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Preliminary Report on *Silicoflagellates* from the Neogene Tertiary of the Hokuriku District, Japan

By

Wataru ICHIKAWA

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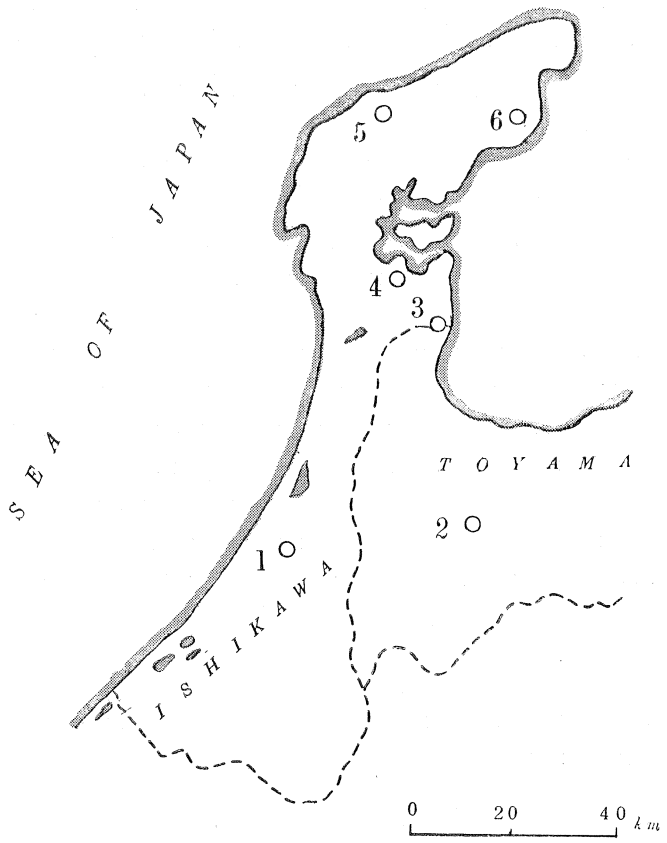
Introduction

For many years engaged in the study of fossil diatom deposits, I have been able to collect specimens of *Silicoflagellates* found in association and mount them on slide glasses for microscopic examination. The material here studied belongs to the collections from different mudstones of the Neogene age of the Hokuriku district where such mudstones are found widely distributed. (Text-figure 1).



Text-figure 1

Chart indicating six localities referred to this paper.

Since the siliceous tests of *Silicoflagellates*, though minute, are preserved quite safely, and since they are found over wide areas especially in the Tertiary and later formations they seem to be highly estimated as being valuable stratigraphical indices.

Little has been known of them in our country, however. The present paper aims at elucidating important features, stratigraphical as well as paleontological, of these minute fossils. As regards the materials from other localities in the Hokuriku district I hope to get further opportunities to investigate so as to carry out a comparative study of various faunal areas within the district.

I wish to express my thanks to Professor I. Hayasaka for his kindly reading the manuscripts.

Localities and Materials

The localities where the samples were taken from are as follows:

Loc. 1. Mitsukouji beds, Hiraguri-town, Kanazawa-city, Ishikawa-prefecture.
Loc. 2. Nishidoujima beds, Houchi-village, Nei-subprefecture, Toyama-prefecture.
Loc. 3. Sugata beds, Minamionomi-town, Nanao-city, Ishikawa-prefecture.
Loc. 4. Wakura beds, Wakura-town, Nanao-city, Ishikawa-prefecture.
Loc. 5. Tsukada beds, Tsukada-town, Wajima-city, Ishikawa-prefecture.
Loc. 6. Iizuka beds, Shoin-town, Suzu-city, Ishikawa-prefecture.

Six samples in all, one from each locality, were analysed. All the rocks are massive but brittle, and some of them appeared to be a black shale. When fresh these mudstones are, in general, characteristically gray or bluish gray, but are turned to yellow or light brown where they have been exposed for a long time.

The vertical and horizontal distribution of the mudstone beds in this district has been discussed already: these beds as a whole are of the Neogene age, probably the Younger Miocene.

