NEOGENE *TASMANITES* AND LEIOSPHERES FROM SOUTHERN LOUISIANA, U.S.A.

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ABSTRACT. *Tasmanites*, *Tytthodiscus*, and leiospheres assignable to *Leiosphaeridia*, are present in Neogene shales of the Gulf Coast area of southern Louisiana, U.S.A. Seven species of *Tasmanites*, one species of *Tytthodiscus*, and two species of *Leiosphaeridia* are described from sidewall core samples; all except *Tytthodiscus* are new.

THE microfossils considered here are important representatives of the microflora and fauna of various brackish-marine clays and shales investigated by the Sun Oil Company palynological research group. All samples are believed to be from upper Miocene sediments. However, the Plio-Miocene boundary is still subject to debate in the area of study, and Neogene seems most applicable. The wells utilized in this investigation are listed below with numerical designations corresponding to their locations on text-fig. 1.

1. Sun Chacahoula L. R. and P. No. 7 (Sec. 66, 15 S., 15 E.) La Fourche Parish, Louisiana.
2. Sun Belle Isle No. 1 (Sec. 26, 17 S., 10 E.) St. Mary Parish, Louisiana.
3. Humble No. 1 (Sec. 12, 22 S., 16 E.) Terrebonne Parish, Louisiana.
4. Sun Lake Pelto No. 1 (Sec. 10, 23 S., 18 E.) Terrebonne Parish, Louisiana.

All of the samples used in this study were processed by means of mechanical disaggregation without the use of acids as described by Felix (1963).

For years there has been debate concerning the microfossils assigned by different investigators to *Tasmanites* and to the various leiosphere genera. Schopf, Wilson, and Bentall (1944) thoroughly covered the nomenclature problem of *Tasmanites*, and Schopf (1957) later surveyed contributions dealing with this problematic genus. Winslow (1962) has made the most systematic survey of *Tasmanites* in upper Devonian and lower Mississippian beds. Eisenack (1938) identified as *Leiosphaera* a microfossil resembling *Tasmanites* in some respects. *Leiosphaera* subsequently proved to be invalid and Eisenack (1958*a*, 1958*b*) established *Leiosphaeridia* as a leiosphere genus to include forms not attributable to *Tasmanites*. These developments and subsequent contributions to leiosphere taxonomy have been reviewed by Staplin (1961), and more recently Downie and Sarjeant (1963) in a critical analysis of leiosphere taxonomy have brought some measure of order to the taxonomy. However, there is still general disagreement among current investigators on both nomenclature and classification of these organisms.

Tasmanites has been most notably associated with the Devonian–Mississippian black shales by American geologists. It has proven to be of practical value in stratigraphic studies, and Jodry and Campau (1961) have surveyed the useful potential of the genus. Even though it is more often associated with Paleozoic sediments, there have been references to *Tasmanites* being present in younger sediments. Radforth and Rouse (1956) noted the projection of the *Tasmanites* range into Cretaceous and Tertiary strata. Rouse (pers. communication) also confirmed the presence of *Tasmanites* in the Onakawana

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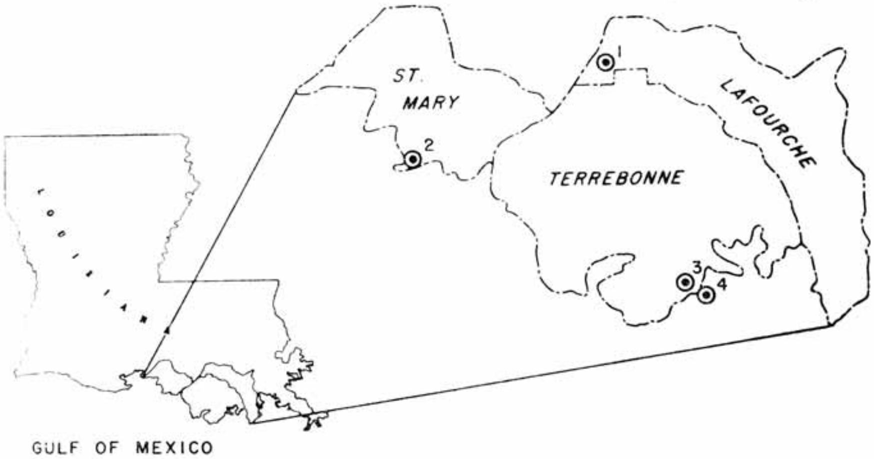
complex of the Tertiary of Ontario, Canada, while recently Winslow (1962) reported probable early Cretaceous occurrences in Alaska. It has also been recorded from the middle Silurian of Illinois in the U.S.A., the lower Carboniferous of England, and the original identification of *Tasmanites* was from beds in Tasmania dated as Permian.

For several years the author has found *Tasmanites* and leiospheres in different Tertiary sediments, and they have been especially numerous in subsurface shales of Neogene age in the Gulf of Mexico coastal area of southern Louisiana. Study of this unexpected



TEXT-FIG. 1. Locality map, showing area of study and wells mentioned in the present investigation.

occurrence was approached with consideration of possible contamination or redeposition. The former possibility must be ruled out in view of the use of core samples and the degree of carefulness employed in sample preparation. Moreover, thousands of samples were processed and many were reprocessed with the same end results. Redeposition was carefully considered since these microfossils do have a long history of such re-occurrence. However, in the final analysis there is no evidence for redeposition of the specimens considered here. These Tertiary specimens do not fit into any forms known from the Paleozoic; their association with other microfossils to form characteristic, and easily recognized, assemblages of specific environments does not remotely resemble associations of the classical Paleozoic forms; and the several other geological and paleontological disciplines of this research laboratory collaborating on the same research problem have not established any evidence for redeposition. Recently the report by Wall (1962) of similar organisms in the modern seas, and this writer's find of *Tasmanites* and leiosphere-like bodies in the modern Gulf of Mexico sediments lends additional credence to their existence in the Tertiary.

