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DIATOM ANALYSIS OF EEMIAN PROFILE IN FRESH-WATER DEPOSITS AT IMBRAMOWICE NEAR WROCŁAW

Analiza okrzemkowa eemskiego profilu osadów słodkowodnych z Imbramowic koło Wrocławia

ABSTRACT

A profile of the fossil lake deposits at Imbramowice near Wrocław (south-west Poland) was submitted to diatom analysis. The obtained results proved to be largely consistent with a parallel palynological investigation. The Imbramowice profile comprises: the end of Late Glacial of Middle Polish Glaciation, the whole Eemian Interglacial, and the beginning of Last Glaciation (Mamakowa 1976). 409 freshwater taxons and 30 redeposited marine ones were determined, including a number of rare species: *Achnanthes lapponica* var. *ninckei*, *Amphora fonticola*, *Navicula abiscoensis*, *N. confervacea*, *N. subocculata*, *N. seminuloides*, *Pinnularia lagerstedtii*. 4 new taxons were described (Kaczmarska 1976): *Fragilaria lapponica* var. *marciniakae*, *F. imbramoviciana*, *Navicula bronislaae*, *N. starmachii*. The respective percent proportion of the species found in the lake deposits and their present-day survival requirements, with the help of coefficients α, C:P (Nygaard 1949, 1956), as well as Foged's C:P index (1954, 1962, 1970) enabled the reconstruction the changes which had taken place in the fossil lake under the influence of climatic oscillations. The changes in climatic conditions have manifested themselves much more distinctly than in the profiles from large, deep lakes. In the climatic optimum of the interglacial age, diatom species now living in the warmer climatic zones, and not recorded in the so far examined habitats in Europe lying further to the north have been found to occur. In the colder interglacial periods, particularly towards the end of it, a number of Boreal and Arctic species have been recorded.

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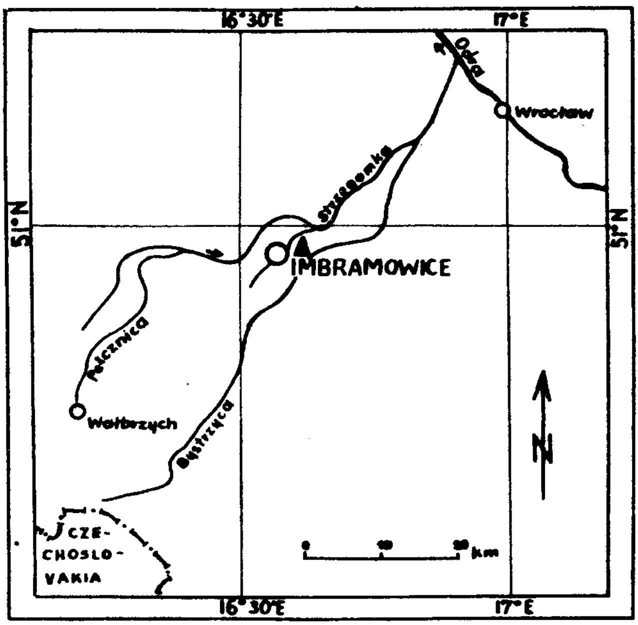
INTRODUCTION

Eemian Interglacial diatom floras have been recorded at a number of sites lying in the European part of the USSR, in Sweden, Denmark and Germany (Jousé 1936, 1939; Hustedt 1954; Behre 1962; Foged 1960, 1962; Sokolova *at al.* 1970; Miller 1971). Probably the oldest (Pfuhl 1911) publication on the flora of Eemian diatoms (86 taxa determined by V. Torka) comes from Polish territory, from the site at Szeląg near Poznań. The first to recognize these deposits as being of the Eemian was Dokturowski (1929, cf. Środoń 1956). The Szeląg diatoms were also studied by Namysłowski (1921), who in his work published in Polish advanced the view, nowadays universally accepted, as to the great importance of quantitative, not only qualitative analysis, in research on the fossil-lake deposits; the view was reasserted later by Hustedt (1948) who, moreover, emphasized the singificance of quantitative analysis in stratigraphic and palaeolimnological reaserch. Namysłowski (l. c.) found the specific composition of the Szeląg diatoms to be very similar to the contemporary, "...but — he wrote (p. 608) — it would be premature to assume that, because the species are identical, the biological conditions must have been identical, as well. A mere list of the species occurring in the given lake is not enough to characterize it properly and, if our intention is to do so with greater insight, altogether inadequate. One ought to give equal consideration to the relation between the respective numbers of specimens of the different species. It is not until the distinction is drawn between the common and rare species imparting their character to different types of waters, that the given communities can be compared. And even though diatoms are eurythermic organisms, a set of the same species at different temperatures will result in different groups, varying by the quantitative relation of different species to one another. This is due to the fact that — dependent on temperature and other conditions — some of the species will find the given lake to be their developmental optimum and therefore these predominante because of the number of specimens, thus becoming "common species" for the lake, — while the same conditions will be less favorable for other species, and these will occur as rare species, with a small number of specimens. Unfortunately, the present-day results of lake research, despite some attempts at classification based on the study of micro-flora, do not permit general conclusions founded upon a comparison of contemporary lake and fossil material."

Geological and palaeobotanical research on interglacial deposits from Imbramowice (Text-fig. 1) has been carried out for many years now (Gürich 1905; Hartmann 1907; Kräusel 1920). Their Eemian origin was recorded by Środoń (1960), as a result of palynological research. This opinion has been corroborated by the results of geological investigations (Szczepankiewicz 1962) as well as by a detailed and comprehensive palaeobotanical study (Mamakowa 1976). Hartmann (1907) recorder diatom occurrence in the Imbramowice deposit, where he determined 20 taxa.



Text-fig. 1. Map showing location of the profile at Imbramowice
Ryc. 1. Mapa okolic Imbramowic z zaznaczonym miejscem pobrania profilu

In 1960, at prof. S. Szczepankiewicz's instigation, a special research boring was undertaken at the site of interglacial deposits at Imbramowice. The palynological analysis of samples collected from a 22-meter profile has shown the occurrence of deposits from the late part of Middle-Polish Glaciation (Saalian), from the whole Eemian Interglacial and from the Early Glacial of the Last Glaciation (Mamakowa 1976). The same samples were submitted to diatom analysis, the results of which could then be synchronized with climatic phases determined by means of palynological analysis.

The new taxons have already been described (Kaczmarska 1976), and the detailed records of the Imbramowice diatom flora will be published separately.

MATERIAL AND METHODS

Diatoms analysis was applied to investigate 38 samples taken at a depth of 3·00—11·95 m from the 22-m profile. Samples were taken from the horizons characteristic of the determined climatic and transitory zones.

Description of profile — depths, nature of deposit and Nos. of samples.

3·00—3·20 m — sand; 16, 22, 27,
3·20—4·20 m — dark silt with a marked content of organic material; 32, 36, 39, 41,
4·20—4·50 m — gyttja with much sand; 45, 48,
4·50—4·80 m — gyttja with lower sand content; no samples for this layer,
4·80—5·10 m — gyttja with small wood splinters; 58, 60,
5·10—5·50 m — gyttja with small wood splinters, small sand content; 65, 68,
5·50—6·05 m — sandy gyttja, at 5·90 m depth, a thin sand layer; 80,
6·05—6·20 m — sand (boring disturbed for technical reasons); 83, 84,
6·20—6·40 m — peaty gyttja; 86,
6·40—7·10 m — slightly limy gyttja; 90, 98, 104,
7·10—8·00 m — markedly limy gyttja; 111, 116, 120, 125,
8·00—9·65 m — somewhat less limy gyttja; 138, 147, 160, 164,
9·65—10·00 m — gyttja with small clay admixture; 166, 172,
10·00—10·40 m — clayey silt with admixture of organic substances; 178, 180,
10·40—10·70 m — dark grey clay; at a depth of 10·70 m, a 1·5 cm peat layer; no samples from this stratum,
10·70—10·90 m — light chalky clay, with sand admixture; 186, 189,
10·90—11·95 m — dark chalky clay; 192, 196, 200, 206, for the last two samples there is no pollen analysis.

1—2 g deposit was taken for each sample, dependent on the amount of the material available. The samples containing calcium carbonate were treated with a 10 per cent HCl solution for 24 hours and then rinsed three or four times in distilled water in a centrifuge. Then, the samples were treated with 10—15 per cent H_2O_2 and heated in a water bath for one or two hours, until the organic remains were removed. The cooled samples were rinsed 3 times by centrifuging them in distilled water. Samples with a marked content of mineral particles were submitted to floatation, using as floatation liquid CdJ_2 in KJ in the relation 1·2 : 1, dissolved in 560 ml distilled water (Jousé 1966). The obtained suspension of diatom frustules was enclosed in pleurax (1·9 refractive index).

To denote the species, use was made of the following monographs and keys: Hustedt (1930, 1930—1966), Proshkina-Lavrenko (1949—1950), Zabelina *at al.* (1951), Cleve-Euler (1951—1955), Siemińska (1964), and Patrick and Reimer (1966), as well as of original descriptions. In the case very variable and rare species, we reverted to the iconographic collections of the Algological Laboratory at the Institute of Botany of the Polish Academy of Sciences.

In order to establish the quantitative relations, in each sample we reckoned

500 valves and fragments containing at least the whole central nodule (in species of the *Pennatae* subdivision) or a major part of the central area (in species of the *Centricae* subdivision). There were a few exceptions, i.e; sample 206, where the number of frustules was so small that only 26 fragments of valves were found in two preparations; samples 200 and 196, where 100 valves in each were counted; and samples 192 and 83, where the number of reckoned valves amounted to 200 and 300, respectively. Other samples poor in diatoms were also Nos. 98, 90, 80 and 65, while samples 166, 164, 160, 147, 138, 125, 120, 116, 111 and 104 were distinguished by a high frequency.

The proportion of each particular species was represented in per cent, the sign + denoting the taxons found after the reckoning was over.

Changes in the conditions in the lake were inferred from the present-day requirements of the taxons determined, and derived from the following studies and monographs: Hustedt (1930—1966), Foged (1954, 1959, 1960, 1962, 1964, 1969, 1970), Dodd and Stoermer (1962), Miller (1964, 1971), Jousé (1966), Patrick and Reimer (1966), Mölder and Tynni (1966), Merilainen (1967, 1969), Cholnoky (1968), Gasse (1969), Florin (1970), Schoemann (1970a, 1970b), Payne, Conoly and Abbott (1972), Tolonen (1972), Tynni (1972), Kolbe (1973), Lowe and Collins (1973), Robertson (1973), and König (1974).

The diagrams represent the sum of per cent proportions of the taxons included into the respective ecological groups.

According to the pH requirements, the taxons were classified as: alkalibiontic (Alb), alkaliphilous (Alf), indifferent (Ind), acidophilous (Acf), and acidobiontic (Acb). For a more accurate designation of the water reaction in which diatom communities were living during the consecutive periods of the lake's history, the index $\alpha = \frac{\text{acid units}}{\text{alkaline units}}$, which we owe to Nygaard's suggestion (1956), was calculated. The acid units consist of the number of acidobiontic species $\times$ 5 $\times$ their frequency + the number acidophilous species $\times$ their frequency. On the other hand, the alkaline units consist of the number of alkalibiontic species $\times$ 5 $\times$ their frequency + the number of alkaliphilous species $\times$ their frequency.

After examining 15 contemporary Dannish lakes, Nygaard (l. c.) found that the coefficient α lower than 1 is characteristic of waters with a pH exceeding 7, and higher than 1 — of waters with a pH lower than 7. The value of this coefficient has been checked in 14 contemporary Finnish lakes (Merilainen 1967). It was also used in palaeolimnological investigations (Wasylik 1965; Foged 1969; Diegerfeldt 1972; Tolonen 1972).

The habitat conditions in lake Imbramowice were characterized by means of species belonging to the following ecological groups: euterrestrial, aerophilous, epiphytic, benthonic, littoral-planktonic, and euplanktonic.

The meaning of the term "euterrestrial" attributed to it by Boye Petersen (1935), embraces both species living in soil and on soil damped only by atmospheric precipitation, i.e. dry-habitat species. In this group we also included species living on dry moss, classified by Beger (1927) as xerothermic types.

The aerophilous group included those of the fresh-water species which live in environments more or less exposed to the action of air, e. g., in damp tufts of moss, on damp or water-sprinkled stones, i. e., in habitats much damper than in the previous group.

Our considerations as to the fertility of this body of water are founded on the C : P coefficient according to Nygaard (1949), expressing the relation of the number of taxons of the *Centricae* subdivision to the *Pennatae*. This ceofficient varies for the different types of lake: thus, in oligotrophic lakes its value amounts to 0 (or is undesignable), while in mesotrophic and eutrophic lakes its value oscillates between 0 and 3. To determine the depth of the lake, use was made of the C : P coefficient according to Foged (1954, 1962, 1970), calculated as the relation between the number of *Centricae* to *Pennatae* valves: the higher the value of this coefficient, the deeper lake.

Besides diatoms, we sometimes found in the preparations some *Chrysophyceae* siliceous cystae. Since identification was impossible, their numbers were determined for the same area as that of diatoms. Their per cent proportion was calculated in relation to the over-all number of diatoms (assuming 100—500 counted diatoms as 100 per cent).

DIATOM SUCCESSION

Diatoms were found to occur in each of the examined samples. In all, 439 taxons were determined (Table 1), of which 409 were fresh-water, and 30 marine redeposited types. The following new taxons were found and described: *Fragilaria lapponica* var. *marciniakae*, *F. imbramoviciana*, *Navicula bronislaae* and *N. starmachii* (Kaczmarska 1976). We also found some taxons considered rare, such as: *Achnanthes lapponica* var. *ninckei*, *Amphora fonticola*, *Navicula abiscoensis*, *N. confervacea*, *N. subocculata*, *N. seminuloides*, *Pinnularia lagerstedtii*, and others.

The qualitative and quantitative composition of diatom flora differed from one strata to another in the profile. This made it possible to distinguish six succesive periods (Text-fig. 2[1]). The species characteristic of the different periods are illustrated in Plates I figs. 1, 2, 3, 6, and II figs. 1, 2, 3, 5, 7, 8, 9, 11.

The periods determined correspond roughly to Mamakowa's division (1976), based on the results of pollen analysis (Text-fig. 2).

Table 1 presents the per cent proportion of all the taxons found in the samples,

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[1] Text-fig. 2 is under the cover.

while the diagram (Text-fig. 2) shows the per cent proportion of the species characteristic of the different periods, and the occurrence of marine diatoms and *Chrysophyceae* cysts.

Throughout the profile we observed a frequent occurrence of many species of the genus *Fragilaria* (Table 1); in our discussion of the results we have taken into consideration only those taxons whose occurrence varies from one period to another.

The *Chrysophyceae* cysts were differently shaped (Pl. I figs. 4, 5; II figs. 4, 6, 12; III and IV). Their proportion in the profile varied greatly: in some of periods they occurred more numerously than the diatoms.

Period I

This period included the samples: 206, 200, 196 and 192. The deposits of this period, which according to Mamakowa (1976) had originated towards the end of the Late Glacial of Middle Polish Glaciation, are very poor in diatoms. The differences in the numbers and frequency of occurrence of the different taxons give grounds for the distinction of two phases in this period: phase A (the older one), comprising samples 206, 200 and 196, and phase B (the younger one) represented by sample 192.

Phase A

In sample 206, among only 26 diatom species, our attention was drawn to the occurrence of only one *Cymbella affinis* valve (Pl. I fig. 6), while in the next two samples this very species, considered a epiphytic alkaliphilous, markedly predominates among taxons such as: *Fragilaria construens*, *F. brevistriata*, *Pinnularia microstauron*, *P. borealis*, *Amphora ovalis* var. *libyca*, *Navicula scutelloides*. The diatoms found in the three samples of this phase have survived — almost exclusively in the form of complete frustules, with epi- and hypovalves undivided. Apart from the frustules of fresh-water species, we also found here fragments of marine taxons, i. e. *Coscinodiscus* sp. 2, *Stephanopyxis* sp., *Melosira ornata* and *M. sulcata* (Table 1a—c [1]).

