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Studies on Genera *Mallomonas*, *Synura* and Other Plankton in Fresh-water with the Electron Microscope Ⅲ.*
Observations on the plankton in the littoral region of Lake Ōtori-ike

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The studies on the plankton in Lake Ōtori-ike are rather few, but recently Uéno et al. (1959) carried out the studies in details on the fauna in this lake and its near ponds in summer. The present author explains the results of his observations on the plankton in the littoral region of this lake, and on *Mallomonas* species and some other algae with an electron microscope.

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Ⅰ. Ecological studies on the plankton.

1. Material and Method

Lake Ōtori-ike lies at the northmost position of the Asahi mountain range in Yamagata Prefecture, and the longitude is 139°50′ (E), the latitude 38°22′ (N), the altitude 963±3 metres, and the length of this lake is 1 kilometre the breadth 0.6 kilometre the maximum depth 65.3 metres.

The plankton were collected twice at 7 : 00 a.m. and 6 : 00 p.m. on July 29 in 1959 by means of the coniform plankton net of ordinary type, the dimentions are 0.3 metre indiam eter at the mouth, 1 metre in length, and the filtering cloth of the müller gauze No. 15 is used. For the quantitative examination, 1.5 litres of water was scooped in a wide-mouth bottle by hand at 7 : 00 a.m. on July 30 th.

The plankton net with the rope of 5 metres was thrown toward the center of the lake from the northern shore, and was towed horisontal in the layers of about 0.5 metre and 3 metre depth five times respectively.

The plankton were examined and counted by using an electron microscope besides an optical microscope. Especially the scales and bristles of *Mallomonas acaroides* were examined by means of the carbon replica method.

2. Result

The temperature of water, the plankton species and the number of individuals or cell are shown in tables Ⅰ－Ⅲ.

Fifteen species of the zooplankton, twenty species of the phytoplankton besides

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* Contributions from the Laboratory of Applied Zootogy, Faculty of Agriculture, Yamagata University. No. 54

Table Ⅰ.
Water temperature and pH value in Lake Ōtori-ike.

(1959)	Time	Weather	A.t (℃)	Depth (m)	W.t (℃)	pH
July 26 th *	14 : 00	fine	26.1	0	20.4	
27 th *	p.m.	fine		0	19.1	6.4
				1	18.4	6.4
				3	14.6	6.2
				5	12.6	6.2
				10	6.8	6.2
				30	5.1	5.9
				60	4.4	5.8
July 29 th	7 : 00	fine	16.5	0	17.0	
	18 : 00	fine	19.0	0	19.2	
30 th	7 : 00	fine	16.0	0	17.0	

*…(Data of July 26, 27 th) from Uéno (1959).

diatom were identified, and among the rest, *Chironomas* larva, Nematoda and *Hydracarina* species were found.

The dominant species at the littoral region of Lake Ōtori-ike is *Dinobryon cylindricum*, and in the zooplankton *Conochilus unicornis* was found dominantly and *Holopidium gibberum*, *Bosmina longirostris* and *Polyarthra trigla* were rich, in

Table Ⅱ.
Number of individuals of Plankton organisms in all filtered water in the littoral region of Lake Ōtri-ike (Ⅶ-29, 1959)

Species / Time / Depth (m)	7 : 00				18 : 00			
	0.5		3		0.5		3	
	Sp. no.	Inds. no.	Sp. no.	Inds. no.	Sp. no.	Inds. no.	Sp. no.	Inds. no.
Holopidium gibberum	1	4,200	1	2,600	1	50		0
Daphnia ambigua	2	168	2	1,200		0		0
Scapholeberis mucronata	3	168		0	2	12		0
Bosmina longirostris	4	300	3	4,000 (600)*	3	62	1	1,800 (200)*
Alona guttata	5	168	4	200	4	37		0
Pleuroxus hamata		0	5	+		0		0
Chydorus sphaericus		0		0	5	12		0
Acanthodiaptomus pacificus	6	600	6	1,400	6	200		0
adult		0		200		0		0
copepodid		600		1,200		200		0
Cyclops vicinus		0	7	+	7	12	2	200
Copepodid				+		12		200
Canthocamptus sp.			8	+				
Total number		5,604		9,400		385		2,000
Euchlanis dilatata	7	+		0				
Polyarthra trigla	8	3,150	9	1,200 (200)*	8	600	3	2,000 (200)*
Synchaeta sp.	9	84	10	200		0		0
Asplanchna priodonta	10	300		0	9	1,400	4	600
Conochilus unicornis	11	34,500	11	96,600	10	3,400	5	45,800
Total number		38,034		98,000		5,400		48,400
Total of Zooplankton	11	43,638	11	107,400	10	5,785	5	50,400
Dinobryon cylindricum		944,400		538,000		742,600		1,138,800
Tabellaria fenestrata		4,320		400		25		6,200
Diatoms spp.		4,320		72,960		3,600		200
Mougeotia sp.		0		0		0		1,800
Micrasterias denticulata var *notata*		0		+		0		0
Chlorophyta sp.		840		0		0		0
Total of Phytoplankton		953,880		611,360		746,225		1,147,000
Chironomus larva		0	1	+		0		0
Nematoda sp.		0	2	+		0		0
Quantity of Plankton (cc)	1.3		2.2		0.1		0.3	

*…The number of individuals having the egg.

the phytoplankton Diatom, two Microplankton species and *Rhizosolenia* species were found in abundance.

The number of species of phytoplankton captured with the plankton net was small, but that of cell was extremely larger than the individual number of zooplankton.

The plankton showed the different distribution according to depth and to time. At 7 : 00 a.m., *Daphnia anbigua*, *Bosmina longirostris* and *Acanthodiaptomus pacificus* were abundant in 3 metre layer, and *Holopidium gibberum* and *Scapholeberis mucronata* in the surface water. But at 6 : 00 p.m., these Crustaceans decreased extremely in the surface water, and other species except *Bosmina longirostris* and *Cyclops vicinus* disappeared from the 3 meter layer. The phytoplankton was found in larger number in the surface water at 7 : 00 a.m. and in 3 metre layer at 6 : 00 p.m. than the other layer respectively. (Table Ⅱ)

Table Ⅲ.
Number of individuals (or cell) of plankton organisms per 10 liters of water in the in littoral region of Lake Ōtori-ike (Ⅶ-30, 1959)