The confusion concerning the systematics of these fossils renders naming difficult. On the basis of Schopf, Wilson, and Bentall's (1944) comprehensive study of *Tasmanites* and Winslow's (1962) emendation of *Tasmanites huronensis*, the genus seems to be amply described. Admittedly some microfossil forms do differ markedly from *Tasmanites* and some of the differences of opinion concerning the taxonomic status of the leiospheres are probably justified. It appears that punctation of the disseminule wall is the major feature of *Tasmanites*. Although degrees of punctation vary in *Tasmanites*, it is never a feature of the leiospheres. The writer does not propose to emend existing taxonomy, nor contribute new genera to the already existing superfluity, since ample classification niches exist for the purposes of this study. Inasmuch as punctations are a feature of the wall in *Tasmanites*, those microfossils with such optical properties will be treated as *Tasmanites*, with the one exception being assignable to *Tytthodiscus*. Those thin-walled disseminules without wall punctations are considered here as leiospherids. Many resemble described specimens of *Leiosphaeridia*, in which Eisenack featured the pylome as a systematic character, but such a structure has not been observed in any of the thousands of specimens examined. Hence it would seem that Timofeev's (1959) *Protoleiosphaeridium* would be most applicable. However, Timofeev indicated a maximum size range of about 50 μ for *Protoleiosphaeridium*, and the author is in agreement with its rejection by Downie and Sarjeant (1963) as a synonym of *Leiosphaeridia*. Their emended diagnosis of *Leiosphaeridia* to include specimens with or without pylomes is also accepted. Numerous leiospheres have been noted in Paleozoic studies in this laboratory in which the pylome is present, and some of the excellent illustrations of Eisenack (1958*a*, 1958*b*) leave little doubt of the pylome's existence. However, in the thousands of specimens viewed in this investigation, the pylome was a very questionable feature and never observed with certainty.

Two of the Neogene species, *T. fissura* and *T. balteus*, are characterized in part by splitting or collapsing of the cell wall. Wall (1962) has discussed a similar splitting as a possible suture, comparable to the pylome, which Eisenack (1958*a*, 1962) has considered to be a germinal opening 'Schlüpflöcher'. Eisenack (1962, p. 74) has also suggested this bursting of the test to be a suture but has never demonstrated this. The presence of any such germinal feature in *Tasmanites* has never been reliably shown. Even considering the questionable presence of a pylome in a few instances, this does not account for the many examples in the literature which possess neither pylomes or suture-like devices. The author is of the opinion that splitting of the cell walls in *T. fissura* and *T. balteus* is due to structural faults only. In the study of plant spores several species have been noted which have a tendency to compress into certain shapes or to develop uniform splits due to preservational compaction, even though they may possess well developed trilete germinal apertures. Chaloner (1953) has demonstrated such a selective orientation under compaction in Sigillarian spores. It does not seem unrealistic to draw such a comparison between *Tasmanites* and the trilete plant spores in view of their comparable modes of preservation, sizes, and similar morphology in many instances.

The determination of species in *Tasmanites* and the leiospheres is especially difficult due to the absence of haptotypic features. Species distinction must necessarily be made on very small differences, and there are relatively few distinctive emphytic characteristics available to provide sharply defined dissimilarities. The species defined in this study have been established with consideration of several points. The dimensions are significant, and total diameters are variable. The relatively small sizes of the Neogene species are noteworthy, for they scarcely attain one-half the size of most Paleozoic forms. Wall thickness has a wide range, and the outer wall may be conspicuously thick or so thin as to be nearly indiscernible. In *Tasmanites* the wall punctae are important in numbers, spacing, and dimensions. They vary in numbers from rare to a high degree of density. A noticeable difference exists in the type of punctae orifices on the body surface. The canals are often a prominent feature and differ in angle of inclination, extent of penetration through the wall, and degree of taper. The manner of folding and the colour are also considered although some investigators question the usefulness of the latter feature. Winslow (1962) has noted that both features are indirectly related to wall thickness versus diameter.

TASMANITES GROUP

Genus TASMANITES Newton 1875

Tasmanites porosus sp. nov.

Plate 5, figs. 1, 2

Holotype. Slide 91–1, location 21·8 × 107 (Ref. 20·2 × 117) (Pl. 5, fig. 1). Core, 11,958 ft. Lake Pelto well No. 1, Terrebonne Parish, Louisiana.

Diagnosis. Spherical, 150–165 μ diameter (12 specimens measured) holotype 160 μ. Wall 10–12 μ thick, penetrated by distinct canals; canals always appear to pass from the inner wall surface, with most not reaching the outer surface. The canals are uniformly distributed 10–15 μ apart; they possess a slight angle of inclination and may pass through more than one optical plane. They are 1–1·5 μ in width, with appreciable taper. Body surface laevigate, characterized only by scattered pores representing termination of some canals. At high magnification they are observed to possess a slightly raised rim some 0·5 μ in width, and pores and encircling rim or border are 2–3·5 μ in diameter. Body outline is very regular and never characterized by folding. Colour yellow to orange in transmitted light.

Comparison. *T. porosus* is easily distinguished from the other Neogene entities by its rather large, uniformly spaced wall canals and the conspicuous bordered pores on its surface. It shows some similarity to *T. roxoi* Sommer (1953, 1956), but the latter species has a minimum size of 370 μ and possesses much larger and more closely spaced wall canals.

Tasmanites fissura sp. nov.

Plate 5, fig. 3

Holotype. Slide 475–1, location 42·6 × 112·4 (Ref. 19 × 117·6) (Pl. 5, fig. 3). Core, 8,536 ft. Belle Isle well No. 1, St. Mary Parish, Louisiana.

Diagnosis. Oval, 170–300 μ diameter, average about 230 μ (25 specimens measured) holotype 276 μ × 293 μ. Wall indistinct, difficult to discern, 6–12 μ thick (11 μ in holotype). Canals rare, scattered; few ill-defined pores on wall surface visible at high magnification. Wall with occasional minor folding; surface usually has weathered or corroded appearance. Colour light yellow to yellow-orange in transmitted light.

Remarks. This species is distinguished by the wall usually being ruptured so as to present an appearance suggestive of a split-open grape hull. It is usually split at only one point, rarely are two such breaks observed, and the rupture extends a distance of one-third to one-half the body diameter. Although the canals and pores are difficult to ascertain, a scattered few are present on every specimen.