Publications on the subject contain no mention of one single *Cymbella* species having so high a per cent proportion. Since we lack data on diatoms from Late Glacial deposits of the Middle Polish Glaciation, we consider it relevant to report the occurrence of the genus *Cymbella* in the Late Glacial deposits of the Last Glaciation. As it is, species of this genus have been frequently found (Foged 1972; Marciniak 1973; Jousé 1974), sometimes in the proportion of several per cent (Alhonen 1970; Florin 1970; Kaczmarska 1973). However,

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[1] Table 1a—c is under the cover.

Miller (1971) is so far the only one to record their occurrence in greater abundance (*Cymbella aspera*, up to 14 per cent; *Cymbella* ssp., fragments up to 54 per cent) in the Eemian deposits of the Swedish Lake Leveäniemi, initiating the origin of the euterrestrial stage, and corresponding to pollen zone b (Robertson 1971). Also Foged (1960) records from the lowest deposit strata of Lake Hallerup in Denmark, larger, although only on an estimate, numbers of *Cymbella affinis*: as no pollen analysis is available for these deposits, one can hardly draw a comparison between the two.

Phase B

Diatoms occur here in somewhat greater numbers (200 specimens were determined), but they are in very poor condition. *Gyrosigma attenuatum* (32·5 per cent, Table 1), in most cases found in fragments comprising only the central nodule, at this phase attains its maximum values. We found in lesser quantities: *Fragilaria brevistriata* (11 per cent), *F. construens* (12·2 per cent), *F. lapponica* and *Melosira granulata* (5 per cent each), *Pinnularia viridis* (3 per cent), *Gyrosigma acuminatum* (2 per cent), *Diploneis ovalis* and *Navicula amphibola* (0·5 per cent each).

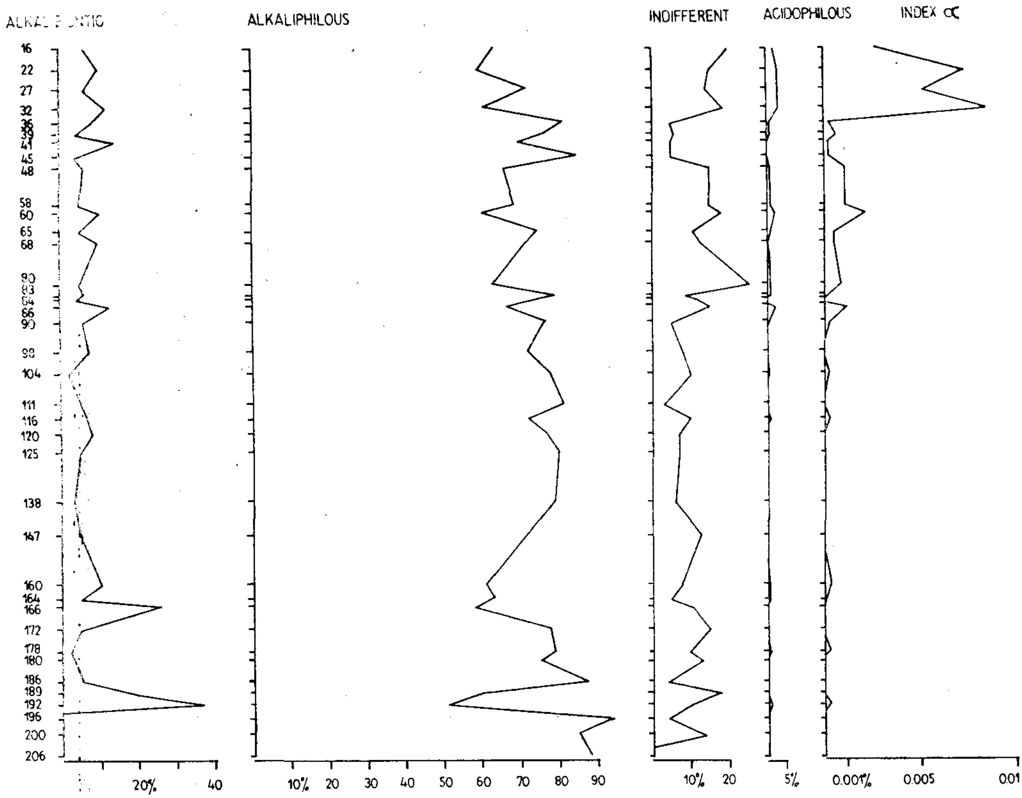
Kabailiene (1959, 1960) regards *Gyrosigma attenuatum* as typical of the Baltic Ice Lake (quoted after Marciniak 1973), while Round (1964) mentions it as characteristic of the Late Glacial of the Last Glaciation and of the early Holocene. Also Marciniak (1973) records the frequent occurrence of this species in the Late Glacial deposits of Lake Mikołajki, as well as of *Campylodiscus moricus* var. *hibernica*, which is also fairly often found in basal deposits of fresh-waters.

The alkaliphilous diatoms were most numerously recorded (51 per cent; Text-fig. 3), whereas the alkalibiontic here attain their maximum proportion (37 per cent; Text-fig. 3); on the other hand, the indifferent taxons do not exceed 10 per cent (Text-fig. 3).

The distribution of the recorded diatoms, resulting from their dependence on habitat requirements, is as follows: benthonic species — 39 per cent, littoral-planktonic species — 38 per cent (Text-fig. 4). In this phase marine taxons are more numerous and have a more varied composition than in the previous one (*Hemiaulus* sp., *Triceratium* sp., *Pyxilla* sp., *Plagiogramma* sp., *Actinoptychus* sp.; Table 1).

The large proportions of alkalibiontic and alkaliphilous species and the values of coefficient a (maximum value: 0·0002; Text-fig. 3), indicate that during the first period the shallow lake at Imbramowice had an alkaline water reaction. This fact may be associated with the activity of Late Glacial waters supplying the lake with mineral substances, rich in calcium.

The action of these waters does not account for the occurrence of marine diatoms in the deposit, which in all probability come from the contiguous Tertiary

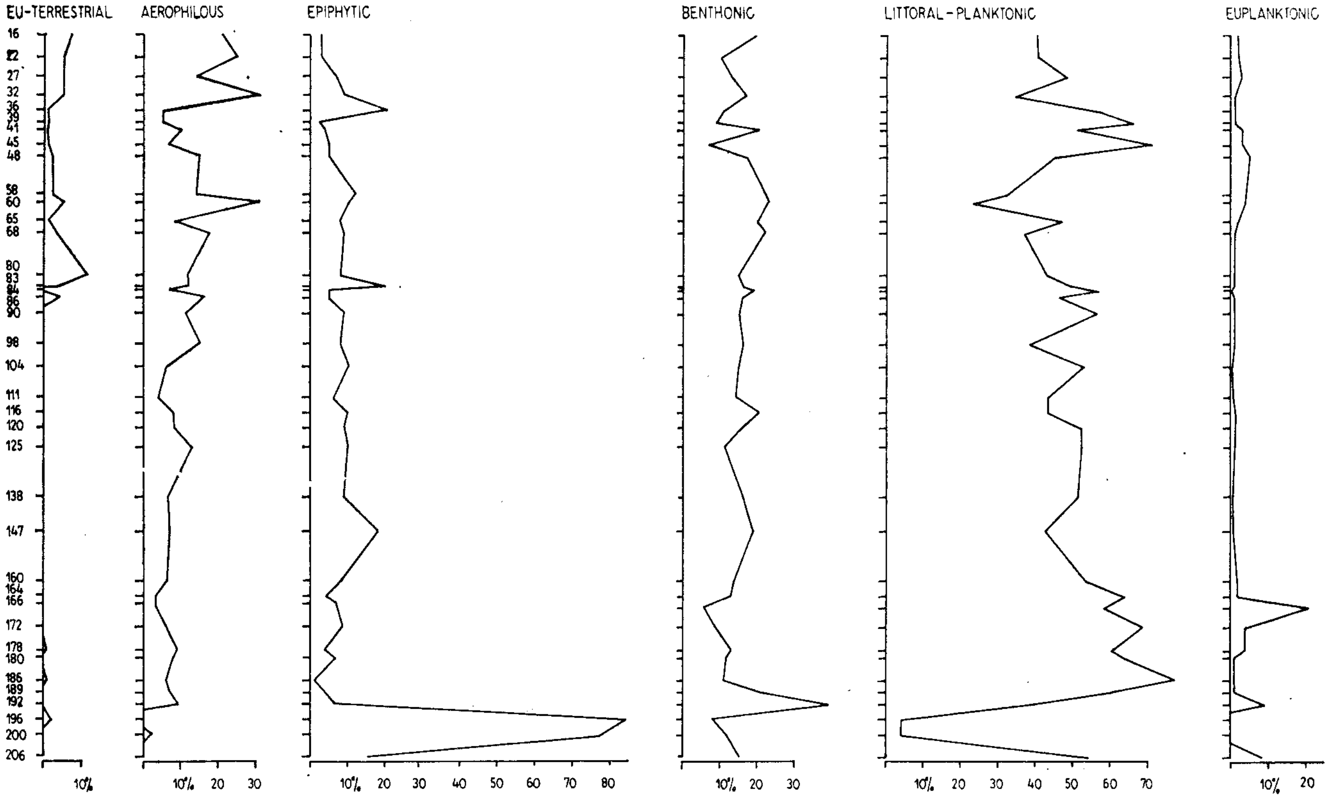


Text-fig. 3. Percent proportion of diatoms according to pH requirements and changes in the values of the Nygaard's α index

Ryc. 3. Udział procentowy okrzemek w zależności od ich stosunku do pH i zmiany wartości współczynnika Nygaarda (1956)

clays (Szczepankiewicz 1962). This assumption has been further confirmed by the occurrence — in the same samples — of redeposited Tertiary pollen grains (Mamakowa 1976). The poverty of flora composition and the quantitative proportion of diatoms in the samples of this period, is no doubt linked with the supply of a large amount of mineral material to the lake, and the ensuing high degree of dispersion of the diatom frustules in the deposit.

The occurrence of many *Chrysophyceae* cysts usually indicates colder climatic conditions. The high proportion of them in sample 206 (phase A, 473 per cent) and sample 192 (phase B, 264·5 per cent), is consistent with the Late Glacial origin of the sample. The decrease in the number of cysts in samples 200 and 196 (11·8 and 44·0 per cent, respectively), is perhaps connected with the increasing warmth of the climate though this, does not seem to be indicated by the examination of diatom flora in these samples; it may, however simply be due to the fact that they have been better preserved in the deposits than the fragile diatom frustules.



Text-fig. 4. Percent proportion of the diatoms according to their ecological demands
Ryc. 4. Udział procentowy okrzemek w zależności od ich wymagań ekologicznych

Period II

This period includes samples 189, 186, and 180. In the samples of this period we found many diatom taxons, occurring more abundantly. Their valves are only slightly destroyed. *Gyrosigma attenuatum* is less numerously represented than during the preceding period. In this part of the deposit taxons such as: *Campylodiscus noricus* var. *hibernica* (Pl. II fig. 7), *Fragilaria brevistriata* var. *linearis*, *Surirella biseriata* f. *punctata*, *Cyclotella comta* var. *oligactis*, *Navicula scutelloides* and N. *abiscoensis* attained their maximum values for whole profile.

A small number of species common to periods II and V were found: *Navicula disjuncta*, *N. jaernefeltii*, *N. anglica* var. *signata*, *N. rotunda*, *N. amphibola*, *N. scutelloides* and *Pinnularia borealis*. On the other hand, the distinctly cold-loving species, which occur in the period V, are here missing, these being *Navicula semen*, *N. ignota*, *N. pseudosilicula* and *Pinnularia lata* var. *costata*. Occasionnally we found species characteristic of period IV (climatic optimum), such as *Navicula seminuloides*, *N. pseudoventralis* and *Cymbella thumensis*. From this one may infer that during the second period the climate was colder than in periods III and IV, while warmer than in period V referred by Mamakowa (1976) to the end of interglacial, and in the glacial period VI. The whole period II is already of interglacial character. The result of palynological analysis induced Mamakowa (1976) to allot samples for this period to the end of late glacial (phase b) and to the first phase of interglacial (phase c).

The water reaction (pH) in the lake can be defined as definitely alkaline. Alkaliphilous taxons continue to be the most numerous (47—75 per cent), particularly a number of species of the genus *Fragilaria* and *Amphora ovalis* var. *pediculus* and var. *libyca*, as well as *Campylodiscus noricus* var. *hibernica*. The alkalibiontic species (*Gyrosigma attenuatum* and *G. acuminatum* Pl. I fig. 3) were found less frequently (18 per cent), which, coupled with the value of coefficient a lower than 0, points to a less alkaline reaction than during period I.

The abundant occurrence of littoral-planktonic diatoms, particularly of *Fragilaria* (36—63 per cent) and benthonic species (11—21 per cent, *Gyrosigma attenuatum*, *Campylodiscus noricus* var. *hibernica*, *Surirella biseriata* f. *punctata* and fairly numerous *Navicula* sp.), with a simultaneously low proportion of euplanktonic diatoms, — indicate that at that time the lake could not have been very deep. The poor development of euplanktonic diatoms is connected also — to some extent — with the still severe climatic conditions, favouring littoral and benthonic taxons (Fjerdingstadt 1954). The interglacial increase of warmth just beginning brought about only an enrichment of diatom flora in the lake. We continued to find well-preserved frustules of marine diatoms, referred to for the preceding period. On the other hand, the proportion of *Chrysophyceae* cysts (up to 13 per cent) is lower, but still fairly high in comparison with period IV (climatic optimum) which also bears witness to the relatively cold climate of this particular period.

Period III

This period includes samples 178, 172, 166, 164 and 160. The period is distinguished by the highest — for the whole profile — proportion of species belonging to the *Centricae* subdivision. There was a more abundant occurrence of diatoms — and they were in a better condition than during period II. Here the characteristic taxons are: *Stephanodiscus astraea* var. *minutulus*, *Cyclotella kützingiana* with varieties, *C. operculata* with varieties, *C. ocellata*, *Synedra acus* var. *radians*, reaching the numbers maximum for that time, and *Asterionella formosa*, recorded only infrequently in other periods (Table 1).

The differences in the fequency of occurrence of the species characteristic of that period, permit the determination of two phases in it, the older, A (samples: 178, 172, 166) and the younger, B (samples 164 and 160).

Phase A

Is distinguished by an increase of the proportion of *Stephanodiscus astraea* var. *minutulus* (up to 19·6 per cent), which needs a high pH and a large content of nutritive substances for its optimum development. Kozyrenko (1961) and Behre (1962) observed the maxima of this species in the Holocene deposits after the *Cyclotella* stage, which started the diatom succession in this lake.

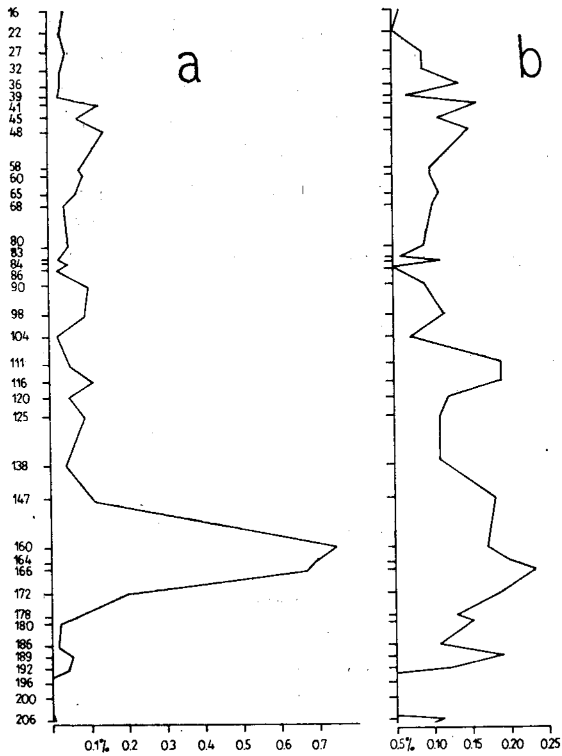
Phase B

The proportion of *Stephanodiscus astraea* var. *minutulus* decreases (down to 1·0 per cent), while there is a more numerous occurrence of species of the *Cyclotella* genus (up to 22·6 per cent), such as *Cyclotella kützingiana* with var. *radiosa* and var. *planetophora*, *C. operculata* with var. *unipunctata*, *C. comta*, *C. ocellata*, *C. bodanica*. No other phase of the discussed profile contained such a great profusion of diatom flora of the *Cyclotella* genus.

