dorsal and central ventral areas, solid, branched, variable in length and breadth, proximally connected, a few distally fused; archaeopyle apical, type (4A), operculum free.

Description :

Shape—Cyst dorso-ventrally compressed, subcircular, sulcal notch offset to left of cyst (Text-fig. 2B), apical margin obtusely angular; antapex with two reduced, unequal prominences separated by a concavity.

Wall relationship—Autophragm only.

Wall features—No parasutural features, autophragm smooth, ornamented with processes restricted to circumferential border zone, absent on central dorsal and central ventral areas; processes solid, branched, variable in size, mostly proximally connected through ridges; others single, unconnected; some distally fused (Text-fig. 2A).

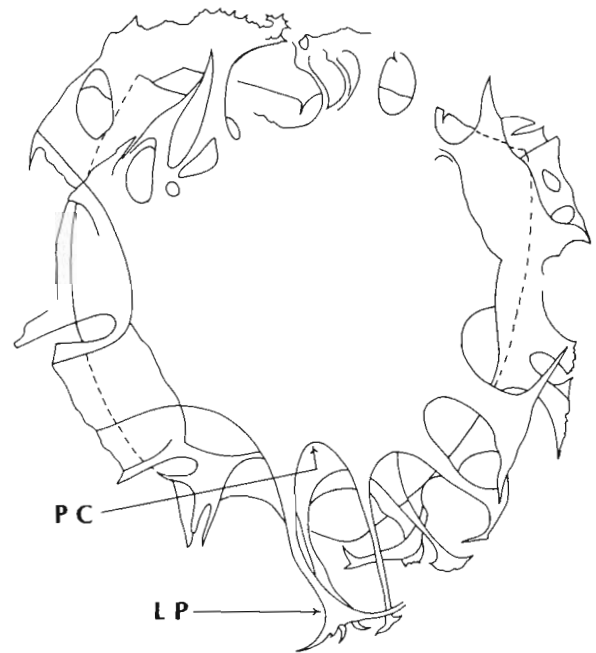
Paratabulation—Indicated by archaeopyle alone.

Archaeopyle—Apical, type (4A), operculum free.

<i>Dimensions</i>	<i>Holotype</i>	<i>Range</i>
Size of body (without operculum)	58 × 64 μm	55.75 × 52-64 μm

<i>Length of</i>	<i>Holotype</i>	<i>Range</i>
processes	8-20 μm	6-22 μm

Comparison—*Cauveridinium intermedium* sp. nov. is an interesting species having features of both *Cyclonephelium distinctum* Deflandre & Cookson 1955 and its own. The occurrence of simple and unconnected processes suggests comparison with *C. distinctum* but proximally connected adjacent processes through a ridge differentiate it from *Cyclonephelium*. The other two species, *Cauveridinium indicum* sp. nov. and *C.*



Text-figure 3—*Cauveridinium longispinosum* sp. nov.: Dorsal view showing long processes (LP) with proximal connections (PC): × ca. 1000.

longispinosum sp. nov., differ from *C. intermedium* in that differentiated autophragm.

Cauveridinium longispinosum sp. nov.

Pl. 3, figs 1-4; Text-fig. 3

Holotype—Pl. 3, figs 1-4; Text-fig. 3; Slide no. BSIP 10275; Coordinates: 13.0 × 159.5; Trichinopoly Formation, Kunnam, Cauvery Basin; Turonian-Santonian.

Diagnosis—Cyst skolochorate, lenticular, subcircular, apex obtusely angular; antapex with two unequal, reduced prominences separated by a concavity; autophragm differentiated, ornamented with processes; processes restricted to circumferential border zone, absent on central dorsal and central ventral areas, variable in size, adjacent processes connected proximally through ridge; archaeopyle apical, type (4A), operculum free.

Description :

Shape—Cyst dorso-ventrally compressed, subcircular, sulcal notch offset to left of cyst, apical margin obtusely angular; antapex with two unequal prominences separated by a concavity.

Wall relationship—Autophragm only.

Wall features—No parasutural features; autophragm fibrous, spongy; fibre-like elements arise from process bases and ridges which merge with others, packing density of these elements increases inwardly, becoming quite continuous,

homogeneous and less spongy toward centre, ornamented with processes, processes restricted to circumferential border zone, absent on central dorsal and central ventral areas, long, variable in length and breadth, constricted in middle but flared and fenestrate distally; adjacent processes of each side of cyst proximally connected through a ridge (Text-fig. 3), larger in size on dorsal than ventral side.

Paratabulation—Indicated by archaeopyle alone.

Archaeopyle—Apical, type (4A), operculum free.

<i>Dimensions</i>	<i>Holotype</i>	<i>Range</i>
Size of body (without operculum)	56 × 66 μm	55-68 × 60-70 μm
Length of processes	9-26 μm	8-35 μm

Comparison—*Cauveridinium longispinosum* sp. nov. differs from *C. intermedium* sp. nov. in having differentiated autophragm and from *C. indicum* sp. nov. in that long, non-membranous processes.

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