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QUATERNARY DIATOMS AND CYSTS FROM XIHU LAKE ON FILDES PENINSULA OF KING GEORGE ISLAND, ANTARCTICA AND THEIR PALAEOENVIRONMENTS

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Abstract The Xihu Lake is Located on the southern Fildes Peninsula. A drill hole is 2. 6 m deep and total 102 samples were collected by Dr. Xie Youyu during 1985—1986. The samples from drill hole in the Xihu Lake contain abundant and well—preserved diatoms and Cysts (Chrysophata), 131 species and variaties of diatoms belonging to 21 genera were recognized. As a result of the detailed research on the diatom assemblages from the Xihu Lake sediments, 9 diatom assemblages were distinguished. From diatom and Cysts (Chrysophyta) data, the changes of the Palaeoenvironments and Palaeoclimate and their age are discussed.

Key words Diatoms, Cysts, palaeoenvironment, palaeoclimate.

Stratigraphic Profile and Research Methods

The Xihu Lake is located in an ice—free area of the King George Island, which is the biggest one of Southern Sheltland Islands. It is one source for drinking water in the Great Wall Station area. The Xihu Lake is 160m long from north to south and 100m wide from east to west, with a maximum water depth of 10 m. Only a small delta with gentle slope is in the west part through which water runs into the lake. The delta is composed of the fine—grained materials, mainly loess—like silt and fine sand. On the other three sides the debris of frost—weathered rocks had collapsed into the lake, so all the successfully sampled holes were sited in the western part of the lake. Dr. Xie Youyu made a drill through the 3. 5—4 m deep water in the Xihu Lake by using a gravity rig. The drill hole is 2. 6 m deep (Fig. 1) and 102 samples was collected there.

A drill core of 2. 6m was taken from the depression of the Xihu Lake, Antarctica, and studied for its diatom content. All Holocene sediments are present in four cores. Analysis of diatom was made on in thin slices of the core samples every 3—8cm. Organic mater was removed using the method of Van der Werff(1955). Carbonate particles were dissolved in HCl. Only the coarser sand grains were removed by decanting carefully, as the risk of altering the fossil assemblages is otherwise substantial.

Diatoms are interesting organisms because they can provide very accurate information on the habitat in which they lived. In the present case, the following characteristics were studied: lifeforms (planktonic to sessile), hydrogen—ion requirements (alkalibiontic to acidobiontic), behaviour towards currents (rheophilous to limnophilous).

As percentages of the total sum of taxa and grouping according to "life—form", the percentages of selected individual taxa are calculated.

Profuse and well—preserved assemblages of diatoms and Cysts (Chrysophyta) are present in most of 43 samples from the Xihu Lake on Fildes Peninsula of King George Island, Antarctica.

21 genera, 131 species and variaties of diatoms are recognized. Using a method of fuzzy mathematics this comprehensive study of the diatom assemblages graphically shows the evolution trend and variations of the diatoms.

The Characteristic of Diatom Flora

There are very abundant diatoms well preserved in the 43 samples of the core, and the diatom flora includes 21 genera, 131 species and variaties (see p69, plate 1,2,3). Using a method of fuzzy mathematics this comprehensive study of the diatom assemblages graphically shows the development and variations of the diatoms.

The diatoms and Cysts (Chrysophyta) from the sediments in the Xihu Lake are composed of 9 diatom assemblage distinguished in W_{5-3}, W_3, W_4 and W_{21} of the core from bottom to top as follows:

1. *Fragilaria construens var. subsalina — Frag. construens var. venter — Melosira italica subsp. subarctina assemblage (260—245cm, No: $W_5$10—7)*

This assemblage contains a great number of genera and species, including 15 genera and 59 species and variaties. The assemblage is characteristically dominated by *Fragilaria construens* var. *subsalina* which often accounts to 18.09%, and *Frag. construens* var. *venter* 14.5%, *Frag. construens* var. *binodis* 11.0%, and *Frag. pinnata* var. *lancettula* 14.0% of the total.

2. *Fragilaria construens var. binodis — Frag. vaecheriae — Synedra rampens assemblage (245—230 cm, No: $W_5$6—4)*

This assemblage includes 16 genera, 48 species and variaties. Assemblages assigned to this zone are characteristically dominated by *Fragilaria construens* var. *binodis* (12.

5%), *Frag. vaecheriae* (9.6%), *Synedra rampens* (10.0%), the epithyllous diatoms are greatly increases in abundance, such as *Navicula muticopsis* (13.5%), and planktonic diatom *Melosira italica* varies slightly.

3. *Opephora martyi—Achnanthes delicatula—Fragilaria vaecheriae assemblage* (*2.25—2.1 cm, No: W* $_{5-3}$ *1*)

This assemblage is composed of 14 genera, 45 species and variaties. the assemblage is marked by the incoming of several new elements, *Fragilaria vaecheriae* accounts to 10.0%, and *Achnanthes delicatula* 11.0%. the assemblage is characterized by the successive appearance of many taxa of the second assemblage and great increase in *Opephora martyi* (19.0%) and other.

This zone is characterized by an abundant Cysts (Chrysophyta).

