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LATE-GLACIAL DIATOM FLORA AT KNAPÓWKA NEAR WŁOSZCZOWA (SOUTH POLAND)

Późnoglacjalna flora okrzemek z Knapówki koło Włoszczowej

ABSTRACT

The diatoms found in the Late-glacial sediments from Knapówka near Włoszczowa (south Poland) were studied. The presumed physical and chemical properties of water during the time of sedimentation were discussed, and an atempt at the reconstruction of the development of the water basin was made.

INTRODUCTION

Publications on fossil diatoms used formerly to provide information only on their specific composition as found in the sediment. In later publications the authors tried to refer the occurrence of diatoms in the sediments to the particular ecological and climatic conditions at the time of their development. Namysłowski (1921), when discussing the list of interglacial diatoms at Szeląg near Poznań, established by Torka (Pfuhl 1911) disagreed with the latter's view that the biological conditions in an interglacial lake did not differ much from those of the present day. Hustedt (1948) pointed out the possibility of using diatoms in palaeolimnological research, and this has found ample confirmation in later works (Alhonen 1969, 1970; Bradbury 1970; Florin 1970; Miller 1971, and others). Diatoms have served as a basis for essays in reconstruction of the history of water reservoirs (Florin 1970), as well as of the ecosystem dynamics of Pleistocene lakes (Alhonen 1970).

The occurrence of particular types of diatoms in the sediment permits the study of the links which had connected the lake with the sea during its successive stages of development (H y v ä r i n e n 1968; A l h o n e n 1969; P r z y b y ł o w s k a 1972). Diatom stratigraphy can also be of use in the study of peat-bog history (T o l o n e n 1971). The authors mentioned above share the opinion that climate is the principal factor influencing diatom flora composition in a water reservoir. A different view has been advanced by M i l l e r (1971) who asserts that the physico-chemical properties of the water itself exert a decisive influence on diatom flora, while the effect of climatic and other factors is less relevant.

The diatoms from the bottom deposits of the Polish lakes have lately been the subject of investigation by W a s y l i k (1965a — Lake „Morskie Oko" and Lake „Wielki Staw" in the Tatra Mts.), M a r c i n i a k (1969 — Lake „Mikołajki" in the Mazury Lake District), and P r z y b y ł o w s k a (1972 — the Lagoon of the Vistula and Lake Druzno).

The object of the present study was the application of diatom analysis to biostratigraphic research on Late-glacial deposits at Knapówka.

MATERIAL

The deposits core which served as a basis for the present analysis was taken in the neighbourhood of the village Knapówka, situated 8 km to the SW of Włoszczowa in the province of Kielce (Fig. 1). The Knapówka peat-bog lies within the Włoszczowa Trough (the NE part of the Nida Trough). In this area the trough is built of Cretaceous marl covered with a thick layer of fluvioglacial sediments from the Middle Polish Glaciation. These are: boulder-clay with erratic blocks and quartz sand with gravel ad-

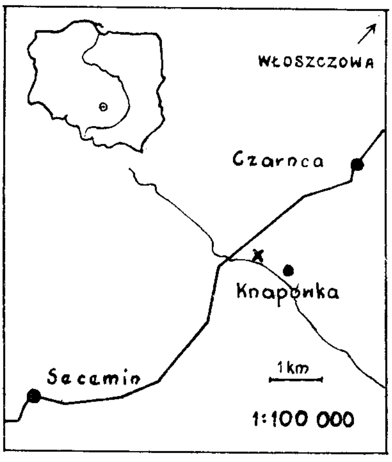

Fig. 1. Situation of the peat-bog at Knapówka (×)
Ryc. 1. Położenie torowiska w Knapówce (×)

mixture. From the NW, the valley bottom was invaded by dunes which dammed the run-off.

The material was collected by A. Żołnierz in December, 1969, by means of the INSTORF-type borer, from the valley bottom situated at 230—240 m above sea level, and then delivered to Dr. K. Wasylikowa for the determination of the age of the dunes by the pollen-analysis method.

Description of deposit (K. Wasylikowa, in typescript)

240—245 cm black-brown swamp peat, well decomposed, with a great number of roots of herbaceous plants;

245—310 cm light brown gyttia of a greenish hue, growing darker on exposure; at a depth of 281 cm a very thin layer of sand;

310—371 cm calcareous gyttia of steelgrey colour, upon exposure changing to greyish-yellow with a greenish hue; admixture of small-grained sand increasing in amount below 330 cm; small gravel at 336 cm;

371—375 cm yellow-greyish, slightly calcareous sand with plant detritus.

Wasylikowa (typescript) has distinguished in the pollen diagram three periods of the Late-glacial: the Older Dryas (Ic), Allerød (II) and the Younger Dryas (III), as well as the initial Holocene periods: the Preboreal and probably also the Boreal.

The Older Dryas is distinguished by a remarkable amount of herbaceous-plant and juniper pollen as well as by occurrence of sea-buckthorn, which seems to indicate that the landscape was not densely wooded, but probably of a park-like character. The occurrence of the following trees has been reported: pine, birch, larch, and aspen. On the sandy sites juniper and sea-buckthorn grew as well as heliophyllous herbaceous plants. In the lake submerged water plants developed with a reed-and-bulrush belt at the shore, and willow scrubs. The climatic conditions were not too severe, resembling those of the present day near the polar forest borderline.

The transition from Older Dryas to Allerød manifests itself in a decrease in the amount of pollen of herbaceous plants and shrubs with a simultaneous increase in pine pollen. The birch-and-pine (IIa) and pine (IIb) phases, typical of the Allerød period, are absent from the Knapówka diagram.

There is no distinct boundary line between the Allerød and the Younger Dryas horizons, which is denoted only by a slight increase in the amount of the pollen of herbaceous plants, juniper and willow. Pine continues to abound. The change in plant composition as compared to Allerød probably consisted in an increased area taken over by sandy-site plants, partly at the expense of wooded areas. The temperature was in all probability not lower than in the Older Dryas horizon.

The transition from the Younger Dryas to the Holocene is manifested in a decrease in the amount of herbaceous plants, juniper and willow, and an increase of birch and poplar. Above this horizon there is an increase in the per cent proportion of trees with higher thermal requirements (elm, oak, hazel, alder).

METHOD

From a core 135 cm long 50 samples were collected, at intervals of 4 cm approximately. Of these, 28 samples were analysed from the palynological aspect (W a s y l i k o w a, typescript); then from the same samples material for diatom analysis was taken. The sample numbers correspond to the depth calculated in centimetres. The volume of material collected from the core for diatom analysis amounted to ca. 1 cc.

The samples were soaked for two hours in 10% HCl; then the material was rinsed in distilled water, with the aid of a centrifuge. The obtained sediment was soaked in 34% H_2O_2 for 24 hours. After re-rinsing the material in the centrifuge, it was put inside pleurax and hyrax, and dried in open air.

500 specimens approximately were reckoned per slide. In very poor samples the diatoms were not reckoned, only their presence being recorded in the summary table.

The α index (N y g a a r d 1956), i. e. the coefficient denoting the degree of water alcality or acidity, was calculated from the formula:

$$\text{Index } \alpha = \frac{\text{acid units}}{\text{alcalic units}}$$

Acid unit = number of acidobiontic species × 5 × their frequency + + number of acidophylous species × their frequency.
Alcalic unit = number of alcalibiontic species × 5 × their frequency + + number of alcaliphilous species × their frequency.

RESULTS

Diatoms were found to occur in 27 samples out of 28. There were no diatom at all in the sample taken at a depth of 315 cm, while those next to it (307, 311, 319, 323) were very poor, containing at most a dozen or so frustules per slide. In the remaining samples diatoms occurred in large numbers, with their frustules well preserved.

As a result of microscopic analysis 31 genera, 132 species, 70 varieties, and 4 forms of diatom were recorded (Tab. 1 *).

* Tab. 1 under the cover.

The distribution of diatoms was not uniform in the profile. Four layers (Fig. 2) were distinguished, each with a different specific composition:

1. at 373—336 cm deep, in limestone gyttia and light brown gyttia;
2. at 336—303 cm deep, in limestone gyttia;
3. at 303—263 cm, in light brown gyttia;
4. at 263—243 cm, in light brown gyttia and swamp peat.

On comparing the layers distinguished with data obtained by pollen analysis (Wasylikowa, typescript), Older Dryas (1), Allerød (2), Younger Dryas (3), and Holocene (4) were distinguished. The boundary lines stand out distinctly and generally coincide with those revealed by pollen analysis; as a rule, too, the changes denoting the beginning of a new period affect the diatoms earlier than the vascular plants.

