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# 伏平粉属(新属)*Fupingopollenites* gen. nov.及其时空分布

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## 一、前言

建立伏平粉属 *Fupingopollenites* 的材料系笔者 1976—1977 年间采自广西百色盆地的中晚渐新世百岗组上部和伏平组。

伏平粉属(新属) *Fupingopollenites* gen nov. 虽然外壁结构和表面纹饰相当复杂，但特征很明显。即使萌发器官(尤其是内孔)看不清楚，亦相当容易鉴定。当前标本保存多十分精美，特别是侧面保存标本更是难得。经研究，目前已发现的标本依大小及加厚带特征可分为两个种：*Fupingopollenites wackersdorfensis* (Thiele-Pfeiffer) gen. et comb. nov. 和 *F. minutus* gen. et sp. nov.

## 二、属种描述

伏平粉属(新属) *Fupingopollenites* gen. nov.

**属征** 花粉粒扁球形至亚球形，中等到大型。极面观轮廓三角形、圆三角形至近圆形；侧面轮廓扁圆形到近圆形。三孔沟，沟细直；内孔大，横长，非侧面或正极面保存时常不甚清晰。外壁因具不均匀的基柱结构而厚薄不匀，在两极、孔沟之间及赤道两侧区域加厚明显。两极加厚区近"Y"形，它们与沟间区加厚带相互联结，形成9个下凹的外壁变薄区。表面纹饰在光学显微镜下为皱网状。在扫描电子显微镜下为交织网状。

**模式种** *Fupingopollenites wackersdorfensis* (Thiele-Pfeiffer) gen. et comb. nov.

**讨论** 新属以其外壁结构不均匀及因此反映出外壁加厚带与变薄区，特殊的表面纹饰及扁圆形的侧面轮廓容易和其它三孔沟花粉区分。*Scabiosapollis* Sung et Zheng 和 *Convolvulus* 花粉均属三沟型，外壁结构及表面纹饰均不同于本属，即使保存状态不好而孔看不见时，以其特殊的外壁结构和纹饰与前两属也不难区分。

**亲缘关系** 不明。Rossignol-Strick (1973, p. 977) 认为和 Verbenaceae 科有关。Thiele-Pfeiffer (1980, p. 154) 则认为和台湾花粉中的 Boraginaceae 科内某些花粉极面观相似（见黄增泉，1972, pl. 27, 28)。作者查对过包括台湾花粉在内的现有的现代花粉资料，尚未发现可资对比者。

**时代分布** 中始新世—早(中?)更新世，以渐新世、中新世常见；欧洲、亚洲。

### 瓦克斯道夫伏平粉(新属、新联合) *Fupingopollenites wackersdorfensis* (Thiele-Pfeiffer) gen. et comb. nov.

(图版1，图5—7，9—16；插图1)

1964 *Convolvulus* sp. (cf. *C. arcensish*), 宋之琛、曹流、李曼英，279页，图版 XXVII，图 16，19
1969 *Dacrydium guillauminii*, Nagy, p. 393, pl. XXXIII, fig. 4
1969 *Dipterocarpacearumpollenites hidaensis*, Nagy, p. 435, pl. XLVIII, fig. 7
1973 Unknown tricolporate pollen, Rossignol-Strick, p. 977, pl. III, figs. 1—6, 10
1978 *Convolvulus* sp. 张清如、马俊荣，573页，图版 CLXVII，图 11
1978 *Convolvulus* sp. 石油化学工业部石油勘探开发规划研究院，中国科学院南京地质古生物研究所，142，143页，

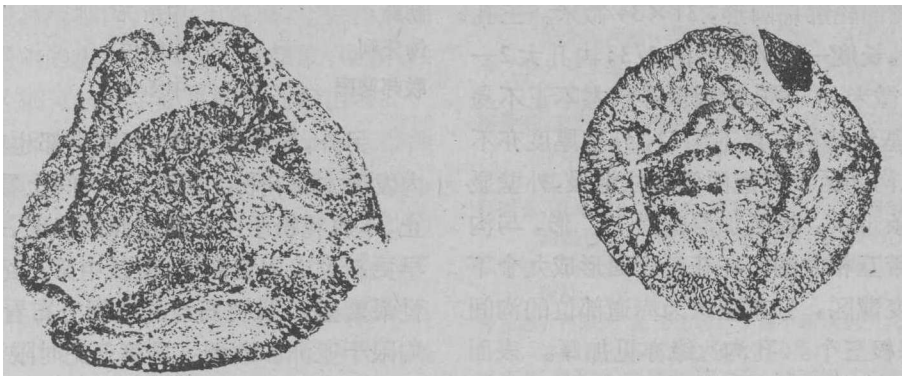

插图 1　*Fupingopollenites wackersdorfensis* (Thiele-Pfeiffer) gen. et comb. nov.
左. 极面观，×800 (polar view),
右. 侧面观，×800 (lateral view)