The water reaction probably continued to be alkaline, as testified to by the high proportion of alkaliphilous taxons (57—78 per cent), and in particular: *Fragilaria*, *Amphora ovalis* var. *libyca* and var. *pediculus*, *Achnanthes lanceolata* var. *rostrata*, *Cyclotella kützingiana* with var. *radiosa* and *C. ocellata*. Another proof is the proportion of alkalibiontic taxons (up to 26·2 per cent) and the still high values of coefficient a, although in most samples (178, 164, 160) it exceeds 0. The per cent of alkalibiontic species, after a temporary decrease in period II, is again higher here: the number of taxons is not large. Their high percent proportion during period I are due to *Gyrosigma attenuatum*, and during period III — to *Stephanodiscus astraea* var. *minutulus*.

It is characteristic of this period that the *Centricae* subdivision is represented by a great profusion of species, suddenly developing and as suddenly disappearing. This phenomenon manifested itself in the values of Foged's C:P coefficient

(Text-fig. 5a), attaining 0·74, while in the remaining periods its value only oscillates between 0·022 and 0·14. The high values of Foged's coefficient mark out the period in sharp opposition to the remaining ones. As a rule, the higher values of his coefficient occur in the case of large, deep lakes. Therefore its value 0·74, highest for the whole profile, indicates that at that time the water level in the lake was highest. However, it seems more proble that this level



Text-fig. 5a. Changes in the values of the Foged's C:P coefficient,
5b. Changes in the values of the Nygaard's C:P coefficient

Ryc. 5a. Zmiany wartości współczynnika C:P Fogeda,
5b. Wartości współczynnika C:P Nygaarda

did not rise as abruptly as might be inferred from the sudden increase in the values of this coefficient, but only slightly in comparison to period II. The development of planktonic diatoms (*Stephanodiscus astraea* var. *minutulus* and numerous species of the genus *Cyclotella*) might have been induced, above all, by the increasing warmth of the climate which permitted better use to be made of nutrative substances. The higher fertility in the lake might have produced favorable developmental conditions at phase A, before the *Cyclotella* stage, for *Stephanodiscus astraea* var. *minutulus*. The *Cyclotella* stage has been frequently observed in fossil and contemporary lakes. Numerous species of this genus were recorded in the fossil deposits of lakes, usually before the *Stephanodiscus* stage, as an initial phase (Hustedt 1954; Kozyrenko 1961; Jousé 1974), which was followed the occurrence of *Stephanodiscus* and *Melosira*, as a result of the increasing warmth of the climate (Kozyrenko 1961; Behre 1962; Jousé 1974), i. e. the reverse of the case in the lake Imbramowice deposit.

Nygaard's C : P coefficient (Text-fig. 5b) also reaches its maximum values during that period. It does not increase and decrease so suddenly as was the case with Foged's index, oscillating between 0·05 and 0·23. This seems to indicate a lake with mesotrophic conditions, with a tendency to a gradual decrease in the nutritive value of the water, which is clearly evident throughout the profile. The impoverishment of water accompanying the development of the lake was observed at Kentmere in the Lake District, England (Round 1975).

Marine diatoms have been sporadically found only in sample 172. Their gradual disappearence during that period should probably be attributed to increased closing in of the woods surrounding the lake (phases c and d according to Mamakowa 1976), which rendered the washing out of the substratum more difficult.

The decrease in the number of the cysts *Chrysophyceae* (6·0—1·6 per cent) is also an indicator of the increasing warmth of the climate.

Period IV

This period includes the samples: 147, 138, 125, 120, 116, 111, 104, 98, 90, referred by Mamakowa (1976) to the climatic optimum (zone f). This was the period when diatoms were most diversified and abundant, and preserved in a very good condition. A change in the qualitative and quantitative composition was observed. The characteristic taxons are the numerous representatives of genus *Navicula* (*N. bronislaae*, *N. cincta*, *N. confervacea*, *N. graciloides*, *N. menisculus*, *N. pseudotuscula*, *N. pseudoventralis*, *N. seminuloides*, *N. schönfeldii*, *N. starmachii*, *N. vitabunda*), of the genus *Achnanthes* (*A. microcephala*, *A. exigua* var. *heterovalvata*, *A. conspicua*, *A. minutissima* var. *cryptocephala*, *A. linearis*, *A. clevei* var. *rostrata*) and *Cocconeis thumensis*, *Cymbella microcephala*, *C. thumensis*, *Diploneis oculata*, *Synedra parasitica* and others.

Navicula seminuloides (Pl. II fig. 8) has not so far been recorded in Europe, while it is nowadays fairly frequent in Asia and Africa (Cholnoky 1954, 1964, 1966; Carter 1966; Iltis 1972). It has also been cited as occurring in the contemporary (Hohn, Hellerman 1962) as well as in the fossil flora (Florin 1970) of North America.

Navicula confervacea (Pl. II fig. 9) is according to Hustedt (1966) a tropical form, brought to Europe along with tropical water plants to the botanical gardens from which it has spread over this continent. The fact that this species has been found at Imbramowice seems to indicate that in European flora of today this is a relict from the warmer phases of the climate.

As to the diversity and abundance of occurrence, the alkaliphilous species continue to predominate (82—90 per cent), mostly those of the genuses *Fragilaria* and *Navicula*, as well as *Achnanthes lanceolata* var. *rostrata* and var. *elliptica*, *Amphora ovalis* with its varieties and *Cyclotella kützingiana* var. *radiosa*. There is a decrease in the number of specimens (8—2 per cent) of the alkalibiontic species (*Navicula graciloides*, *Cocconeis thumensis*). This proves that the water reaction continues to be alkaline.

A slight increase — up to 10 per cent — in the proportion of oligohalobous halophilous species (*Navicula cincta*, *Anomoeoneis sphaerophora*) so far represented in small numbers only is observed. Here they attain their not very high maximum occurrence. The optimum had probably brought a slight increase of salt concentration in water, due to the lake gradually growing shallower. This process can be inferred, moreover, from an almost total absence of euplanktonic diatoms (0·2—1 per cent), with a simultaneous abundant growth of littoral-planktonic (40—60 per cent — mostly *Fragilaria*), benthonic (up to 20 per cent) and epiphytic (up to 15 per cent) species (*Achnanthes clevei* var. *rostrata*, *A. conspicua*, *A. lanceolata* with varieties, *Amphora ovalis*, *Cymbella diluviana*, *Diploneis oculata*, *Navicula cincta*, *N. graciloides*, *N. vitabunda*). It should be stated, however, that in all likelihood this process was not so abrupt as might be inferred from the decrease in the numbers of euplanktonic diatom specimens. In this period Dr K. Mamakowa (oral information) records an abundant growth of submerged water vegetation, and particularly of the species belonging to genus *Najas*. This might have induced a restriction of the free-water zone and a deterioration of the conditions for the development of euplankton in the lake.

This period shows no trace of sea diatoms, while the *Chrysophyceae* cysts have been found to occur very seldom as compared with other periods (0·2—2 per cent).

The occurrence of taxons with greater thermal requirements, nowadays unrecorded on the examined area, such as *Navicula confervacea* and *N. seminuloides*, seems to suggest that climatic conditions might have been more favourable at the Eemian Interglacial optimum than they are now. This has been corroborated by Jousé (1974). It ought to be recorded, too, that both species are not so far known from the Holocene Atlantic period in Europe.

Period V

This period includes the samples: 86, 84, 83, 80, 68, 65, 60, 58, 48, 45, 41, 39 and 36. Mamakowa (1976) has included them in the late interglacial. Diatoms are less abundant in number and are frequently in bad condition. Period V is distinctly divided the preceding one by the total disappearance or a considerable reduction in the number of specimens and species characteristic of the climatic optimum. New, formerly unrecorded species, appear: alpine, boreal and even arctic, such as *Navicula pseudosilicula*, *N. semen* (Pl. II fig. 11), *Pinnularia lata* var. *costata* (Pl. II fig. 3), *P. nodosa* (Pl. I fig. 1). We found also some species common to periods I and II, viz.: *Navicula scutelloides*, *N. mutica*, *N. amphibola* (Pl. II fig. 10), *Caloneis amphisbaena*, *Pinnularia borealis* (Pl. II fig. 4).

The differences in the per cent proportion of the respective taxons and ecological grups permit the determination of three consecutive phase: A, B and C. This in also so in the case of pollen analysis.

Phase A

Includes samples: 86, 84, 83, 80, 68, 65 and 60. The characteristic taxons are as follows: *Hantzschia amphioxys* and var. *maior*, *Navicula mutica*, *N. dicephala*, *N. radiosa*, *Gomphonema angustatum* var. *productum*, *G. intricatum* var. *pumillum*, *Pinnularia borealis*, *Cocconeis placentula* var. cf. *lineata*, *Stauroneis anceps*, which here attain their maximum per cent, also, as in periods I and II, the more numerous species: *Gyrosigma attenuatum*, *Cymbella affinis* and *Fragilaria brevistriata* var. *linearis*.

The beginning of period V is marked by the appearance of euterrestrial species (*Hantzschia amphioxys*, *Navicula mutica*, *N. neoventricosa*, *Pinnularia borealis*), which in this phase reach their maximum of frequency of occurrence (11·2 per cent). There is also an increase in the frequency of occurrence of aerophilous species (up to 31·2 per cent), while the per cent proportion of littoral-planktonic diatoms slightly decreases (*Fragilaria* and *Cyclotella*).

There is an increasing frequency (up to 1·8 per cent) of acidophilous species, which in the lower part of the profile were only found occasionally. From sample 90 on (in period IV) they constitute a constant element of diatom flora (*Eunotia praerupta* with varieties, *E. pectinalis* var. *minor*, *E. veneris*, *E. sudetica*, *Pinnularia subcapitata*, *P. viridis* var. *minor*). Simultaneously there is a growth in the number and frequency of indifferent diatoms, which reach their developmental optimum at water pH about 7, while the per cent of alkaliphilous species decreases. The index *a* also rises; from sample 90 on, it is constantly above 0.

There is a different diatom composition in sample 84, coming from the part bordering upon a stratum of well watered sand (6·20 m) which it was not possible to sample during boring. Sample 84 does not reveal the occurrence of euterrestrial, acidophilous and arctic species characteristic of this period which had been encountered in the upper border stratum of this sand. The diatom spectrum of sample 84 recalls rather the previous period. Perhaps the process of climatic cooling (increasing frequency of some species characteristic of period IV, *Navicula seminuloides*, *Cocconeis thumensis*) and of the overgrowing of the lake had been slowed down at this point. This suggestion, however, should be treated with great caution, and only a thorough investigation of the sand stratum can resolve these doubts.

Phase B

Includes samples 58 and 48. Its characteristic features are: a marked decrease in the proportion of the above listed taxons, and an increase in the frequency of *Pinnularia viridis* var. cf. *leptogongyla* and *Gyrosigma acuminatum* var. *gallicum*. The per cent of *Cyclotella operculata* and of var. *unipunctata* increase again.

This phase differs from the previous one by a smaller per cent of euterrestrial (1·8—2·2 per cent) and aerophilous (14 per cent) diatoms, while the number and frequency of planktonic species slightly increases (up to 6 per cent).

Phase C

Includes the samples 45, 41, 39 and 36. It is distinguished by a renewed — after period II and phase A — growth of the proportion of *Gyrosigma attenuatum*, *G. acuminatum*, *Fragilaria brevistriata* var. *linearis*, *F. pinnata*, *F. construens* var. *binodis*, *Cyclotella kützingiana* and *C. ocellata*. The alkaliphilous species continue to prevail (up to 92 per cent), particularly *Fragilaria* and *Amphora ovalis* var. *libyca*. There is a slight increase in the frequency of alkalibiontic diatoms (14 per cent), especially of *Gyrosigma attenuatum*, *G. acuminatum*, *Cymbella ehrenbergii* and of the *Epithemia* species, while the proportion of acidophilous and indifferent species decreases. In this phase the index α has its minimum value (0·0001) for period V. We also observed a decreasing frequency of euplanktonic species with a simultaneous growth in the proportion of the littoral-planktonic (71 per cent) and epiphytic (up to 20 per cent) species.

The marked differences recorded for period V in diatom flora are no doubt a result of climatic change as well as of the physico-chemical features of the water in the lake. The irregular frequency of occurrence of the species and of ecological groups characteristic of this period seems to indicate that this was not a period of a slow, gradual order of succession. This makes it difficult to give an authoritative picture of the ecological conditions in the lake.

The appearance of acidophilous diatoms, the growth of coefficient α to values constantly greater than 0, as well as, the increasing frequency of indifferent species, point to increasing changes in water reaction towards one more neutral. This process is probably connected with the spread of fir and pine forests and with the souring of soil common at the end of interglacial. Particles of soil penetrated to the lake, brought by the then abundant supply of surface water. An argument in support to this view is the reappearance of marine diatoms, washed out of the Tertiary sediments. The lowering of water pH favoured the development of acidophilous species. The neutralization of water was not a steady process, as shown by the oscillations in the proportion of the respective groups of diatoms. Acidophilous species reach their not very high maximum in samples 66 and 60, i. e., at the beginning and at the end of phase A, than they are somewhat less frequent in phase B, which is followed by a further decrease in phase C, down to values very much like those recorded for period IV. The per cent of the alkaliphilous species decrease from sample 90 down to 60; then up to sample 36 they increase attaining their maximum values (81·6 per cent), i. e. greater than in period IV. The changes in the value of index α follow a similar course. The oscillations in the water pH may be briefly presented as follows. After a distinct lowering of pH at the beginning and the end of phase A, it increases constantly (with some oscillations) during phases B and C. There is a growth in the occurrence of alkalibiontic species, which had been constantly encounted during period IV, but in small quantities only. During period IV water reaction was certainly more alkaline than it was during period V, yet the alkalibiontic diatoms constitute a less numerous group. It seems that their more abundant growth (*Epithemia*, *Cymbella*, *Gyrosigma*) may have been induced by the appearance of new shallow and possibly in part mossy habitats on the shore of the lake. The above listed diatoms in habitats of similar type were cited by Beger (1927), Krasske (1933), and Florin (1970). The lowering of the water level and reaction produced sites favourable to the development of mossy communities suitable for the growth aerophilous diatoms. Since the very beginning of the lake's history they had constituted an ever present group, though small as to the number of taxons and specimens, which reached its maximum occurrence during period V. The appearance of euterrestrial species is another argument in support of the view that the lake gradual became overgrown. Both the water reaction and its level probably oscillated during period V. The above mentioned overgrowing of the lake had probably been somewhat checked in phase B, when there was a slightly increased reappearance of euplanktonic species, which are as scarce in the remaining phases as they were at the climatic optimum. The littoral-planktonic species follow quite the opposite line of development. These data indicate that the lake had become shallower during phase A; it is possible, too, that its area decreased assuming the form of separate bodies of water. This situation may have lasted throughout the phase A. The intensified water action induced by wetter climate (Mamakowa 1976) resulted in an increase of the water level, putting a check to the development of euterrestrial and aerophilous diatoms, while favouring the growth of littoral-planktonic and even of euplanktonic species. In phase A, the lake is comparable to the prelimnic stage recorded at Kirchner Marsh (Florin 1970).

The appearance of euplanktonic species may be also the outcome of a slight increase in the warmth of the climate during phase B. The results of pollen analysis (Mamakowa 1976) clearly indicate a warmer deviation within phase h (h_2, samples 68—70 to 49), which as far as diatom flora is concerned. manifests itself indistinctly only in samples 58 and 48.

During period V one observes a marked effect exerted by the cold climatic conditions upon diatom flora composition. The cold-loving species appeared almost simultaneously with a decline — in the pollen diagram — of a curves representing the thermophilous trees and shrubs (*Quercus*, *Fraxinus*, *Tilia* and

Corylus) and with the spread of hornbean, pine, and the herbaceous plants. One should note, too, the sporadic appearance, during period V, of arctic diatoms, which in their present-day sites occur also in the form of singly specimes (Hustedt 1948).