Older Dryas. The following taxons were established as occurring in this period only: *Amphipleura pellucida, Amphora ovalis, Anomoeoneis exilis, Cyclotella Kützingiana, C. operculata, C. ocellata, Cymbella Cesatii, C. leptoceros, Diatoma hiemale, D. hiemale* v. *mesodon, Epithemia sorex, Fragilaria intermedia, F. pinnata* f. *ventriculosa, Gyrosigma attenuatum, Mastogloia Smithii* v. *lacustris, Navicula lanceolata* v. *cymbula, N. oblonga, Nitzschia sinuata* v. *tabellaria, Opephora Martyi* (Fig. 2 *). The above species did not differ much in number within the respective samples, as a rule not exceeding 5 per cent.

The group of species common to the Older and the Younger Dryas were equally frequent and evenly distributed as to amount. These are: *Cyclotella bodanica, C. comta, Cocconeis placentula* v. *euglypta, Cymbella aspera, C. angustata, C. cistula, C. naviculiformis, Diploneis elliptica, Epithemia zebra, Fragilaria leptostauron, F. pinnata* v. *lancettula, Gomphonema acuminatum* v. *coronatum, Navicula bacilliformis, N. tuscula, Nitzschia angustata* v. *acuta, Rhopalodia gibba, Synedra acus* v. *angustissima, S. rumpens, S. tabulata* v. *fasciculata.* In the Older Dryas the predominant species was *Fragilaria brevistriata* reaching its maximum at the bottom (48 per cent), it decreased gradually to 5 per cent. There were also large amounts of *Fragilaria construens* v. *binodis* which reached its maximum 25 per cent at a depth of 369—352 cm. These two taxons were less numerous in the remaining horizons (Fig. 2).

Allerød. The sediments from this period are extremely poor in diatom frustules. Very few taxons were found and were represented by only a small number of specimens. The boundary lines for that period were determined by a marked disappearance of diatoms in the deposit. The author fully realizes that this criterion is hardly adequate to establish with certainty what the exact origin of the Allerød layer was, nor is it easy to deliminate this period by pollen analysis.

* Fig. 2 is under the cover.

Y o u n g e r D r y a s. While in the Older Dryas there were many taxons with a similar number of specimens, in the Younger Dryas there was a marked prevalence of some few taxons (Fig. 2). During the younger part of this period the *Fragilaria pinnata* was distinctly predominant, reaching up to 40 per cent, whereas in the Older Dryas this particular species did not exceed 5 per cent. During the younger part of the Younger Dryas, *Fragilaria construens* was also well represented, reaching up to 25 per cent. The other species were less numerous and only exceptionally amounted to 15 per cent. During the older part of the Younger Dryas the proportion of *Fragilaria pinnata* decreased to 13 per cent, while *Fragilaria construens* systematically increased to reach 35 per cent at the end of the period. At the same time there was a growth in the number of the following species which had not occurred in the Older Dryas: *Achnanthes exigua* v. *heterovalvata* (5%), *Cyclotella Meneghiniana* (19%), *Fragilaria construens* v. *venter* (7%). There were also finds of *Fragilaria pinnata* v. *lacettula* (5%) *F. lapponica* (scanty in Older Dryas) and *Navicula bacilliformis* (15%). The whole profile had frequent occurrences of *Navicula vulpina* (15%) and *Tabellaria flocculosa* (7%); these reached their maximum in the Younger Dryas. The group of taxons not surpassing 2 per cent comprised: *Achnanthes conspicua, A. exigua, Cymbella incerta* v. *linearis, Fragilaria producta, F. construens* v. *capitata,* and *Navicula disjuncta.*

H o l o c e n e. The lower boundary line for this period has been determined at a depth of 263 cm, where many species recorded in the Younger Dryas disappear. There are not many taxons confined to this period only, the frequency of their occurrence not exceeding 1 per cent. Only exceptionally *Melosira granulata* v. *angustissima* reaches as much as 6 per cent. Some of the species recorded in the Younger Dryas, sometimes even in fairly large amount, attain their maximum number here, e. g., *Cyclotella Meneghiniana* (25 per cent), *Melosira italica* (12 per cent). There is a marked predominance of the frustules of *Fragilaria construens,* reaching up to 65 per cent and not decreasing below 40 per cent. *Fragilaria pinnata, Navicula vulpina,* and *Achnanthes exigua* v. *heterovalvata,* very frequent in Younger Dryas, are less numerous in the Holocene.

Generally, there were not many taxons in the Holocene diatom flora, but the few species which did occur during that period found favourable conditions for a very intense development.

INTERPRETATION OF RESULTS

The information collected on the ecological requirements of the determined diatoms (S i e m i ń s k a 1964; C h o l n o k y 1968; F l o r i n 1969; M i l l e r 1971; P l i ń s k i 1971) permits only an approximate reconstruction of the history of the fossil reservoirs at Knapówka and its successive stages of development.

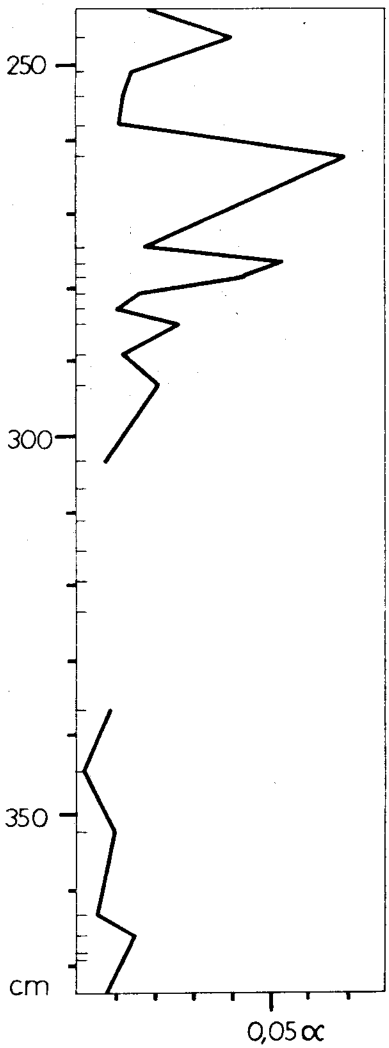

Fig. 3. Changes in water reaction expressed by changes in N y g a a r d's α index (on the abscissa value of α index)

Ryc. 3. Zmiany odczynu wody wyrażone zmianami indeksu α Nygaarda

O l d e r D r y a s. The large number of species with a similar frequency of occurrence in the sediment seems to indicate that the reservoir waters were fairly fertile, with a markedly alcaline reaction, probably about pH=8·5. This supposition is founded upon N y g a a r d's α index (Fig. 3), which for that period does not exceed the value of 0·015, and even attains a value as low as 0·0022: this according to N y g a a r d (1956), gives ground for assuming the alcaline pH mentioned above. This high pH may account for the presence of many species characteristic of brackish water. Their occurrence needs not necessarily be linked with an increased salt content in water. As pointed out by H u s t e d t (1934, 1938, 1957), C h o l n o k y (1960), S i m o n s e n (1962, 1965), F l o r i n (1970), in some cases well oxygenized fresh water may favour the occur-

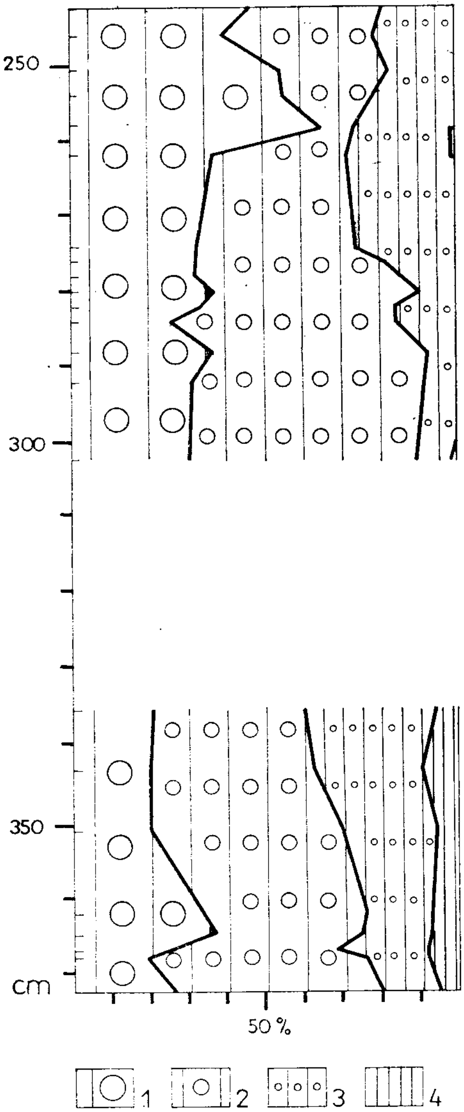

Fig. 4. Per cent of diatoms belonging to different groups, dependent on the respective degree of saltness, the optimum value for their development. 1 — mesohalobous; 2 — halophilous; 3 — fresh-water; 4 — halophobous