图版 XLIX, 图 33, 34; 图版 L, 图 1, 2, 4, 5
1978 Indeterm. pollen angiosperma, Korenova & Kartashova, p. 962, pl. III, figs. 1, 3, 4
1980 *Convolvulus* sp., 孙秀玉、范永琇、邓茨兰、余正清，图版 III, 图 7
1980 *Tricolporopollenites wackersdorfensis*, Thiele-Pfeiffer, p. 153, 154, pl. XII, figs. 22—28
1981 *Tricolporite rugulatus*, 李文漪、梁玉莲，481, 482 页，图版 IV, 图 10—18
1981 *Convolvulus* sp., 孙湘君、李明兴、张一勇、雷作祺、孔昭宸、李彭、欧柒、刘绮娜，图版 XII，图 45
1981 *convolvulus* sp., 郑亚惠、周山富、刘祥祺、王连元、徐淑娟、王宪曾，69 页，图版 X, 图 1, 2
1982 *Convolvulus* sp., 宋之琛、郑亚惠、刘金陵、叶萍宜、周山富、王从凤，151 页，图版 LVI, 图 6, 7
1982 *Convolvulus* sp., 郑亚惠，图版 II, 图 8

**描述**　花粉粒扁球形至亚球形，个体偏大型，直径 40—65 微米，以 42—55 微米左右居多。极面观轮廓三角形、圆三角形或多角圆形；侧面观轮廓扁圆形至亚圆形。三孔沟，沟细直，长度一般为半径的 2/3；内孔大，横长，3—5×8—10 微米，常因保存位置不好不易看清。因基柱结构在花粉粒外壁各处发育不均匀，外壁厚度亦有不同。两极、沟间区和赤道两侧基柱发达，外壁显著加厚呈条带状。两极加厚区轮廓近“Y”形，与沟间区加厚带相互联结，在花粉表面形成九个下凹的外壁变薄区，分布于每极各三个，沟间区三个。有不少标本沿孔、沟边缘亦有外壁加厚。外壁加厚区和变薄区交界处最易褶皱，使得外壁结构更加复杂。表面纹饰在光学显微镜下为皱网状。轮廓线微波状。在扫描电子显微镜下，纹饰为交织网状，网脊蠕虫状。

**比较与讨论**　本种和 *Fupingopollenites minutus* sp. nov. 的区别在于个体较大（大约 40 微米），加厚带常较宽。当前标本和 Thiele-Pfeiffer (1980, p. 153, pl. XII, figs. 22—28) 所描述的标本特征基本一致，唯个体较大。他的描述中提及有八个变薄区，可能系观察上的误差。

**产地层位**　广西百色四扩暨马村北，百色城郊斩龙颈水库，田阳那坡，田东小龙村北；中、晚渐新世百岗组、伏平组。

## 小型伏平粉(新属、新种) *Fupingopollenites minutus* gen. et sp. nov.

(图版 I, 图 1--4, 8; 插图 2)

**描述**　花粉粒扁球形，中等大小。极面轮廓圆三角形，直径 30—39 微米，模式标本直径

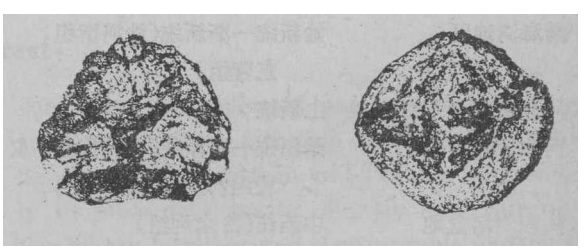

插图 2　*Fupingopollenites minutus* sp. nov.
左. 极面观，×800 (polar view),
右. 侧面观，×800 (lateral view)