4. *Opephora martyi—Navicula pseudoscutoformis—Melosira roeseana assemblage* (*214—182 cm, No: W* $_4$ *25—22*)

This assemblage consists of 14 genera, 50 species and variaties. Assemblages from this zone are characterized by presence of many forms in the underlying diatom assemblage i.e. *Opephora martyi*, and by the disappearance of *Achnanthes delicatula* and Cys. (Chrysophyta).

The base of this assemblage is defined by the first appearance of *Navicula pseudoscutoformis*, together with *Melosira roeseana*.

5. *Achnanthes lanceopata var. rostrata—Navicula hungarica—Pinnularia subcapitata assemblage* (*181—178 cm, No: W* $_{21}$ *20*)

This assemblage includes 10 genera, 37 species and variaties. This assemblage is characterized by abundant specimens of *Achnanthes lanceolata* var. *rostata* (7.5%), *Navicula hungarica* (9.0%), and *Pinnularia subcapitata* (4.5%), the stenothermal cold diatoms accounts for 25% of the total.

The Cysts (Chrysophyta) is very abundant.

6. *Melosira roeseana var. epideneron—Gomphonema var. subclarata—Achnanthes delicatula—Ach. lanceolata var. rostrata assemblage* (*177—147 cm, No: W* $_4$ *19—9*)

This assemblage is similar to preceding diatom zone, but richer in genera and species than the latter. The Cysts (Chrysophyta) almost disappear in this assemblage. The assemblage includes 14 genera, 73 species and variaties. the chief species in this zone includes *Melosira roeseana* var. *epidendron* (12.5%), *Gomphonema logiceps* var. *subclarata* (12.1%), *Achnanthes delicatula* (11.5%), *Ach. lanceolata* var. *rostrata* (9.5%), *Ach.* sp. (9.3%), *Melosira roeseana* (12.3%), and *Pinnularia isostauron* (11.1%) in abundance.