Ryc. 4. Udział procentowy okrzemek należących do różnych grup w zależności od optymalnego dla ich rozwoju zasolenia. 1 — mezohalobowe; 2 — halofilne; 3 — słodkowodne; 4 — halofobowe

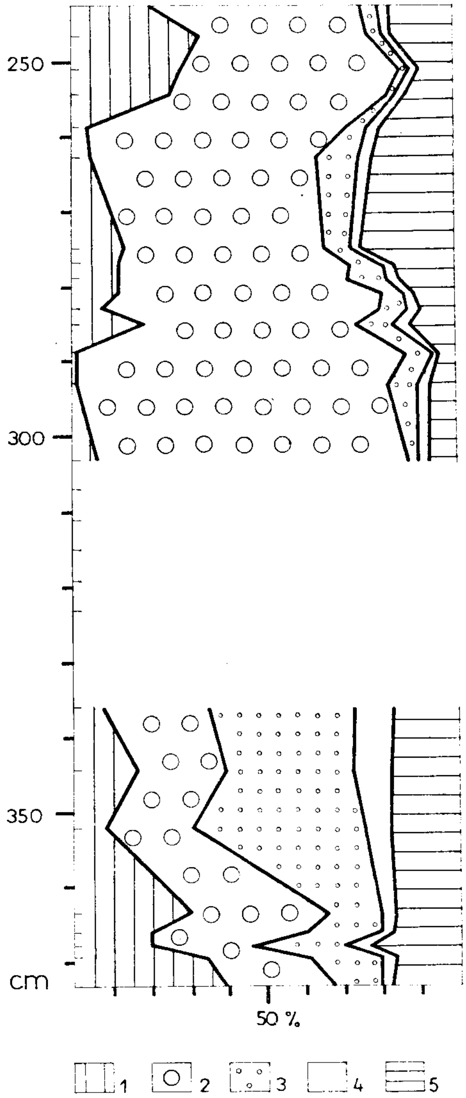

Fig. 5. Per cent of diatoms belonging to different groups, dependent on the optimum — for their development — pH value. 1 — pH over 8.0; 2 — pH from 7.5 to 8; 3 — pH from 7.0 to 7.5; 4 — pH from 6.0 to 7.0; 5 — pH below 6.0

Ryc. 5. Udział procentowy okrzemek należących do różnych grup w zależności od optymalnego dla ich rozwoju pH. 1 — pH powyżej 8; 2 — pH od 7,5 do 8; 3 — pH od 7,0 do 7,5; 4 — pH od 6,0 do 7,0; 5 — pH poniżej 6,0 rence of halophilous and mesohalobous species, or even of euhalobous ones (K o l b e 1927). The recorded species of halophilous diatom amounted in all to 50 per cent, and the mesohalobous to 20—30 per cent (Fig. 4). In the samples from that period (horizon) many fresh-water, and even halophobous species were also found. Since some of them are characteristic of well-heads, they may be an indication of the presence of springs supplying water to the reservoir.

The Older Dryas has the highest water level, particularly in the older part of it, as shown by the comparatively abundant plankton flora (Fig. 5). During the younger part of this period the proportion of plankton species decreases with a simultaneous growth of the rôle of epiphytes. The littoral also developed throughout the Older Dryas. The decrease in the number of plankton species shows that there was a gradual lowering of the water level.

A l l e r ø d. As the number of diatoms in the sediment is scarce, there is virtually nothing to be said about the character of the basin at that time. It ought to be noted that apart from the few fragments of frustules, the well-preserved frustules, mostly of the *Fragilaria* genus, were also found there. Another significant fact is that the pine and birch curves do not run along the typical lines in the pollen diagram. It is possible that during the Allerød the physico-chemical properties of water had changed so much as to cause the almost complete disappearance of diatom flora.

Y o u n g e r D r y a s. During that period it may be observed how the reaction becomes less alcaline. This is proved by the disappearance of diatoms developing at pH of ca. 8·5 (Fig. 6), and the value of α index (Fig. 3). The reaction continued to be alcaline, probably not exceeding pH=8. The complete absence of halophobous diatoms corroborates the view that there were fresh-water springs in the Older Dryas, which then disappeared in the Younger Dryas. The observed increase in the number of halophilous diatom (60%), and especially of the mesohalobous ones (30%), with a simultaneous decrease of pH is perhaps a proof of more intense salinity. The lowering of the water level and the presumable growth of salinity may have been the result of a more continental climate during that period. Another phenomenon closely linked with the lowering of the water level was the abundant development of littoral flora, amounting to 80 per cent of specimens. From the 281 cm level approximately there was an increase in the number of fresh-water diatoms, a slight increase in the water level (growth of plankton, Fig. 6), and an increase in the α index (Fig. 3), i. e., a lowering of the alcaline reaction; taken together, all these elements seem to suggest that there was an influx of fresh water.

H o l o c e n e. The transition from Younger Dryas to Holocene manifests itself in a sharp decrease in the α index (Fig. 3), and an increase in the number of halophilous as well as of the plankton species (Fig. 6).

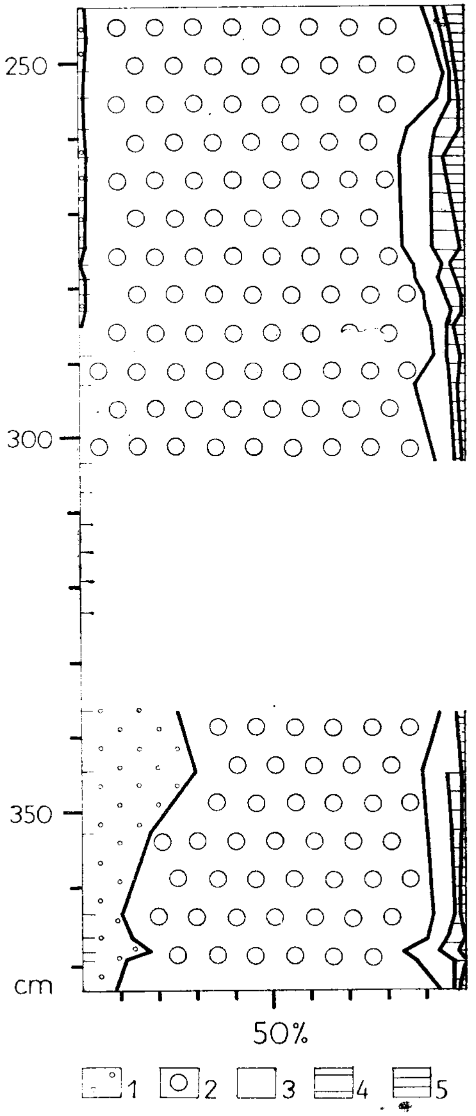

Fig. 6. Per cent of diatoms belonging to different ecological groups. 1 — plankton group; 2 — plankton-epiphytes group; 3 — epiphytes group; 4 — epiphytes-benthos group; 5 — benthos group

Ryc. 6. Udział procentowy okrzemek należących do różnych grup ekologicznych. 1 — planktonowe; 2 — planktonowo-epifityczne; 3 — epifityczne; 4 — epifityczno-bentosowe; 5 — bentosowe

This proves that there was a rise in the water level, a fact perhaps to be referred to greater humidity of climate. A higher pH (Fig. 5) might have again stimulated the occurrence of halophilous diatoms. On the other hand, the analysis of the qualitative and quantitative composition of diatom flora seems to indicate that salinity had actually increased. In conditions resembling those of the Older Dryas (the α index, water level), there was a more abundant development of mesohalobous diatoms, their per cent proportion being from 40 to 60 p. c. The transition of gyttia into swamp peat (245 cm level) was related to the lowering of water level, as shown by the decrease of plankton, and to the increased water alcalinity, as testified to by the reduced α index.

NOTES ON MORE REMARKABLE SPECIES AND THOSE OF UNCERTAIN DETERMINATION

Cyclotella antiqua W. Sm. (Pl. I, fig. 6). Diameter 15—16 μ, 15—17 striae per 10 μ; Older Dryas, calcareous gyttia. Recorded Polish habitats: contemporary, „Mały Staw" Lake in the „Five-Lakes" Valley in the Polish Tatras (Gutwiński 1909); fossil: the Vistulan Lagoon (Brockman 1954).

Cyclotella bodanica Eulenst (Pl. I, fig. 12). Diameter 20—23 μ, 12—14 striae per 10 μ; Older and Younger Dryas, calcareous and light brown gyttia. Polish contemporary habitats: the river Warta, near Gorzów Wielkopolski (Bennin 1926).