As the samples of the mudstones are homogeneous in nature, their chemical treatment is rather simple. First, the material is loosened in a test-tube with some distilled water. After then, concentric sulphuric acid twice or thrice as much as the used material is poured into it and then it is boiled. The test-tube is left standing for three or four hours. After having been sufficiently washed by distilled water, the material is taken out of the test-tube, and is dried in the constant temperature furnance until it becomes whitish gray or white powder. This powder is used for the microscopical test of fossil *Silicoflagellates*.

Notes on Species

For the systematic classification of the *Silicoflagellates* Konrad Gemeinhardt's work is followed in the present work.

Genus ***Mesocena*** EHR.

Mesocena crenulata EHR. var. *diodon* (EHR.) LEMM.

Only in the sample of Iizuka beds(6) : very rare.

Mesocena polymorpha LEMM. var. *hexagona* (HAECK.) LEMM.

Only in the sample of Wakura beds (4) : frequent.

Mesocena polymorpha LEMM. var. *triangula* (EHR.) LEMM.

Only in the sample of Mitsukouji beds (1) : very rare.

Mesocena polymorpha LEMM. var.

Only in the sample of Iizuka beds (4) : frequent.

Mesocena circulus (EHR.) var. *apiculata* LEMM.

Only in the sample of Wakura beds (4) : rare.

Genus ***Dictyocha*** EHR.

Dictyocha triacantha EHR.

Only in the sample of Nishidoujima beds (2) : common.

Dictyocha triacantha EHR. var. *apiculata* LEMM.

Only in the sample of Nishidoujima beds (2) : rare.

Dictyocha triacantha EHR. var. *hastata* LEMM.

Only in the sample of Mitsukouji beds (1) : frequent.

Dictyocha staurodon EHR.

Only in the sample of Wakura beds (1) : frequent.

Dictyocha fibula EHR.

In the samples of Nishidoujima beds (2), Wakura beds (4), and Iizuka beds (6) : very common.

Dictyocha fibula EHR. var. *rhombica* SCHULZ

In the samples of Mitsukouji beds (1), Sugata beds (3), Wakura beds (4) and Iizuka beds (6) : common.

Genus ***Distephanus*** HAECK.

Distephanus crux (EHR.) HAECK.

In the samples of Nishidoujima beds (2), Sugata beds (3), Wakura beds (4), Tsukada beds (5) and Iizuka beds (6) : very common.

Distephanus crux (EHR.) HAECK. var. *mesophthalmus* (EHR.) LEMM.

In the samples of Mitsukouji beds (1) and Nishidoujima beds (2) : very rare.

Distephanus crux (EHR.) HAECK. var. *schauinstandii* (LEMM.) SCHULZ

In the sample of Mitsukouji beds (1) : rare.

Distephanus speculum (EHR.) HAECK.

In the samples of Mitsukouji beds (1), Wakura beds (4) and Iizuka beds (6) : common.

Distephanus speculum (EHR.) HAECK. var. *octonarius* (EHR.) JOERG

In the sample of Wakura beds (4) : frequent.

Distephanus speculum (EHR.) HAECK. var. *pentagonus* LEMM.

In the samples of Sugata beds (3), Wakura beds (4) and Iizuka beds (6) : frequent.

Distephanus speculum (EHR.) HAECK. var. *septanarius* (EHR.) JOERG

In the sample of Iizuka beds (6) : very rare.

Table I

Table showing the distribution of fossil *Silicoflagellates* in the Hokuriku district