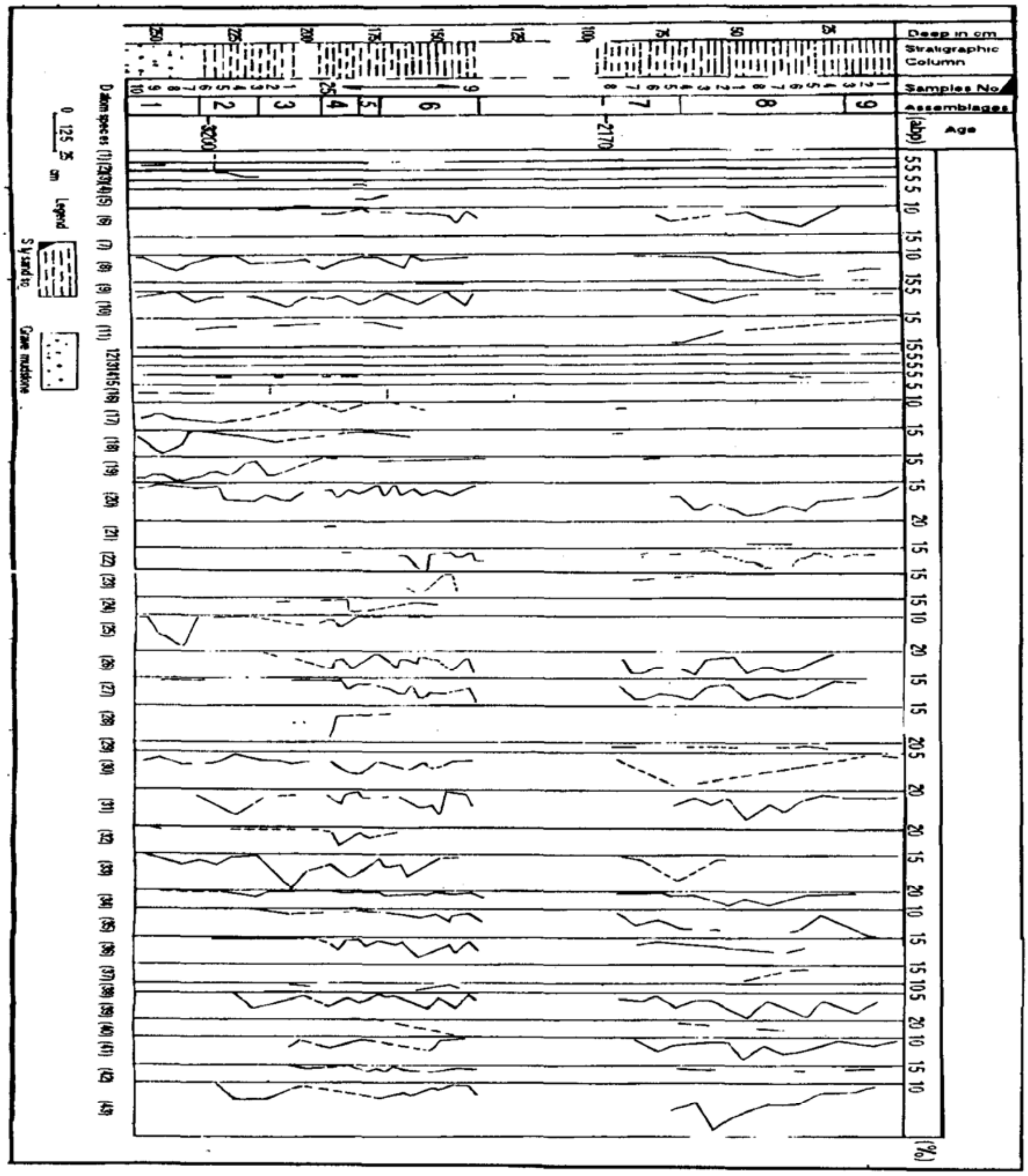

Fig. 1. The percentage curve of main diatoms in the Xihu Lake sediments, Great Wall Station, Antarctica. (1). *Achnanthes coarctata*; (2). *Ach. exigua*; (3). *Ach. exigua var. heterovalva* (—*ta*); (4). *Ach. hungarica*; (5). *Ach. sp.*; (6) *Ach. lapidosa*; (7) *Ach. lanceolata*; (8). *Ach. lanceolata f. capitata*; (9). *Ach. lanceolata var. rostrata*; (10).. *Ach. linearis var. pusilla*; (11). *Amphora fontinalis*; (12). *Cymbella minuta*; (13). *Eunotia alpina*; (14). *Eunot. praerupta var. inflata*; (15). *Eunot. tenella*; (16). *Fragilaria construens*; (17). *Frag. construens var. binodis*; (18). *Frag. construens var. venter*; (19). *Grag. pinnata var. lancettula*; (20). *Frag. vaecherica*; (21). *Gomphonema longiceps*; (22) *Gomph. longiceps var. subclavata*; (23). *Gomph. parvulum*; (24). *Gomph. parvulum var. subelliptica*; (25). *Melosira italica subsp, subatctica*; (26). *Melos. roeseana*; (27). *Melos. roeseana var. epidendron*; (28). *Melos. roeseana var.*; (29). *Navicula cincta*; (30). *Nav. hungarica*; (31). *Nav. mutica*; (32). *Nav. pseeudoscutiformis*; (33). *Opephora martyi*; (34). *Pinnularia borealis*; (35). *Pinn. gibba f. subundulata*; (36). *Pinn. isostauron*; (37). *Pinn. lata*; (38). *Pinn. leptosoma*; (39). *Pinn. microstauron*; (40). *Pinn. microstauron var. brebissonii*; (41). *Pinn. molaris*; (42). *Stauroneneis anceps*; (43). *synedra rumpens*.

7. *Fragilaria vaecheriae — Achnanthes delicatula — Achnanthes lanceolata var. rostrata assemblage* (*97—89 cm, No: $W_4$8—4*)

This assemblage is similar to third assemblage *Opepohora martyi — Achnanthes delicatula — Fragilaria vaecheriae*, but less in genera and species than the latter. The Cysts (Chrysophyta) is very abundant in this assemblage.

This assemblage is composed of 11 genera, 43 species and variaties. This assemblage contains elements rich and diverse in composition like *Fragilaria vaecheriae* (14.1%), *Achnanthes delicatula* (11.5%), *Ach. lanceolata* var. *rostrata* (8.1%), and *Ach. lineeris* var. *pusilla* (14.5%) in abundance.

8. *Synedra rumpens — Fragilaria vaecheriae — Melosira roeseana var. epidendron — Achnanthes inflata assemblage* (*88—29 cm, No: $W_4$4—1, $W_3$8—4*)

This assemblage contains 11 genera, 42 species and variaties. The diatom assemblages assigned to this zone are characterized by the appearance of *Synedra rumpens* (12.1%), *Fragilaria vaecheriae* (17.5%), and *Achnanthes inflata* (13.3%). The stenothermal cold diatoms are about 28% of the total. The Cysts (Chrysophyta) almost disappear in this assemblage.

9. *Pinnularia gibba f. subundulata — Pinn. microtauron — Melosira epidendron — Fragilaria vaecheriae assemblage* (*28—0 cm, $W_3$3—1*)

This assemblage is composed of 10 genera, 19 species and variaties. The assemblage from this zone is characterized by presence of forms in the underlying zone, but is distinguished by the presence of the *Pinnularia gibba f. subundulata* (13.5%), *Pinn. microstauron* (11.1%). the stenothermal cold diatoms are about 36% of the total.

The Palaeoenvironments of the Xihu Lake

Application of diatoms to palaeolimnological interpretation follows a variety of approaches that are all based on the modern observations on the life history, habitat, and ecological preferences of living diatoms. Occationally, gross diatom morphology can be used to imply palaeoenvironmental conditions.

The Xihu Lake is a glacial—erosion lake in the ancient glacial through wich was formed on T_4 and T_5 marine erosion terraces.