Achnanthes cf. *saxonica* Krasske (Pl. I, fig. 2). Length 9·9 μ, width 5·5 μ, Hypovalve, ca. 30 striae in 10 μ. Well developed central area, radial striae, less frequent in the middle, perpendicular at the end. Only some specimens of hypotheca were found in the Younger Dryas and Holocene in light brown gyttia and swamp peat. As there is no epitheca, the record is uncertain.

Achnanthes sp. (Pl. II, fig. 7). Epivalve 11—13 μ long, 5·0—5·5 μ wide, 16—20 striae in 10 μ. Striae in the centre radial, perpendicular at the end, or slightly convergent. Small central area, very narrow linear axial area. Found in comparatively large numbers but only the epivalves in the light brown gyttia of Younger Dryas sediments.

Achnanthes sp. (Pl. I, fig. 3). Epivalve 8·6 μ long, 4·0 μ wide, 13—20 striae in 10 μ. Striae in the centre radial, perpendicular at the end; very narrow axial area, small central area. Only a small number of epivalves have been found, Younger Dryas, in light brown gyttia.

Navicula halofila f. *robusta* Hust. (Hustedt 1961) (Pl. II, fig. 5). 46·0 μ long, 9·5—10·0 μ wide, 17—18 striae in 10 μ; Younger Dryas, light brown gyttia. — Unrecorded in Poland.

Navicula pseudotuscula Hust. (Pl. II, fig. 2). 35·0—43·0 μ long, 12·5—13·2 μ wide, 14—15 striae in 10 μ; Older Dryas, calcareous and light brown gyttia. Polish habitats: fossil, the Vistulan Lagoon (Brockman 1954).

Navicula pseudoscutiformis Hust. (Pl. I, fig. 4). 9·5 μ long, 9·3 μ wide, 18—20 striae in 10 μ; Younger Dryas, light brown gyttia. — Polish habitats: contemporary, „Morskie Oko" Lake (Kawecka 1966); fossil, bottom deposits at „Morskie Oko" (Wasylik 1965a).

Navicula punctulata v. *marina* (Ralfs.) Cl. (Pl. I, fig. 5). 46·0 μ long, 16·2 μ wide, 13—14 striae in 10 μ, 13 carinal dots in 10 μ, light brown gyttia, Older Dryas. — Recorded as fossil species in the Bay of Gdańsk (S c h u l z 1926), and now in the Baltic Sea (on the *Chlorophyceae*), and in the neighbourhood of Pława (S c h u m a n n 1867)

Navicula Krasskei Hust. (Pl. I, fig. 1). 12·5 μ long, 6·5 μ wide, ca. 30 striae in 10 μ, Younger Dryas and Holocene, light brown gyttia and swamp peat. — Polish habitats, contemporary: mill-pond seston at Mydlniki near Cracow (G u m i ń s k i 1947), the river Czarny Dunajec (W a s y l i k 1971).

Navicula disjuncta Hust. (Pl. I, fig. 8). 18·5 μ long, 4·0 μ wide, 25 striae in 10 μ; Younger Dryas, light brown gyttia. — Polish habitats, contemporary: the seston of the rivers Vistula and Biała Przemsza (S t a r m a c h 1938), seston of the river Dunajec upstream from the Rożnów retention lake (S i e m i ń s k a 1952), and in the river Czarny Dunajec (W a s y l i k 1971).

Neidium Hitchcockii (Ehr.) Cl. (Pl. II, fig. 1). 66·0 μ long, 17·2 μ wide, 18 striae in 10 μ, Younger Dryas, light brown gyttia. — Polish habitats, fossil: the Vistula Bay (B r o c k m a n 1954).

Nitzschia vitrea v. *salinarum* Grun. (Pl. II, fig. 4). 85·8 μ long, 8·0 μ wide, 30 striae in 10 μ, 7 carinal dots in 10 μ, Older Dryas, calcareous gyttia. — Polish habitats, contemporary: pond at Inowrocław (L i e b e- t a n z 1925).

Cymbella angustata W. Sm. (Pl. II, fig. 6). 40·0 μ long, 7·0 μ wide, 15 striae in 10 μ, Older Dryas, calcareous gyttia. — Polish habitats, contemporary: „Morskie Oko" Lake (K a w e c k a 1966), the river Czarny Dunajec (W a s y l i k 1971).

Epithemia turgida v. *vertagus* (K ü t z.) Grun. (Pl. I, fig. 9). 101·6 μ long, 13·2 μ wide, 2—4 ribs in 10 μ, 10 alvaeolae in 10 μ, and 3—5 between two ribs; Older Dryas, calcareous gyttia. — Polish habitats, contemporary: Lake Raduń (B o h r 1967).

Pinnularia acrosphaeria Bréb. (Pl. I, fig. 7). 68·3 μ long, 9·9 μ wide, 11—12 striae in 10 μ, Younger Dryas, calcareous gyttia. — Polish habitats, contemporary: the basin of the river Soła (W a s y l i k 1965b), and in the Tatra Mts. on the Slovak side (B i l ý 1941).

Pinnularia globiceps v. *Krookei Grun.* (Pl. II, fig. 9). 21·8 μ long, 5·5 μ wide, 18—19 striae in 10 μ, Holocene, swamp peat. Polish habitats, contemporary: Mydlniki near Cracow (S i e m i ń s k a 1947).

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STRESZCZENIE

PÓŹNOGLACJALNA FLORA OKRZEMEK Z KNAPÓWKI KOŁO WŁOSZCZOWEJ

W pracy przedstawiono wyniki badań nad okrzemkami w późnoglacjalnych osadach z Knapówki koło Włoszczowej.

W 28 próbach pobranych z rdzenia o długości 135 cm oznaczono 206 jednostek systematycznych okrzemek. Podano opisy 17 taksonów bardziej interesujących lub niepewnie oznaczonych.

Zestawione na podstawie literatury informacje o wymaganiach ekologicznych oznaczonych gatunków okrzemek, dane o ich wzajemnych stosunkach ilościowych oraz wartości tzw. współczynnika α Nygaarda (1956), wyliczone dla prób z różnych poziomów osadu, pozwoliły odtworzyć przypuszczalne warunki fizyczne i chemiczne wody w zbiorniku w czasie tworzenia się osadów oraz po części historię jego rozwoju.

Na początku starszego dryasu zbiornik miał charakter jeziora o zasadowym odczynie wody, które szybko się wypłycało, przy jednoczesnym wzroście zasadowości. W Allerødzie nieznane czynniki wpłynęły na niemal całkowity zanik flory okrzemek w osadzie. W młodszym dryasie zbiornik był już bardzo płytki. W holocenie po przejściowym wzroście poziomu wody nastąpiło ponowne jego obniżenie i zbiornik uległ zabagnieniu.

