hemizygous for irradiated chromosomes. The observed "heterosis" was therefore spurious, in that it was not in fact the effect of a viability of the heterozygote superior to that of either homozygote. It is suggested that some previous reports on differences in mutability between types of crosses or on "heterosis" of flies heterozygous for induced mutations were also caused by intraculture competition.

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*A DISCUSSION AND PROPOSALS CONCERNING FOSSIL DINOFLAGELLATES, HYSTRICHOSPHERES, AND ACRITARCHS, II**,†

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Family AREOLIGERACEAE n. fam.

Type genus: *Areoligera* Lejeune-Carpentier 1938.[1]

Diagnosis: Dorso-ventrally flattened dinoflagellate tests, circular to irregularly elliptical or triangular in dorsal or ventral view. Wall of central body smooth or with a few to many projecting surface structures in the form of apiculate granules or basically spinelike processes on the one hand, low ridges, folds, or membranous septa on the other, or both in combination. Processes are typically either nontabular or intratabular (single or in groups), but granulate tests may show some larger sutural granules. The tips of processes may be free or interconnected by either trabeculae or a membranous outer layer. Archeopyle exclusively apical with conspicuous sulcal notch that lies consistently away from the midline of ventral surface. Bilateral symmetry commonly suggested by larger processes.

Genera referable to the family: *Areoligera* Lejeune-Carpentier 1938, *Canningia* Cookson & Eisenack 1960, *Chiropteridium* Gocht 1960, *Circulodinium* Alberti 1961, *Cyclonephelium* Deflandre & Cookson 1955, *Membranophoridium* Gerlach 1961, *Tenua* Eisenack 1958.

Discussion: The family is distinguished from the Hystrichosphaeraceae by the nontabular or intratabular major processes and by the exclusively apical archeopyle. It is distinguished from both the Hystrichosphaeraceae and the Hystrichosphaeridiaceae by several features: (1) the dorso-ventral flattening, (2) the offset sulcal notch, (3) a tendency for surface structures on dorsal and ventral surfaces to be developed to different degrees, and (4) a tendency toward a bilateral symmetry in the form and distribution of large processes.

The outline in dorsal or ventral view may or may not show a distinct but rounded apical prominence and one or two unequal antapical prominences that reflect apical and antapical horns. The dorsal and ventral surfaces are commonly unlike in convexity (ventral surface less convex) and in details of the size, form, and distribution of processes (see Fig. 4, Part I[†]). Processes tend to be reduced in number and length in the central portions of these surfaces, especially the ventral one. A tendency toward bilateral symmetry in the distribution of processes of similar size and form is usually recognizable (conspicuous in some heavily ornamented types). This quasi-symmetry of the processes contrasts with the asymmetrical position of the sulcal notch and the asymmetrically developed traces of two antapical horns.

The wall may appear one-layered or distinctly two-layered. The inner layer of a two-layered wall forms the capsule, which varies from smooth to spinose. The outer layer surrounding the capsule may be relatively featureless, may form outwardly radiating processes, or may be itself supported by processes that extend from the capsule. Processes may be hyaline or fibrous, solid or hollow, and may stand freely or have simple or intricate connections with adjacent processes (especially in a more or less meridional row along the sides of dorsal and ventral surfaces). The girdle and polar processes may be of somewhat different design than the rest. A typical dinoflagellate tabulation often can be inferred partially from the number and arrangement of processes, but in many forms its only suggestion is the typically zigzag archeopyle margin. The distinctive sulcal notch in the margin of the exclusively apical archeopyle lies consistently to the left side of the ventral surface.

Lejeune-Carpentier[1] discussed thoroughly the morphology of *Areoligera*, omitting only one significant point in her analysis. She did not mention the conspicuous opening, the apical archeopyle, that truncates the outline of most specimens (see Fig. 4A, Part I). Her drawings, however, show this truncation: for example, her Fig. 1 of *A. senonensis*, the type species, and Fig. 7 of *A. coronata*; her Fig. 5 appears to represent the operculum of the archeopyle in still another species, *A. medusettiformis*. (Compare Evitt, 1961, pl. 8, Figs. 13–15; pl. 9, Figs. 3–5.) Mr. Hans Gocht has examined the holotype of *A. coronata*, which Lejeune-Carpentier also studied, and reports (*in litt.*) that the zigzag rupture line is clearly developed. The same features are well shown in Gocht's[2] illustrations of the similar genus *Chiropteridium*.

Most described species that are referable to Areoligeraceae as conceived here fall into two groups:

1. In one group, typified by *Tenua hystrix*, Forma C of Evitt (1961, pl. 1, Figs. 18–22), *Cyclonephelium compactum* and *C. distinctum* (Deflandre and Cookson, 1955), *Canningia*, and *Circulodinium*, the surface is smooth or ornamented with many closely spaced, short, subequal elements, often with expanded or T-shaped tips and some interconnections. The wall may appear to consist of one layer. If two wall layers are apparent, the outer one is supported by processes that rise from the inner one. A tabulation is usually not clearly indicated.