Species	No. of Species	No. of Individuals
Nauplius of *Copepoda*	1	7
Polyarthra trigla	2	442(40)
Synchaeta sp.	3	7
Asplanchna priodonta	4	7
Conochilus unicornis	5	174
egg		221
Total of Zooplankton		637
*Merismopedia glauca**	6	80
Mougeotia sp.	7	409
Staurastrum sp.	8	27
Aphanocapsa sp.	9	7
Microplankton sp. No. 2	10	21,440
M. sp. No. 4	11	13,668
M. sp. No. 6	12	+
Dinobryon cylindricum	13	139,360
Mallomonas akrokomos	14	3,350
M. acaroides var. *crassiquama*	15	5,360
M. tonsurata	16	1,809
M. sp. No. 24	17	1
cf. M. areorata	18	+
Synura sphagnicola	19	3,886
Rhizosolenia sp.	20	17,420
Tabellaria fenestrata	21	70
Diatoms spp.	22	38,860
Total of Phytoplankton		245,745
Total of Zooplankton	5	637
Total of Phytoplankton	17	245,745
Total of Both	22	246,382
Phytoplankton in Total (%)		99.7
Hydracarina sp.		20
Chironomus larva		13
Nematoda sp.		7

*···The number of colony.
( )···The number of individuals having the egg.

From the material collected by means of the bottle, 4 species of zooplankton

Table Ⅳ.
Composition of Zooplankton in Lake Ōtori-ike.

Species	Total of Forth		7 : 00, 0.5m		7 : 00, 3m		18 : 00, 0.5m		18 : 00, 3m	
	%	order	%	order	%	order	%	order	%	order
Conochilus unicornis	85.0	1	78.0	1	87.5	1	58.8	1	90.5	1
Polyarthra trigla	3.3	2	7.2	3	1.1	6	10.4	3	4.0	2
Holopidium gibberum	3.2	3	9.7	2	2.4	4	0.9	6		
Bosmina longirostris	2.9	4	0.7	5	3.6	2	1.1	5	3.6	3
Nauplius of Copepoda	1.6	5			2.5	3			1.2	5
Asplanchna priodonta	1.1	6	0.7	5			24.2	2	1.9	4
Acanthodiaptomus pacificus	1.0	7	1.4	4	1.3	5	3.5	4		
Daphnia ambigua	0.7	8	0.4	6	1.1	6				
Cyclops vicinus(copepodaid)	0.1	11					0.3	8	1.2	5

and 17 species of phytoplankton besides diatom were identified. The individual number of zooplankton is 637 per 10 litres of water and that of phytoplankton 245,745 and the phytoplankton amount to 99.7%, Chrysophyceae 62.5%, two Microplankton species 14.2% and Diatom 22.8% of the total number of plankton. (Table Ⅲ)

The composition of zooplankton is shown in table Ⅳ. The order of individual number of *Conochilus unicornis* was the first in every cases but it's other species is variable in the order according to time and to depth.

The microphytoplankton were obserbed with an electron microscope and these electron micrographs are shown in plates Ⅰ to Ⅶ, and the morphological subject on them is explained in latter part of this paper.

3. General consideration

1) The composition of plankton community in the littoral region of Lake Ōtori-ike:

The number of species of plankton taken from the littoral region is 15 species of zooplankton, and 20 species of phytoplankton besides diatom. The present data differs remarkably from the results of Abe (1949) and Uéno et al. (1959), namely Abe (1949) reported that 6 species of zooplankton and 4 species of phytoplankton were collected from the littoral region, and Uéno et al. (1959) reported that 12 species of zooplankton and 2 species of phytoplankton were collected from the pelagic region. But the present author's result obtained by using the plankton net is very similar to theirs.

The present author found many micro-algae in the material of the bottle sampling, but these micro-algae could not be seen in that of the net sampling (Tables Ⅱ and Ⅲ). This fact shows that such micro-algae as two Microplankton species and *Mallomonas* species may over-flow with a pond water from the mouth of the net, and also the greater part of the zooplankton run away when the water is scooped into the bottle, therefore we must use both sampling methods, namely the plankton net, and the bottle or pump sampling.

The composition of the zooplankton cnmmunity in the littoral region differs from that of the pelagic region, though the dominant species is quite the same species in both cases. And in the pelagic region, *Conochilus unicolnis* is the first in order and shows 58%, and Crustaceans as *Holopidium gibberum*, *Cyclops vicinus*, *Acanthodiaptomus pacificus* and *Daphnia ambigua* are main composers, and Rotatorian are few (Uéno et al. 1959), but in the littoral region, *Conochilus unicornis* is 85% *Polyarthra trigla*, *Holopidium gibberum* and *Bosmina lngirostris* are main composers as are shown in table Ⅳ.

The plankton community in the pelagic region consisted of all species of zooplankton which are existing in every layer from the surface water to the bottom of the lake. The author thinks, by examining the data of Yamamoto (1948) in Lake Aoki, that the species found in abundance in the deeper layer of water of the pelagic region distribute toward the littoral region along the bottom.

In the pelagic region of Lake Ōtori-ike, the maximum occurrence of *Acantho-diaptomus pacificus* appeared in the layer from 1 to 2 metre deep, that of *Daphnia ambigua* in the layer from 0 to 5 metre deep and that of *Cyclops vicinus* in the deeper layer then 5 metres (Mizuno, 1959), but in the littoral region, they were found only in small number. These crastaceans migrate up and down periodically in wide range (Motoda, 1953), consequently they seem to distribute rather in the pelagic region than in the littoral region in one lake.

The vertical distribution of plankton in the littoral region, in general, does not appeare distinctly, because the stratification of environmental factors and plankton are disturbed by wave and wind. And Yamamoto (1948) reported on the horizontal distribution of the plankton, that the centre of the maximum occurrence was found at different position in each species by reason of the influence of environmental factors as wind and sunlight. In Lake Ōtori-ike, the distribution of plankton in the littoral region at 7 : 00 a.m. is similar to that in the pelagic region in the after-noon, but at 6 : 00 p.m., the crustaceans seem to have migrated to other parts of this lake by above-mentioned reasons.

2) Productivity of Lake Ōtori-ike:

The number of plankton in the littoral region in summer was culculated at 247,000 per 10 litres of water. As compared with the number of plankton of other lakes in this district in summer, the total number of individuals of plankton in Lake Ōtori-ike is 1/4 of that of Arasawa-dam in 1957 (Abe et al. 1960), and 1/10 of that of a ditch of Tsuruoka Park (Takahashi, 1957), except *Mallomonas*, *Synura* and Microplankton species in both stations. This fact shows that Lake Ōtori-ike belongs to the oligotrophic type as was pointed out by Uéno (1959).

But on the other hand, the number of cell of the phytoplankton as the primary producer in the littoral region was larger than that of the pelagic region (Uéno, 1959). That fact may show that the water of the littoral region contains more abundantly the nutritious matters than the pelagic region in this lake.