Instytut Botaniki Uniwersytetu Jagiellońskiego w Krakowie

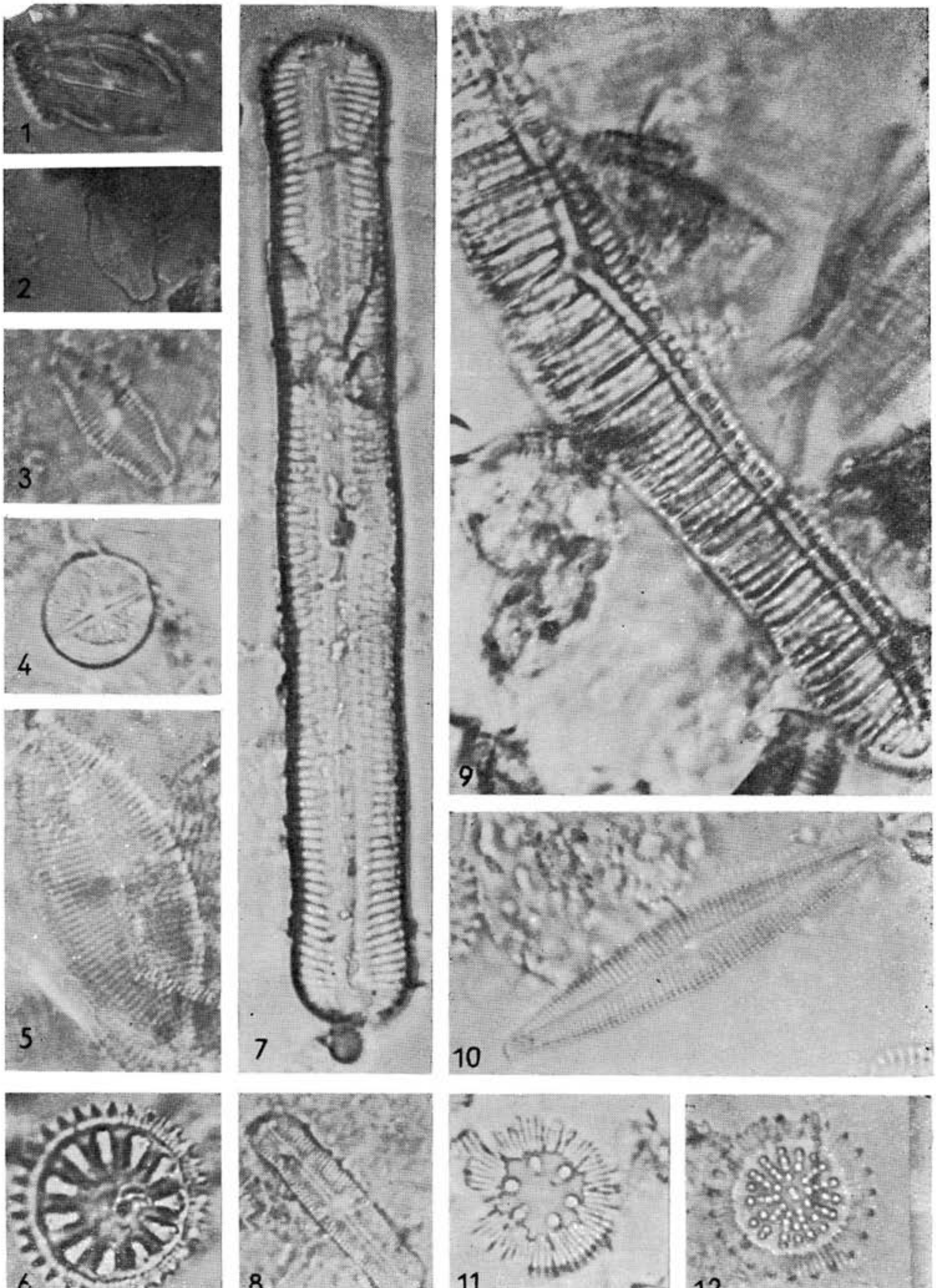
Plate I

Tablica I

x 1670

1. *Navicula Krasskei* Hust.
2. *Achnanthes* cf. *saxonica* Krasske
3. *Achnanthes* sp.
4. *Navicula pseudoscutiformis* Hust.
5. *Navicula punctulata* v. *marina* (Ralfs.) Cl.
6. *Cyclotella antiqua* W. Sm.
7. *Pinnularia acrosphaeria* Bréb.
8. *Navicula disjuncta* Hust.
9. *Epithemia turgida* v. *vertagus* (Kütz.) Grun.
10. *Cymbella Cesatii* (Rabh.) Grun.
11. *Cyclotella ocellata* Pant.
12. *Cyclotella bodanica* Eulenst

Plate I
Tablica I



I. Kcczmarska
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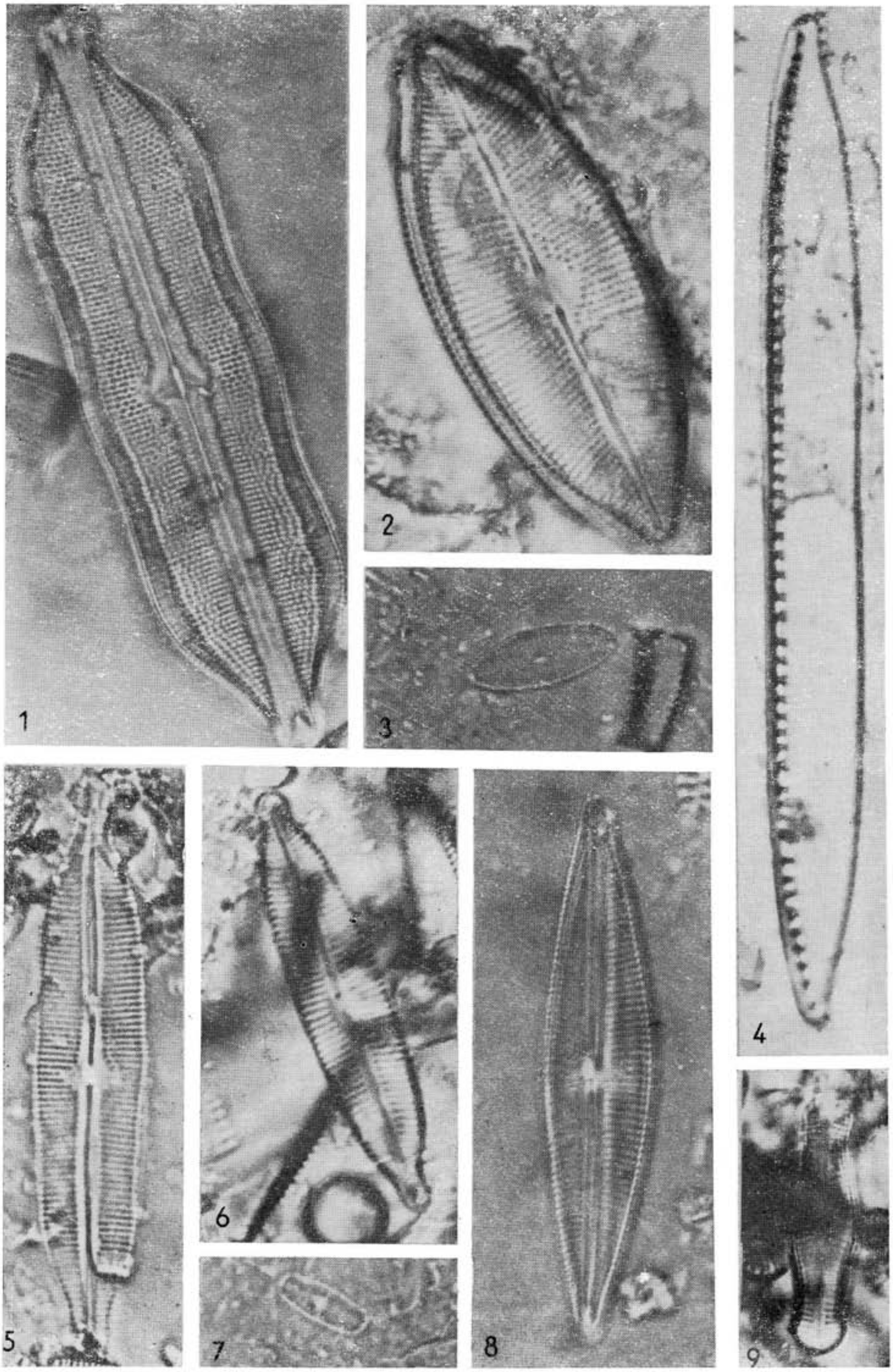
Plate II

Tablica II

x 1670

1. *Neidium Hitchcockii* (Ehr.) Cl.
2. *Navicula pseudotuscula* Hust.
3. *Navicula muralis* Grun.
4. *Nitzschia vitrea* v. *salinarum* Grun.
5. *Navicula halophila* f. *robusta* Hust.
6. *Cymbella angustata* W. Sm.
7. *Achnanthes* sp.
8. *Cymbella laevis* Näg.
9. *Pinnularia globiceps* v. *Krookei* Grun.