2. In the second group, typified by *Areoligera* (see Fig. 4, Part I), *Chiropteridium*

and *Membranophoridium*, the often conspicuously intratabular processes or process-groups are relatively longer, larger, and fewer. It is in this second group that an approach toward bilateral symmetry of process arrangement may be striking. The ventral tabulation is usually not distinct because the processes in the central area are reduced. The determinable tabulation is 4′, 6″, 5‴ (6‴ probably), 1p, 1⁗. The wall is usually distinctly two-layered, one layer forming the processes and one the capsule.

In larger perspective, many of the differences in morphological details that distinguish typical Hystrichosphaeraceae and Hystrichosphaeridiaceae on the one hand from typical Areoligeraceae on the other seem to relate to just two fundamental morphologic differences. One difference concerns the degree of dorso-ventral flattening, accompanied by a lateral shift in the position of the sulcal notch. The nearly spherical (or ellipsoidal) Hystrichosphaeraceae and Hystrichosphaeridiaceae approach a radial (or axial) symmetry. Such slight bilateral arrangement of their surface structures as can be detected is related to a sagittal plane that passes through the inferred position of the sulcus. The Areoligeraceae, in contrast, have compressed bodies with the inferred sulcus (at least the sulcal notch that marks its apical end) off toward one side of the ventral surface. The bilateral arrangement of processes, which is often conspicuous, is not related to the position of this notch, but to a plane that passes through the centers of dorsal and ventral surfaces. These features already have been described in some detail[3] in connection with a comparison of *Areoligera* and *Systematophora*.

The second fundamental difference concerns the degree of variation in the distance between the inner wall of the cyst and the inner surface of the theca, as measured by the processes that are inferred to have supported the cyst against the theca. In the Hystrichosphaeraceae and Hystrichosphaeridiaceae the approximately equal length of all processes on a single specimen indicates a central body essentially concentric within the theca. In the Areoligeraceae the lengths of processes on a single specimen are graded in a manner suggesting that the central portions of the ventral and dorsal capsule surfaces were close to, or in contact with, the theca, whereas the lateral portions were more remote from it.

New Group: Acritarchs

Definition: Small microfossils of unknown and probably varied biological affinities consisting of a central cavity enclosed by a wall of single or multiple layers and of chiefly organic composition; symmetry, shape, structure, and ornamentation varied; central cavity closed or communicating with the exterior by varied means, for example: pores, a slitlike or irregular rupture, a circular opening (the pylome).

Discussion: Many taxa of fossils once assigned to the Order Hystrichosphaerida can now be referred to the Dinophyceae on the basis of definitive morphological criteria. Among these taxa are the genus *Hystrichosphaera* and the family Hystrichosphaeraceae, the taxa upon which the name Hystrichosphaerida was based. Left behind by this transfer is a "residue" of forms of unknown affinities for which the name Hystrichosphaerida is no longer appropriate. It is for this "residue" that I propose the name *acritarchs* (Latin, acritarcha; French, acritarche; German, Acritarch; Russian, акритарх). A name is desirable to facilitate communication about these widespread, often abundant, and morphologically varied microfossils that cannot (at the present state of our knowledge) be more precisely identified. The name chosen implies no affinity with any other organisms and is not derived from the name of any taxon included in the group (ακριτος, uncertain, confused, and ἀρχή, origin).

Along with Deflandre[4, 5] and others, I believe that the acritarchs as defined here are a polyphyletic assemblage. At this moment of proposal the group comprises the former Hystrichosphaerida broadly construed, with the exception of those fossils identifiable as dinoflagellates. Some acritarchs are probably dinoflagellates that lack the minimum of morphological features required for positive recognition. Surely most of them are not dinoflagellates, but, in aggregate, represent a variety of life stages (e.g., eggs, cysts, mature tests) of assorted one-celled and higher organisms, both plants and animals. Accordingly, and in contrast to the Hystrichosphaerida which was proposed as an order, this group is proposed as an informal, utilitarian, "catch-all" category without status as a Class, Order, or other suprageneric unit (no matter whether the vernacular or the Latin form of the name is used). Whenever the biological affinities of individual acritarch genera can be established with sufficient precision, those genera should forthwith cease to be referred to as acritarchs and should be assigned to their proper places in the taxonomic hierarchy under the appropriate nomenclatural code. For example, almost immediate removal of at least *Tasmanites* to the Chlorophyceae seems warranted.[6] As remarked earlier in this paper, I recommend that the acritarchs be treated under the Botanical Code.