The approaching cooling of the climate was preceded by a slight change in the physico-chemical characteristics of the water in the lake. This has already become evident in sample 90 of period IV, in the increased number of indifferent taxons and the appearance of acidophilous ones: their occurrence, in Hustedt's opinion (1948) forecasts the approaching cool.

The differences in the per cent of the cysts of *Chrysophyceae* divide period V into three phases much more distinctly than the differences in diatom occurrence. The first phase (samples : 86, 84, 83, 80, 68) and the third (samples : 41, 39, 36) contain a large number of cysts (up to 20·4 and 40·4 per cent respectively), which should be attributed to the colder climatic conditions. In the second phase (samples: 65, 60, 58, 48, 45), the number of cysts is much smaller (6 per cent) which was probably due to the warmer climate. Nevertheless, it should be added that the diatom phases do not correspond to the limits set by the frequency of cysts.

Period VI

Includes samples: 32, 27, 22, 16 referred by Mamakowa (1976) to the beginning of the Last Glaciation. Here, diatom flora clearly recalls phase A of period V, with yet more pronounced changes in its composition. The frustules are in a much worse condition than during the preceding periods (except sample 192). The large-value species (*Pinnularia viridis* with var. *comutata* and var. *maior*, *Navicula oblonga*, *Gyrosigma* ssp. (Pl. I figs. 2, 3; Pl. II figs. 2), *Cymbella ehrenbergii*) are found most frequently as a fragments, which despite being damaged were identifiable in many cases. The number of valve fragments which could not be definitely determined, was at the most 9·6 per cent.

During that period, nearly all the species characteristic of period IV (climatic optimum) but not so frequent during period V, either disappear altogether or are encountered very infrequently. There is a renewed increase of the per cent of *Eunotia praerupta* var. *bidens*, *Navicula amphibola*, *Cymbella aspera*, *C. cistula*, *Pinnularia viridis* and var. *comutata*, *P. borealis*, and *Caloneis silicula*. There is a more abundant occurrence of boreal and arctic diatoms: *Navicula ignota*, *N. jaernefeldii*, *N. semen*, *N. amphibola*, *Pinnularia lata* var. *costata*, *P. lagerstedtii* and *P. borealis*. The processes which took place in phases B and C of period V, still connected with the climatic optimum, were definitely checked here. The growing neutralization of the lake's water manifests itself in the high proportion of acidophilous diatoms, (highest for the profile, up to 3·4 per cent) and by the increased proportion of indifferent species (up to 20 per cent). There is also an increase of the index a (to 0·008), which in all the fifth-period samples was lower than 0·001, while in the remaining periods in most cases it was lower than 0. The occurrence of acidophilous species, usually characteristic of oligotrophic lakes, also seems to point to the gradual impoverishment of the lake's water in nutritive substances. This process becomes more evident when one compares the values of Nagaard's C:P index for the periods I, II, III and IV with those for the periods V and VI (Text-fig. 7).

Here, too, one can observe a renewed increase of euterrestrial diatoms (5—6 per cent), lower than in phase A, but higher than in phases B and C, as well as of the aerophilous diatoms (14—31 per cent), with a simultaneous decrease in the diversity of littoral-planktonic (34—47 per cent) and euplanktonic species (up to 1·2 per cent); this, too, should probably be attributed to progressive cooling of the climate. These changes indicate that the lake must again have become shallower or that its area had diminished. The increased occurrence of acidophilous and aerophilous diatoms suggests the presence of habitats dominated by mosses, in all probability occupied during the previous periods by the lake.

The cysts of *Chrysophyceae* were recorded for this period more frequently (to 40 per cent) as compared to the preceding ones, which again seems to point to a distinct cooling of the climate.

The increased proportion of boreal and arctic diatoms as well as of the cysts of *Chrysophyceae* justifies referring this period to the beginning of Last Glaciation, consistently with the results of palynological analysis.

DISCUSSION OF RESULTS

Diatom analysis has revealed the following climatic differences within the examined profile, in order of succession of the singled-out periods: cold (period I), warm (II and III), warmer (IV) cool (V) and cold (VI). Such a sequence is characteristic of the interglacial periods. The first cold period has been referred to the end of the Late Glacial of Middle Polish Glaciation. In determining this period, it has been taken into consideration that it was generally poor in diatom flora and that the thermophilous taxons, numerous during the climatic optimum, but sporadic in almost every interglacial period, were absent. The lower boundary line of the interglacial is designated by a stratum in which diatom flora is enriched and there is a consistent appearance of thermophilous species, i. e. at the beginning of period II. Compared to the Late Glacial of the Last Glaciation (Fjerdingstadt 1954; Round 1957, 1961; Alhonen 1968; Evans 1970; Diegerfeldt 1972; Pennington *et al.* 1972; Marciniak 1973; Jousé 1974) it is stricking to note the scarcity of diatom taxons and specimens. The beginning of the Last Glaciation has been inferred from the following data: an increased per cent proportion of boreal and arctic species, a higher degree of neutralization of the lake water which manifested itself in the increased proportion of the acidophilous species, and an almost total disappearance of species characteristic of the climatic optimum.

The border lines between the periods set down by diatom analysis in most cases are consistent with those established by Mamakowa (1976) as a result of palynological analysis. The differences consist in a smaller number of the diatom periods determined, in locating the lower interglacial border at an earlier time within the diatom profile, and in a less pronounced tri-partite character of period V (pollen zone h). These differences, however, are not significant in the whole picture of the changes occurring in diatom flora under the effect of the oscillating climate.

The diatom analysis penetrated deeper into the deposit than the palynological research. There are no palynological data for samples 206 and 200 (phase I A); in the latter, among the rarely encountered diatoms, the prevailing species was *Cymbella affinis* (without any trace of devastation). It cannot be excluded that the proportion of *Cymbella affinis* was due to a warmer oscillation of the climate, which is further corroborated by the relatively small per cent of the cysts of *Chrysophyceae*.

During period I the lake had a strongly alkaline water reaction, it was shallower in phase A than in phase B, with a greater inflow of surface waters during that second phase. Period II brought greater profusion of diatom flora, mostly of the littoral-planktonic and benthonic species (*Gyrosigma*, *Campylodiscus*, *Surirella*, *Fragilaria*). Thermophilous species began to appear, as well as those common with period V, i. e., the late interglacial. Water reaction continued to be alkaline. Period III brought a further increase in the warmth of the climate and an abundant growth of planktonic flora — the stage of *Stephanodiscus* (III A), and after it, the stage of *Cyclotella* (III B). There was probably a slight rise of the water level in the lake, while the development of planktonic species may have been the result of an increased fertility of water. During the climatic optimum (period IV) the lake was populated by a flora typical of the well heated, alkaline and eutrophic lakes. The last stage of the interglacial development of the lake (period V) was diversified and can be divided into three phases. The first was distinguished by the appearance of cold-loving diatoms (boreal and arctic) and the constant occurrence of the acidophilous species, which shows that the climate had cooled, and the water in the lake had become neutralized and impoverished in nutritive substances. There was also a growth in the proportion of euterrestrial and aerophilous species as a result of lake becoming overgrown. The second phase brought a slight growth of the number of euplanktonic and alkaliphilous diatoms, probably as a result of a transitory increase in the warmth of the climate, with a simultaneous decrease in the proportion of acidophilous and euterrestrial diatoms. The transitory increase in warmth during that phase seems also to be indicated by the frequency of occurrence of the cysts of *Chrysophyceae*. This process came to a definite end during period VI, when the changes begun in phase A of period V became still more evident.

The frequency of cysts in the profile sometimes makes it possible to establish the existence of periods of colder climate more distinctly than does diatom analysis.

From the relation of pure diatom material obtained from the sample, to the amount of deposit taken for the purposes of research, it results that diatoms occur in greater numbers during periods II and III, and most abundantly in samples which represent the climatic optimum. During period V their frequency markedly decreases, especially in samples 84 and 83. We reckoned only 300 valves in the former, and 500 in the latter. In the other samples for periods V and VI diatoms appeared in fairly large numbers but in a very bad condition.

Compared the obtained results with the list of 20 taxons cited for the Imbramowice deposit by Hartmann (1907); some of them were not found at all: *Navicula maior* (= *Pinnularia maior*), *Amphora lineolata*, *Diatoma vulgare*. In the latter case we encountered only *Diatoma vulgare* var. *ehrenbergii*. The other species cited by Hartmann are as follows: *Cyclotella kützingiana*, *C. meneghiniana*, *Cystopleura turgida* (= *Epithemia turgida*), *Cymatopleura elliptica*, *Cocconeis placentula*, *Cymbella ehrenbergii*, *Fragilaria mutabilis* (= *F. pinnata*), *F. capucina*, *Eunotia gracilis*, *Navicula cuspidata*, *N. acuta* (= *Stauroneis acuta*), *N. viridis* (= *Pinnularia viridis*), *N. mesolepta* (*Pinnularia mesolepta*), *Pleurosigma attenuatum* (= *Gyrosigma attenuatum*), *P. acuminatum* (= *G. acuminatum*), *Stauroneis anceps* and *Synedra capitata*. These species were constantly encountered almost in every sample examined, and therefore can hardly correlate the strata set down by Hartmann (6 and 7a) with the periods determined in the present paper.

A much more abundant diatom flora (86 species, quoted after Torka by Namysłowski 1921) was recorded for the Eemian lake at Szeląg near Poznań. This deposit which was dated by pollen analysis (Szafer, Trela 1928; Środoń 1956), probably does not comprise the climatic optimum as a whole, but only in its late stage. Of the species cited by Torka, we failed to find twelve: *Pinnularia maior*, *Gomphonema mustella*, *Gomphonema subtile*, *Cymbella lanceolata*, *Eunotia pectinalis*, *E. maior*, *Nitzschia sigmoidea*, *N. linearis*, *Surirella splendida*, *S. elegans*, *S. angustata* and *Campylodiscus noricus*. Namysłowski (1921) defines the Szeląg flora as a benthonic and freshwater, typical of stagnant or slow-flowing water, with widespread species. Unfortunately we lack the data for the frequency of occurrence of these species at Szeląg. On the other hand, however, even a list of them reveals some marked resemblances between the two flora compositions. Considering that the Szeląg deposit dates from the second half of the interglacial, the most relevant factor is the occurrence of taxons characteristic of the colder periods at Imbramowice: *Melosira varians*, *M. arenaria*, *Odontidium harissonii* (= *Fragilaria leptostauron*), *Meridion circulare*, *Pinnularia nobilis*, *P. comutata*, *Navicula americana*, *N. scutelloides*, *Stauroneis smithii*, *Hantzschia amphioxys*. On the other hand, the distinctly cold-loving species, which at Imbramowice appeared as early as in period V (late interglacial) and VI (early Last Glaciation), are absent in the Szeląg deposit. Thus, drawing a comparison with Imbramowice, the Szeląg flora can be placed after the climatic optimum, but before the beginning of Last Glaciation.

Eemian freshwater deposits have been recorded for Europe at a great many sites, but only a few of them have been so far studied by diatom analysis. Most of the described diatom profiles have been derived from large, deep fossil lakes (Jousé 1939; Hustedt 1954; Foged 1960; Behre 1962; Sokolova *at al.* 1970). The deposits of this type of lake cannot be said to be a convenient object for palaeoclimatological and palaeolimnological investigations because of of their deep watei, a site where the life conditions change at a slow rate, reacting only slightly, if at all, to the minor changes in the climate, and thus not reflecting the physico-chemical changes in the water. There sometimes occur long periods in this type of lake when diatom flora retains the same composition, without any visible change. The situation is quite different in shallow lakes, often eutrophic with large sediment accretions, sometimes extending over surprisingly long periods. It is to be regretted that the number of publications on diatom flora in this type of lake is small (Krasske 1933; Jousé 1936; Miller 1970).

The profile of deposits in the Swedish lake Leveäniemi (Miller 1970) contains only some parts of Eemian Interglacial (pollen zones: a, b, c, d, e and doubtful rudiments of f, Robertson 1970). The initial stages of this lake's history (diatom periods: 1, 2, 3, 4 and 5) were correlated by Miller (1970) with the pollen zones a and b, corresponding to the Late Glacial of Middle Polish Glaciation. For these periods the same author describes a flora rather poor in taxons (27), but not in specimens, citing among the species also the thermophilous: *Navicula oblonga*, *N. cuspidata*, *Cymbella ehrenbergii*. The first of these attains very large per cent (up to 80). In zone b the water level in Leveäniemi also rises to become lower again in the first interglacial period (6, euterrestrial stage) and then again to rise. At Imbramowice no oscilation in the water level of this kind has been observed. Moreover, unlike the strongly alkaline lake Imbramowice, that at Leveäniemi towards the end of the Late Glacial of Middle Polish Glaciation proves to have been for a time acid in character.

Lake Imbramowice during the initial stages of its history had probably attained its highest water level, as was so in the profile from the Dannish lake Hallerup (Foged 1962). The situation is very much the same in the deposits of Polometi River (the north-western part of the European part of the USSR, Jousé 1936), where *Cyclotella* and *Melosira* are most numerous in the lowest strata of interglacial deposits. The first interglacial periods contain such cold-loving species as: *Diatoma hiemale*, *Meridion circulare*, *Achnanthes clevei*, *Eucocconeis flexella* (= *Achnanthes flexella*), *Navicula pseudoscutiformis*, *Pinnularia borealis*, *P. divergentes*, *P. sublinearis* and others. Some of them were found to occur at Imbramowice also at the beginning of the interglacial. Jousé (1936) cites the following species as being characteristic of the warm period of interglacial, which moreover denote an eutrophic and well heated lake: *Navicula oblonga*, *N. cuspidata*, *N. gastrum* var. *ambigua*, *Stauroneis acuta*, *Anomoeoneis sphaerophora*, *Gyrosigma attenuatum*, *G. acuminatum*, *Cymbella ehrenbergii*, *C. affinis*, *Synedra capitata*, *Achnanthes lanceolata*, *Amphora ovalis*, *Cymatopleura ellipitica*, *C. solea*, *Epithemia turgida* with var. *granulata*, and others. Al these species were found at Imbramowice.

Krasske (1933) cites the following diatoms from Oderberg-Bralitz, as characteristic of his material, and occurring also in the Polometi deposits: *Navicula schönfeldii*, *N. diluviana* (= *Cymbella diluviana*) and *Cymbella parvula* (= *C. thumensis*) (quoted after Jousé 1936). This is how Krasske (l. c.) characterized this lake: not deep, eutrophic with a well developed littoral zone, rich in calcium while poor in humus substances, i. e., of a character similar to Polometi and Imbramowice. It should be borne in mind, however, that both lakes lie further north than Imbramowice. Besides the previously enumerated taxons as characteristic of the warm phases of Eemian shallow-water lake, Jousé (1974) cites the *Fragilaria construens* var. *binodis*, *Navicula tuscula*, and *Stauroneis schulzii*, not encountered at Imbramowice, while the remaining two species have been recorded for this lake. It is interesting to note that most of the enumerated taxons are not most numerous in the climatic optimum. They are much more abundant before and after the climatic optimum, during somewhat colder periods. At the same time this lake has revealed two species with very high thermal requirements, so far unrecorded for the interglacial habitats of this age in Europe and the European part of the USSR, namely *Navicula seminuloides* and *N. confervacea*.

A comparison between diatom flora from Imbramowice and the floras of West European Eemian profiles (Hustedt 1954; Foged 1960; Behre 1962) must take into account that these were usually large, deep lakes — at least, at the beginning of their history — with a well developed palagic zone.

The monospecific genuses: *Gomphocymbella ancyli* and *Cymbellanitzschia diluviana*, typical of the deposits in these terrains (Jousé 1974) have not been found to occur at Imbramowice.