Species \ Localities	Hiraguri (1) (Kanazawa)	Houchi (2) (Toyama-pref.)	Minami-onomi(3) (Nanao)	Wakura(4) (Nanao)	Tsukada(5) (Wajima)	Shoin (6) (Suzu)	
Mesocena crenulata var. *diodon*						R	fossil
Mesocena polymorpha var. *hexagona*				F			resent | fossil
Mesocena polymorpha var. *triangula*	R						fossil
Mesocena polymorpha var.						F	fossil
Mesocena circulus var. *apiculata*				R			fossil
Dictyocha triacantha		C					fossil
Dictyocha triacantha var. *apiculata*		R					fossil
Dictyocha triacantha var. *hastata*	F						fossil
Dictyocha staurodon				F			resent | fossil
Dictyocha fibula		C		C		C	resent | fossil
Dictyocha fibula var. *rhombica*	C		C	C		C	resent | fossil
Distephanus crux		C	C	C	C	C	resent | fossil
Distephanus crux var. *mesophthalmus*	R	R					resent | fossil
Distephanus crux var. *schauinstandii*	R						resent | fossil
Distephanus speculum	C			C		C	fossil
Distephanus speculum var. *octonarius*				F			resent | fossil
Distephanus speculum var. *pentagonus*			F	F		F	resent | fossil
Distephanus speculum var. *septenarius*						R	resent | fossil
Distephanus speculum var.						R	fossil
Cannopilus binoculus				R			resent | fossil
Ebria antiqua	C	C	C	C	C	C	fossil
Ebria antiqua var. *rectangularis*	R		R				fossil
Ebria antiqua var. *simplex*			R				fossil
	8	6	6	11	2	10	

C = common R = rare F = frequent

Distephanus speculum (EHR.) HAECK. var.

In the sample of Sugata beds (3) : very rare.

Genus ***Cannopilus*** HAECK.

Cannopilus binoculus (EHR.) LEMM.

Only in the sample of Wakura beds (4) : rare.

Genus ***Ebria*** BORG.

Ebria antiqua SCHULZ

Widely distributed in each locality (1,2,3,4,5 and 6) : very common.

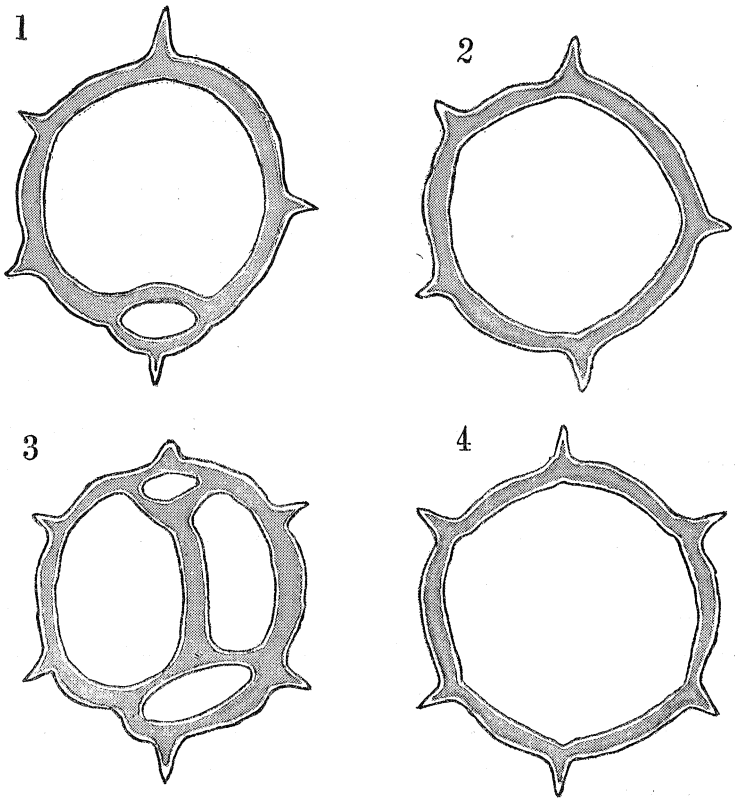
Ebria antiqua SCHULZ var. *rectangularis* SCHULZ

In the samples of Mitsukouji beds (1) and Sugata beds (2) : very rare.

Ebria antiqua SCHULZ var. *simplex* SCHULZ

Only in the sample of Sugata beds (3) : rare.