In the sense proposed here, the acritarchs include some of the microfossils from the Huronian Gunflint formation, all Paleozoic ex-hystrichospheres, and many ex-hystrichospheres from the Mesozoic and Tertiary. However, most fossils from the last two eras that have been termed hystrichospheres in the past appear to be dinoflagellates. The following list includes the principal genera I would refer to the acritarchs until their biological affinities can be recognized: *Acanthodiacrodium* Tim. 1958 em. G.&M. Defl. 1962, *Anthatractus* Denuff 1954, *Antrosphaera* Sarjeant 1961, *Archaeohystrichosphaeridium* Tim. 1959, *Aremoricanium* Deunff 1955, *Baltisphaeridium* Eis. 1958, *Ceratocystidiopsis* Defl. 1937, *Cirrifera* Cook. & Eis. 1960, *Crassosphaera* Cook. & Manum 1960, *Cymatiogalea* Deunff 1961, *Cymatiosphaera* O. Wetzel 1933 em. Defl. 1953, *Dasydiacrodium* Tim. 1959 em. G. & M. Defl., 1962, *Deunffia* Downie 1959, *Dictyosphaeridium* W. Wetzel 1952, *Dictyotidium* Eis. 1955, *Dioxya* Cook. & Eis. 1958, *Diplofusa* Cook. & Eis. 1960, *Diplotesta* Cook. & Eis. 1960, *Disphaeria* Cook. & Eis. 1960, *Disphaerogena* O. Wetzel 1933, *Domasia* Downie 1959, *Estiastra* Eis. 1959, *Fromea* Cook. & Eis. 1958, *Gillinia* Cook. & Eis. 1960, *Kalyptea* Cook. & Eis. 1960, *Komewuia* Cook. & Eis. 1960, *Korojonia* Cook. & Eis. 1958, *Leiosphaeridia* Eis. 1958, *Leiosphaeridium* Tim. 1959, *Lophodiacrodium* Tim. 1958 em. G. & M. Defl. 1962, *Lophosphaeridium* Tim. 1959, *Lunulida* Eis. 1958, *Micrhystridium* Defl. 1937, *Multiplicisphaeridium* Staplin 1961, *Netrelytron* Sarjeant 1961, *Omatia* Cook. & Eis. 1958, *Orycmatosphaeridium* Tim. 1959, *Palaeostomocystis* Defl. 1935, *Palaeotetradinium* Defl. 1934, *Platycystidia* Cook. & Eis. 1960, *Pleurozonaria* O. Wetzel 1933, *Polyedryxium* Deunff 1954, *Priscogalea* Deunff 1961, *Priscotheca* Deunff 1961, *Protoleiosphaeridium* Tim. 1959, *Pterocystidiopsis* Defl. 1935, *Pterospermopsis* W. Wetzel 1952, *Pulvinosphaeridium* Eis. 1954, *Sam-*

landia Eis. 1954, *Symplassosphaeridium* Tim. 1959, *Tasmanites* Newton 1875, *Trachydiacrodium* Tim. 1959 em. G. & M. Defl. 1962, *Trematosphaeridium* Tim. 1959, *Trigonopyxidia* Cook. & Eis. 1961, *Tytthodiscus* Norem 1955, *Vavososphaeridium* Tim. 1959, *Veryhachium* Deunff 1954, *Vulcanisphaera* Deunff 1961, *Zonosphaeridium* Tim. 1959. The shapes of some of the post-Paleozoic fossils included in the above genera suggest they may well be dinoflagellates, but other morphological characters that would substantiate their dinoflagellate affinities have not been noted.

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† For Part I, *see* these PROCEEDINGS, vol. 49, p. 158.

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*RESTRICTED INFRAPOLYNOMIALS AND TRIGONOMETRIC INFRAPOLYNOMIALS**

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The object of this note is (*i*) to present a complement to a theorem recently proved by the present writer and (*ii*) to indicate that the enlarged theorem applies to the study of trigonometric infrapolynomials. The result previously established[1] is

THEOREM 1. *Let the compact point set E containing at least* n *points lie on the circle* $|z| = 1$, *and let* A_n *be prescribed, with* $|A_n| = 1$. *Then all zeros of every restricted infrapolynomial* $p_n(z) \equiv z^n + a_1z^{n-1} + \cdots + a_{n-1}z + A_n$ *on E with prescribed constant term* A_n *lie on* $|z| = 1$.

For the terminology the reader may refer to reference 1. We shall indicate the proof of the

COROLLARY. *Under the conditions of Theorem* 1, *every arc of* $|z| = 1$ *containing two zeros of* $p_n(z)$ *contains at least one point of E.*

That is to say, the zeros of $p_n(z)$ are weakly separated on $|z| = 1$ by a subset of E.

Let an arc α of $|z| = 1$ contain two zeros z_1 and z_2 (not necessarily distinct) of $p_n(z)$, but contain no point of E; we shall reach a contradiction. The polynomial