3) Relation of the plankton in Lake Ōtori-ike to that in Arasawa-dam:

Arasawa-dam is connected with Lake Ōtori-ike by the River East-Ōtori (Higashi-Ōtori Kawa), and lies 19 kilometres lower than Lake Ōtori-ike. The plankton of Lake Ōtori-ike are carried into Arasawa-dam. In comparing the plankton in Arasawa-dam during three years (1956-1958) (Abe et al. 1960) with that of Lake Ōtori-ike, the results are as follows: a) *Hollopidium gibberum* disappeared on the way of migration, because this species was not found in Arasawa-dam from 1956 to 1958. The present species is abundant in ponds or lakes in Europe which have little calcium concentration (Uéno, 1938), and in Japan this species occurs in Lakes Tazawa, Oze-numa, Akimotoko and Kizaki (Kokubo, 1944), and is not nearly so common as *Acanthodiaptomus pacificus*, *Bosmina longirostris* and *Cyclops* species. It seems that the present species was destroyed on the way of migration owing to its characteristic structure of body, or even if this species had arrived in Arasawa-dam, it could not have been alive in this dam for the reason that the water poured into the dam was turned into the unsuitable condition, though the auther has not yet undergo the chemical analysis of the water. b) *Daphnia ambigua*, *Acanthodiaptomus pacificus* and *Conochilus unicornis* decreased gradually, c) *Bosmina longirostris* has increased and become the dominant species since summer in 1957 in the dam.

Ⅱ. Morphological studies of Mallomonas species and other algae of Lake Ōtori-ike.

In this part, the author tried to explain the results on the morphological observation of two *Mallomonas* species, *Rhizosolenia* species and two microplankton apecies in the materials from Lake Ōtori-ike by means of the electron microscope.

These electron micrographs are shown in plates Ⅰ to Ⅶ.

1) *Mallomonas acaroides* var. *crassisquama* (Plates Ⅰ－Ⅲ, figures. 1-19) Cell is oval and 10μ-17.6μ in length and 8μ-15.4μ in breadth. The scale belongs to "Tripartite" group, and is 4μ-7μ in length, 3.5μ-4.3μ in breadth, that shape is oval to elliptical, and some of them are comparatively rhombic.

The apical scales have the cristated edge at a half side of the dome, and this edge is made of the ridge which divides the shield from other parts. And in the other half side of dome, there are a number of minute teeth, and on the dome a number of papillae are found as is shown in figures 2 and 5. These scales are rather rhombic (figs. 1-3). The body scale has not the cristated edge, but has the considerably raised ridge and well-developed V-rib (fig. 5). The inner side of scale is flat, the cristated edge is thick. The dome is hollow, hemisphere, and projects obliquely outerside (fig. 6) as was pointed out by Harris (1953) on *Mallomonas teilingii*. The body scales not bearing a dome at the posterior portion of cell are smaller in size than the other body scales bearing the dome.

But these scales have small number of papillae on the portion of dome as is shown in figures 7 and 8. The rear-end scale is asymmetrical, smaller than the body scale, and some of them have a spine projecting from the anterior part of rib (fig. 10).

These scales, except some of rear-end scale, have a well-developed mesh pattern on the shield, and radial straight ridges on the flange. These characteristic structures of scale agree closely with a diagnosis of Asmund (1959), except that the dome has a small number of papillae. But the present species in Lake Ōtori-ike is shorter in length and larger in breadth of cell, and also the dimensions of the scale are in the narrower range than that of diagnosis.

The bristle is 8.6μ-32μ in length, all of them are helmet type. The distal portion has the particular structure, which is very complex as is shown in plate Ⅲ. This portion is seen as two teeth when using the optical microscope, the present author examined the distal portion using the carbon replica method, the electron micrographs of which are shown in figures 13–15. The median rib of shaft arrives at the apex of bristle and becomes the pointed apex, which is various in legth, namely 0.5μ–3.7μ as is shown in figures 16–19. The basal portion of pointed apex forms the folded projection of 1.5μ–2.0μ in length toward the convex side, which is seen as a tooth near the pointed apex of bristle under the optical microscope. And there is a narrow interstice between the shaft and folded projection, and the concavity is formed under this interstice. Another tooth consists of a perpendicular rib to the median rib of shaft and a triangular thin membrane which is connected with the median rib of shaft (figs. 13, 14). Some of the bristles have two widely spaced teeth at the convex side of shaft (fig. 20). But a cell with serrated bristle could not be found in the material from this lake.

On the other hand, the present author observed a few scales whose rib of flange forms a well-developed mesh-pattern (fig. 11), and the ribs of shield and flange are less developed and are rather similar to that of *M.* var. *striatula* (fig. 12). But it is indistinct whether these scales are of the variant of individuals or of other variatus.

The present species was collected from Lake Katakai-numa at Mt. Zaō, and Arasawa-dam in addition to Lake Ōtori-ike (Takahashi, 1959).

2) *Mallomonas* sp. No. 24 (Plate Ⅳ, figures. 21–24)

Only one cell of the present species was observed this time. A cell is a long elliptical near fusiform, and about 18μ in length and 9μ in breadth. The scale belongs to "Tripartite" type, and is oval but slightly asymmetrical in shape, and is 2.3μ–4.2μ in length, 1.4μ–2.7μ in breadth. The dome and V-rib are well developed, the shield and flange have a number of perforations which are very regularly arranged in crossing row, and the perforations of a row are 9 to 11 in 1μ. The surface of shield is rough, rather undulated. The dome has numerous minute perforations, and is divided from the shield by a solid rib as other *Mallomonas* species. On the marginal area, the small radial ribs are arranged in the distance of about 0.2μ as *Mallomonas papillosa* and *Mallomonan striata* (figs. 21, 22). The body scales of the posterior portion of cell have not the dome, and they are smaller than the others (fig. 23). The bristle is 4.5μ–7.5μ in length, and is delicate, slightly tapered, and considerably curved at the basal portion, and the base of bristle is cut acutely. The each side of bristle is smooth, and the tip of it is forked into two branches; the longer one is at the concaved side of the bristle, and curves toward the convex side (fig. 24).

The present species is found in the swamp at Mt. Gassan in addition to Lake Ōtori-ike.

3) Microplankton sp. No. 2 and Microplankton sp. No. 4 (Plates Ⅴ–Ⅵ, figures. 25–33)

The present author described that these species have numerous minute elliptical plates within the circular cell wall with a spine, and these minute plates have one elliptical shallow indentation in Sp. no. 2 and one or two indentations in Sp. no. 4 in previous paper (Takahashi, 1959).