The annexed Table 1 shows the relation between the fossil forms and the localities. The siliceous skeletons of the above-mentioned *Silicoflagellates* do not always present structures resembling those of the forms already known. *Mesocena polymorpha* var. *pentagona*, for instance, is anomalous in point of structure. (Text-fig. 2. 1-2). This



Text-figure 2

1. An anomalous structure of *Mesocena Polymorpha* var. *pentagona*
2. *Mesocena polymorpha* var. *pentagona*
3. An unusal structure of *Mesocena polymorpha* var. *hexagona*
4. *Mesocena polymorpha* var. *hexagona*

pecular form is found only in the material from the Wakura beds (4). *Mesocena polymorpha* var. *hexagona* approaches towards some species of *Dictyocha* or *Cannopilus*. (Text-fig. 2, 3-4) This form is found in the sample from Iizuka beds (6). Some of other species and varieties in these samples take more or less anomalous skeletal structures.

Forms possibly regarded as New Varieties

Mesocena polymorpha LEMM. var. (Pl. 1, 1)

Polygon, with many heavy short spines at about equal distances. In this case, there are 14 spines, but this is only an instance among the many. In the inner part of the siliceous ring, many spots are situated at regular intervals not coinciding with the short spines outside. Diameter of the ring is 50μ. Length between two spines is about 13μ. Locality : Iizuka beds, Shoin-town, Suzu-city, Ishikawa-prefecture.

This form represents a variety of *Mesocena polymorpha* LEMM. according to every possible point of view.

Gemeinhardt (1930) described the following form form the Simonsbay of South Africa: *Mesocena polymorpha* var. *biseptenaria*. Lemmermann (1901) also described *Mesocena polymorpha* var. *bioctonaria* from the same locality.

These forms are formed of dilicate polygonal test, and their spines regularly project outward. In the inner part, spines shorter compared with them also project towards the center of polygon from the middle point of each side.

The form described here does not show regular polygon in outline, but is roundly polygonous with many sides. For the determination of its taxonomic position re-examination of the type materials from different localities is indispensable.

Distephauus speculum (EHR.) HAECK. var. (Pl. 1, 2)

Pentagonal, with concave side and a heavy short spine at each corner. From the middle part of all five sides bars project towards the center of the pentagon. In the central part these bars form a small circle. Only from one side of the pentagon two bars project towards the center. But this is anomalous. The sides of the pentagon varies in about 18-35 μ. Locality : Iizuka beds, Shoin-town, Suzu-city, Ishikawa-prefecture.

This form belongs to the type of *Distephanus speculum* (EHR.) HAECK. var. *pentagonus* LEMM., but the inner structure of the pentagon and the appearence of the short heavy spines are similar-looking but of different type.

Lemmermann (1901) described *Distephanus speculum* var. *pentagonus* from Moron and Oamaru. As the varietal name shows, this form is characterized by its pentagonal shape. The spines at the corners are long and distinct, but the small spines situated at inner side are shorter, thiner and ill developed.

The above mentioned form lacks small spines at the inner side. The outline of its pentagon is irregular, and each of the five sides but one has a bar, the other having

two: the bars also are irregular in form. But there is no doudt that this form is a variety of *Distephanus speculum*. For further description of this variety, examination of many more samples in these localities are necessary.

Conclusion

The *Silicoflagellates* date back as fossil to the Upper Cretaceous. They have siliceous skeletons of unique structure and are extremely well suited for fossilization. Together with diatoms, radiolarians, pollens and spores, they are excellent indicators of fossil marine deposits. A few of them are found living near the surface of the sea, and play a part of an excellent indicator of the water-masses of the Recent sea. For example, *Dictyocha fibula* and *Dictyocha speculum* are indicators of the cold northern water-masses met with around our country.

In six localities of the Hokuriku district, 23 species and varieties of *Silicoflagellates* are found. Among them *Mesocena polymorpha* var. and *Distephanus speculum* var. are probably new varieties. The other more or less anomalous species and varieties, can be easily recognized by comparing with the original works.

G. Dallas Hanna pointed out that these organisms are paleontologist's almost ideal marker-fossils. The mudstone beds taken into consideration in this paper would turn out to be very useful as a key in the stratigraphical research in this district, if the details of the facies characteristics of the rock and of the faunal assemblages of the contained *Silicoflagellates* could be more closely investigated.

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Plate

Plate 1