1
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9

The list of diatoms found in the Knapówka profile

Lista okrzemek znalezionych w profilu z Knapówki

Table 1

Table 1

Periods / Okresy	Holocene Holocen					Younger Dryas Młodszy dryas										Allerød					Older Dryas Starszy dryas							
Species / Gatunek — Sample No. / Nr próby	243	247	251	255	259	263	275	277	279	281	283	285	289	293	303	307	311	315	319	323	336	344	352	363	366	368	369	373
Melosira granulata (Ehr.) Ralfs																												
- - v. angustissima (O.Müll.) Hust.	1.0	2.8	5.2	1.2																								
- islandica O.Müll.			+																									
- - subsp. helvetica O.Müll.			+	1.8																								
- italica (Ehr.) Kütz.	8.2	10.8	8.0	11.0	7.0	3.2	+	+	0.4	0.2	0.2	0.4			1.0													
Cyclotella Kützingiana Thw.																												
- - planetophora Fricke																					0.4	4.6	+	0.2	0.2	0.4	0.2	0.2
- Meneghiniana Kütz.	19.0	26.2	21.0	21.6	4.8	2.2	12.6	10.4	11.2	10.8	6.2	18.6	0.2	4.0		+												+
- stelligera Cl. et Grun.	+	1.0	0.4	0.2	0.6	0.2	1.4																		+		+	
- ocellata Pant.											+										0.4	1.2	0.2	0.2	0.2	0.2	0.2	0.2
- antiqua W. Sm.																						0.2	+	+	0.2	+	0.4	
- operculata (Ag.) Kütz.																									+			
- - v. mesoleia Grun.																					0.8	2.2	+	0.2	0.4	0.6	1.4	0.8
- comta (Ehr.) Kütz.					+	0.8	0.4	0.4	0.2	0.2	0.4	+	0.4		0.2						0.4	0.8	+	0.2	0.2	+	+	
- bodanica Eulenst.							0.4				0.4				+						1.0	1.8	0.4	0.6	0.4	0.4	0.4	0.2
Tabellaria flocculosa (Roth) Knud.	0.8	1.0	0.8	0.4	1.2	5.0	0.8	1.2	1.8	0.4	0.4	0.4	0.6	1.2	0.4						0.2	+	0.6	0.4	1.4	1.4	0.2	0.4
Meridion circulare Ag.					+		+																					
Diatoma vulgare Bory v. lineare Grun.															+													
- hiemale (Lyngb.) Heib.																					0.4	2.4	0.2	+	0.8	0.3	2.6	0.2
- - v. mesodon (Ehr.) Grun.																					0.2	0.6	0.2	+	0.4	0.4	0.6	0.4
Opephora Martyi Hérib.																					0.2	0.4	5.4	0.6				
Fragilaria capucina Desm.											+												+					
- intermedia Grun.																					2.0	1.0	1.2	+	0.2	0.6	0.4	0.2
- leptostauron (Ehr.) Hust.											0.2		+	0.2	0.6						3.0	5.4	3.4	7.4	6.0	5.4	5.0	4.6
- inflata (Heid.) Hust.	3.0	0.8	+					0.2		1.0	1.8		0.8	2.0	1.8						+			0.8	0.4	0.4	0.2	
- construens (Ehr.) Grun.	41.8	38.4	54.2	55.2	65.2	33.4	29.8	26.2	24.2	30.2	26.2	22.0	26.0	20.0	27.0	+	+		+	+	11.2	9.0	13.0	7.6	9.6	7.6	10.6	19.6
- - v. venter (Ehr.) Grun.		0.2		+				4.2	6.0	2.6	2.7	1.6	4.8	1.8	1.6													
- - v. binodis (Ehr.) Grun.	+	+	+			+	0.8	0.2	0.8	1.0	1.2	0.2	3.2	6.8	0.2						1.8	2.4	1.2	20.8	22.2	9.2	3.6	1.0
- - v. triundulata Reich.			+		+				+	+	+				+													
- - v. capitata Hérib.	4.6					0.8	0.8	0.2		0.4					0.2													
- - v. cruciata (Ag.) Cl.	0.2					+					+		+	+														
- pinnata Ehr.	2.4	1.4	1.0	0.4	1.0	12.6	9.6	9.6	11.6	16.2	20.4	12.2	31.8	37.8	38.8	+	+		+	+	8.2	7.4	4.2	2.4	2.2	1.4	4.1	4.0
- - f. ventriculosa Schum.																					0.4	0.6	0.2	0.2	0.6	0.4	0.8	1.0
- - v. lancettula (Schum.) Hust.	1.4					3.2	2.6	8.6	7.2	9.0	9.2	7.8	13.2	7.6	6.2	+			+		0.2	0.6	0.6	1.4	0.4	1.4	0.8	1.6
- - v. intercedens Grun.					+	+							+								+	0.4			0.2	0.2		
- brevistriata Grun.	1.4	3.8	1.4	1.2	0.2	0.8	0.2	1.2	1.0	0.6	0.8	0.8	0.8	+	1.2				+	+	5.2	5.8	8.2	28.2	17.6	19.8	32.4	37.6
- - linearis May									+					+														
- lapponica Grun.					0.6	0.6	3.2	3.6	1.6	4.6	4.6	5.6	1.8	2.4	2.8	+												
- producta (Lagst) Grun.										0.2	+		0.6	1.2	0.8													
Synedra Vaucheriae Kütz.	+	+				+		0.2		+		+		0.4	0.2						+	0.2	0.2	0.2				
- - v. capitellata Grun.	+		+						0.2	+											+							
- - v. continua (Ag.) Cl.	+																									+		
- ulna (Nitzsch) Ehr.	0.8	1.0	+	+	+	0.6	+	0.4	+	1.0	+	0.2	+	0.2	0.2						2.0	1.0	0.8	0.6	0.4	1.4	0.2	0.2
- - v. biceps (Kütz) v. Schönf.	+	+	+	+		0.6		+	+		1.0	+		0.4							0.4	0.4	0.4	0.2	0.4	0.2	0.2	
- capitata Ehr.	+	+				+	+	0.2	+					0.4							2.4	2.4	1.6	0.8	0.4	1.6	0.4	0.2
- acus Kütz. v. angustissima Grun.										+					0.2							0.2	0.2	0.8	0.4	0.2	+	0.4
- rumpens Kütz.						0.4	0.2	+	+	0.4	+			0.2	+						1.6	1.0	0.6	1.2	0.2	+	0.2	+
- - v. scotica Grun.	+		+					0.4				0.2		0.2												0.6		
- parasitica (W. Sm.) Hust.																												
- - v. subconstricta Grun.	1.0	0.2	0.2	0.2	0.2	+								0.2														
- tabulata (Ag.) Kütz.																												
- - v. fasciculata (Kütz.) Grun.					+	+	+	+	0.4	+	0.8	1.2	1.0	1.8	0.4						5.0	2.8	3.2	2.4	2.8	3.2	3.4	1.4
Eunotia diodon Ehr.		+																										
- arcus Ehr. v. fallax Hust.		+																			0.2	+	0.2		0.2	0.2		
- - v. bidens (Grun.)		+				0.2			+														+					
- pectinalis (Dillw.? Kütz.) Rabh.																												
- - v. minor (Kütz.) Rabh.		+																										
- - - f. intermedia Krasske		+				+																						
- valida Hust.						+																						
- lunaris (Ehr.) Grun.						+								+											+			
Cocconeis placentula Ehr.	0.6		+		+	+			+				+	0.2							0.6	4.6	3.0	+	1.2	0.4	+	1.8
- - v. euglypta (Ehr.) Cl.						+	+		+	+	0.2				0.6						0.6	4.6	3.8	0.2	1.0	0.4	0.8	0.2
Achnanthes microcephala (Kütz.) Grun.																					+				+	0.6		+
- minutissima Kütz.		+												+														
- - v. cryptocephala Grun.			+	+	0.2	0.6	+	0.2	1.0	0.2	0.2	0.2		0.2	+	+					0.4	0.8	0.2	0.4	0.6	1.4	1.0	0.8
- linearis (W. Sm.) Grun.		0.2		+		0.4	0.2	0.8	0.4	1.0	0.4	1.4		1.4	0.6	+					+		+	+	+	+	+	
- - v. pusilla Grun.		0.2								+														+	+	+	+	
- exigua Grun.								+	0.2	0.2	0.2	0.6																
- - v. heterovalvata Krasske	3.6	3.0	2.6	0.8	1.0	6.4	4.2	4.8	6.0	2.8	2.8	5.0	4.0	1.4	1.8													0.4
- - v. constricta Torka	+																											
- saxonica ? Krasske						1.0	0.8	0.4	1.2																			
- conspicua Mayer				0.2			0.2	0.2	0.2	+	+		0.4	1.0														
- lanceolata (Bréb.) Grun.	+	+	0.6	0.2	1.0	0.2	+		0.2	+	+	1.0	+	1.0							0.2		0.2					
- - f. capitata O. Müll.						0.2		+							+						+							
- - v. rostrata (Østr.) Hust.	0.2	0.2		+			0.4		0.4	+	0.2	0.4	1.2	0.4	+						+			+	+			
- flexella (Kütz.) Brun.										0.2	+		0.2								+	0.2	0.4		0.2	0.4	0.4	
Mastogloia Grevillei W. Sm.																							+					
- Smithii Thw. v. lacustris Grun.																					+	1.0	1.4	+	0.8	1.2	0.4	0.8
Diploneis elliptica (Kütz.) Cl.					0.2	+	0.4	0.4	0.4	+	+	+	0.4	+	+						+	0.4	0.8	0.6	1.0	0.6	0.2	2.0
Amphipleura pellucida Kütz.																					0.2	+	0.2	0.4	0.2	0.4	0.2	0.2
Frustulia rhomboides (Ehr.) De Toni																												
- - v. saxonica (Rabh.) De Toni					0.2																							
Anomoeoneis sphaerophora (Kütz.) Pfitz.									+	0.2	0.2		+	+	+						0.6	+						
- exilis (Kütz.) Cl.																							0.2	+	+	0.6	+	0.2
Stauroneis phoenicenteron Ehr.	0.4	0.2	0.4	+	1.2	1.0	1.6	2.4	0.6	1.2	1.6	0.8	0.2	+	1.2						+		+		+			+
- anceps Ehr.	0.8	0.6	0.2	0.2	0.6	0.8	0.2	1.0	0.2	0.4	0.2	+	0.6	0.2	+												+	
- acuta W. Sm.	+											+	+	+														
Navicula cuspidata Kütz.	+	+	0.2	+	0.4	+	0.2	0.4	0.4	0.2	0.6	0.2	0.2	0.2	0.2	+					0.4							
- - v. ambigua (Ehr.) Cl.						0.2		+													+							
- halophila (Grun.) Cl. f. robusta Hust.								+	+																		+	0.4
- bacilliformis Grun.						0.6	0.6	2.4	3.0	1.2	2.2	2.6	0.6	0.2	1.4						0.2	0.2				0.2	+	+
- disjuncta Hust.						0.2		+	0.8	+	+	+	+														+	
- mutica Kütz.						+															+							
- - v. ventricosa (Kütz.) Cl.						+																						
- americana Ehr.	+																											
- bacillum Ehr.	0.2	0.2		+	0.2	+	+			+		+		+	0.2						+			+	0.2			
- pupula Kütz.	0.2			+			+		+				+	0.4	+						+				0.2		0.2	
- - v. rectangularis (Greg.) Grun.	0.6	1.2	0.6	0.4	+	+	1.6	1.0	1.2	0.8	+	1.0	0.2	+	+						0.2	+	0.4	+	0.2	+	0.4	
- - v. capitata Hust.					+						0.2	+	+	0.2							+				+			
- Krasskei Hust.	+					1.0		0.2	+	+	+	+	+	0.6														
- muralis Grun.														+														