In the later examination, it was made clear that the circumference of indentation is comparatively thickened and that of the plate is narrow raised rim, but the reverse side of plate is smooth and the median portion is distended, and in both species, the structure of minute plate is similar to each other but the indentation of Sp. no. 4 is deeper than that of Sp. no. 2, and the number of indentation of Sp. no. 2 is one but that of Sp. no. 4 is one or two (figs. 27, 33).

These two species are common in lakes and ponds in the mountainous region, and are important as a producer in these lakes. The number of cell per 10 litres of water in Lake Ōtori-ike is 13,668 in Sp. no. 2 and 21,440 in Sp. no. 4.

4) *Rhizosolenia* sp. (Plate Ⅶ, figures. 34–38)

Cell is 35 μ to 60 μ in length except the spine, 10 μ in breadth. The intercalary band is narrow, and is scarcely visible in the dry material under the optical microscope, but it was clearly observed with the electron microscope as is shown in plate Ⅶ.

The number of intercalary band is about 12 in 10 μ. The intercalary band has numerous pores and they are regularly spaced in 6–8 rows crossing the band, and the diameter of it is lager than that of *Rhizosolenia longiseta*.

The edge of intercalary band toward the calyptra is narrow raised rim, and it overlaps on the flat egde of next intercalary band. The edge of other side is flat, and this flat edge is underlaid the raised rim of the next intercalary band (fig. 38). The calyptrae is coniform, and has a short and hollow spine, and the apex of spine is forked into two teeth. The longer one becomes a pointed apex, the shorter one is bifurcate as is shown in figure 36. This structure differs from that of *Rhizosolenia longiseta* as is shown in figure 37, and the intercalary band of *Rhizosolenia longiseta* is wider than that of the present species, and the number of it in 10 μ is six.

Summary

The result of observation on the plankton in the littoral region of Lake Ōtori-ike in summer of 1959, and on *Mallomonas acaroides* var. *crassisquama* and some species of phytoplankton using the electron microscope were explained in this paper.

(1) From the materials by means of the plankton net and the wide-mouth bottle collection, 35 species besides diatom were identified, and 15 species in zooplankton 20 species besids diatoms in phytoplankton.

(2) In comparison of the plankton which were collected with the plankton net and bottle sampling, the greater part of species of zooplankton and a few phytoplankton were collected with the plankton net, but a few species of zooplankton and 17 species of phytoplankton besides diatom are collected by the bottle sampling.

(3) The plankton community in the littoral region consists of *Conochilus unicornis*, *Holopidium gibberum*, *Bosmina longirostris* and *Polyarthra trigla* in the zooplankton, and *Dinobryon cylindricum*, Diatom, Microplankton sp. No. 2, Sp. no. 4 and *Mallomonas* species in the phytoplankton.

(4) The relation between the plankton in Lake Ōtori-ike and that of Arasawa-dam from 1956 to 1958 is as follows: *Holopidium gibberum* does not migrate to the dam, *Daphnia ambigua*, *Acanthodiaptomus pacificus* and *Conochilus unicolnis* have decreased gradually in the dam and *Bosmina longirostris* has increased greatly and become the dominant species in the dam.

(5) The individual or cell number of plankton in the littoral region in summer is 274,000 per 10 litres of water and phytoplankton amount 99.7%. This number is 1/4 of that in Arasawa-dam of 1957, and 1/10 of that in a ditch of Tsuruoka Park, therefore this lake belongs to oligotrophic type.

(6) *Mallomonas acaroides* var *crassisquama*, *Mallomonas* sp. No. 24, the minute elliptical plate of Microplankton sp. No. 2 and No. 4, and *Rhizosolenia* sp. are examined with the electron microscope. Especially, the fine structure of scales and bristles of *Mallomonas acaroides* was made clear by means of the carbon replica method.

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摘　　要

Mallomonas, *Synura* 属及び他の淡水産プランクトンの電子顕微鏡による研究 Ⅲ.
大鳥池沿岸部の1959年夏のプランクトンに就いて

高　橋　永　治

1959年7月29日，大鳥池の北岸で午前7時と午後6時の2回，5メートルの綱のついたプランクトンネツトを用いて，50センチメートルと3メートルの深さの層から採集したプランクトンと，7月30日午前7時同じ北岸の地点で広口瓶で採水した 1.5 リツトルの水の中のプランクトンを観察した結果及び，マロモナス2種とその他3種を電子顕微鏡で観察した結果を報告する．

大鳥池沿岸部のプランクトン種数は，35種と珪藻類で，動物性プランクトン15種，植物性プランクトン20種と珪藻類，その他に昆虫幼虫，ミズダニ1種，線虫類1種が採集された．(Ⅱ，Ⅲ表)

沿岸部のプランクトン群集の構成は，動物性プランクトンでは，*Conochilus unicornis* が優占的に多数であり，*Polyarthra trigla*, *Bosmina longirostris*, *Holopidium gibberum* がそれに次いで多数であつた．植物性プランクトンでは *Dinobryon cylindricum* が優占種で，次いで珪藻類が多数であつた．

動物性プランクトンについては，湖心部の表層部のプランクトン組成と類似している．しかし，植物性プランクトンは，総個体数の99%以上もあり，*Dinobryon cylindricum* は60%以上を占めている．

沿岸部プランクトンを10リツトルの水に生息する個体数に計算すると，約 247,000 となる．湖心部の結果（上野．1959）より可成り多く，沿岸部の方が湖心部より栄養に富んで生産力が高いと思われる．又その数は当地方の荒沢ダムの夏期のそれの 1/4，鶴岡公園堀の 1/10 であつて，大鳥池は貧栄養的であると云えよう．

同定，計数の際，微小で，光学顕微鏡では高倍率を必要とするものの場合は電子顕微鏡を併用した．

採集の場合，用いる器具によつて，結果が異るが，プランクトンネツトを用いた場合は第Ⅱ表に，瓶を用いた場合は第Ⅲ表に示されるような結果となつた．

沿岸部ではプランクトンの垂直分布は一般に明確には現われない，午前7時，午後6時の2回観察した結果は，第Ⅱ表に示される．出現数の増減は，週期的行動の著しい甲殻類

に明瞭に現われた.