Comparison. This species is among the largest in size of the Neogene entities. *T. balteus* has a similar size range and rare wall canals, as well as an affinity for a collapsed or split wall. However, the possibility of misidentification is remote since *T. balteus* has a well defined and much thicker wall and a more regular breaking of the cell wall. The only published reference of *Tasmanites* similar to this species appears to be from the Winnipegosis formation of the middle Devonian from the Williston Basin of North America, where Jodry and Campau (1961) figured a representative within the size range of *T. fissura* and possessing a similar type of wall rupture. However, their *Tasmanites* illustrations were not accompanied by formal descriptions.

Tasmanites corrugatus sp. nov.

Plate 5, fig. 4

Holotype. Slide 88–1, location 27 × 116·1 (Ref. 17 × 118) (Pl. 5, fig. 4). Core, 4,769 ft. Lake Pelto well No. 1, Terrebonne Parish, Louisiana.

Diagnosis. Spherical, 130–190 μ diameter (15 specimens measured) holotype 188 μ. Wall usually distinct about entire body periphery and 5–10 μ thick (9 μ in holotype). Wall with narrow, inclined canals, passing from inner wall surface but seldom penetrating outer surface; canals scattered, usually about 10 μ apart. Body outline irregular and folded. Colour light yellow in transmitted light.

Comparison. The species bears a general resemblance to *Leiosphaeridia plicata* but is not as plicated and crumpled, and the wall canals are always very easily distinguished in *T. corrugatus*. The canals resemble those of *T. fulgidus* but the wall structure, size, and the degree of folding are distinctly different from those of that species. It also bears a general resemblance to both *T. sinuosus* Winslow and to *T. mourai* Sommers. Winslow (1962) noted the similarity between *T. sinuosus* and *T. mourai* and chose to treat them as distinct partly on the age differences of sediments and the degree of geographic separation. However, *T. corrugatus* is completely outside of the size range of *T. mourai*, being very small in comparison. The dense, well-marked punctae of *T. mourai* do not compare with the scattered punctae of *T. corrugatus*. *T. corrugatus* is included within the lower size limits of *T. sinuosus*, but the punctae of the latter are numerous, tubular, and straight, while those of *T. corrugatus* are relatively few, scattered, and possess a pronounced angle of inclination.

Tasmanites usitatus sp. nov.

Plate 6, fig. 5

Holotype. Slide 485–1, location 33·9 × 124·5 (Ref. 19 × 118·3) (Pl. 6, fig. 5). Core, 9,342 ft. Belle Isle well No. 1, St. Mary Parish, Louisiana.

EXPLANATION OF PLATE 5

Figs. 1, 2. *Tasmanites porosus* sp. nov., holotype. 1, Entire specimen, × 500. 2, Wall detail, × 750. Slide 91–1, location 21·8 × 107 (Ref. 20·2 × 117).

Fig. 3. *Tasmanites fissura* sp. nov., holotype. × 300. Slide 475–1, location 42·6 × 112·4 (Ref. 19 × 117·6).

Fig. 4. *Tasmanites corrugatus* sp. nov., holotype. × 500. Slide 88–1, location 27 × 116·1 (Ref. 17 × 118).

Fig. 5. *Leiosphaeridia ralla* sp. nov., holotype. × 500. Slide 784–1, location 29 × 117·6 (Ref. 17·3 × 118).

Diagnosis. Oval, 80–120 μ diameter (25 specimens measured) holotype 112 μ × 113 μ. Wall usually distinct, forming pronounced marginal rim 5–8 μ thick (7 μ in holotype). Wall with scattered pores 10–20 μ apart, with slight border visible at high magnification. Canals very rare and difficult to distinguish, slightly inclined and seldom more than 2 or 3 visible in one plane of focus. Body outline regular with only minor folding evident; wall plications not a diagnostic feature. Colour light to dark yellow in transmitted light.

Remarks. *T. usitatus* probably illustrates even better than does *T. balteus* the tenuous boundary between *Tasmanites* and the leiospheres. The wall canals are easily overlooked in a casual survey, and the pores are not easily distinguished. With its relatively thin wall, failure to differentiate the canals could possibly result in its assignment to *Leiosphaeridia*.

Comparison. In size and general appearance *T. usitatus* resembles *T. medius* Eisenack. Eisenack (1963) does indicate a somewhat thicker wall for his species, as well as more conspicuous pores and canals. In addition he cites the pylome as a diagnostic feature and illustrates an undoubted circular aperture in the body wall (1962, pl. 4, figs. 7–8; 1963, fig. 6). *T. usitatus* is one of the more numerous species in the Neogene sediments, and scores of specimens have been examined. However, no evidence of a pylome has been noted, and virtually no variation in wall, pore, or canal features is displayed. At this time there is insufficient evidence to warrant its assignment to *T. medius*.

Tasmanites fulgidus sp. nov.

Plate 7, figs. 1–4

Holotype. Slide 802–2, location 27·3 × 112·5 (Ref. 20 × 118) (Pl. 7, fig. 1). Core, 8,730 ft. Chacahoula well No. 7, La Fourche Parish, Louisiana.

Diagnosis. Spherical, 180–275 μ diameter (25 specimens measured) holotype 270 μ. Wall prominent, 10–18 μ thick (15 μ in holotype); penetrated by narrow, steeply inclined canals 10–16 μ apart and some passing from outer to inner surface. Canals present a bordered appearance where they penetrate the surface, which is laevigate otherwise. Body outline regular, rarely folded; fig. 1 shows the maximum degree of folding observed in the species. Colour yellow-orange to red-orange in transmitted light.

Remarks. There is a possibility that additional research will warrant a further division. Two general size groups appear represented, one about 180–200 μ and a second 250–275 μ. The majority of specimens do fall within these ranges, but there is a sufficient gradient between them to render it difficult to draw a line on size only. Occasionally specimens appear to have canals differing from the majority. Plate 7, fig. 3 illustrates a specimen with canals more numerous and less inclined than most and ending in a more pronounced pore than is usually the case. There is relatively little other variation, and there is not sufficient differentiation to necessitate additional specific division.

Comparison. The relatively large diameter of this species is a distinguishing characteristic, along with the thick wall and numerous, evenly spaced, steeply inclined punctae. It does resemble the classic *T. huronensis* in general appearance, although smaller in all dimensions. In her emendation of *T. huronensis*, Winslow (1962) described the punctae as being straight, radially aligned, and flared on the interior. The punctae of *T. fulgidus* possess a steep angle of inclination and show no evidence of flaring. It compares slightly with *T. avelinoi* Sommer, which also has steeply inclined canals, but the latter is significantly larger in diameter, and the canals are fewer in number and without the pronounced surface pores observed in *T. fulgidus*.