There are very abundant diatoms well reserved in the 43 samples from drill hole in the Xihu Lake are the modern deep—water species widely distributed and mainly belong to Pinnularia type. The plant community of this diatom has the following features:

1. In the lowermost zone of the Xihu Lake, *Fragilaria* is very abundant, it is littoral "plankton" or benthic diatom. The dominant species of this assemblage in the Xihu Lake are *Fragilaria construens* var. *subsalina*, *Frag. construens* var. *venter*, *Frag. construens* var. *binodis*, *Frag. pinnata* var. *lancetula* with a pH of about 6.5—7.8.

2. The abundant diatoms plant community is found in the sediments of four drill holes except minor samples, among the community there is no real plankton type, only the semi—plankton species of *Molosira roesena* was found. The species of the most *Fragilaria*, *Cocconeis*, *Achnanthes*, *Navicula*, *Pinnularia* and the other genus are the coastal benthic species, of which a plentiful amount of *Cocconeis* and *Achnanthes* belong to stationary or adhering type of diatoms. From the living type of diatom it is evident that the water body was shallow, with a small extent during sedimentation.

3. Most of the species in the whole plant community lived in the water environment with a pH value less than 7. Although some species, such as *Achnanthes hungarica*, *Ach. lanceolata*, *Cocconeis placentula*, are found in alkaline water, that is, they are living in the water body with a pH 7 or slightly more, the diatom plant belongs to a plant community on the fresh—water condition.

4. *Melosira roeseana* is a semi—planktonic diatom, it is living in the slow flow of marsh in the mountain area and a typical cold water diatom. Occurrence and amount of this species are different in the profile. This kind of cold water species is not found in the samples (from —200cm to —260cm) numbered with W_5, except for sample W_{5-4}(—120cm) in which one or two *Melosira roeseana* are present. In the samples numbered with W_4(—120cm to —192cm), *Melosira roeseana* generally occurring in large quantity indicates that the water temperature has decrease, only a few *Melosira roeseana* are found in the samples from the drill hole of W_3(0—100cm), except for sample W_{3-324}(—2.0—3.8cm) in which one or two individuals of this species are found. The variation feature of *Melosira roeseana* in the vertical profile reflects that the climatic fluuctuation has taken place during sedinmmentation in the Xihu Lake. Combined with the depths of the samples containing the cold water species mentioned above in the cores from the lake bottom, the climatic status, warmer at two ends and cold in the middle, is concluded. This is in correspondance with the climatic conditions reflected by the grain—size characteristics mentioned above.

5. In assemblages 3, 5, 7, a larger number of the Chrysophyceae Cysts was found among few diatoms.

The fluctuation of the Cysts (Chrysophyta) forms as proportional to the total number of the Cysts throughout these zones, together with the change in the diatom assemblages, are interpreted as a reflection of palaeoenvironmental and palaeoclimatic changes.

6. The age of the sediments in the Xihu Lake, reflected by diatom species is very young and it is possibly late Holocene.

The diatoms in the sediments of Xihu Lake is dominated by *Pinnularia*, a presently existing species in the cold water extensively distributed. It is a lake facies diatom in the fresh—water, and the marine diatom has not been found, indicating that the lake basin was not influenced by trangression. The individuals of the diatom are small, stationary or cohereing. The secondary ones are the coastal benthic species. There are hardly any planktonic species, showing that the lake is small and short of nutrient. The age reflected by the diatom is late Holocene.

References

Beyens, L. (1985): On the subboreal climate the Belgian Campine as deduced from diatom and testate amoebae analyses, *Rev. Palaeobat. and Palyniol.*, 46, 9—31.

Bradbury, J. P. (1987): Late Holocene diatom Paleolimnology of Walker Lake, Nevada, *Arch. Hydrobiol. Suppl*, 79(1),1—27.

Burns, D. A. (1975): Nannofossil boistratigraphy for Antarctic sediments, Leg 28, Deep Sea Drilling Project, *Initial Rep. Deep Sea drill. Proj.*, 28,589—598.

Ellis-Evans, J. C. (1981): Freshwater Microbiology in Antarctica, *British Antarctic Sur.* Bull., 54,85—121.

Fogg, G. E. Horne, A. J. (1970): The physiology of Antarctic Freshwater Algae, In M. W. Holdgate (Ed.), *Antarctic Ecology* ,2, 632—638.

Gaillard (1991): A late Holocene record of land—use history, soil erosion, late trophy and lake—level fluctuation at Bjaresjon (South Sweden), *Journal of Paleolimnolog*, 6:51—81.

Goldman, C. R. (1963): Light injury and inhibition in Antarctic freshwater phytoplankton, *Limnology and Oceanography*, 8, 313—322.

Kilham, P. (1971): A hypothesis concerning silica and the fresh water planktonic Diatom. *Limnology and Oceanography*, 16:10—18.

Koivo, L. K. (1978): Modern diatom assemblages from lake sediments in the boreal arctic transition region near the Machenzie Delta, N. W. T., *Canada—Can. J. Bot*, 56, 1010—1020.

Lowe, K. L. (1974): Environmental Requirements and Pollution Tolerance of freshwater Diatoms, EPA—674(4), 33.

Mello, J. F. et Buzas, M. A. (1968): An application of cluster analysis as a method of determining biofacies, *J. Paleantology*, 42(3), 747—758.