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STRESZCZENIE

ANALIZA OKRZEMKOWA EEMSKIEGO PROFILU OSADÓW SŁODKOWODNYCH Z IMBRAMOWIC KOŁO WROCŁAWIA

Na znanym od dawna stanowisku utworów interglacjalnych w Imbramowicach (Gürich 1905; Hartmann 1907; Kräusel 1920) zostało wykonane staraniem prof. dr S. Szczepankiewicza z Wrocławia, specjalne wiercenie badawcze (ryc. 1). W uzyskanym profilu osadów o miąższości 22 m, na podstawie badań paleobotanicznych, Mamakowa (1976) wyróżniła pełną serię osadów jeziornych z interglacjału eemskiego. zawartą pomiędzy utworami ze schyłku zlodowacenia środkowopolskiego (Saalian) i wczesnego glacjału ostatniego zlodowacenia (Vistulian). Próby do analizy okrzemkowej — w liczbie 38 — pochodzą z poziomów charakterystycznych dla poszczególnych faz klimatycznych i ich stref przejściowych, wyróżnionych w diagramie pyłkowym.

Materiał okrzemkowy okazał się bardzo bogaty. Oznaczono 439 taksonów, a wśród nich szereg rzadko znajdowanych takich jak: *Achnanthes lapponica* var. *ninckei*, *Amphora fonticola*, *Navicula abiscoensis*, *N. confervacea*, *N. subocculata*, *N. seminuloides*, *Pinnularia lagerstedtii* i inne. W osobnej publikacji (Kaczmarka 1976) opisano nowe taksony: *Fragilaria lapponica* var. *marciniakae*, *F. imbramoviciana*, *Navicula bronislaae*, *N. starmachii*. Pełną listę taksonów i ich udziały procentowe zawiera tabela 1. Zamieszczono tam również udziały procentowe cyst *Chrysophyceae* i gatunki redepodowanych okrzemek morskich. Kompletna dokumentacja florystyczna i ilustracyjna ukażą się w oddzielnej publikacji.

W pracy uwzględnione są przede wszystkim te taksony i ich kompleksy, którym przypisuje się znaczenie wskaźników ekologicznych. Pozwoliły one na rekonstrukcję zmian, jakie zachodziły w jeziorze kopalnym pod wpływem oscylującego klimatu. W ocenie warunków klimatycznych oparto się na obecności gatunków ciepłolubnych, borealnych i arktycznych. Natomiast zmiany w samym jeziorze odtworzono na podstawie procentowego udziału taksonów i ich współczesnych wymagań ekologicznych oraz przy pomocy współczynników α i C:P Nygaarda (1949, 1956) jak również współczynnika C:P Fogeda (1954, 1962, 1970). Uzyskane wyniki oddają przebieg zmian pH wody oraz wahania jej poziomu w jeziorze.

Jakościowe i ilościowe zmiany we florze okrzemek pozwoliły na wydzielenie 6 okresów (z kilkoma fazami) rozwoju jeziora kopalnego (ryc. 2), pokrywających się w większości przypadków z wynikami badań palinologicznych.

Okres I

Osady tego okresu powstały — zdaniem Mamakowej (1976) — u schyłku późnego glacjału zlodowacenia środkowopolskiego. Wydzielono dwie fazy — starszą A (próby: 206, 200, 196) z dużym udziałem procentowym *Cymbella affinis* (tablica I fig. 6) i młodszą B (próba 192) z przeważającą *Gyrosigma attenuatum* (tablica I fig. 2). Udziały procentowe gatunków alkalibiontycznych i alkalifilnych (ryc. 3) i współczynnika α (ryc. 3) dowodzą, że w okresie tym jezioro posiadało wyraźnie alkaliczny odczyn wody. Odczyn ten pozostawał prawdopodobnie w związku z napływem do jeziora wód późnoglacjalnych, zawierających wypłukane z gleb glacjalnych alkaliczne substancje mineralne. Z działalnością tych wód wiąże się również obecność okrzemek morskich i redeponowanych ziarn pyłku (Mamakowa 1976), pochodzących z sąsiadujących iłów trzeciorzędowych (Szczepankiewicz 1962). Ubóstwo jakościowe i ilościowe okrzemek jest prawdopodobnie związane z dużą akumulacją allochtonicznego materiału mineralnego i tym samym znacznym rozproszeniem okrzemek w osadzie.

Okres II

Okres ten, dość bogaty w taksony, ma już charakter interglacjalny. Zjawiają się okrzemki ciepłolubne, natomiast zimnolubne licznie znajdowane w schyłkowym okresie V spotykano tu tylko w pojedynczych okazach. Klimat okresu II był prawdopodobnie cieplejszy niż w okresie V. Odczyn wody w jeziorze był nadal wyraźnie alkaliczny. Obficie występujące okrzemki litoralno-planktonowe i denne wskazują na jezioro płytkowodne (ryc. 4).

Pierwsze stadium ocieplenia interglacjalnego spowodowało przede wszystkim ogólne wzbogacenie flory okrzemek. Znajdowano nadal redeponowane okrzemki morskie (tabela 1).

Okres III

Cechą znamienną tego okresu jest obfita flora okrzemek z podgromady *Centricae*. Występujące różnice pozwalają na wydzielenie tu dwóch faz: starszą A, z panującym *Stephanodiscus astraea* var. *minutulus*, i młodszą B, z obfitym udziałem gatunków z rodzaju *Cyclotella*. Odczyn wody nadal alkaliczny.

W związku z licznie reprezentowaną podgromadą *Centricae*, maksymalne wartości osiąga współczynnik C:P Fogeda (ryc. 5a). Jego wyższe wartości wiąże Foged (1954, 1962, 1970) z dużymi rozmiarami i większymi głębokościami jezior. Odnotowane maksymalne wartości tego współczynnika dowodziłyby, że w tym okresie wody jeziora osiągnęły najwyższy poziom. Możliwe jest również, że wzrost ten był nieznaczny, a bujny rozwój okrzemek z podgromady *Centricae* mógł być także wywołany ociepleniem klimatu i wzrostem żyzności wody w jeziorze.

Współczynnik C:P Nygaarda (1949; ryc. 5b) osiąga i w tym okresie maksymalne wartości, ale bez nagłych wzrostów i spadków, jak współczynnik Fogeda. Współczynnik Nygaarda odpowiada w tym przypadku jeziorom o mesotroficznych warunkach odżywczych.

Okres IV

Próby tego okresu zalicza Mamakowa (1976) do optimum klimatycznego. Notowano w nim bogatą w taksony i okazy florę okrzemek, szczególnie obficie występowały gatunki z rodzaju *Navicula*. Oprócz wielu okrzemek ciepłolubnych stwierdzono dwa gatunki o wyższych wymaganiach termicznych; *Navicula confervacea* (tablica II fig. 9) i *N. seminuloides* (tablica II fig. 8).

Pod względem rozmaitości i obfitości najliczniejsze były nadal okrzemki alkalifilne, natomiast zmniejszyły się udziały alkalibiontycznych, co wskazuje na mniej alkaliczny odczyn wody niż w poprzednich okresach.

Niemal kompletny brak planktonowych gatunków z podgromady *Centricae* dowodzi spłycenia jeziora. Taki zanik tych okrzemek może też pozostawać w związku z bujnym rozwojem roślinności wodnej (inf. ustna K. Mamakowa), która spowodowała zmniejszenie się strefy wolnej wody. Było to oczywiście możliwe tylko w niezbyt głębokim jeziorze. W próbach z tego okresu nie znaleziono okrzemek morskich.

Okres V

Próby tego okresu Mamakowa (1976) wiąże z późnym interglacjałem. Obfitość okrzemek zmniejszyła się i gorszy był stan ich zachowania.

Dolną granicę tego okresu charakteryzuje zanik lub zmniejszenie się udziałów procentowych niemal wszystkich gatunków charakterystycznych dla poprzedniego okresu. Pojawia się natomiast nowa, nie spotykana dotychczas grupa okrzemek arktycznych. Ponadto stwierdzono tu pewną liczbę gatunków wspólnych z chłodnym okresem II. Wyróżniono trzy fazy: A, B i C.

Duże zmiany we florze okrzemek to następstwo zmiany warunków klimatycznych i chemizmu wody jeziora. Nierównomierna częstość występowania charakterystycznych gatunków i grup ekologicznych wskazują, że był to okres szybko następujących po sobie zmian. Dlatego jednoznaczne określenie warunków ekologicznych w tym czasie nastręcza trudności.

Silnie rysuje się tendencja do neutralizacji odczynu wody, wywołanej zmianą klimatu i pojawieniem się słabo zwartych lasów szpilkowych (Mamakowa 1976), z których wody powierzchniowe mogły nanosić do jeziora cząstki gleb kwaśnych. Jest również prawdopodobne stopniowe lądowacenie zbiornika przez rozrastające się u jego brzegów torfowisko. Procesy te zostały przypuszczalnie zahamowane w środkowej fazie B, kiedy to ponownie pojawiły się okrzemki alkaliczne, charakterystyczne dla poprzedniego okresu, oraz litoralno-planktonowe i euplanktonowe, co — być może — jest śladem przejściowego ocieplenia klimatu.

Obserwuje się tu także wzrost udziału okrzemek alkalibiontycznych, mniej licznych w poprzednim okresie (optimum klimatyczne), kiedy odczyn wody był bardziej alkaliczny. Ich obecność (głównie rodzaje *Epithemia*, *Gyrosigma* i *Cymbella*) może także wiązać się z powstaniem bardzo płytkich częściowo mchami porosłych siedlisk na brzegu zbiornika.

Okres VI

Próby tego okresu Mamakowa (1976) wiąże z początkiem ostatniego zlodowacenia. Flora okrzemek wyraźnie nawiązuje do fazy A okresu V. Definitywnie zostały zahamowane procesy zachodzące w fazach B i C mninionego okresu. Ponownie zaznacza się tendencja do neutralizacji odczynu wody w zbiorniku i wyraźniej postępujące jego lądowacenie. Do ostatniej jednak zbadanej próby zbiornik nie osiągnął stanu całkowitego zatorfienia. Klimat był chłodny, o czym świadczą większe, niż w okresie V, udziały gatunków borealnych i arktycznych.

Zmiany udziału cyst Chrysophyceae (ryc. 2)

Cysty złotowiciowców okazały się tutaj bardzo dobrym wskaźnikiem ochłodzenia klimatu. Zwiększeniu ich ilości towarzyszyło zawsze pogorszenie warunków klimatycznych. Najobficiej występowały w fazie B okresu I. Znacznie mniejsze ich ilości w fazie A tego okresu tj. w próbach z maksymalnym udziałem *Cymbella affinis*, rejestrują, być może, cieplejsze wahnienie klimatu w obrębie późnego glacjału zlodowacenia środkowopolskiego. Niestety z powodu braku opracowania palinologicznego tych prób nie ma możliwości potwierdzenia tej sugestii. W okresach II i III ich udział zmiejszał się stopniowo, aby, wraz z postępującym ociepleniem w okresie IV (optimum klimatyczne), osiągnąć minimalne wartości. Ponowny wzrost udziału cyst obserwuje się od okresu V i ich występowanie dzieli ten okres wyraźniej niż okrzemki na trzy fazy. Spadki ilości cyst pokrywają się lepiej z granicami faz wyznaczonymi w strefie h przez Mamakową (1976). W okresie VI wzrost ilości cyst jest jeszcze wyraźniejszy niż w okresie V, ale nie osiągają one wartości tak wysokich jak w okresie I.

Plate I

Tablica I

1. *Pinnularia nodosa*; × 2500
2. *Gyrosigma attenuatum*; × 2500
3. *Gyrosigma acuminatum*; × 2500
4, 5, Cysts of *Chrysophyceae*; × 1000
6. *Cymbella affinis*; × 2500

Plate I
Tablica I

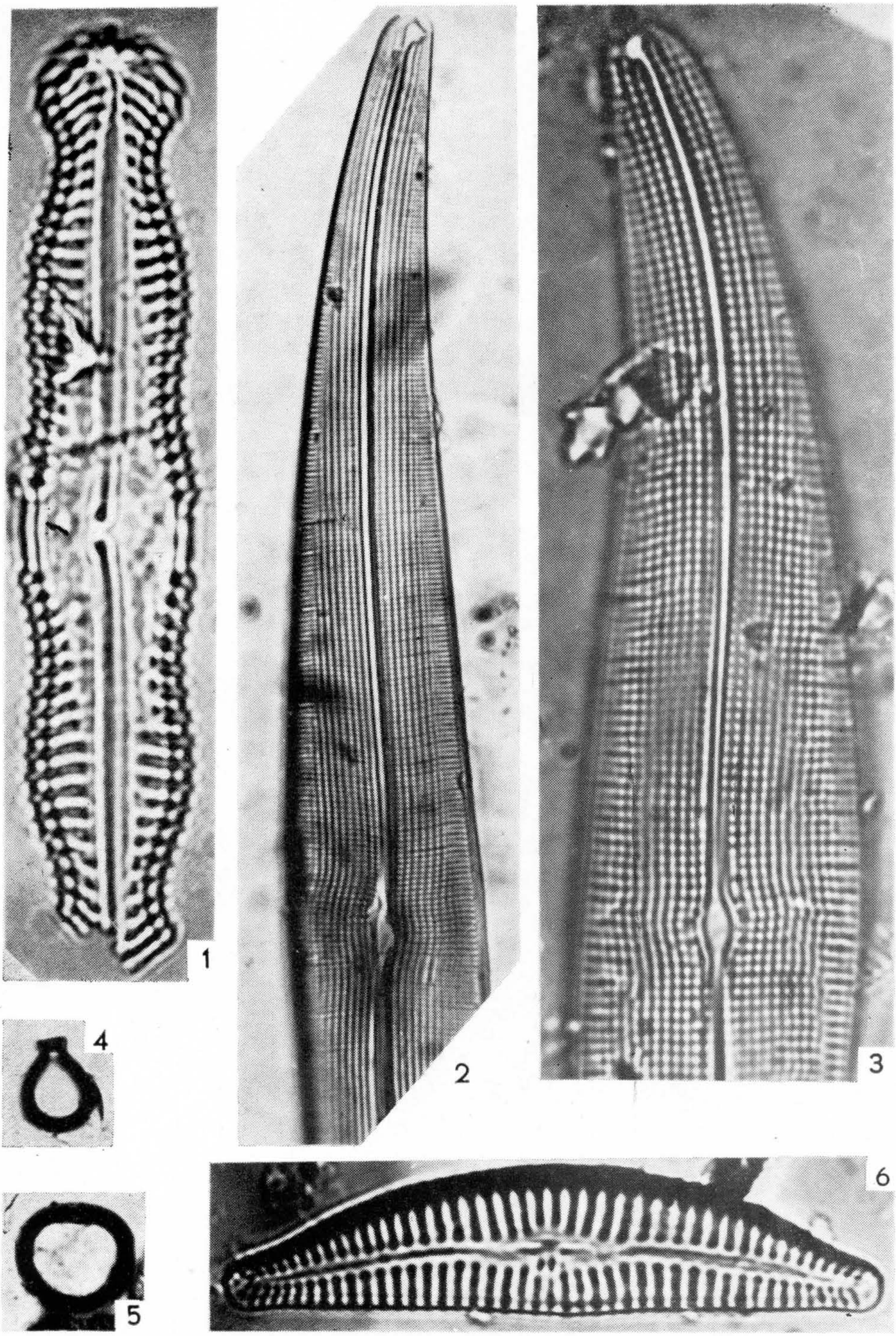


Plate II

Tablica II

1, 2. *Gyrosigma acuminatum* var. *gallicum*; × 1000, × 2500
3. *Pinnularia lata* var. *costata*; × 1000
4. Cyst of *Chrysophyceae*; × 1000
5. *Pinnularia borealis*; × 2500
6. Cyst of *Chrysophyceae*; × 1000
7. *Campylodiscus noricus* var. *hibernica*; × 400
8. *Navicula seminuloides*; × 2500
9. *Navicula confervacea*; × 2500
10. *Navicula amphibola*; × 1000
11. *Navicula semen*; × 1000
12. Cyst of *Chrysophyceae*; × 1000