大鳥池は東大鳥川で荒沢ダムと連結し，19キロメートル上流にある．大鳥池と荒沢ダムの1956年から58年までのプランクトンとを比較すると 1) *Holopidium gibberum* は途中で消失したと思われ，荒沢ダムからは採集されなかつた．2) *Acanthodiaptomus pacificus* と *Daphnia* と *Conochilus unicornis* は荒沢ダムに移住したが年々減少した． 3) *Bosmina longirostris* は年と共に増加し，遂には優占種になつたことがわかつた．

大鳥池のプランクトンから，マロモナス属5種が同定された．本文第Ⅱ章には，特に *Mallomonas acaroides* 等を電子顕微鏡を用いて観察した結果が述べられている．そしてそれらの電子顕微鏡写真は図版のⅠからⅦに示してある．

Mallomonas acaroides var *crassisquama* はヘルメツト型の剛毛を持つことが知られている．その構造は複雑であるが，カーボンレプリカ法を用いてその微細構造を殆ど明確にした．又鱗片の微細構造も，透過，シヤドー，レプリカの3法による観察によつて明かになつた．

Mallomonas sp. No. 24 は，まだ一個体しか観察出来なかつたが，剛毛，鱗片の構造が明らかになつた．この種は月山湿原と大鳥池から採集されたのみである．

Rhizosolenia を観察したところ，*Rh. longiseta* と異つた構造をもつていることがわかつた特にこの種の棘の先端部と *Rh. longiseta* の棘のほぼ中央部の微細構造，及び中間帯の連結の様子を写真で示した．

Plate Ⅰ. *Mallomonas acaroides* var. *crassisquama* (All figures except figs. 13, 15 are ×10,000)

Fig. 1 Apical scale
Fig. 2 do. (Cr shadow)
Fig. 3 do. (Carbon replica)
Fig. 4 Body scale
Fig. 5 Outer side of body scale (Carbon replica)
Fig. 6 Inner side of body scale (Carbon replica)

Plate Ⅱ.

Fig. 7 Domeless body scale
Fig. 8 do. (Carbon replica)
Fig. 9 Rear-end scale
Fig. 10 Rear-end scale with spine (Cr shadow)
Fig. 11 Variety of apical scale
Fig. 12 do.

Plate Ⅲ.

Fig. 13 Distal portion of helmet bristle (Carbon replica)×20,000
Fig. 14 Helmet bristle (Carbon replica)
Fig. 15 Basal portion of bristle (Carbon replica)×25,000
Figs. 16-19 Distal part of helmet bristles
Fig. 20 Helmet bristle with teeth (Cr shadow)

Plate Ⅳ. *Mallomonas* sp. No. 24 (All figures are×15,000)

Fig. 21 Apical scale and bristle
Fig. 22 Apical scale (Cr shadow)
Fig. 23 Body scale (Cr shadow)
Fig. 24 Bristle (side-view)

Plate Ⅴ. Microplankton sp. No. 2

Fig. 25 Intact cell×2,000
Fig. 26 do. ×2,000 (Cr shadow)
Fig. 27 Minute plates (Cr shadow)
Fig. 28 Intact cell under the optical microscope
Fig. 29 Microplankton sp. No. 4 under the optical microscope

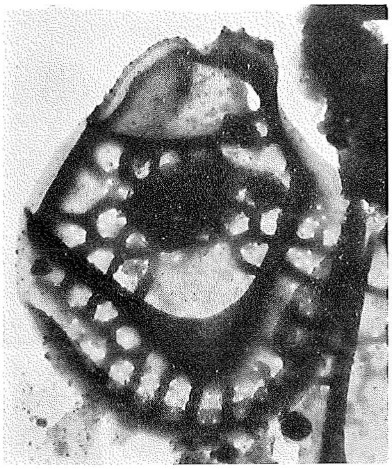
Plate Ⅵ. Microplankton sp. No. 4

Fig. 30 Intact cell×5,000
Fig. 31 do.×5,000 (Cr shadow)
Fig. 32 Spines (Cr shadow)
Fig. 33 Minute plates (Cr shadow)

Plate Ⅶ. *Rhyzosolenia* species

Fig. 34 Intercalary band×5,000
Fig. 35 do.×20,000
Fig. 36 Tip of spine×45,000 (Cr shadow)
Fig. 37 A part of spine of *Rhizosolenia longiseta* in Arasawa-dam×25,000
Fig. 38 Calyptrae with spine and intercalary band×10,000 (Cr shadow)

Plate Ⅰ



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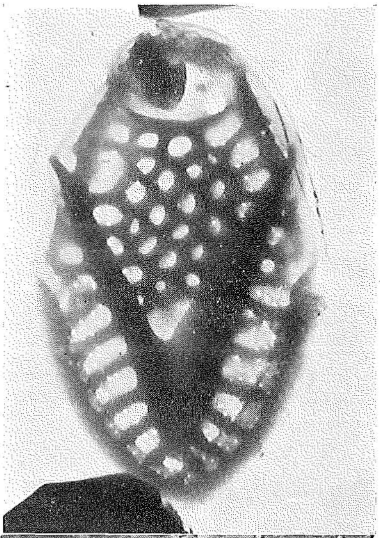

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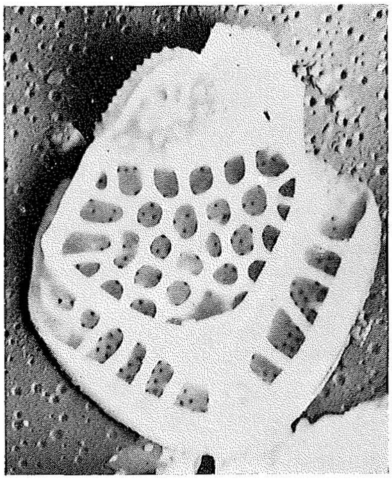

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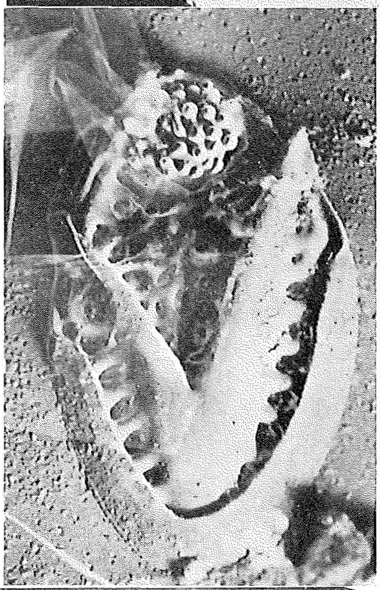