32 微米；侧面轮廓扁圆形，31×34 微米。三孔沟，沟细直，长度一般为半径的 2/3；内孔大 2—3×4—6.5 微米。内孔常因保存状态不正不易看清。因基粒结构发育不均匀，外壁厚度亦不等。两极、沟间区及赤道两侧基柱粗强，外壁显著加厚呈条带状。极区加厚带呈"Y"形，与沟间区加厚带互相联结，在花粉表面形成九个下凹的外壁变薄区，分布型式为赤道部位的沟间区三个，每极三个。孔沟边缘亦见加厚。表面具皱网-近网状纹饰。轮廓线微起伏。

**比较** 本新种以个体较小（不超过 40 微米）、外壁加厚带相对较窄与 *Fupingopollenites wackersdorfensis* 相区分。

**产地层位** 广西百色四圩暨马村北，田东小龙村北，百色城郊斩龙颈水库；渐新世百岗组、伏平组。

## 三、时空分布

目前已发现的伏平粉的产地层位表明其在地质时期曾有过相当广泛的分布（见下表）。

| 产 地 | 层 位 |
|---|---|
| 南海北部涠洲岛 | 中上渐新统（涠洲组） |
| 广西百色盆地 | 中上渐新统（百岗组、伏平组） |
| 广西南宁盆地 | 中第三系（邕宁群） |
| 浙江宁海、仙居 | 中新统（蛾县群） |
| 湖北潜江 | 中新统（广华寺组） |
| 湖北应城 | 中新统（广华寺组） |
| 江苏北部及南黄海 | 上第三系（盐城群） |
| 安徽淮南 | 上第三系 |
| 山东临朐 | 中新统（山旺组及尧山组下部） |
| 渤海湾地区 | 始新统—渐新统（沙河街组、东营组） |
| 河北黄骅 | 上新统 |
| 河北任丘 | 始新统—渐新统（沙河街组、东营组?） |
| 陕西渭河盆地 | 中新统（冷水沟组） |
| 青海柴达木盆地 | 中新统 |
| 地中海东部 | 早—中更新统（?）及维拉方阶 |
| 黑海西部 | 上新统 |
| 朝鲜 | 中新统 |
| 匈牙利 | 中新统 |
| 联邦德国 | 中新统 |

另外，在青海东部、湖南中部也都在中新统内发现本属花粉。因此，从时间上看，到目前为止，本属花粉于中始新世开始出现，一直延续到早更新世或中更新世，但以中第三纪，尤以中新世最繁盛。从化石点的空间分布看，已发现的均限于亚洲和欧洲。早第三纪时限于亚洲东部中纬度地区，中新世时分布范围最广，上新世时分布范围大大缩小，到第四纪初仅零星出现，直至绝灭。

分析上述分布规律后，可以得出如下结论：

1. 伏平粉属可以视为新生代时期的欧亚特有属，虽然其在中第三纪时曾一度繁盛过，但在早（或中）更新世以后即迅速衰落，再未发现其化石记录。根据我们能够得到的现代花粉资料，亦未发现可资对比者。因此推测其为一类已绝灭的植物花粉，可能的亲缘关系尚待进一步研究。

2. 对所有含本属的孢粉组合研究后发现，都没有典型的旱生植物花粉大量出现，均以中生或喜湿的花粉为主，甚至有生存于淡水环境的水生植物孢子花粉。如广西百色盆地百岗组上部和伏平组的孢粉组合中，主要成分为：*Ulmipollenites*, *Zelkovaepollenites*, *Alnipollenites*, *Juglanspollenites*, *Caryapollenites*, *Quercoidites*, *Cupuliferoipollenites*, *Euphorbiacites*, *Engelhardtioipollenites*, *Rhoipites*, *Pinuspollenites*, *Tsugaepollenites* 等，及水龙骨科、石松科孢子；*Schizosporis* 和 *Ovoidites* 也经常出现。这样的组合无疑反映了潮湿的亚热带气候环境。尤其是卵形孢属被认为和绿藻门有关，只存在于淡水水域内（Rich et al., 1982）。此外，目前已发现的化石点均限于北纬 20° 以北，50° 以南地区。因此，推测本属花粉的母体植物应该是分布于亚热带-暖温带的中生植物。很有意思的是，如果把化石点的分布区和现代世界植被类型图作一比较，就会发现化石点多位于现代的亚热带常绿阔叶林