Tasmanites validus sp. nov.

Plate 8, figs. 1, 2

Holotype. Slide 802–1, location 21·3 × 111·6 (Ref. 16·1 × 117·5) (Pl. 8, fig. 1). Core, 8,730 ft. Chacahoula well No. 7, La Fourche Parish, Louisiana.

Diagnosis. Spherical, 150–215 μ diameter (15 specimens measured) holotype 166 μ × 168 μ. Wall distinct, 7–15 μ thick (10–11 μ in holotype); penetrated by short, narrow canals, slightly inclined and passing through more than one optical plane. Canals scattered, 10–20 μ apart, appearing to pass from outer to inner wall surface, terminating on the otherwise laevigate surface in small pores with only slight rim or border development. Body outline irregular, somewhat undulate, but rarely folded. Colour yellow to orange in transmitted light.

Comparison. The slightly undulate margin and sturdy wall with its distinct, but widely spaced, pores distinguish this species. The only similar published example appears to be a specimen of *T. huronensis* figured by Eisenack (1963, fig. 4), and the undulate outline is the only comparative feature. *T. validus* is markedly different from *T. huronensis* in size, wall thickness, and character of canals and pores.

Tasmanites balteus sp. nov.

Plate 8, fig. 3

Holotype. Slide 488–1, location 25·1 × 106·9 (Ref. 16·6 × 117·2) (Pl. 8, fig. 3). Core, 9,644 ft. Belle Isle well No. 1, St. Mary Parish, Louisiana.

Diagnosis. Oval, 205–285 μ diameter (10 specimens measured) holotype 210 μ × 280 μ. Wall prominent, 9–15 μ thick (13–14 μ in holotype); canals very rare and widely spaced, appearing always to extend from the inner wall surface and not reaching the outer surface; wall surface laevigate without visible pores. Specimens characteristically resembling a collapsed sphere as to present two half spheres superimposed one upon another. Colour red-orange with wall considerably lighter in colour in transmitted light.

Remarks. The rarity of canals in the species adds to the existing taxonomic difficulty of the group. The canals are difficult to detect and may be easily overlooked. Since wall canals are a feature of *Tasmanites*, but not of the leiospheres, failure to detect canals would necessitate its inclusion in the leiospheres. Should such a form be described in which the canals could not be distinguished, there would likely not be a depository for

EXPLANATION OF PLATE 6

Figs. 1–4. *Tytthodiscus californiensis* Norem 1955. 1, × 500. Slide 1556–1, location 31·8 × 124·1 (Ref. 14·2 × 118). 2, Entire specimen. × 500. Slide 1501–1, location 23·9 × 112·2 (Ref. 16 × 120). 3, Wall detail. × 750. 4, Detail of outer rim. × 750.

Fig. 5. *Tasmanites usitatus* sp. nov., holotype. × 500. Slide 485–1, location 33·9 × 124·5 (Ref. 19 × 118·3).

it. *Leiosphaeridia* is described as possessing a pylome, which is not evident in *T. balteus*, but Downie and Sarjeant (1963) have included thin-walled leiospheres without pylomes in *Leiosphaeridia*. However, the thick wall of *T. balteus* would appear sufficient to exclude it from *Leiosphaeridia*. Thus *T. balteus* seems to be transitional in several features between *Tasmanites* and the various leiosphere genera, and it provides some support to belief by various investigators that they constitute a single biological group.

Comparison. The collapsed sphere shape and the wide, relatively undifferentiated marginal ring are diagnostic. In this respect *T. balteus* appears to resemble *T. euzebioi* (Sommer 1953) except for the size difference. The latter ranges from 370–520 μ or nearly twice the dimensions of *T. balteus*.

Genus TYTTHODISCUS Norem 1955

Tytthodiscus californiensis Norem 1955

Plate 6, figs. 1–4

Figured specimens (Plate 6, figs. 1–4) are from core at 8,040 ft. (Slide 1501–1) and from 8,970 ft. (Slide 1556–1). Humble well No. 1, Terrebonne Parish, Louisiana.

Diagnosis. Spherical, 150–185 μ (25 specimens measured). Wall distinct, 5–14 μ thick with average of about 12 μ; no apparent thickness pattern, and walls are usually less than 10 per cent. of diameter. Closely spaced oval canals 1·5–2 μ apart, not inclined; about 1 μ in diameter, without taper and all completely penetrate through the wall. Body sturdy with only minor folds viewed where considerable compression occurred. Colour light yellow in transmitted light.

Remarks. The assignment to *Tytthodiscus* is based largely upon the feature of numerous and closely spaced wall canals. It is the author's belief that *Tytthodiscus*, *Tasmanites*, and many of the leiospherids possess similar biological affinities. Eisenack (1958*a*) suggested this by his inclusion of *Tytthodiscus* within the family Leiosphaeridae. However, *Tytthodiscus* is a validly described entity, and admittedly its true biological relationship is still conjectural. In addition to Norem's (1955) original report of its occurrence in marine Tertiary sediments of California, representatives of the genus have been reported by Waloweek and Norem (1957) from Miocene age rocks of Alaska, and from Tertiary sediments of Colombia by Sole de Porta (1961).

Comparison. Norem (1955) considered the hexagonal pattern of the wall segments to be diagnostic for the genus. These hexagonal wall segments characterize the Louisiana specimens and are quite unlike the scattered canal pattern of *Tasmanites*. The Neogene specimens compare with Norem's description of *T. californiensis* in general appearance, size, wall thickness, and character of the hexagonal wall units. *Tytthodiscus chondrotus*, the only other described species, is considerably smaller. It also possesses a granulate surface with the granules arranged in a triangular pattern.