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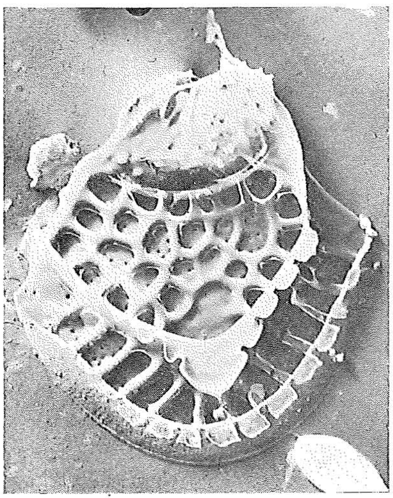

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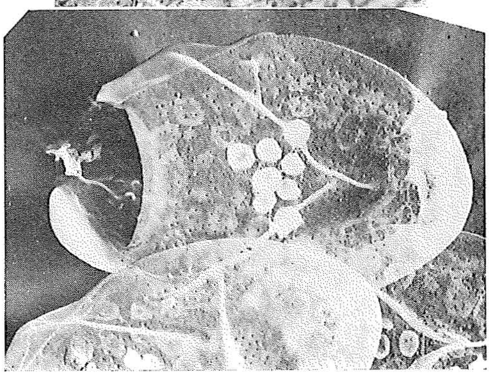

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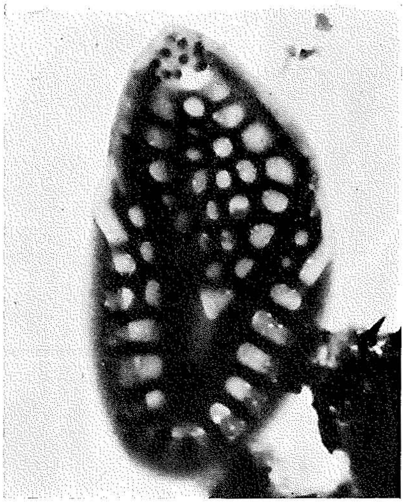

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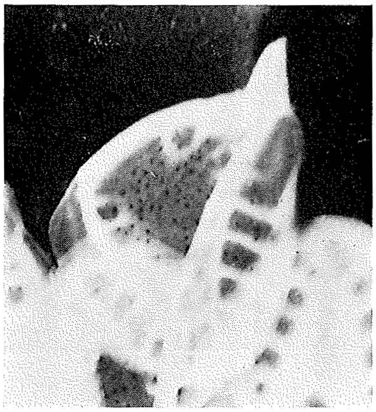

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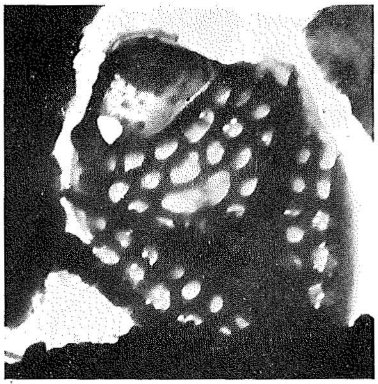

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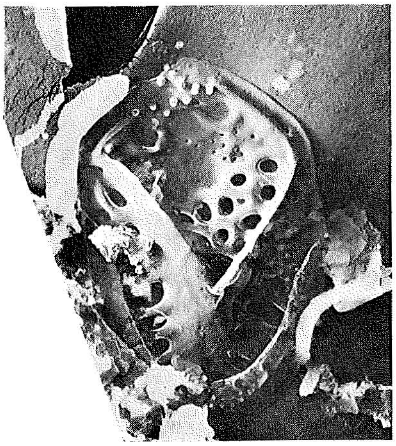

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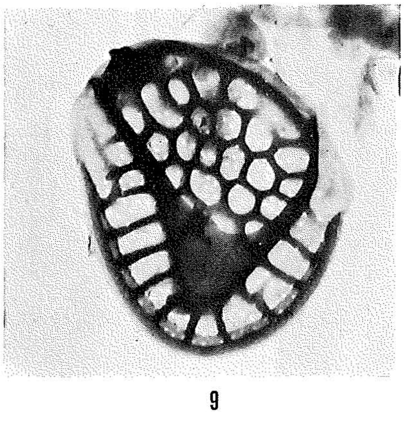

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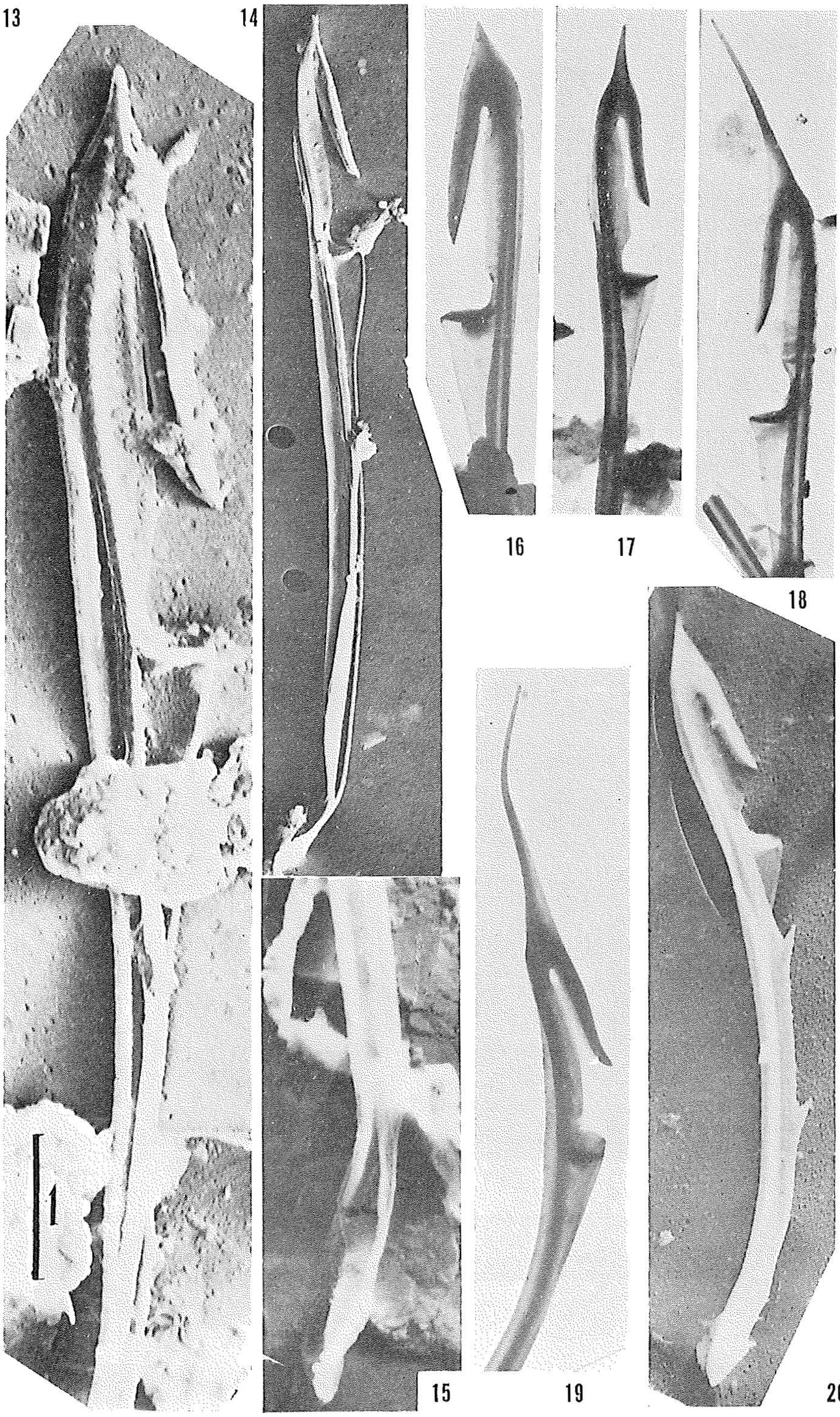