和温带夏绿林范围内，而位于荒漠，半荒漠及温带草原范围内的极少。因此可以想象，中亚、西亚的干旱区很可能自中新世即已开始出现。

3. 根据已知的伏平粉属的地史分布，推测其起源中心位于我国东部亚热带-暖温带地区，发生时间在中始新世前后。渐新世时，虽种的分异度增大，但分布区仍限于东亚。只是到了中新世时，本属才发展到鼎盛时期，分布区亦达到最大，向东向西迅速扩大，横垮欧亚两洲亚热带-暖温带地区。但如果考虑种的数目及化石标本的数量，当时的分布中心可能仍旧位于我国东部和东南部。到上新世后期，气候开始恶化，其分布区也迅速退缩，形成东亚和南欧的间断分布形式。此时中亚和西亚干旱区大约已经形成，不利于本属植物生长。到了第四纪时，气候进一步恶化，全球性冰期导致本属植物绝灭。

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# *FUPINGOPOLLENITES* GEN. NOV. AND ITS DISTRIBUTION


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## Abstract


In the present paper *Fupingopollenites* is erected as a new genus, under which a new species and a new combination, *F. minutus* sp. nov., *F. wackersdorfensis* (Thiele-Pfeiffer) comb. nov. are described and illustrated.

Very complex and distinctive exine structure and surface sculpture have led to the confusion that different names were given for such pollen type, although it does appear to be widely distributed in mid-Tertiary, especially in Miocene deposits of Asia and Europe. The known localities and stratigraphic positions are listed below:

| Localities | Stratigraphic positions |
|---|---|
| Weizhou Island, North Gulf, South China Sea | $E_3^{2-3}$ (Weizhou Fm.) |
| Bose Basin Guangxi | $E_3^{2-3}$ (Baigang and Fuping Fms.) |
| Nanning Basin, Guangxi | E—$N_1$ (Yongning Group) |
| Ninghai and Xiangju area, Zhejiang | $N_1$ (Chengxian Group) |
| Qianjiang, Hubei | $N_1$ (Guanghuasi Fm.) |
| Yingcheng, Hubei | $N_1$ (Guanghuasi Fm.) |
| Northern Jiangsu | N (Yancheng Group) |
| Southern Yellow Sea | N (Yancheng Group) |
| Huainan, Anhui | N |
| Lingju, Shandong | $N_1$ (Shanwang Fm. and Lower part of Yaoshan Fm.) |
| Coast areas of Bohai Gulf | $E_{2-3}$ (Shahejie and Dongying Fms.) |
| Huanghua, Hebei | $N_2$ |
| Renqou, Hebei | $E_{2-3}$ (Shahejie and Dongying Fms.) |
| Weihe Basin, Henan | $N_1$ (Lengshuigou Fm.) |
| Eastern Mediterranean | Villafranian and $Q_1$ |
| Western Black Sea | $N_2$ |
| Hungary | $N_1$ |
| W. Germany | $N_1$ |
| Korea | $N_1$ |

An analysis of palynological assemblages from the localities listed above reveals that the mother plant of *Fupingopollenites* was of mesophyte (mesad) that existed under the subtropical to warm-temperate climatic conditions. And it also enables us to draw some conclusions as follows:

1. Stratigraphically, the genus ranges from Middle Eocene to Lower Quataernary in the middle latitude areas of Asia and Europe.

2. The new genus probably originated in Middle Eocene age in the subtropical area of East China. In Oligocene, it began to develop, its distribution area expanded but still was limited within East Asia, while in Miocene it reached a highly prosperous period, its distribution area rapidly extending to the largest extent, covering most non-arid middle latitude areas of Asia and Europe. Comparing the distribution sites of the fossil genus with the modern world vegetation map, one would find that the majority of localities happen to fall in the scope of the subtropical broadleaved evergreen forest and warm-temperate summer green forest. Such an interesting fact implies that the existence of the Central and West Asian Desert and Semi-desert Area may be traced probably to Miocene. This genus began to decline in Late Pliocene age, its distribution area retreating simultaneously eastward and westward resulting from an arid to semiarid vegetation formed in Central and West Asia. In Early Quaternary, it became extinct even-

tually as a result of a climatic deterioration on the whole globe.

***Fupingopollenltes* gen. nov.**

**Diagnosis** Pollen grain subspherical to spherical in shape, medium to large in size. Polar view triangular, roundly triangular to subcircular; lateral view oblate to circular in outline. Tricolporate, colpi narrow and straight, about 2/3 the lenth of radiate; inner pores large, oblate, visible only under right polar or equatorial view. Exine columnar, not homogeneous in thickness because of special development of exine columnar structure in certain areas; thickening on both poles approximately "Y" form, which combine with those in mesocolpium areas to form nine concave plate-like thinning areas. Surface sculpture rugureticulate under optical microscope, inter-twined reticulate under SEM.