Patrick, R. et Reimer, C. W. (1966, 1977): The Diatoms of the United States (Exclusive of Alaska and Hawaii) wol. I, Philadephia, 668.; Vol. II, Part 1, 213.

Pollingher, U. *et al.* (1986): The Planktonic Diatoms of Lake Kinneret (Israel) During the last 5000 Years — Their Contribution to the Algal Biomass, Proceedings of the Eighth Inter. Diat. Symp, Paris, 667—686.

Porter, S. C. et Stuiver, M. (1984): Holocene variation of Sea level along the Magellan and Beagle Straits at Most Southern American, *Quaternary Reseatch*, 22, 59—67.

Xie Youyu (1987): Geomorphic features and Environmental evolution of the Great Wall Station Area of Fildes Peninsula of King George Island, Antarctica, *Kexue Tongbao (Chinese Science Bulletin)*, 15, 1175 (in Chinese).

Xie Youyu, Li Jiaying (1990): Preliminary study on sedimentary environment of Xihu Lake in the Great Wall Station Area, Antarctica, *Antarctic Research (Chinese edition)* 2(1), 43—52.

Xie Youyu, Cui Zhijiu (1990): The environmental events at King George Island since the last Glaciation, *Quaternary Sciences*, 3: 272—281.

Zhao Junlin (1989): The environmental evolution in Fildes Peninsula of King George Island, Antarctica, *Kexue Tongbao (Chinese Science Bulletin)*, 16, 1240—1242 (in Chinese).

Plate 1

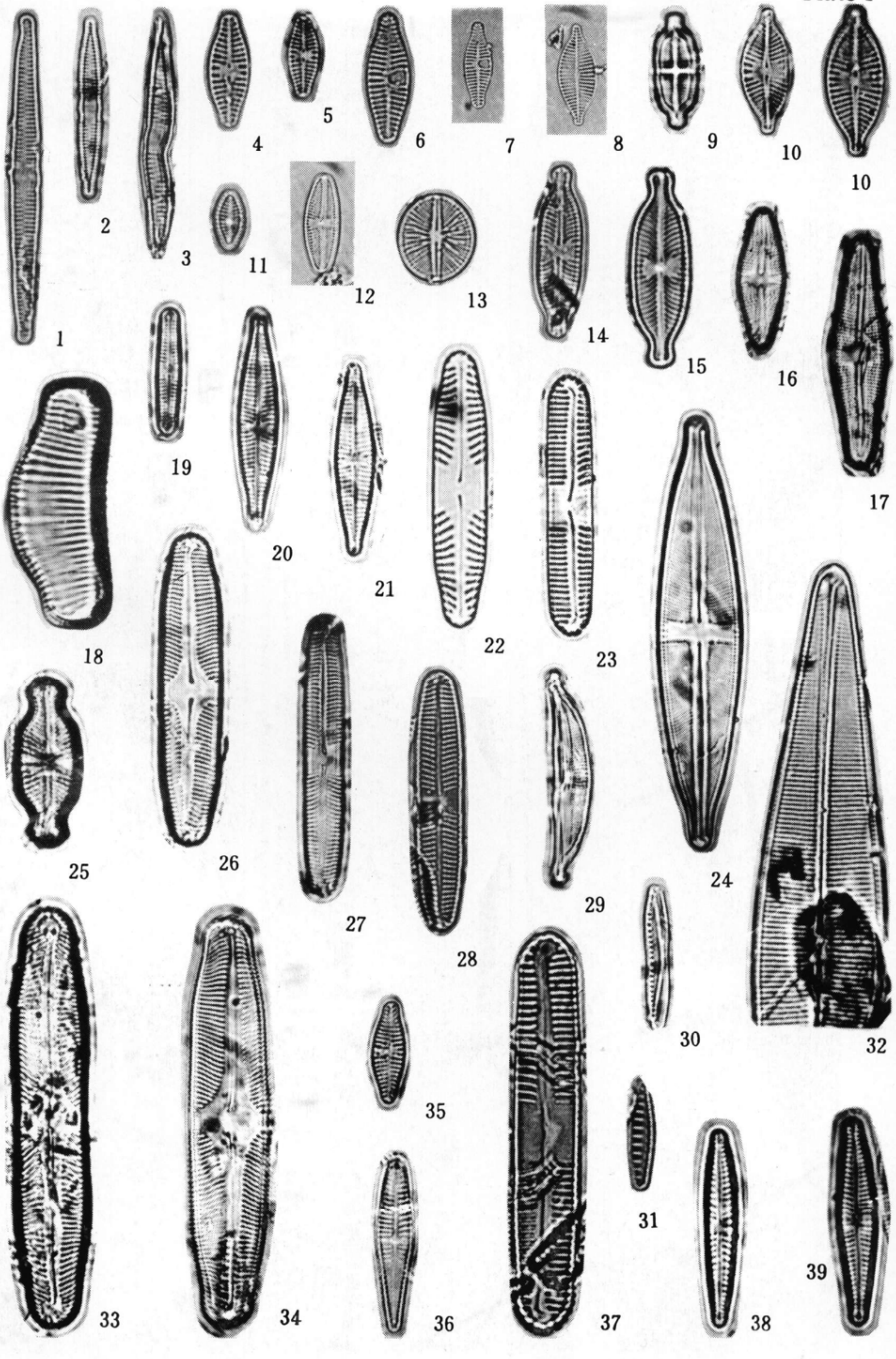
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Plate 2