A micro-organism bearing some similarity to *Tytthodiscus* is *Hungarodiscus*, described by Kriván-Hutter (1963) from the Palaeogene of the Dorog Coal Basin of Hungary. The author distinguished it from *Tasmanites* and *Tytthodiscus* primarily on its extremely thin wall, which is only 1/55 to 1/65 of the total diameter. She further differentiated it from *Tasmanites* on its development of radially oriented tubules opening to outer and inner surfaces and from *Tytthodiscus* by the lack of hexagonal wall segments; however, in her species type description the author does describe the pores as having hexagonal symmetry. Although Kriván-Hutter's description of the wall pore symmetry is somewhat unclear, the illustrated pore arrangement is neither the hexagonal type of *Tytthodiscus californiensis* nor the triangular of *T. chondrotus*. Actually *Hungarodiscus* appears to have different size pore openings, and there is a difference in pore pattern between the pylome side and the opposite side of the body. Perhaps its most distinguishing feature is the conspicuously large pylome, occupying about one-third of the entire diameter. The very thin wall, the large pylome, and the variable pattern of the wall tubules suffice to distinguish the genus from *Tytthodiscus*. Kriván-Hutter has placed it into the family Leiosphaeridae, and this taxonomic assignment appears acceptable in view of features similar to *Tasmanites* and *Tytthodiscus*.

LEIOSPHAERE GROUP

Genus LEIOSPHAERIDIA (Eisenack) Downie and Sarjeant 1963

Leiosphaeridia plicata sp. nov.

Plate 8, fig. 4

Holotype. Slide 512–1, location 42·1 × 107·4 (Ref. 18 × 118·6) (Pl. 8, fig. 4). Core, 11,150 ft. Bell Isle well No. 1, St. Mary Parish, Louisiana.

Diagnosis. Spherical, 120–200 μ diameter (50 specimens measured) holotype 145 μ × 154 μ. Wall distinct, thin, 3–7 μ thick (5 μ in holotype). Canals or pores not present on cell wall and no evidence of pylome. Body outline irregular, always crumpled and plicated with the numerous folds being characteristic of the species. Surface laevigate. Colour light yellow in transmitted light.

Remarks. There is also a suggestion of an intergradational population such as occurs in *Tasmanites fulgidus*. A single, excellently preserved specimen of 240 μ in diameter, and indistinguishable from the species in other respects, was observed. However, this was the single instance, in a study of hundreds of specimens, in which the 200 μ figure was exceeded, and it does not appear to warrant extension of the size range at present.

EXPLANATION OF PLATE 7

Figs. 1–4. *Tasmanites fulgidus* sp. nov. 1, holotype. × 300. Slide 802–2, location 27·3 × 112·5 (Ref. 20 × 118). 2, holotype. Wall detail, × 500. 3, Specimen showing wall detail, × 500. Slide 1403–1, location 34·6 × 119·1 (Ref. 17 × 112·6). 4, Entire specimen, × 300. Slide 495–1, location 32·1 × 127·8 (Ref. 23·1 × 118).

EXPLANATION OF PLATE 8

Figs. 1, 2. *Tasmanites validus* sp. nov., holotype. 1, Entire specimen, × 500. 2, Wall detail, × 750. Slide 802–1, location 21·3 × 111·6 (Ref. 16·1 × 117·5).

Fig. 3. *Tasmanites balteus* sp. nov., holotype. × 300. Slide 488–1, location 25·1 × 106·9 (Ref. 16·6 × 117·2).

Fig. 4. *Leiosphaeridia plicata* sp. nov., holotype. × 500. Slide 512–1, location 42·1 × 107·4 (Ref. 18 × 118·6).

Comparison. The species bears some similarity to *Leiosphaeridia voigti* (Eisenack 1958*b*) in appearance, but the pylome is well defined in *L. voigti* and is definitely not present in *L. plicata*. This species was the most numerous encountered in this study, and hundreds of specimens were examined without any suggestion of a pylome. *L. plicata* compares also with both *Tasmanites mourai* Sommer (1953) and *T. sinuosus* Winslow (1962) in general appearance, but both species of *Tasmanites* possess numerous punctae. In size and the characteristic plications it resembles *Tasmanites salustianoi*, but Sommer (1953, 1956) does note the presence of a few canals in the latter, although admittedly difficult to distinguish. *L. plicata* definitely does not possess canals or pores.

Leiosphaeridia ralla sp. nov.

Plate 5, fig. 5

Holotype. Slide 784–1, location 29 × 117·6 (Ref. 17·3 × 118) (Pl. 5, fig. 5). Core 6,930 ft. Chacahoula well No. 7, La Fourche Parish, Louisiana.

Diagnosis. Spherical, 87–100 μ diameter (15 specimens measured) holotype 99 μ. Wall thickness 1–3 μ (3 μ in holotype) but indistinct, without well-defined marginal rim. Canals or pores not present in cell wall and no evidence of a pylome. Body outline irregular, usually with one to three prominent folds. Surface laevigate. Colour light to dark yellow in transmitted light.

Remarks. The species is easily differentiated from *L. plicata* both in size and morphology. It is never crushed or plicated in the manner of *L. plicata* but usually with only a few elongate folds. The very appearance of the specimens bears a suggestion of fragility.

Comparison. *L. ralla* shows the greatest similarity to *Leiosphaeridia voigti*. However, its smaller size is far less than *L. voigti*, whose lower size range is 190 μ. A further distinction is the definite pylome of *L. voigti*.

Location of types. The exact field position of specimens is noted in text and plate explanations as coordinates, in parentheses, followed by a reference point coordinate for each slide. Calibration was on a Leitz Ortholux microscope mechanical stage to tenths of millimeters, with horizontal (smaller) reading listed first. Traverse (1958, 1960) and Pierce (1959) have dealt in detail with methods of coordinate conversion used here. Type slides are filed in the Sun Oil Company Paleontological Collections, Richardson, Texas, U.S.A.

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REFERENCES

CHALONER, W. G. 1953. On the megaspores of *Sigillaria*. *Ann. Mag. Nat. Hist. Ser. 12*, **6**, 881–96, 1 pl.

DOWNIE, C. and SARJEANT, W. A. S. 1963. On the interpretation and status of some hystrichosphere genera. *Palaeontology*, **6**, 1, 83–96.

EISENACK, A. 1938. Hystrichosphaerideen und verwandte formen im baltischen Silur. *Z. Geschiebeforsch. u. Flachlandsgeol.* **14**, 1–30, 4 pl.