**Type species** *Fupingopollenites wackersdorfensis* (Thiele-Pfeiffer) gen. et comb. nov.

**Discussion** The present new genus is easily distinguished from other tricolporate pollen by its large size, perculiar exine structure and surface sculpture. The pollen of *Scabiosapollis* Sung et Zheng and *Convoluvlus* looks like the new genus, though tricolpate in type. Even inner pores of *Fupingopollentes* are obscure, it may be identified by surface sculpture.

**Botanical affinity** In fact, its affinity remains unknown, although some authors consider it to be Verbenaceae (Rossignol-Strick, 1973, P. 977) or Boraginaceae (Thiele-Pfeiffer, 1980, P. 154).

**Range and Distribution** Middle Eocene to Early Quaternary; Asia and Europe.

**Derivation of Name** Fuping, a small village of the Bose Basin, Guangxi.

***Fupingopollenites wackersdorfensis* (Thiele-Pfeiffer) gen. et comb. nov.**

(Pl. I, figs. 5—7, 9—16, text-fig. 1)

Synonym is listed in Chinese text.

**Description** Pollen grain spherical to subspherical in shape, medium to large in size, with a diameter of 40—65 μ, mostly of 42—55 μ. Outline triangular, roundly triangular or polyangular in polar view, subcircular or oblate in lateral view. Tricolpate, colpi narrow and straight, about 2/3 the length of radiate; inner pores large, 3—5 width by 8—10 μ, often obscure under wrongly preserved position. Exine with columnar structure. Columnar structure on both poles in mesocolpium areas much developed, forming exine thickening bands, which are combined each other, leaving nine concave plate-like thinning areas on pollen surface. Thickening sometimes developing along pore and cokpus margine. Folds more easily occurring along the boundaries between thickening and thinning areas to form a more complex sculpture pattern. Surface with rugureticulate ornamentation under optical microscope, intertwined reticulate under SEM, muri vermiculate.

**Comparison and Discussion** The present species is different from *Fupingopollenites minutus* sp. nov. in its larger size, and its wider thickening bands.

Specimens assigned to the present species look like very much those from Miocene deposits of W. Germany (Thiele-Pfeiffer, 1980, pl. 12, figs. 22—28) except with larger average size. These eight exine thinning areas given in Thiele-Pfeiffer's description (1980, p. 53) are possibly due to miscounting. Specimens from the Pliocene sediment of eastern Hebei Province described by Li et al. (1981) as a new speciés of *Tricolporite rugulatus* are exactly the same as the present ones. The species name is, therefore, the junior one of *Tricolporopollenites wackersdorfensis* Thiele-Pfeiffer.

**Locality and Horizone** Suburb of Bose, Napo of Tianyang, Fuping of Tiandong; Middle and Upper Oligocene Baigang and Fuping Formations.

***Fupingopollenites minutus* gen. et sp. nov.**

(Pl. I, figs. 1—4; text-fig. 2)

**Description** Pollen grain subspherical,

medium in size, with a diameter of 30—39 μ, holotype 32 μ. Outline roundly triangular in polar view, oblate in lateral view. Tricolporate, colpi narrow and straight, about 2/3 the length of radiate; inner pores large, 2—3×4—6.5 μ, obsecure under wrongly preserved position. Exine with columnar structure. Columnar structure much more developed on both poles in mesocolpium areas to form exine thickening bands, which are combined with each other, leaving nine concave, plate-like thinning areas on surface. Exine thickening occurring also along pore and colpium margins. Surface sculpture rugureticulate to parareticulate.

**Holotype** Pl. I, fig. 1, slide number: GB 219 (2), Zhanlongjing of Bose, Guangxi; Upper Oligocene Fuping Fm. Paratype: Pl. I, fig. 2, slide number: GB 156 (4), Xiaolong Village, Tiandong, Guangxi; Middle Oligocene upper member of Baigang Fm.

**Comparison** This new species is different from *Fupingopollenites wackersdorfensis* (Thiele-Pfeiffer) gen. et comb. nov. in having smaller size, and comparatively narrower thickening bands.

## 图 版 说 明

所有标本存放在中国科学院南京地质古生物研究所孢粉室内，其中图 1—15 均×800 倍。

All specimens illustrated here are preserved in Palynological Section of Nanjing Institute of Geology & Palaeontology, Academia Sinica. Figs. 1—15 ×800.