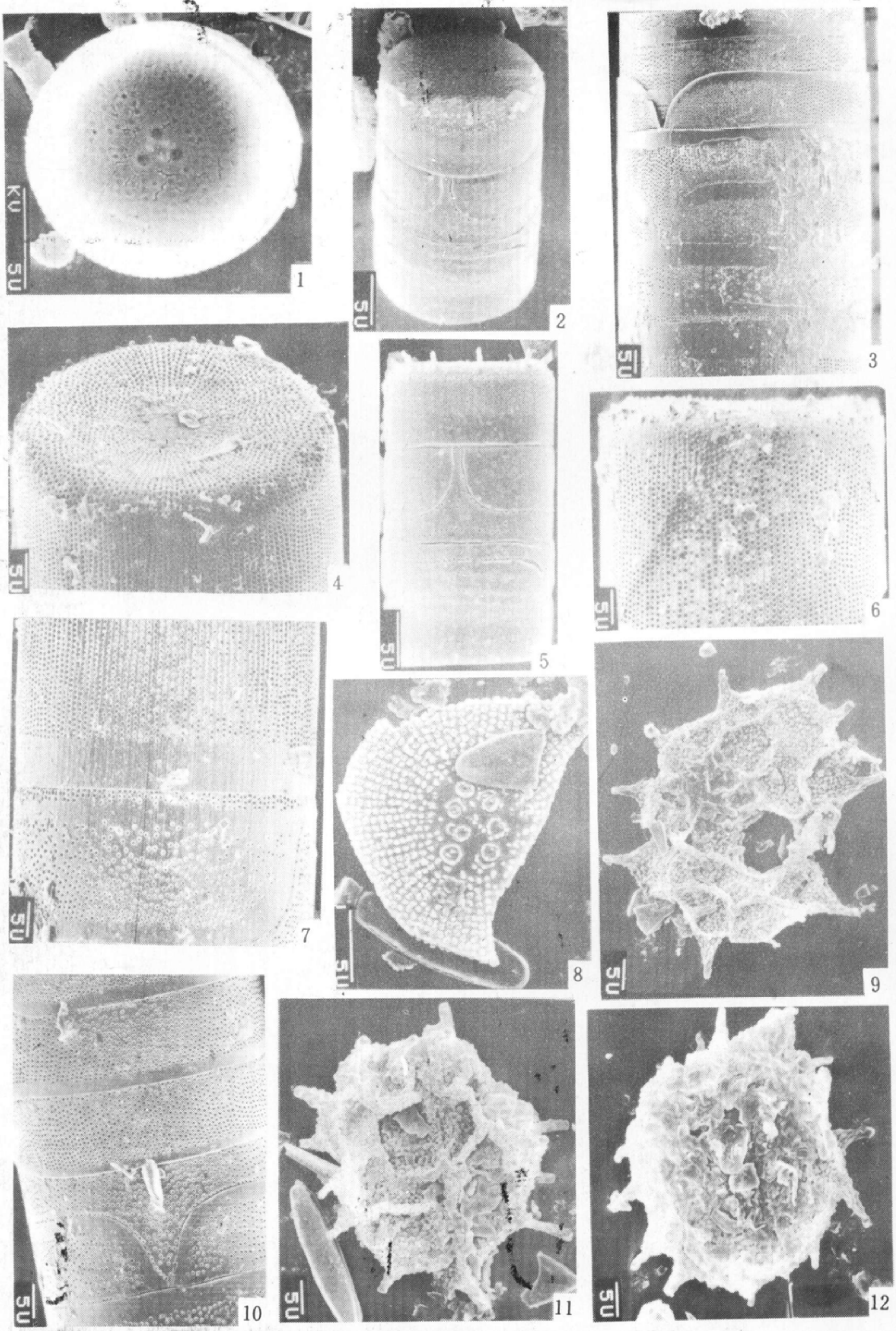
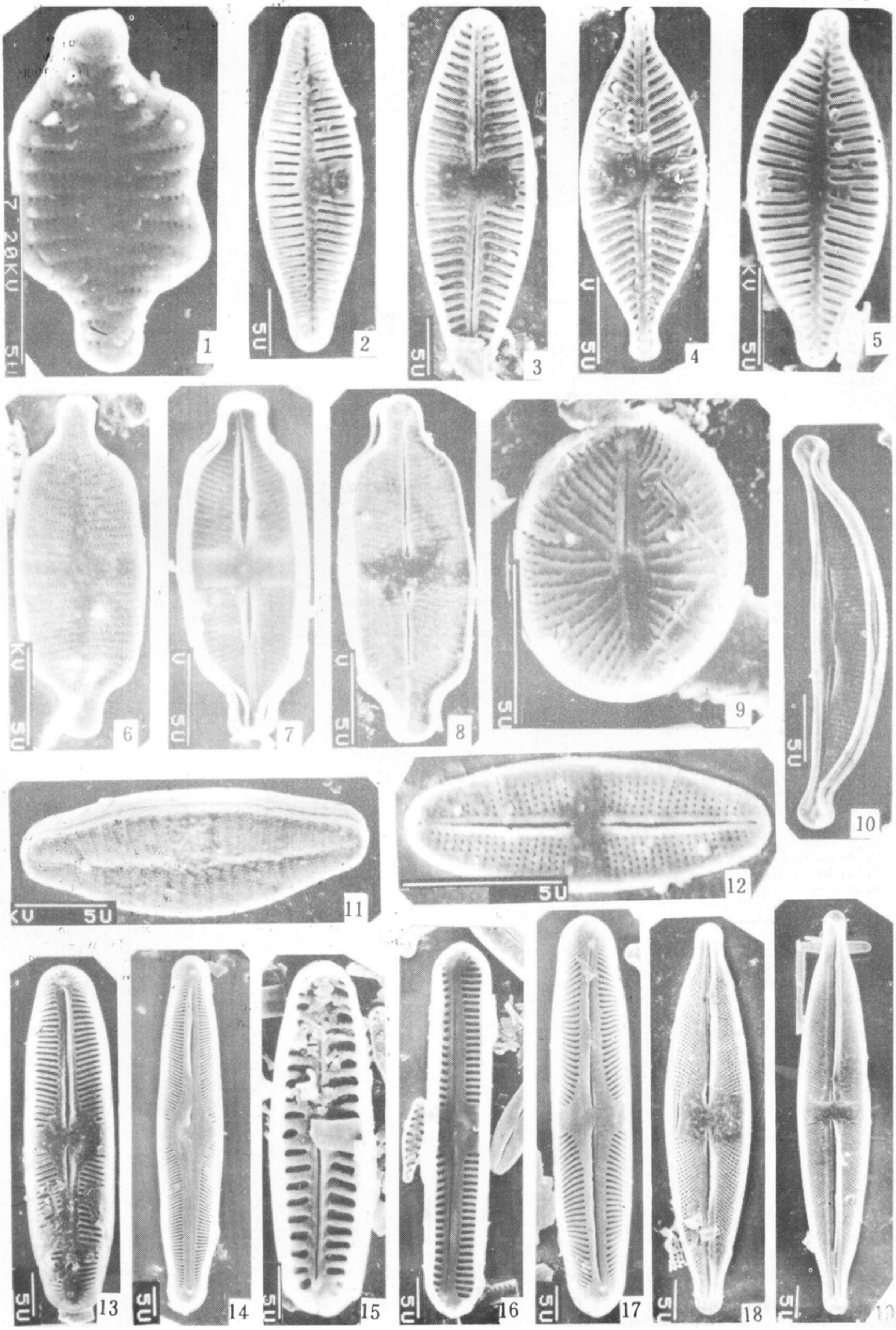