—— 1958*a*. *Tasmanites* Newton 1875 und *Leiosphaeridia* n.g. als gattungen der Hystrichosphaeridia. *Palaeontographica*, **A 110**, 1–19, 2 pl.

—— 1958*b*. Mikrofossilien aus dem Ordovizium des Baltikums. *Senckenbergiana*, **39**, 389–405, 2 pl.

—— 1962. Mitteilunger über Leiosphären und über das pylom bei Hystrichospharen. *N. Jb. Geol. Paläont.* **114**, 58–80, 3 pl.

EISENACK, A. 1963. Über einige arten der gattung *Tasmanites* Newton 1875. *Grana Palynologica*, **4**, 203–16, 1 pl.

FELIX, C. J. 1963. Mechanical sample disaggregation in palynology. *Micropaleontology*, **9**, 337–9, 1 pl.

JODRY, R. L. and CAMPAU, D. E. 1961. Small pseudochitinous and resinous microfossils: new tools for the subsurface geologist. *Bull. Amer. Assoc. Geol.* **45**, 1378–91, 3 pl.

KRIVÁN-HUTTER, E. 1963. Microplankton from the palaeogene of the Dorog Basin. I. *Ann. Univ. Sci. Budapest, Sect. Geol.* **6**, 71–91, 6 pl.

NOREM, W. L. 1955. *Tytthodiscus*, a new microfossil genus from the California Tertiary. *J. Paleont.* **29**, 694–5, 1 pl.

PIERCE, R. L. 1959. Converting co-ordinates for microscope scales. *Micropaleontology*, **5**, 377–8.

RADFORTH, N. W. and ROUSE, G. E. 1956. Floral transgressions of major geological time zones. *Trans. Roy. Soc. Canada*, **50**, 17–26, 1 pl.

SCHOPF, J. M. 1957. 'Spores' and problematic plants commonly regarded as marine. *Geol. Soc. Amer. Mem.* **67**, 709–18.

——, WILSON, L. R., and BENTALL, R. 1944. An annotated synopsis of Paleozoic fossil spores and the definition of generic groups. *Rept. Inv. Ill. State Geol. Surv.* **91**, pp. 72, 3 pl.

SOLE DE PORTA, N. 1961. Contribucion al estudio palinologico del terciario en Colombia. *Bol. Geol.* **7**, 55–81, 5 pl.

SOMMER, F. W. 1953. Os esporomorfos do folhelho de Barreirinha. *Brazil Div. Geol. Min., Bol.* **140**, pp. 49, 2 pl.

—— 1956. South American Paleozoic sporomorphae without haptotypic structures. *Micropaleontology*, **2**, 175–81, 2 pl.

STAPLIN, F. L. 1961. Reef-controlled distribution of Devonian microplankton in Alberta. *Palaeontology*, **4**, 3, 392–424, 4 pl.

TIMOFEEV, B. V. 1959. The ancient flora of the Pre-Baltic and its stratigraphic significance. *Mem. VNIGRI*, **129**, pp. 350, 25 pl. [In Russian.]

TRAVERSE, A. 1958. Locating plant microfossils on mixed slides. *Micropaleontology*, **4**, 207–8.

—— 1960. Still more on conversion of microscope co-ordinates. Ibid. **6**, 424.

WALL, D. 1962. Evidence from recent plankton regarding the biological affinities of *Tasmanites* Newton 1875 and *Leiosphaeridia* Eisenack 1958. *Geol. Mag.* **99**, 353–62, 1 pl.

WALOWEEK, W. and NOREM, W. L. 1957. Geographic range of *Tytthodiscus* extended to Alaska. *J. Palaeont.* **31**, 674–6.

WINSLOW, M. R. 1962. Plant spores and other microfossils from upper Devonian and lower Mississippian rocks of Ohio. *USGS Prof. Paper* **364**, pp. 93, 22 pl.

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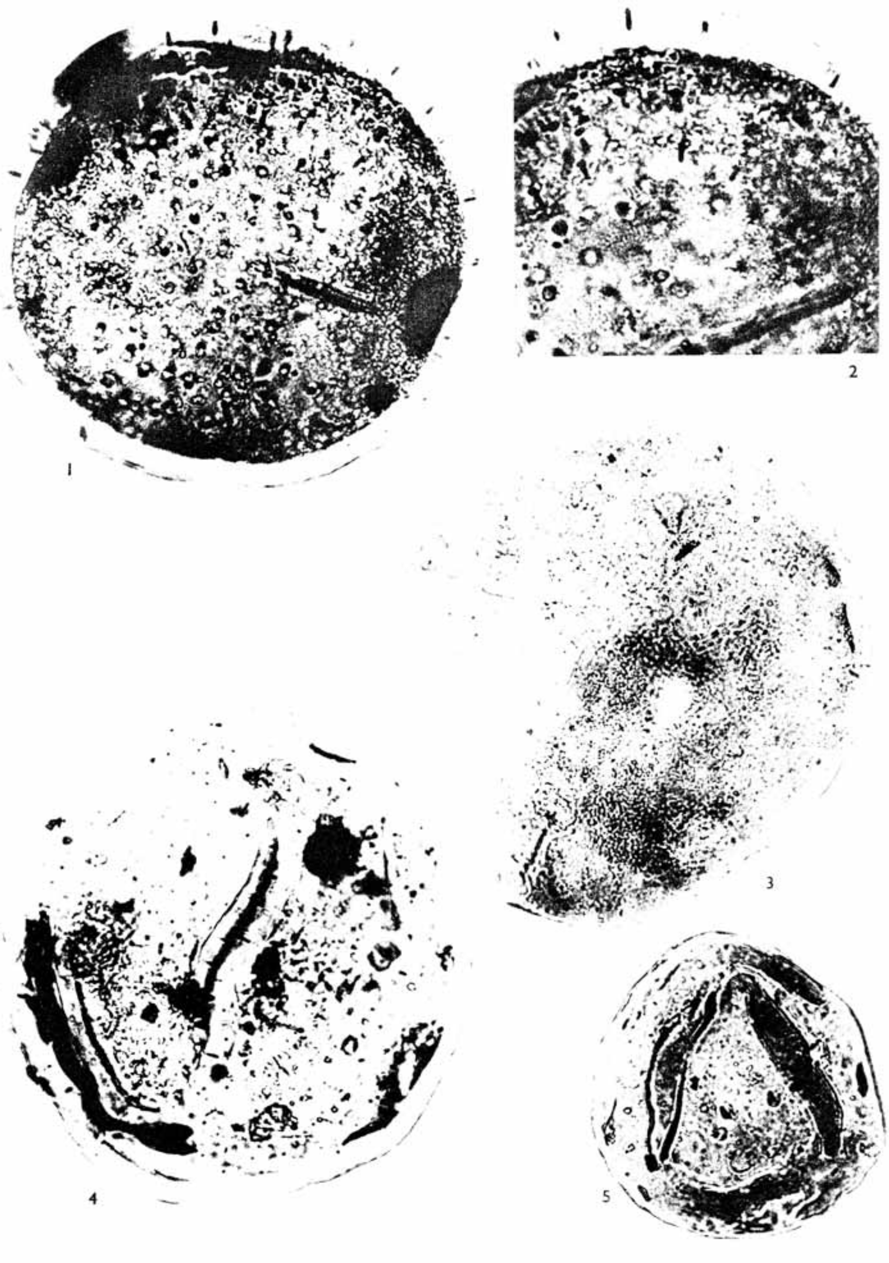