Plate II
Tablica II

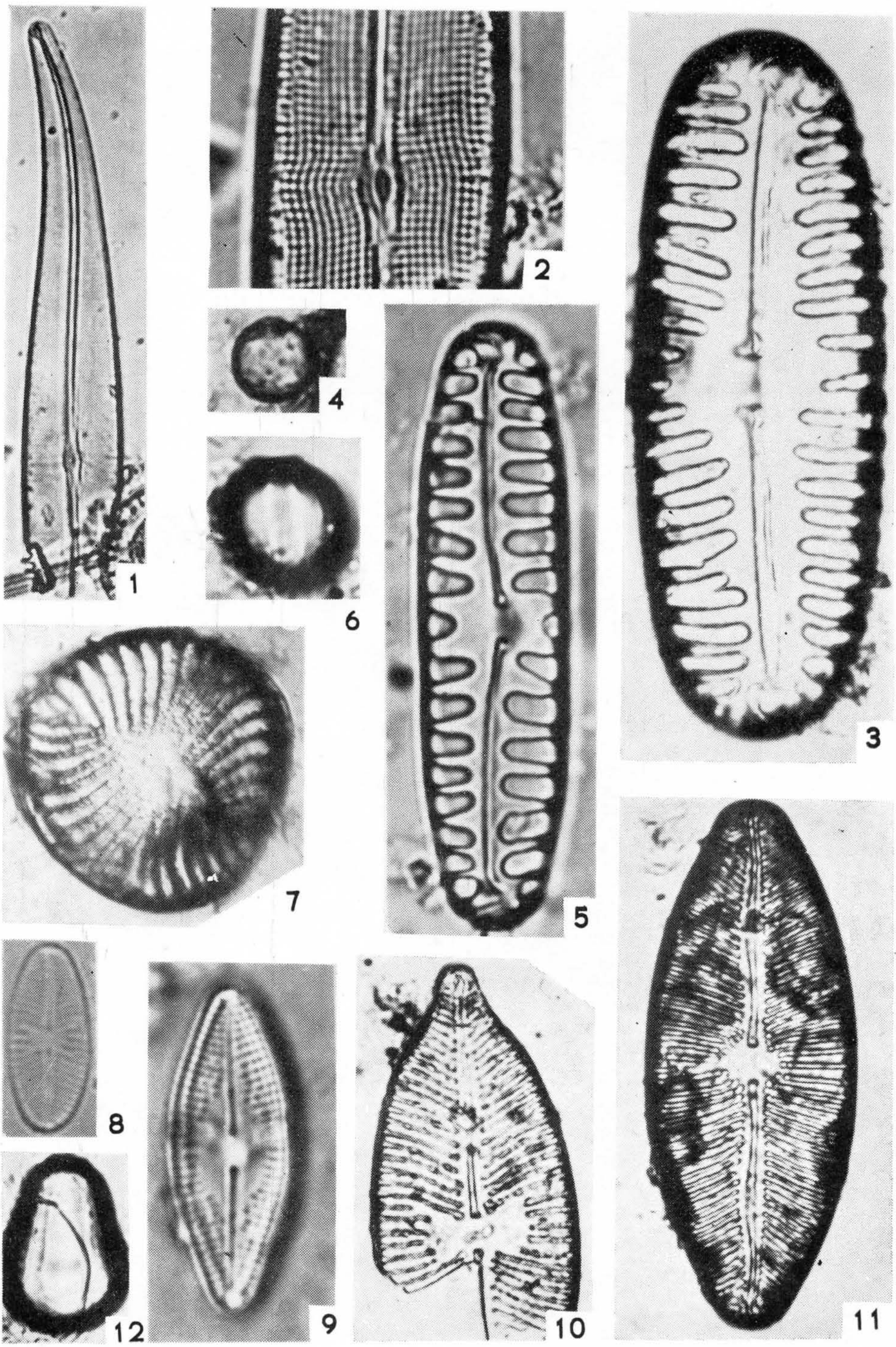


Plate III

Tablica III

1—18. Cysts of *Chrysophyceae* (figs. 3, 4; × 1000, others × 2500)

Plate III
Tablica III

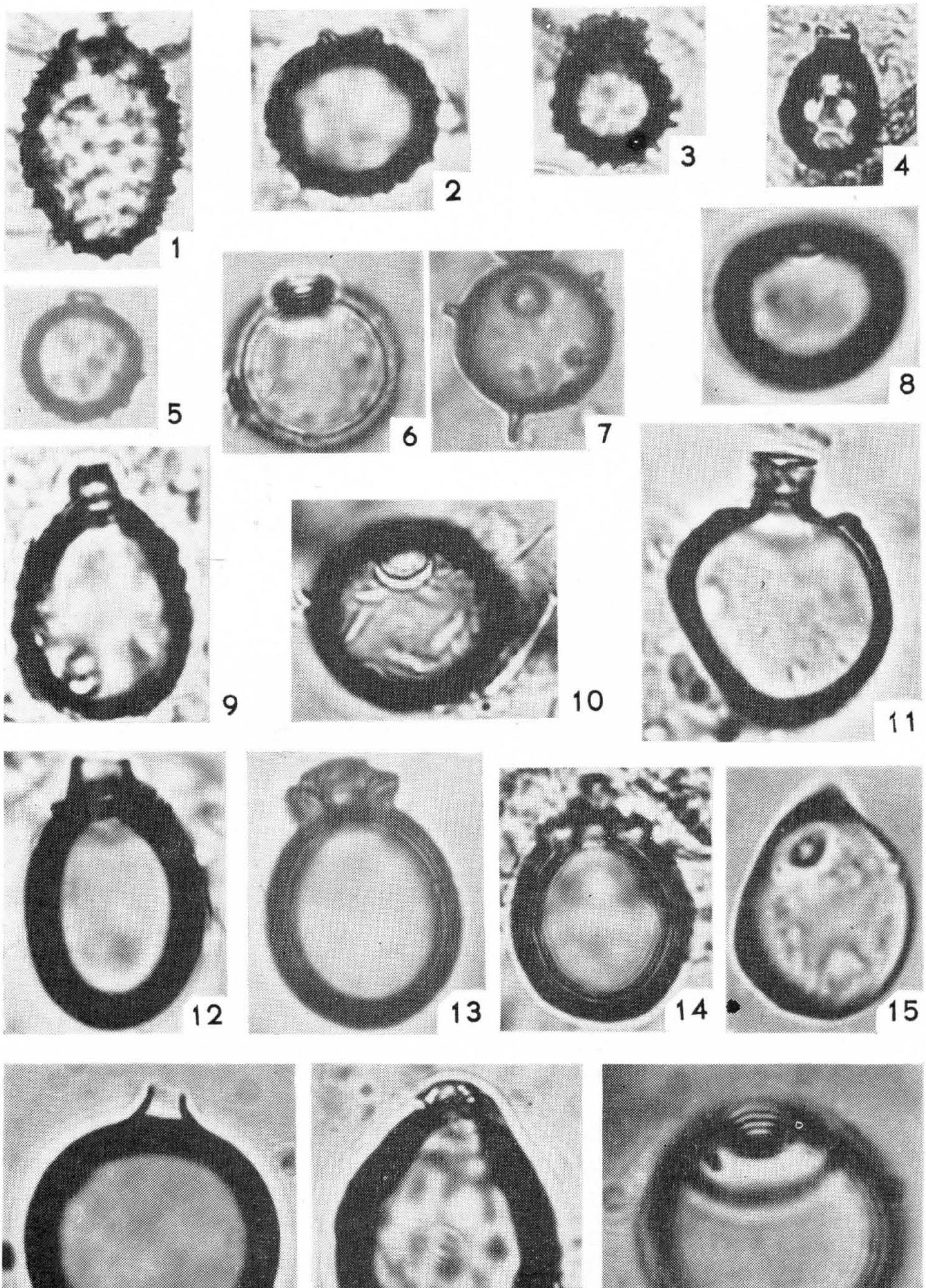
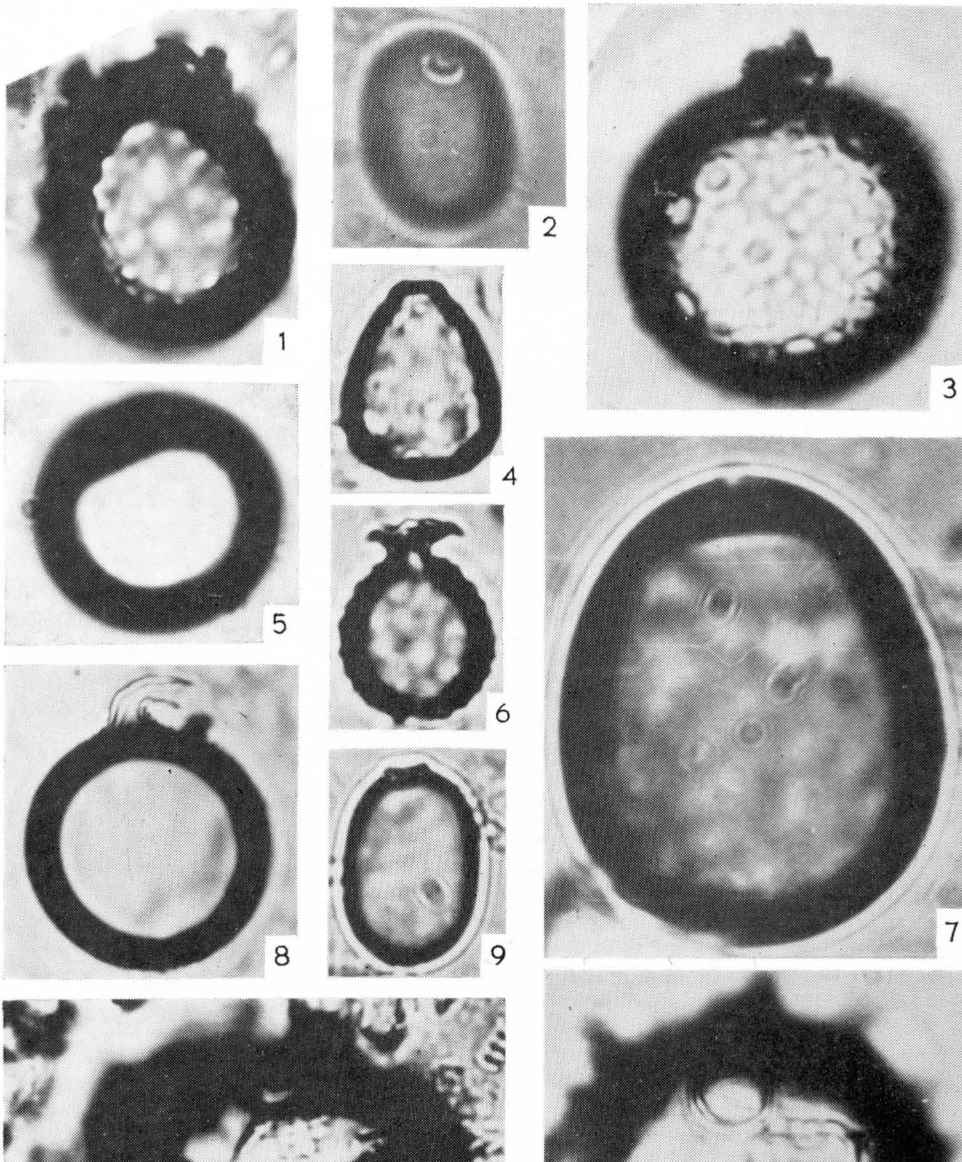


Plate IV

Tablica IV

Cysts of *Chrysophyceae*; × 2500


1
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Text-fig. 2. Succession diagram of the diatom main components
Ryc. 2. Diagram przedstawiający sukcesję głównych składników flory okrzemek

Percent proportion of diatom taxons and cysts of Chrysophyceae
Udział procentowy okrzemek i cyst Chrysophyceae

Abbreviations - skróty: Alb - alkalibiontic - alkalibiontyczne; Alf - alkaliphilous - alkalifilne; Ind - indifferent (circumneutral) - obojętne; Acf - acidophilous - acidofilne; Acb - acidobiontic - acidobiontyczne; Et - euterrestrial - euterrestrialne; Ae - aerophilous - aerofilne; Ep - epiphytic - epifityczne; Be - benthonic - bentosowe; Lp - littoral-planktonic - litoralnoplanktonowe; Pl - euplanktonic - euplanktonowe.