Plate 3



Explanation of the Plates

Plate 1 (All magnifications showing LM)

1, *Synedra rumpens* var. *fomiaris* (Ktz.) Grun., valve view, No: W_4—18(3), ×1500.
2, *Synedra rumpens* Ktz., valve view, No: W_4—17(4), ×1000.
3, *Synedra rumpens* Ktz., valve view, No: W_4—16(4), ×1500.
4, *Achnanthes lanceolata* var. *rostrata* (Oestr.) Hust., Raphe valve view, No: W_4—16(5), ×1500.
5, *Achnan. lanceolata* var. *rostrata* (Oestr.) Hust., Raphe valve view, No: W_4—16(6), ×1500.
6, *Achnan. lanceolata* var. *rostrata* (Oestr.) Hust., Pseudoraphe valve view, No: W_4—16(4), ×1500.
7, *Achnan. lanceolata* var. *rostrata* (Oestr.) Hust., Pseudoraphe valve view, No: W_4—16(9), ×1000.
8, *Achnan. delicatula* (Ktz.) Grun., Pseudoraphe valve view, No: W_4—18(4), ×1000.
9, *Achnan. exigua* var. *heterovalva* Krasske, Pseudoraphe valve view, No: W_5—8(2), ×1000.
10, *Achnan. delicatula* (Ktz.) Grun., Raphe valve view, No: W_4—16(11—12), ×1500.
11, *Achnan. hauckiana* Grun., Pseudoraphe valve view, No: W_4—18(6), ×1000.
12, *Navicula mutica* Ktz., valve view, No: W_4—12(9), ×1000.
13, *Nav. pseudocutiformis* Hust., valve view, No: W_4—9(2), ×1500.
14—15, *Nav. dicephala* (Ehr.) W. Sm., valve view, No: W_4—6(3—4), ×1000.
16—17, *Achnanthes* sp., Raphe valve view, No: W_4—25(14,18), ×550.
18, *Eunotia praerupta* var. *inflata* Grun., valve view, No: W_5—6(3), ×1500.
19, *Pinnularia subcapitata* Greg., valve view, No: W_4—12(3), ×1000.
20—21, *Navicula alpha* Cl., valve view, No: W_4—19(6—7), ×1000.
22, *Pinnularia obscura* Krasske, valve view, No: W_4—21(3), ×1000.
23, *Pinn. isostauron* Grun., valve view, No: W_4—21(5), ×1000.
24, *Stauroneis anceps* Ehr., valve view, No: W_4—21(20), ×1000.
25, *Navicula muticopsis* V. Heurck, valve view, No: W_4—12(18), ×1000.
26, *Pinnularia microstauron* (Ehr.) Cl., valve view, No: W_4—12(19), ×1000.
27—28, *Pinn. leptosoma* (Grun.) Cl., valve view, No: W_4—19(21, 24), ×1500.
29, *Amphora fontinalis* Hust., valve view, No: W_4—12(16), ×1000.
30, *Nitzschia tibetana* Hust., valve view, No: W_4—16(18), ×1000.
31, *Nitz.* sp., valve view, No: W_4—16(20), ×1500.
32, *Navicula cuspidata* Ktz., valve view, No: W_4—20(3), ×1000.
33, *Pinn. microstauron* (Ehr.) Cl., valve view, No: W_4—12(33), ×1000.
34, *Pinn. gibba* f. *subundulata* A. Mayer, valve view, No: W_4—12(33), ×1000.
35, *Gomphonema parvulum* var. *micropus* (Ktz) Cl., valve view, No: W_4—16(21), ×1000.
36, *Gomph. angustatum* var. *citera* (Hohn. et Hellerm.) Patr. valve view, No: W_4—16(10), ×1000.
37, *Pinnularia isostauron* Grun., valve view, No: W_4—20(8), ×1000.
38, *Gomphonema olivaceoides* var. *lanceolata* Manguin, valve view, No: W_4—12(32), ×1000.
39, *Gomph. subclavalum* var. *commutum* (Grun.) A. Mayer, valve view, No: W_4—12(34), ×1000.