- pseudoscutiformis Hust.						+			+				+															
- cryptocephala Kütz.	0.4								0.6	+		+	0.4	+							0.4	0.4			+	+	0.2	+
- - v. veneta (Kütz.) Grun.									+					0.2	0.4													
- - v. intermedia Grun.						0.4	0.6	0.2	0.4	0.2	0.8	0.4	+	0.6							0.4	0.2	+	1.0	0.6	0.6	1.0	1.0
- salinarum Grun. v. tenuirostris Hust.									0.2					+							0.2			0.4	+	+	+	
- rhynchocephala Kütz.																									+	0.4	0.4	
- vulpina Kütz.	0.4	+		0.4	5.2	12.0	13.4	7.8	4.6	4.0	5.0	5.4	1.0	0.8	1.0		+				0.6	0.2	0.2	0.2	0.2	+	0.6	1.4
- cincta (Ehr.) Kütz.					+																							
- radiosa Kütz.	0.2	+		+		0.4	0.2	0.2	2.0	0.4	0.2	0.6	+	1.0	0.2	+					1.2	0.6	1.2	0.4	1.2	1.6	1.0	0.2
- menisculus Schum.																					+							
- digitoradiata (Greg.) A. Sm.									0.2	0.2	+	0.4	0.2	0.4	+													
- Reinhardtii Grun.									+	+			0.2	0.2												+		
- Schönfeldii Hust.	+	1.0	0.6	+	0.2	0.2			+			+													+			
- laterostrata Hust.	+	+	+	+	1.0	0.4	2.4	0.4	0.4	0.8	0.6	2.8	+	+	+													
- dicephala (Ehr.) W. Sm.	+				+				+	+				+							0.2	+				0.2	+	
- - v. elginensis (Greg.) Cl.	+	+	+																									
- similis Krasske													0.4	+														
- anglica Ralfs	+											+			+						+	+	+		0.2	+		
- - v. subsalsa Grun.	1.0	0.8	+	+	+	+	0.2	0.6	0.2	+	0.6	0.2	0.2	0.8							0.2	+	+	+	+	+	+	0.2
- placentula (Ehr.) Grun.	+	0.4	+	+		+	0.4	0.2	+	0.4	0.2	+	+	+	+													
- gastrum Ehr.										+			0.2	+							+	0.2	+	0.2	0.2			
- lanceolata (Ag.) Kütz.	0.2	+					+	+	+	+													+	0.2	0.4	0.2	0.2	0.2
- - v. cymbula (Donk.) Cl.																								+	0.2	0.8	2.6	0.4
- oblonga Kütz.																					3.6	0.2	2.4	1.4	1.6	2.8	1.4	1.8
- tuscula (Ehr.) Grun.					+		+	+	0.4	0.2	0.6	+	+	0.2	0.6						0.4	0.2	+	0.2	0.2	0.2	0.2	+
- lacustris Greg.																					+							
- avenacea Bréb.	+																				+							
- pseudotuscula Hust.																					+	0.2	+	+				
- punctulata (W. Sm.) v. marina (Ralfs.) Cl.									+		+																	
Pinnularia undulata Greg.																							+					
- interrupta W. Sm.	0.2	+																										
- mesolepta (Ehr.) W. Sm.	+	0.2				+	0.2	+	0.4	0.2	+	+	+	+	+										+		+	+
- globiceps Greg. v. Krookei Grun.	+																											
- microstauron (Ehr.) Cl.																												
- - v. Brebissonii (Kütz.) Hust.																						0.2	+				+	0.2
- - v. ambigua Meist.														+														
- legumen Ehr.	+	0.2																										
- intermedia Lagerst.																										0.2		
- gibba Ehr. v. linearis Hust.	+	0.4		+	+	0.2	+	0.2	0.2	+		+	+	+	0.2	+												
- brevicostata Cl.												+																
- acrosphaeria Bréb.									+																			
- viridis (Nitzsch) Ehr.	1.0	1.8	1.2	1.8	3.6	0.6	2.8	2.6	1.4	1.8	0.6	1.8	1.0	0.4	0.6	+					+	0.2	0.6	+	0.2	+	0.8	+
Neidium iridis (Ehr.) Cl.	0.6	0.4	0.4	1.2	1.8	2.0	2.6	1.8	0.4	1.0	0.6	1.2	0.8	0.4	0.4	+							+		+		+	0.2
- - v. amphigomphus (Ehr.) V.H.									+	+	+	+															+	
- iridis (Ehr.) Cl. f. vernale Reich.								+	+																+			
- productum (W. Sm.) Cl.	+									+		+																
- dubium (Ehr.) Cl.									+						+							+			+		+	
- Hitchcockii (Ehr.) Cl.									+		+																	
Caloneis silicula (Ehr.) Cl.	+						+		+	0.2		+			+							0.2	+	0.2				0.2
- - v. truncatula Grun.	+																				+	+		+	+	0.2	0.2	0.4
Gyrosigma attenuatum (Kütz.) Rabh.																					0.6	0.6	1.6	0.6		0.8	0.4	1.2
Amphora ovalis Kütz.																					0.2	0.2	0.2	+	0.8	0.4	0.2	0.6
- - v. libyca (Ehr.) Cl.	0.6	0.4	0.6	0.6	0.8	0.2	1.4	0.6	1.0	0.8	0.8	0.8	0.4	1.0	0.6						2.2	0.8	1.0	0.4	0.2	0.2	0.5	0.2
- - v. pediculus Kütz.																					2.4	0.8	0.8	1.0	0.4	+	1.2	0.2
Cymbella microcephala Grun.				+					+												0.2	0.2	1.2	1.2	1.2	2.2	2.8	1.8
- Cesatii (Rabh.) Grun.																					1.4	2.6	0.2	0.4	1.8	2.2	0.2	0.6
- angustata (W. Sm.) Cl.																					0.8	0.6	0.2	0.2	0.6	0.6	0.6	
- laevis Näg.																					+	0.2	0.2					
- leptoceros (Ehr.) Grun.																					3.4	2.6	4.0	3.4	1.6	4.2	0.4	0.6
- Reinhardtii Grun.	+	+				0.2		+	+	+				+	0.6	+						+	+	+	+	+	0.2	+
- Ehrenbergii Kütz.	0.2	1.2	0.2	0.8	2.6	0.2	+	1.2	0.4	0.2	0.4	0.2	0.4	+							+	+	0.2	+	+	+	0.2	0.2
- naviculiformis Auersw	+	+	+			0.2	+	+	+	0.4			+	+	0.2						0.2	0.2	+	0.4	0.4	1.2	1.0	+
- cuspidata Kütz. v. anglica (Lagst.) Cl.	+					+		+					+	+	+						+		+		+	+	0.4	0.2
- prostrata (Berkeley) Cl.																					0.2					0.6		
- ventricosa Kütz.	+			0.2	1.6	2.0	2.2	1.0	0.8	0.8	1.0	0.2	0.2	0.2	+						1.6	1.4	2.4	0.8	1.6	1.4	2.2	0.4
- incerta Grun. v. linearis Font.									0.4	+	+	+	+	+														
- aequalis W. Sm.						+			+												0.2	0.2	0.6	+	0.4	0.6	0.2	
- sinuata Greg.											+		+	0.2							+		0.2	0.2				
- affinis Kütz.	+					+		0.4	0.4	+	0.6		+	+	+						4.8	4.2	2.0	0.8	1.6	1.6	1.2	0.4
- cistula (Hemp.) Grun.						+		0.2	0.6	+	0.2			+							2.8	2.2	2.0	0.4	0.2	1.6	0.4	
- aspera (Ehr.) Cl.								+		+											1.8	0.2	1.2	0.2				
Gomphonema acuminatum Ehr.	+					+	+	+	+	+	+		+								+				+	0.2		
- - v. coronatum (Ehr.) W. Sm.						+		+				+		+							0.8	0.2	0.2	0.2	0.2	+	+	
- - v. Brebissonii (Kütz.) Cl.	+	+				+	+							+														
- - v. trigonocephalum (Ehr.) Grun.						+						+	+	+														
- parvulum (Kütz.) Grun.																												
- - v. exilissimum Grun.	+						+					+		+	+						+							
- - v. micropus (Kütz.) Cl.	+		0.2	+	+	0.2	0.2	0.2	0.4	+				0.4	+				+		1.4	1.0	0.6	+	0.4	0.2	0.2	
- angustatum (Kütz.) Rabh.									+																			
- - v. productum Grun.	+					+				+																		
- longiceps Ehr.																					+	0.4	0.2	+				
- intricatum Kütz.						+	+				+										+							
- - v. pumilum Grun.						+			+	+				+	+						1.8	2.0	1.2	0.4	0.4	0.2	0.4	0.2
- gracile Ehr.						+				+		+																
- subtile Ehr.						+	+	0.4	+	+	+										0.2	0.2						
- constrictum Ehr.	+					0.2	0.2	+		+	0.2	0.2		+	+						0.8	0.4	0.2		0.2	+	+	
- capitatum Ehr.	0.2	+					+	+		+	+	+	0.2	0.2							+	0.2	+	0.2	+	+		
Epithemia argus Kütz.																					0.2	+	0.2		0.2			
- sorex Kütz.																					0.6	2.0	4.4	0.2	1.0	2.2	2.6	0.2
- - v. gracilis Hust.																							+					
- zebra (Ehr.) Kütz.										+	+		+	+							1.2	0.2	0.4	0.2	0.2	0.2		
- - v. saxonica (Kütz.) Grun.	+	+				+	+		0.6	0.2	0.6	+		+							1.8	1.4	1.8	0.2	0.2	0.6	+	
- - v. porcellus (Kütz.) Grun.	+					+	+			+	+	+	+	+							0.8	0.4	1.0	0.2	0.4	+	+	
- turgida (Ehr.) Kütz.																												
- - v. granulata (Ehr.) Grun.																					0.2	0.2	0.4	0.4	0.2	0.4		
- - v. vertagus (Kütz.) I. Kiss																						+	+					
Rhopalodia gibba (Ehr.) O. Müll.									+		+	0.2		+							3.6	0.6	3.4	1.0	1.8	2.4	1.0	0.2
Hantzschia amphioxys (Ehr.) Grun.						+						+										+					+	
Nitzschia angustata (W. Sm.) Grun.																												
- - v. acuta Grun.							+		0.2	+	+	+	+	0.2							0.6	0.8	0.2	0.8	0.8	0.4	0.4	0.2
- denticula Grun.	+	+				+	0.2	+	+	0.2	+	0.2	+	+	0.4						2.0	2.0	3.0	2.0	2.8	1.8	1.2	1.0
- sinuata (W. Sm.) Grun.																					+							
- - v. tabellaria Grun.																						0.6	1.2	0.8	0.8	1.2	0.8	0.2
- linearis W. Sm.														+							+		+	+	0.2	+	+	0.2
- vitrea Norman															0.2						0.2				0.4	+		
- - v. salinarum Grun.															+						+	+			0.2	+		
- frustulum (Kütz.) Grun.									+			+									+	0.2			0.2			
- palea (Kütz.) W. Sm.	0.4	0.2		+	0.2		+		+					+	0.2		+				+		+	0.4	1.2	0.8	0.6	0.6
- sigma (Kütz.) W. Sm.									+																			
- parvula Lewis	+								+																			
Cymatopleura solea (Bréb.) W. Sm.										+	+		+		+						+	+	+	+	+	+	0.2	
- elliptica (Bréb.) W. Sm.																							+	+	+			
- - v. nobilis (Hantzsch) Hust.																					0.2							
Surirella linearis W. Sm.									+					+														
- - v. constricta (Ehr.) Grun.									+			+																
- tenera Greg.									+			+													+		0.2	+