### 图 版 I

1—4, 8. *Fupingopollenites minutus* gen. et sp. nov.

1. Holotype, 玻片号: GB219 (2); 广西百色斩龙颈水库；晚渐新世伏平组。

2, 3. Paratype, 玻片号: GB156 (4); 广西田东小龙村北；渐新世百岗组上段。不同焦距侧面观。

4, 8. 玻片号: GB219 (3); 产地层位同 1。

5—7, 9—15. *Fupingopollenites wackersdorfensis* (Thiele-Pfeiffer) gen. et comb. nov.

5, 6. 玻片号: GB156 (4); 广西田东小龙村北；渐新世百岗组。

7. 玻片号: GB219 (3); 广西百色斩龙颈水库；晚渐新世伏平组。

9. 玻片号: GB156 (8); 产地层位同 5, 6。

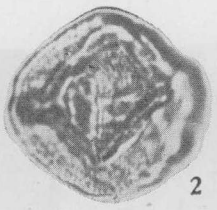
10, 15. 玻片号: GB156 (6); 产地层位同 5, 6。 15. 侧面观。

11—13. 玻片号: GB156 (3); 产地层位同 5, 6。 侧面观。

14. 玻片号: GB156 (2); 产地层位同 5, 6。 侧面观。

16. *F. wackersdorfensis* (Thiele-Pfeiffer) 的外壁表面纹饰电子扫描照片。 SEM photograph showing surface sculpture of *F. wackersdorfensis* (Thiele-Pfeiffer).


1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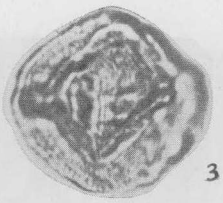
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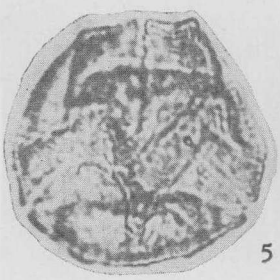
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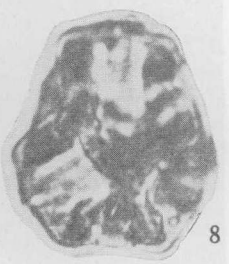
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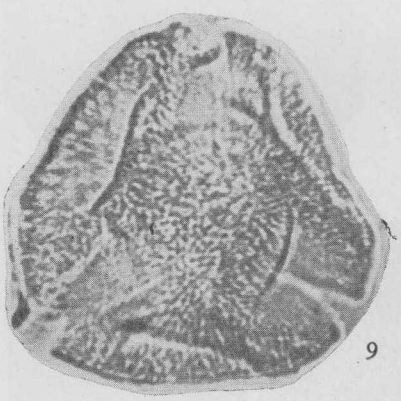
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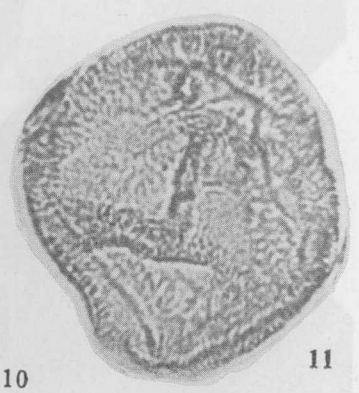
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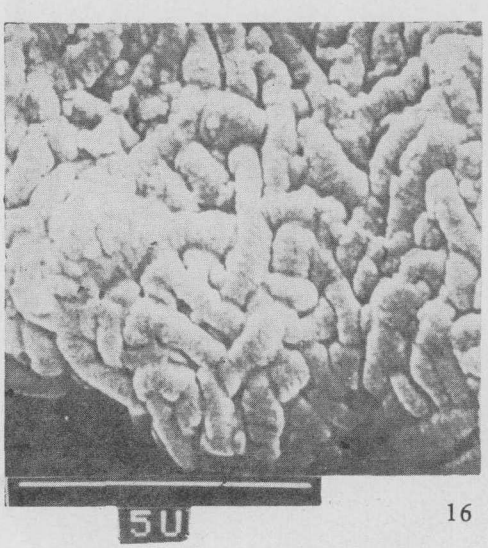

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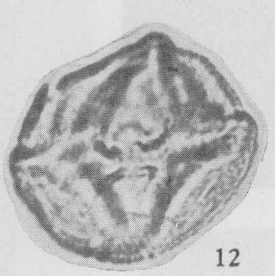
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