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Plate Ⅳ.

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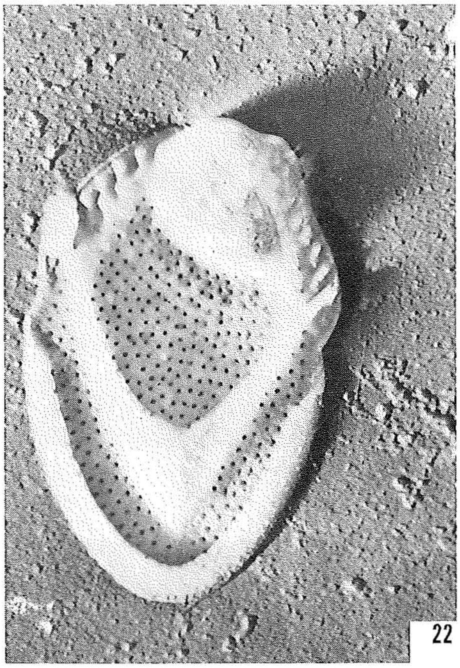

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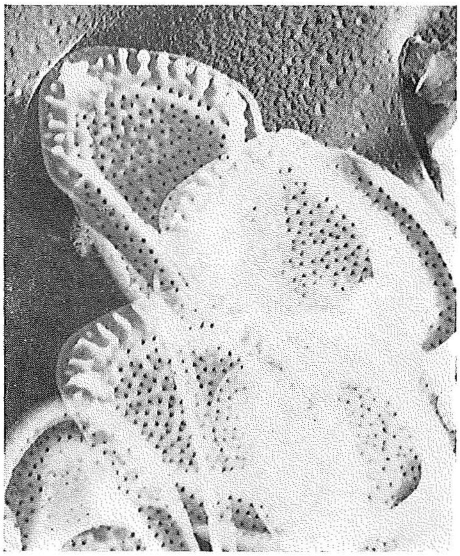

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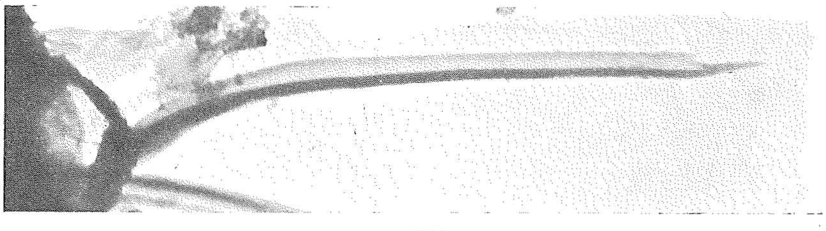

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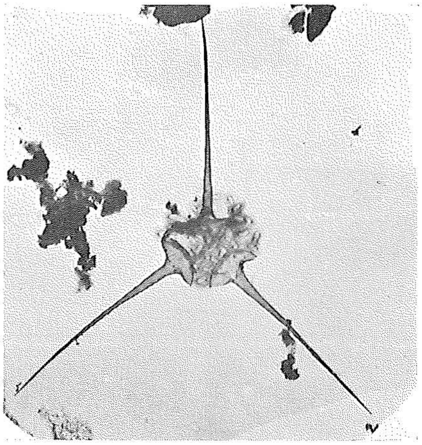

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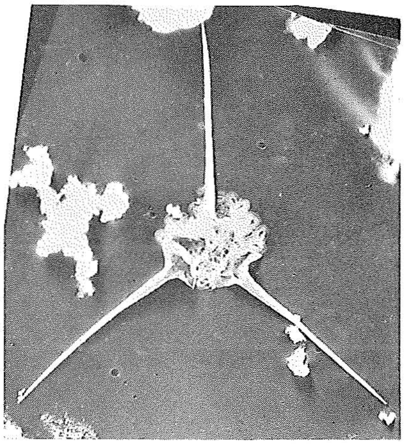

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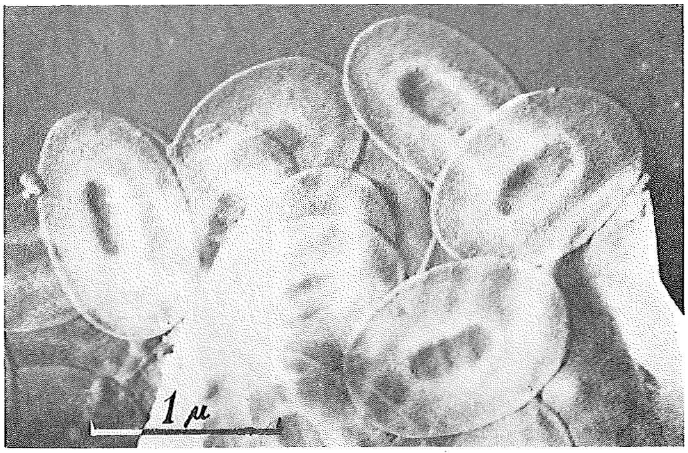

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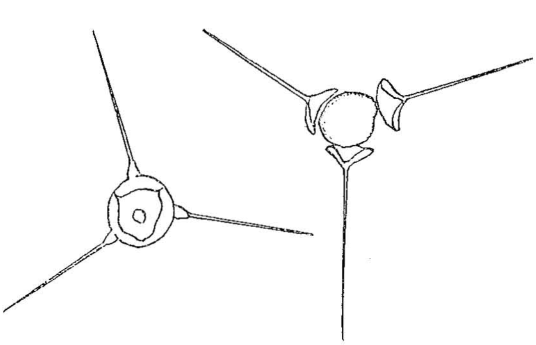