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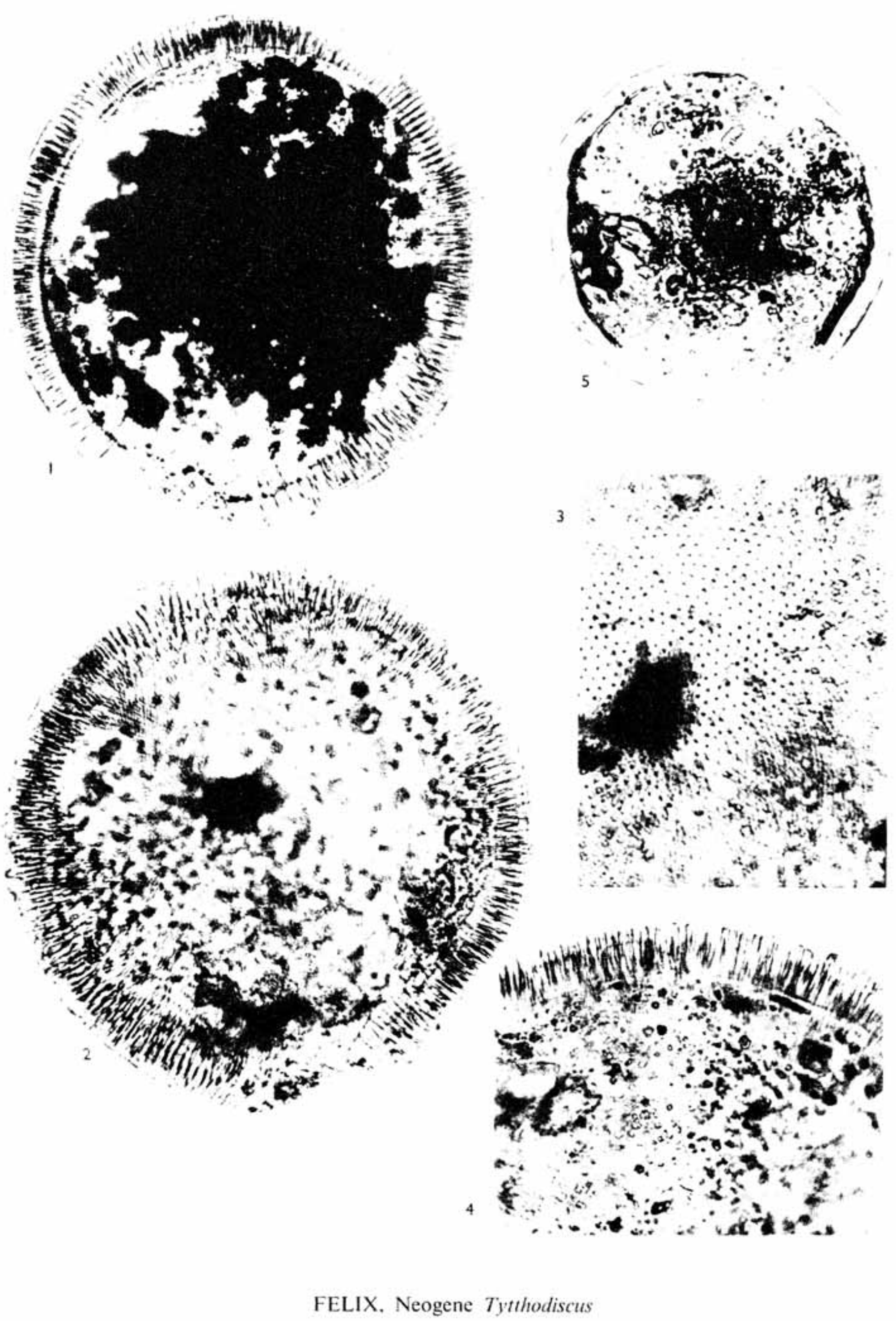