		Stratygraphy - stratygrafia	VI				V C				V B		V A							IV									III B		III A			II			I B	I A		
		No. of sample - nr prób	16	22	27	32	36	39	41	45	48	58	60	65	68	80	83	84	86	90	98	104	111	116	120	125	138	147	160	164	166	172	178	180	186	189	192	196	200	206
		ACHNANTHES																																						
Alf	Ep	affinis Grun.						0,4		0,2										+	+						+													
		bottica Cl.													÷							+	+						÷	0,2										
Alf	Be	clevei Grun.				0,2	÷				+	0,4	0,4		0,6	0,4		0,2	+	1,8	0,4	1,2	0,2	0,2	0,4	0,4	0,2	+	0,6	0,2	+	0,2			+	0,6				+
Alf	Be	var. rostrata Hust.			0,2		+		+			1,2	+	0,6		+	0,3	0,4	+	1,4	0,2	+	+	1,2	1,0	0,8	0,4	1,2	0,2	0,2	0,2	1,2	0,4	0,6	+	+				
Alf	Ep	conspicua Mayer	+		0,2		+		0,2	0,2			+	0,2	0,2	0,2	1,0	0,2	+	1,8	0,6	0,2	+	1,0	0,8	1,4	2,4	1,0	1,0	0,8	0,2	0,4	0,2			+				
		var. brevistriata Hust.				+	+				0,4		0,2	0,2		+					0,4	0,2	+	+	1,4	0,4	0,4	0,2	0,6	+	0,2			+		+				
Alf	Ep	exigua Grun.														+						0,2	+	0,2	+	+	+	+	+		+	0,4	+							
Alf	Ep	var. constricta Torka							+					0,2	+	+				+					+		+	0,2	+	+	+									
Alf	Ep	var. heterovalvata Krasske		+	0,2	+			+	0,2	0,4	0,2	0,2	1,0	0,2	0,4	0,3	2,2	+	0,4	0,2	1,0	0,6	0,2	1,2	0,8	+	+	+	+	+	0,2	0,2	0,4		0,6				
Acf	Ep	flexella (Kütz.) Brun.				0,2	+		0,7		0,4				+	+				+	+	+	+				+	+	+		+	+	0,2							
Alf	Ep	hungarica Grun.			0,2	+				0,2	+	0,4	+	0,2		+					+								+											
Alf		kolbei Hust.								0,2		1,0	+		+	0,4				0,2	+	+	+	+	+															
Alf	Ae	lanceolata (Bréb.) Grun.		0,2	0,2	+	0,2		0,4	0,2	+	0,6	+		0,2	+			+	+	0,2	0,2		+	+	+	0,2	+	+		+	+		+	\	0,2				
Alf	Ep	f. capitata O. Müll.				0,2					+	0,2	+						+	+											+	+	+			+				
Alf	Ep	f. ventricosa Hust.																					+							+										
Alf	Ep	var. elliptica Cl.	+		1,0	+	0,6	0,4	+	0,8	+	3,0	0,4	1,2	0,4	0,2	0,3	0,2	0,6	0,4	0,4	0,4	0,6	0,2	+	0,4	0,4	1,6	0,4	+	+	+	1,4	1,0	0,4					
Alf	Ep	var. rostrata (Östr.) Hust.	0,2	0,4			0,6		1,0	0,4	0.4	4,0	0,6	2,0	1,4	0,8	1,0	1,6	0.4	1,2	2,2	2,2	2,0	2,6	3,8	2,2	1,8	7,2	2,2	2,2	0,6	2,2		+		1,0				
		lapponica Hust. var. ninckei (Mang.) Rein.					+								+					+		+		+					+											
Ind	Ae	linearis (W. Sm.) Grun.						0,4		0,2	+	0,2		0,2				0,2		+	1,2	1,2	0,6	0,2	0,2	0,2	+	0,8	0,6	+	0,2		+	0,2	0,2					
Ind	Ae	var. pusilla Grun.		+						0.2				0,2					+			1,0		+					+	+		1,0								
Ind	Ep	microcephala (Kütz.) Grun.														+				+	0,2	0,6	+	0,4	+	+	+	+	+	+	0,2	+	+							
Ind	Ep	minutissima Kütz.						0,2				0,2	+	0,2										+	+	+			+	+	+		0,2							
Ind	Ae	var. cryptocephala Grun.		+					+	+						+				+	0,6	+	0,2	0,2	0,2	0,2	0,2	+	0,2	+	0,4									
Ind	Ep	peragallii Brun. et Herib.					0,2				+			0,2	+				+																					
Alf		plönensis Hust.																			+								+			+				+				
		AMPHIPLEURA																																						
Alf	Be	pellucida Kütz.																			+	0,2		+	+	+			+		+									
		AMPHORA																																						
		fonticola Maillard		+							+			0,2						+																				
Alf	Be	ovalis Kütz.	0,6	0,4	0,4	0,4	0,2	0,6	1,0	0,2	2,0	0,6	4,0	1,0	1,8	1,0	0,3		2,4	+	1,0	+	0,2	0,6	0,4	0,2	0,2	0,6	1,4	+	+	1,0	1,6	1,8		+	0,5			
Alf	Be	var. libyca (Ehr.) Cl.	2,8	1,8	2,6	0,2	1,6	1,4	0,8	0,8	2,2	4,0	4,0	2,0	4,6	1,4	1,0	0,4	3,2	0,6	0,8	0,6	1,2	0,6	+	1,0	0,2	0,4	0,8	+	0,4	1,2	2,4	+	0,2	0,6	0,5	4,0	3,6	
Alf	Ae	var. pediculus Kütz.	0,2	+	0,8		1,2	0,8	2,4	1,4	1,0	1,4	2,2	2,4	2,0	1,6	1,3	4,8	1,0	6,4	11,4	3,8	2,4	4,0	5,0	10,6	4,0	5,8	5,0	1,6	1,4	2,8	7,0	6,6	5,2	5,8			1,8	
Alb		veneta Kütz.	+	+	0,6	0,2					+				+	+				0,4	+								+											
		ANOMOEONEIS																																						
Alb	Be	exilis (Kütz.) Cl.					+		+		+					+			÷	+	+	+				+	+	+	+	+	+									
Alb	Be	sphaerophora (Kütz.) Pfitz.	0,2	0,2	0,2	0,8	0,6	0,2	0,6		+	0,4	0,4	0,4	0,4	0,2	0,7	+	0,6	+	+	+	+	0,2	0,2	+	+	+	+	+	+	+				+				
		ASTERIONELLA																																						
Alf	Pl	formosa Hassal		+					+												+								+	+	+	+								
		CALONEIS																																						
Alf	Ae	alpestris (Grun.) Cl.					+													+						+														
Alf	Be	amphisbaena (Bory) Cl.					+		+		+																													
Alf	Ae	bacillum (Grun.) Mer.	+	0,4	0,2	+	+				+				0,4	+	0,3		0,4	+		+		+				0,2	+		+	+	0,2	+	+	+				
		var. fontinalis (Grun.) Mayer	0,2	0,4	+				+	+	+			+	+					+		+		+	+	+			+		+	+	0,2	+		+				
Alf		var. lancettula (Schulz) Hust.														+													+			+								
Alf		clevei (Lagst.) Cl.																				+				+			+											
Alf	Be	schumanniana (Grun.) Cl.							+			0,2		+		+													+							+				
Alf	Be	var. biconstricta Grun.								+																						+	+	+						
Alf	Ae	silicula (Ehr.) Cl.	0,8	0,4	0,2	0,8	+		0,2		0,4	0,4	0,4	0,4	0,6	+	0,7		+	0,2	+	+	+	+		+	+	+	+	+	+	+	0,2			+				
		var. gibberula (Kütz.) Grun.	0,2	+					+		+								+		+	+																		
Alf	Ae	var. truncatula Grun.		+			+		+		0,2			0,2	+				+	+	-					+		+	+			+	+	+						
Alf		var. tumida Hust.														+																								
Alf	Be	var. ventricosa (Ehr.) Donk.	+			+									+				0,2				+		+							+								
		CAMPYLODISCUS																																						
Alf	Be	noricus Ehr. var. hibernica (Ehr.) Grun.					+		+		+		+					+	+	+			+	+			·+	0,2	+	+	+	+	1,0	4,0	2,6	0,6	1,0			
		COCCONEIS																																						
Alf	Ep	disculus (Schum.) Cl.									+										+																			
Alf	Ep	var. diminuta (Pant.) Cl.	+	+		0,2	+	0,2	0,4	0,4	0,2	0,4	2,0	0,2	1,8	1,0	0,7		0,2	0,2		0,2	+	+	+				+			+								
		var. minor Fontel			0,2			0,2	+		+	0,2	0,2		+	0,4			0,2	0,4	+	+	+	+	+		+	+	+	+	+	+								
Alb	Ep	pediculus Ehr.					+				+				+					+	0,6	+	+			0,2		+	+			0,6								
Alf	Ep	placentula Ehr.	0,6	1,2	1,0	2,0	0,6	0,4	0,2	0,4	1,2	0,8	2,2	0,4	2,0	1,2	0,3	+	2,4	0,6	+	+	0,6	0,8	0,4	0,2		0,2	+	0,2	0,2	0,6		0,2		0,2				
Alf	Ep	var. englypta (Ehr.) Cl.	0,6	0,4	0,8	0,2	+	+	0,8	0,4	0,8	0,6	0,6	0,2	0,8	0,4	2,0		0,6	0,4	0,4	0,8	+	0,2	0,2	0,4	0,4	+	0,2		+	+				+				
	Ep	var. intermedia (Herib. et Perag.) Cl.				0,4	+																																	
		var. cf. lineata (Ehr.) Cl.	1,0	1,0	0,6	0,2	+	0,4	+	0,6	+	0,8	0,4	0,6	0,2	0,2		0,4	0,2	+	+			+			+	+	+	+	+	+	0,4			+				+
Alb		thumensis A. Mayer		+			+		0,2		0,2		0,2	0,4		0,4	0,7	0,4		1,2	+	0,8	1,2	0,8	2,2	1,2	1,2	1,2	0,8	+	+	+				0,2				
		CYCLOTELLA																																						
Ind	Pl	bodanica Eulenst	+	÷	0,2	0,4	0,8		+	0,4	0,2	0,8	+	0,2	+	0,4		+	0,6	+	+	0,4	0,2	0,2	+	0,2	0,2		+	0,2	0,2	0,8	0,8	+		+				
Ind	Pl	comensis Grun.		+			+				0,2	0,2								+	0,2	+	0,2	0,2																
Alf	Pl	comta (Ehr.) Kütz.	0,4	+	0,6	0,2	0,2		2,2	1,0	3,8	0,2	3,0	0,2	0,8	0,2	0,3	0,2	0,2	0,6	0,4	+	0,4	0,6	+	0,4	0,2	1,0	1,8	0,2	0,2	0,8	1,0	+	0,4	0,2				
		var. glabriuscula Grun.				+				0,4										+	+			+			+						0,4							
Ind		var. oligactis (Ehr.) Grun.	0,2			+					+					+													+		+	+	0,4	0,4						
		distinguenda Hust.	÷				+	0,4	1,4	0,6	0,6	0,2	0,6	0,4	+	0,2	0,7	0,2	1,0	1,4	1,0	0,6	1,6	2,0	+	0,8	+	+	0,8	0,6	0,8	0,8	0,4	0,2		0,4				
Alf	Pl	kützingiana Thw.	÷	0,4			0,2		1,2		0,6	0,2	0,4	0,8	0,4	0,2	0,7	1,0	0,4	1,4	0,4	+	0,2	0,6	0,6	1,2	0,8	0,6	2,8	1,4	1,8	1,0	0,8			+				
Alf	Lp	var. planetophora Fricke		0,2											+						+							0,2	0,4	1,2		0,6								
Alf	Lp	var. radiosa Fricke			0,4		0,2	0,2	0,4	1,4	0,2	0,4	0,8	0,6	0,6	1,0		1,2	+	1,8	1,8	0,2	0,4	2,2	1,0	1,4	0,8	3,4	10,6	7,4	8,0	4,8	+	0,6		1,4				
Alf	Lp	meneghiniana Kütz.	+			0,2			0,2		+		+			+			+	+	0,2		+	+	0,2	+			+		+									
Alf	Lp	ocellata Pant.	+		0,4	0,2	0,4		1,8	0,6	1,0	0,4	0,8	1,2	0,4	0,6	1,3	1,8	0,4	2,8	1,6	0,8	0,6	2,2	1,2	2,8	0,4	1,4	8,0	9,8	3,6	4,0	1,4	0,2		0,8				
Ind	Lp	operculata (Ag.) Kütz.							0,4		0,4		+			0,2							0,8	0,2	0,4	+	+	0,2	0,8		1,6	1,0								
	Lp	var. mesoleia Grun.				+	0,2		0,2							±				÷									0,6	1,2	+	+				0,8				
	Lp	var. unipunctata Hust.	0,2			+	0,6	0,8	3,4	1,0	5,6	2,0	1,2	1,0	0,6	1,0	0,3	0,4	+	0,6	2,2	0,4	0,2	1,4	1,6	1,0	1,6	2,6	9,0	17,8	2,2	0,6	1,4		0,2	0,8				
Ind	Pl	stelligera Cl. et Grun.									+					+			0,2		+	+		0,2	+	0,4			+		0,6	+								
		CYMATOPLEURA																																						
Alf	Be	elliptica (Bréb.) W. Sm.	+	+		0,2	+	+	0,2	+	+	+	0,2	0,2	+	0,2	0,3	+	0,2	+	+	+	+	0,2	+	+	+			+		+	+	0,2						
		var. constricta (Bréb.) W. Sm.									+													+			+													
		var. nobilis (Hantzsch) Hust.	+			+	0,2		+				+			+								+			+	+				+		+						
Alf	Be	solea (Bréb.) W. Sm.		+	0,2		+	+			+		+			+			0,2	0,2	0,2	+	+	+	+	+	+	+	+	+	+	+		+						
		CYMBELLA																																						
Alf	Ep	aequalis W.Sm.	+	0,2		+	+	0,2	0,6		0,4	+	0,4	0,2	+	+			+	+	+	+			+	+								0,2		+				
Alf	Ep	affinis Kütz.	0,4	0,2	0,2				+		0,4	0,4	1,4	0,8	0,6	0,2	0,7	0,4	+	+	0,2	+	0,2	+	+	+	0,2	+	+	+	+	0,2	+	+						
Ind		amphicephala Näg. var. intermedia A. Cl.				+	0,2	0,2	+	+	+				+				+	+	+	+	+	+	+	+	0,2	+	+	+	+			+	+	0,2	2,0	84,0	75,4	+
Alf	Ae	aspera (Ehr.) Cl.	1,2	2,0	0,8	2,0	+	+	0,4		0,8	0,2	0,6	0,6	0,8	0,4	0,7	0,2	0,6	+	+	+	+	+	+	0,2	+	0,2	+	+	+	+		+		+				
Ind	Ep	cesatii (Rabh.) Grun.	0,2								+																									+	0,5			
Alf	Ae	cistula (Hemp.) Grun.	1,2	0,4		1,2	0,2	0,2	+	0,2	0,4		0,6	0,6	0,4	0,4	0,7		0,2	+	+	+	0,2	+					+	0,2		+		+						
Ind	Ae	cuspidata Kütz.	0,2	+			+		+	+	0,2				0,2				+	+		+	+	+	0,2	+	+	+	+	+	+	0,2	+	0,2						
Alf	Ep	cymbiformis (Ag? Kütz.) V. H.				0,8	0,2		0,4	0,4	1,0		1,2		0,8	1,0			1,2	0,2	+	+	+	0,2	+	0,2	0,2	+	+	0,2	+	0,2		0,2		+				
Alf		diluviana (Krasske) Florin	0,2	+	0,2	+	+	0,8	3,8	0,8	1,8	0,4	0,6	1,2	0,4	0,6	2,3	0,8	0,6	1,2	1,0	2,0	3,4	1,0	1,0	+	1,0	0,2	1,4	2,8	0,8	0,4	0,2	+	+	2,8	1,0			
Alb	Ae	ehrenbergii Kütz.	0,2	0,8		2,0	1,0	+	0,4	0,4	0,8	0,6	1,8	+	1,0	0,4		0,2	2,0	+	+	+	0,2	+	+	+	+	0,2	0,2	+	0,2	0,2	+	+		0,4				
Alf	Ep	helvetica Kütz.									+					+		+	+	+	+	+	+	+	+	+	+	0,2	0,2	+	0,2	0,2	+	+		0,2				
Alf		hustedtii Krasske									+		+							+		+	+	+	+	+	+	+	+	+	+	+								+
Acf	Ae	laevis Näg.								+										+					+	+	+	+												
Alb	Ep	leptoceros (Ehr.) Grun.	+			+			0,2	0,2	+				+	+			0,2	+	+	0,4		+	+	+	+		+	0,2		+								
Alb	Ep	microcephala Grun.						+	+	+	+	0,2			+	+				+	0,6	0,6	+	0,2	0,2	0,2	+	+	0,6	+	+	0,2	+	+						
Ind	Ep	naviculiformis Auersw.								+	+		+			+						+							+											
Alf	Ep	prostrata (Berkeley) Cl.									+					+								+	+	+			+			+	+	+		+	0,5			
Ind	Ep	sinuata Greg.	÷		+	0,2	+		+			0,4	0,2		0,4	0,4			+	+		+			+						+	+				+				
Ind		f. ovata Hust.		+								0,4							+						+							+				0,4				
Alf	Be	thumensis (A. Mayer) Hust.	+						+		0,2	0,2		1,2		0,4	1,0	1,2	+	+	0,4	1,4	0,4	1,0	0,6	0,8	2,2	4,4	1,6	1,4	0,4	0,4	2,6	2,0	2,8	+				
Alf	Ep	tumida (Bréb.) V. H.		0,2						+	0,2		0,2			+					+	0,4	+		+	+	0,2				+									
Alf		tumidula Grun.																											+											
Alf	Ep	turgida (Greg.) Cl.							+		+	0,2		0,2						÷		+	+		+	+			+			+								
Ind	Ep	ventricosa Kütz.	+	+	0,4	+	+	+	0,2		0,4		0,2	+	+	+	0,3	+	+	0,4	0,2	0,2	+	0,2	+	0,2	+	0,4	+	+	+	0,2	+	+		+			1,8	
		DIATOMA																																						
Ind	Lp	elongatum (Lyngb.) Ag.																													+									
Alf	Ep	hiemale (Lyngb.) Herib. var. mesodon (Ehr.) Grun.																																						
Alb	Be	vulgare Bory var. ehrenbergii (Kütz.) Grun.																		0,2	+				+			+				+		+				2,0		
		DIPLONEIS																																						
Alf	Be	elliptica (Kütz.) Cl.	+	+	+		+		0,8		1,0	0,2	0,6	0,4	0,6	0,2		0,4	0,2	0,2	0,8	+	+	0,4	+	+	+	0,2	0,4	0,4			0,2	+						
Ind		marginestriata Hust.							+													+							+			+	0,2	+						
Ind	Be	oculata (Bréb.) Cl.							+			0,2									+	+	+	0,2	+	0,2	2,2	+	+	0,2	+	+	0,6	+		+				
		ölandica Cl.										0,2							+							+			+	+										
Alf	Ae	ovalis (Hilse) Cl.	1,4	1,6	0,2	1,4	0,2		+	0,2	0,2	0,6	1,6		1,0	1,0	0,7		0,4	+	+											+		0,2	+		0,5			
Alf	Ae	var. oblongella (Näg.) Cl.		0,2		0,4							+		+				+	+		+			+	0,2	+	+		+							1,0			
		pseudovalis Hust.																						+	+	+		+												
		EPITHEMIA																																						
Alb	Ae	argus Kütz.	0,4				+		0,2		0,2	+	+		0,2	0,2			+	+	0,2	+	+	+		0,2	+	+	+	+	+	+	+	+						
Alf		var. capitata Fricke																	+							+					+	+	+							
Alb	Ep	intermedia Fricke							+		+		+		-																	+		+						
Alf	Ep	~~mülleri Fricke~~							+		+					+			+	+			+	0,2							+									
Alb	Ep	sorex Kütz.		+		+	+		+		0,4		0,6		+	0,2			0,6	0,2	+	+	+	+	+	+	+	+	+	+		+								
Alb	Ae	turgida (Ehr.) Kütz.	0,8	1,6	1,0	8,0	+	0,2	+	0,4	0,2	0,4	1,0		1,0	0,2	0,7	+	0,6	0,2	+	+	0,2	+	+	+	+	+	0,2	0,6	0,2	+		+						
Alb	Ae	var. granulata (Ehr.) Grun.	+	0,8	+				+	+	+		+	+		0,4				+		+	+	+		+	+	+	+	+	+		+		0,2	+	1,0			
Alb	Ae	zebra (Ehr.) Kütz.	1,4	0,6	0,6	0,6	+	0,4			0,2	+	0,2		0,4	0,2	0,3	0,2	0,8	0,2	1,0	+			+		+	+	+		+	0,4		+						
Alb	Ae	var. porcellus (Kütz.) Grun.	0,6	2,4	0,4	0,8	+	0,4	0,4	+	0,2	0,2	0,4	0,4	1,0	+		+	0,4	0,4	+	+	0,2	0,4	0,2	0,4	+	0,4	+	+	+	0,2	0,2	+		+	0,5			
Alb	Ae	var. saxonica (Kütz.) Grun.	+	1,0	+		0,2	+	0,2	+	0,8		0,8		+	+			+	+	+	+				0,2	+		+		+	0,2	+	+	+	+				
		EUNOTIA																																						
Ind	Ae	arcus Ehr.							+	0,2	+	+						+	+	+		+																		
Ind		var. bidens Grun.								+						+																								
Ind	Ae	var. fallax Hust.							+	+	+		0,4		0,2	0,2			0,2	0,2	+	+		0,4	+	+	+	+	+	+				+						
Acf	Ep	floxuosa (Bréb.) Kütz.																		+																				
Ind	Be	formica Ehr.		+		+					+																													
Ind	Ae	cf. gracilis (Ehr.) Rabh.	+			0,4	+				+		0,4	0,2	+	+			+	+	+	+	+		+	+	+		+	+							0,5			
Ind	Ae	lunaris (Ehr.) Grun.		+										0,2								+									+									
		cf. lunaris (Ehr.) Grun.		0,2	0,2		+		+	+	0,4	0,2	0,2	0,2	0,4	0,4	0,3	0,2	+	+	+	+	+	0,2	+	+	+	+	0,2	0,4	+			+		+				
Acf	Be	pectinalis (Dilw? Kütz.) var minor (Kütz.) Rabh.	0,2	0,4	0,6	0,2	+				0,4	0,4	+	0,2	+	+		+		+	+	+	+	+	+			+	+	0,2	+									
Acf		var. ventralis (Ehr.) Hust.		0,6	0,4	+					+					+																					0,5			
Acf	Ae	praerupta Ehr.	0,4	+	0,6	0,2	0,2					0,2				+	0,7		+	+																				
Acf	Ae	var. bidens (W. Sm.) Grun.	0,4	1,4	0,6	2,0	+		+		0,6	+	0,8	0,2	+	+			0,6																					
Acf	Ae	var. inflata Grun.				+																																		
Acf		var. musicola Petersen	0,2	0,2		0,2			+		+	0,2	+		+	0,2			0,4																					
Acf	Be	sudetica O. Müll.	0,2			+					+	+	+	0,2					+																					
Aob		suecica A. Cl.				+																																		
Acf	Be	veneris (Kütz.) O. Müll.	+	+		+									+																									
		sp.																		+																				
		FRAGILARIA																																						
Ind	Lp	bicapitata Mayer																0,2				+																		
Alf		bidens Heiberg	+	+	0,4					0,2		+			+	+					0,2		+			+			+		+									
Alf	Lp	brevistriata Grun.	8,0	12,0	7,6	11,0	23,6	11,6	15,8	16,4	6,8	6,4	3,2	14,4	10,4	11,6	13,3	15,4	10,4	15,8	12,4	18,0	17,4	16,2	29,4	25,8	16,4	15,0	2.8	4,8	7,4	14,4	28,2	31,6	25,0	20,0	7,5		1,8	+
Alf	Lp	var. elliptica Herib.			0,2			0,6		0,8	1,0	0,2	0,6	0,6	0,6	1,0			+	0,2	0,2	0,2				+	1,0	0,4	+		0,8	1,4	0,8	0,4	1,2	+				
		var. linearis Mayer	0,6	2,8	2,4	0,2	0,8	4,2	1,4	1,2	0,4	0,8	0,2	1,0	0,6	0,6	0,7	0,6	+	0,2	+	+	+	+						+	+	+	5,8	5,2	3,6	1,0	0,5			
Alf	Lp	capucina Desm.																	+	+			+	+		+	+													
Alf	Lp	construens (Ehr.) Grun.	15,8	16,8	18,2	16,0	15,2	9,8	10,0	26,6	22,0	11,0	8,0	16,8	15,0	15,2	19,0	18,6	17,4	17,2	11,8	22,6	17,2	14,4	10,8	9,2	18,2	6,4	8,0	10,8	16,0	19,8	8,8	6,0	15,6	11,2	12,5	4,0		+
Alf	Lp	var. binodis (Ehr.) Grun.	6,0	1,2	2,4	2,2	17,6	1,8	0,2	3,2	0,2			0,2	0,4	0,6	0,3	0,8			+	+	0,2	+	+	0,2	+	+	+	+	0,4	3,8	1,4	1,6	0,2	1,0				
Alf	Lp	var. triundulata Reich.	1,4	1,4	1,4	1,6	0,2	0,2	0,4	2,0	1,4	1,0	0,4	0,4	0,6	0,8	1,7	0,4	1,2	1,8	0,2	0,8	0,6	0,6	+	0,4	+	+	0,2	1,4	1,0	+	+			+				
Alf	Lp	var. venter (Ehr.) Grun.	5,0	6,0	1,8	4,4	7,2	8,0	5,4	6,4	2,8	1,8	2,2	2,4	1,8	3,6	6,3	5,4	4,0	5,6	5,2	2,4	1,6	5,0	1,2	2,8	3,2	2,6	2,8	3,2	3,8	6,2	2,6	5,4	8,4	5,4	2,0			+
		imbramoviciana Kaczm.	+			0,4	0,2			0,6	+			0,2					+	0,2		+			+	0,4	+	+		+		+								
Ind	Ep	inflata (Heid.) Hust.							+												0,2				0,6	+	0,2													