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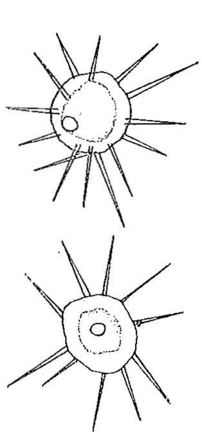

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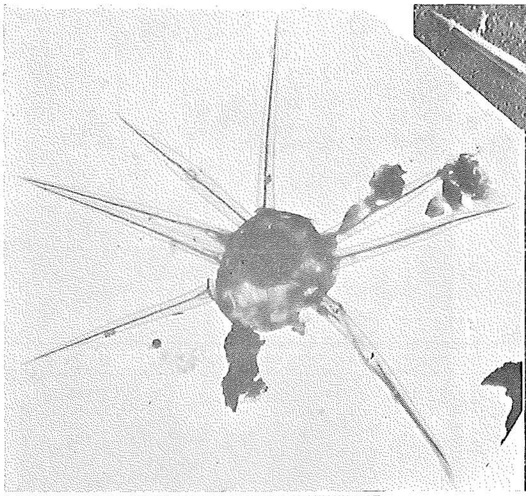

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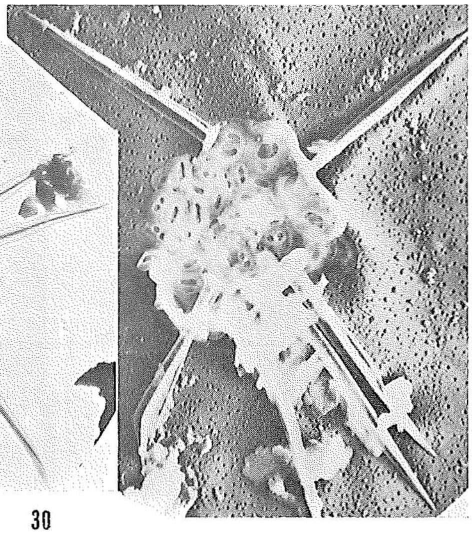

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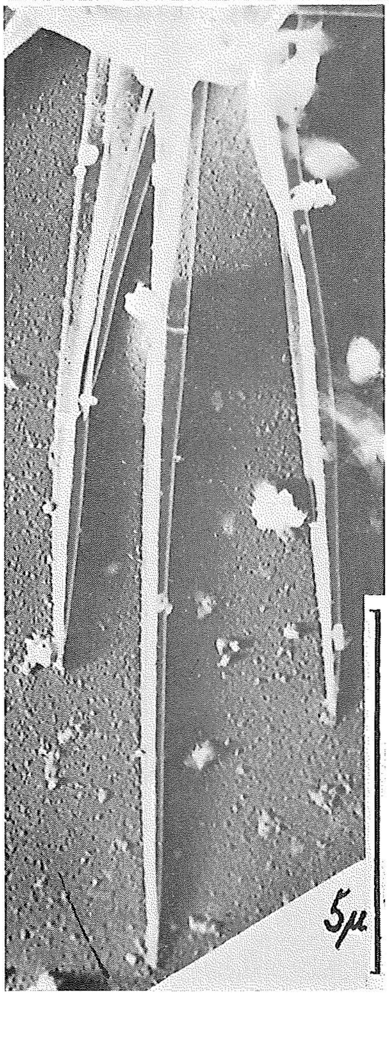

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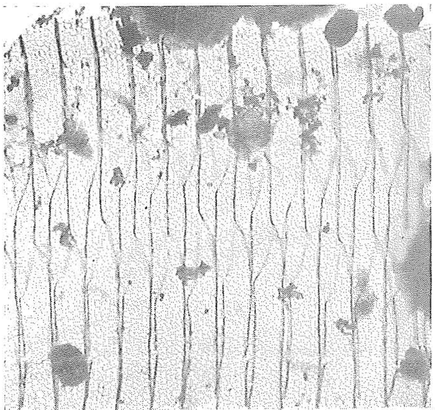

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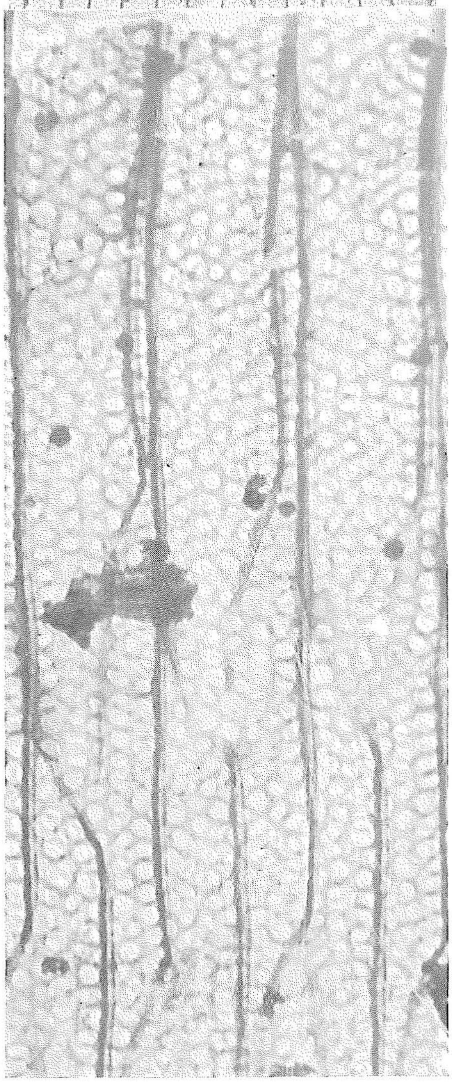

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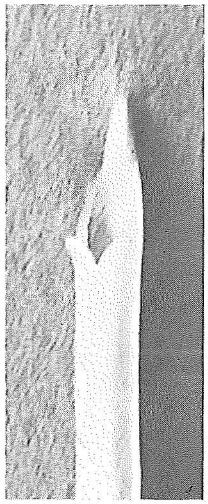

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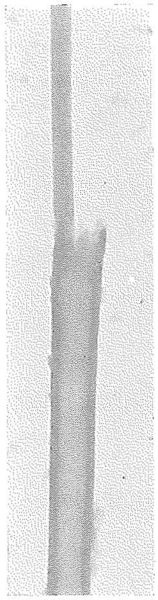

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