Plate 2 (All magnifications showing: SEM)

1, *Melosita roeseana* Rabh., External view of valve, No: W_4—19(11).
2, *Mel. roeseana* Rabh., Girdle view, No: W_4—19(3).
3, *Mel. roeseana* Rabh., Girdle view, No: W_4—11(34).
4, *Mel. roeseana* var. *epidendron* f. *spinasa* Skv., External view of valve, No: W_4—11(14).
5, *Mel. roeseana* Rabh., Girdle view, No: W_4—12(22).
6, *Mel. roeseana* var. *epidendron* f. *spinasa* Skv., Girdle view, No: W_4—11(14).
7, *Mel. roeseana* Rabh., Girdle view, No: W_4—11(19).
8, *Mel.* sp., valve view, No: W_4—19(30).
9, *Pediastrum* sp., No: W_4—12(38).
10, *Melosira roeseana* Rabh., Girdle view showing structure, No: W_4—12(22).
11, *Pediastrum* sp., No: W_4—12(31).
12, *Ped.* sp., No: W_4—12(32).

Plate 3 (All magnifications showing SEM)

1, *Fragilaria construens* var. *venter* (Ehr.) Grun., valve view, No: W_4—10(3).
2, *Achnanthes lanceolata* var. *rostrata* (Oestr.) Hust., Internal view of pseudoraphe valve, No: W_4—12(6).
3, *Achnan. lanceolata* var. *rostrata* (Oestr.) Hust., Internal view of raphe valve, No: W_4—12(9).
4, *Achnan. delicatula* (Ktz.) Grun., Internal view of raphe valve, No: W_4—16(23).
5, *Achnan. delicatula* (Ktz.) Grun., Internal view of pseudoraphe valve, No: W_4—15(23).
6, *Achnan. exigua* var. *heterovalva* Krasske, External view of pseudoraphe valve, No: W_4—16(32).
7, *Achnan. exigua* var. *heterovalva* Krasske, Internal view of raphe valve, No: W_4—16(35).
8, *Achnan. exigua* var. *heterovalva* Krasske, Valva view of raphe valve, No: W_4—16(37).
9, *Navicula pseudocutiformis* Hust., Internal view of valve, No: W_5—9(5).
10, *Amphora fontinalis* Hust., Internal view of valve, No: W_4—12(19).
11, *Achnanthes lanceolata* var. *rostrata* (Oestr.) Hust., External view of pseudoraphe valve, No: W_4—12(23).
12, *Achnan. exigua* var. *elliptica* Hust., External view of raphe valve, No: W_4—12(26).
13, *Pinnularia microstauron* var. *australis* Manguin, Internal view of valve, No: W_4—12(17).
14, *Pinn. gibba* f. *subundulata* A. Mayer, Internal view of valve, No: W_4—12(32).
15, *Pinn. borealis* Ehr., Internal view of valve, No: W_4—12(36).
16, *Pinn. isostauron* Grun., Internal view of valve, No: W_4—12(32).
17, *Pinn. microstauron* (Ehr.) Cl., valve view, No: W_4—12(13).
18, *Stauronis anceps* Ehr., valve view, No: W_4—21(8).
19, *Staur. anceps* Ehr., valve view, No: W_4—21(11).