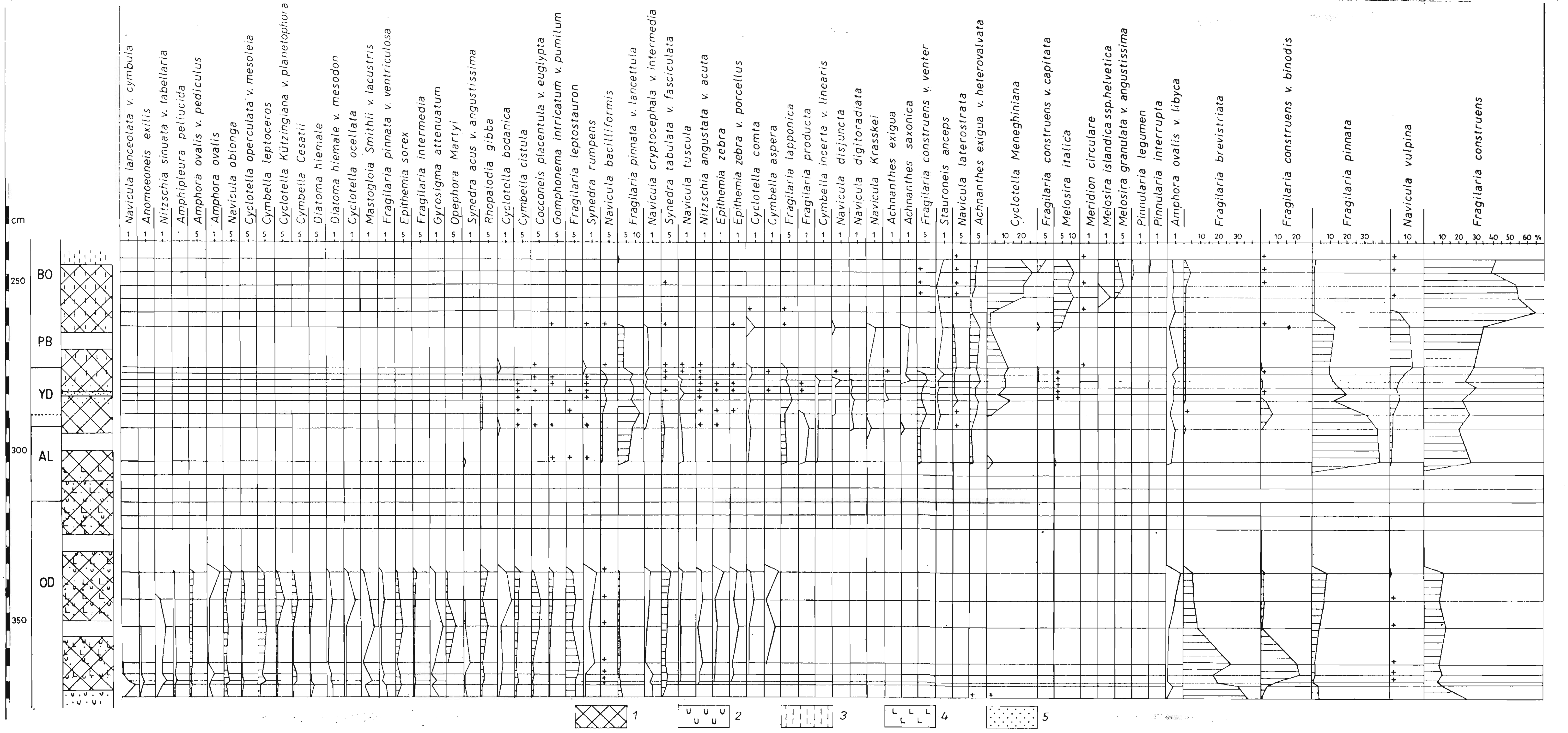

Fig. 2. Diatom succession in profile (deposit symbols after T r o e l s - S m i t h 1955). 1 — gyttia; 2 — limestone gyttia; 3 — swamp peat; 4 — clay; 5 — sand; OD — Older Dryas; AL — Allerød; YD — Younger Drńas; PB — Preboreal period; BO — Boreal period

Ryc. 2. Sukcesja okrzemek w profilu (symbole osadów według T r o e l s - S m i t h a, 1955). 1 — gytia; 2 — gytia wapienna; 3 — torf bagienny; 4 — ił; 5 — piasek; OD — starszy dryas; AL — Allerød; YD — młodszy dryas; PB — okres preborealny; BO — okres borealny