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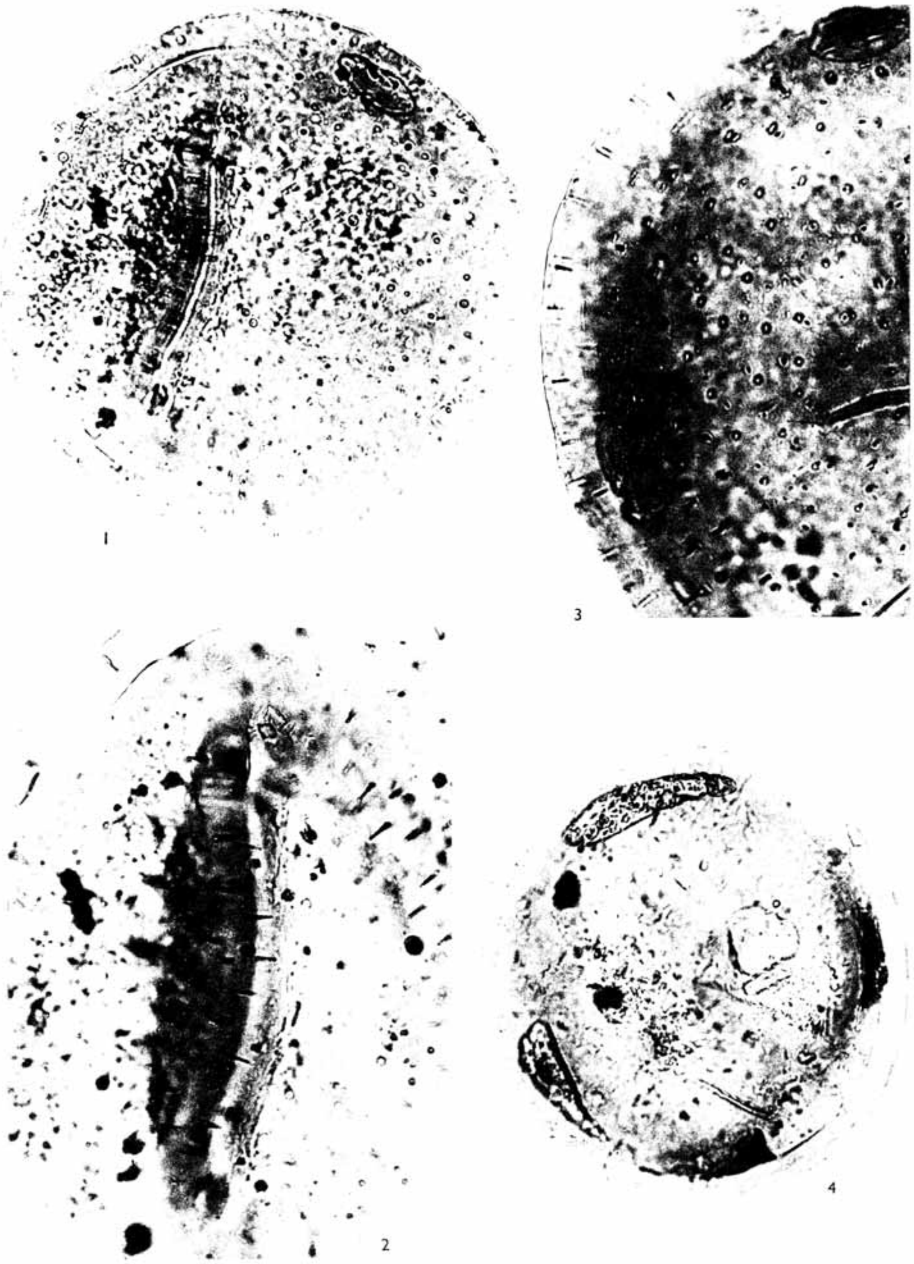

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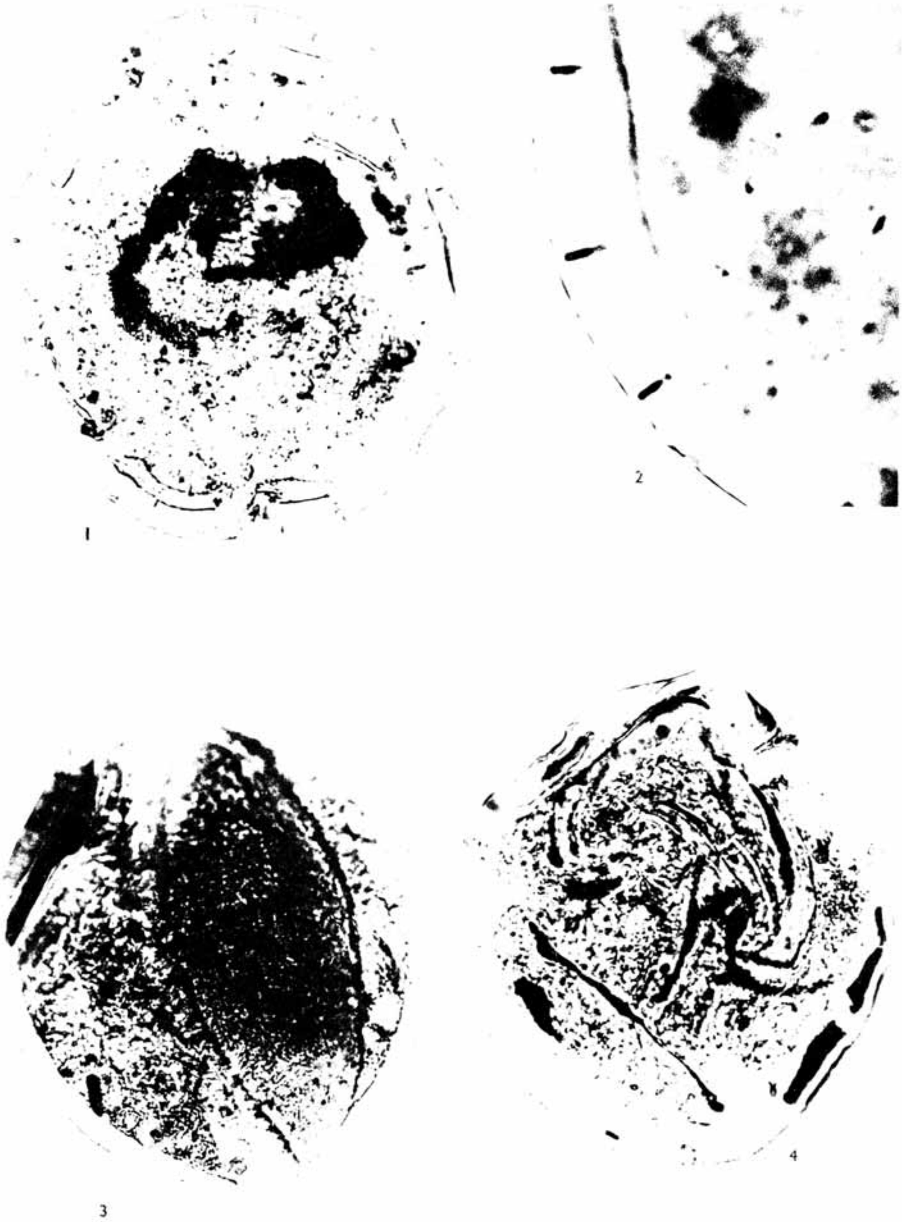

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