			16	22	27	32	36	39	41	45	48	58	60	65	68	80	83	84	86	90	98	104	111	116	120	125	138	147	160	164	166	172	178	180	186	189	192	196	200	206
Alf	Lp	intermedia Grun.	+	0,2	0,2	0,2	+		+	0,2	+	0,4	+		0,2	0,2			0,2	0,8	1,0	+	+	+	0,2	0,2	+	+	+	0,2	+	0,2				+				
Ind	Lp	lapponica Grun.	1,0	0,8	1,2	0,2	1,6	1,4	1,6	1,8	4,6	2,8	2,6	4,2	3,2	6,4	0,7	8,2	5,6	2,8	3,6	6,0	6,8	4,4	2,8	4,4	6,2	6,6	3,6	2,8	7,2	11,4	2,4	9,4	1,2	16,2	5,0		3,6	
		var. marciniakae Kaczm.					+								+									+				+			+	+		+						
Alf	Ae	leptostauron (Ehr.) Hust.		+					+	0,4	+	0,4	+		0,2	+			+								+	+		+	+	1,0	+			+				
Alf	Be	var. dubia Grun.						0,4											0,2		0,4	+		+																
Alf	Be	var. rhomboides Grun.													0,2	+														+		+		+		+				
Alf	Lp	pinnata Ehr.	2,2	0,6	9,6	1,4	7,6	30,4	9,6	8,6	0,8	3,6	0,4	2,0	3,2	1,8	6,0	3,0	1,6	2,6	1,6	3,0	2,0	0,8	3,6	2,2	1,0	1,6	0,6	1,2	3,2	2,0	11,8	10,0	24,4	2,8	11,0			
Alf	Lp	var. lancettula (Schum.) Hust.	+	0,6	1,4			1,2		1,6		0,6		2,4			+	0,2												0,2			1,0		0,2					
		virescens Ralfs	+																																					
		cf. virescens Ralfs							+																															
Ind	Lp	var. mesolepta v. Schönf.									+					+						+		+	+		+	0,2			+			0,2						
		var. oblongella Grun.	+	+	0,4	0,4	+			0,4																					+		0,2							
		FRUSTULIA																																						
Alf	Ae	vulgaris (Thw.) De Toni	+	+	0,4				+		+		+						0,2																					
	Ae	var. capitata Krasske														+																								
		GOMPHONEMA																																						
Alf	Ae	acuminatum Ehr.				+	+			+			+		0,2	+			+	+	+	+	+					+	+			+								
Alf	Ep	var. brebissonii (Kütz.) Cl.	+	+		+					+					+	0,3	0,2		+	+		+	+		+	+				+									
Alf	Ep	var. coronatum (Ehr.) W. Sm.	+	+	0,2	+			+	+	+		+		0,2	+	0,3		+	+	+	+		+		+	+	+	+	+	+	+	+			+				
	Ep	var. elongatum (W. Sm.) V. H.																							+															
	Ep	var. pantocsekii Cl.	+	+		+						0,2			+										+															
Alf	Ae	var. trigonocephalum (Ehr.) Grun.	+	+					+		+	+	+		+				+	+	+	+	+	+		+	+	+	+		+									
Alf	Ae	var. turris (Ehr.) Cl.								+					+				+	+																				
Alf	Ae	angustatum (Kütz.) Rabh.	+	0,2	0,6	0,2	+	0,4	0,2	+	+	1,0	0,4	0,2	0,6	0,4			0,2	+	+	+		+	+	+	+	+			+	+	+		+	+				
Alf	Ep	var. productum Grun.	0,4	0,6	1,6					0,2	+	+	+		0,4	0,2	0,3		+			+	+						+	+	+	+								
		augur Ehr.	+																																					
		cf. augur Ehr.				+					+		+			+			+		+					+					+	+								
Alf		var. gautieri V. H.				+	+				+										+				+															
Alf	Ep	cf. clevei Fricke																											+											
Alf	Ae	constrictum Ehr.	+	0,2	0,2	0,6	+		+	0,2	0,2	0,4	0,4	0,2	0,4	+	0,3		0,2	0,2	+	+	+	+	+	+	+	+		+	0,2	+		+						
Alf	Ep	var. capitatum (Ehr.) Cl.	+	+		+	+		0,2		0,4	+	0,2		0,2	+	0,3		+	+	+	+	+	+	0,2	+	+	+	+	+	+		0,2		0,2					
Alf	Ep	gracile (Ehr.)				+		+	+				+			+			+	+		+		+		+					+	+				+				
Ind		var. lanceolatum (Kütz.) Cl.									+																													
Alf	Ae	intricatum (Kütz.)	+	0,2	0,2		+		0,2		0,6	0,6	0,2	0,2	0,6	+			+	+	+	+	+	0,2	+	+		+	+	+	+	+		+						
Alf	Ep	var. dichotomum (Kütz.) Grun.				+										+			+																					
Alf	Ep	var. pumilum Grun.	+	+	0,2		+	0,4		0,6	+	0,8	1,0	0,6	0,8	0,2	0,3	+	0,6	+	+	+	+	+	+	+	+	+	+	0,4	0,2	0,2	+	+		+				
	Ae	var. vibrio (Ehr.) Grun.					0,2			+	+	0,2				+		0,2	+	+					+	+		+	+				+							
Alf	Ep	lanceolatum Ehr.										0,2			+				+																					
Alf	Ep	olivaceum (Lyngb.) Kütz.														+										0,2	+				+	+		+		+				
Alf	Ep	var. calcareum Cl.				+																																		
Alf	Ae	parvulum (Kütz.) Grun.	+	0,2					0,2	+	0,2		0,2		+	0,4	0,3				+							+	+		+									
		var. exilissimum Grun.	+	+	+		+			+					+	+			+	+	+	+	+		+	+						+								
Alf	Ep	var. micropus (Kütz.) Cl.				0,8					+	+					0,3		0,8	+		+		0,2	+	0,4														
Ind	Ep	var. subellipticum Cl.																				+																		
	Ep	sphaerophorum Ehr.														+													+		+	+								
Ind		subtile Ehr. var. sagitta (Schum.) Cl.		0,2							+	+													+															
		ventricosum Greg.																														+								
		GYROSIGMA																																						
Alb	Be	acuminatum (Kütz.) Rabh.	2,4	0,4	0,2	0,8	1,8	1,4	1,8	0,4	0,4	0,4		0,2	0,4	0,2	0,3		0,6	+					+					+		+	0,2	+	1,0	+	2,0			
		var. gallicum Grun.	1,8	0,6	0,6	+	1,6	4,0	3,0	0,8	1,0	1,0	1,2	0,2	0,6	+			0,4	0,2	0,2	+	+	0,4	+	0,2	0,2	0,2	0,2	+	+	0,2	0,4	0,8	0,2	0,6				
Alb	Be	attenuatum (Kütz.) Rabh.	0,8	1,2	0,2	2,0	4,6	1,2	8,6	0,2	1,6	0,8	4,2	0,8	4,0	1,2	1,3	0,8	4,2	0,2	1,0	0,4	[illegible]	1,2	0,8	0,4	0,2	0,2	0,4	0,2	0,4	0,8	0,2	2,8	3,6	16,2	32,5			
		HANTZSCHIA																																						
Alf	Et	amphioxys (Ehr.) Grun.	1,0	0,6	1,2	0,4	+	0,8	+	0,2	0,2	1,6	0,4	0,4	0,2	0,8	1,3		0,4															+		+				
Ind	Et	f. capitata O. Müll.	+	1,6	1,0	1,4	0,2	+	0,2	+	0,4		0,8	0,2	0,6	0,6			0,2													+		+						
Alf	Et	var. maior Grun.	0,4	1,2	1,0	0,6	+	+	+	+	0,4		0,8	0,2	0,6	0,6			0,6																					
		MASTOGLOIA																																						
Alf	Be	elliptica (Ag.) Cl.					+		+		+			+		0,2	0,7	+	+	0,2	+	+	+	0,2	+	0,2	+	+	+	+		+		+	0,4					
Alf	Ep	var. dansei (Thw.) Cl.				+			+		+				+	+		+	+	+	+	+	+	+	+	+	+		+			+				+				
Alf	Ae	grevillei W. Sm.														+															+	+		+	+					
Alf	Be	smithii Thw. var. amphicephala Grun.						0,2			+	0,2	+	0,2		0,2		+		+	+	+		+		+	+		+	0,4		+		+	0,4	+				
Alf	Ae	var. lacustris Grun.							0,6		+		+		+	+					+						+	+	+	+	+	+		0,6		0,2				
		MELOSIRA																																						
Alf	Pl	ambigua (Grun.) O. Müll.							+																															
Alf	Ae	arenaria Moore	1,0	1,4	0,2	0,8	0,2		0,2	+	0,6	0,2	0,4	0,2	0,4	+			+	0,2							+	+	0,4	+										
Alf	Pl	granulata (Ehr.) Ralfs	0,2	+		+	+	+	+	0,8	0,8	0,8	+	0,8	0,2	+					+				+											+				
Alf	Pl	var. angustissima Müller	+		0,4							0,2	+		+		0,7																							
		f. curvata O. Müll.			+									0,2																										
Alf	Pl	islandica O. Müll.	+			0,4						+	+												+															
		cf. islandica O. Müll.	1,6	1,0	1,0	0,2			+	0,2	0,2	0,6	0,8	0,4	0,2	0,6			+				+		+		+	0,2	+	+	+	0,2				0,2				
Alf	Lp	italica (Ehr.) Kütz.		0,2		+			+		+	1,0	+	0,2	+	+			0,2						+											+	1,5			+
Alf	Ae	roseana Rabh.	+																																					
Alf	Be	varians Ag.									0,2		+			+							+			+														
		MERIDION																																						
Alf	Lp	circulare (Greg.) Ag.	+	+	+	0,4							0,2		+	+			0,2	+			+		+	+	+	+		+	+			+						
Alf	Be	var. constricta (Ralfs) V. H.	0,2	0,4	0,2		+		+		+		+		+	+			+	+	+		+	+				+	+											
		NAVICULA																																						
Ind	Be	abiscoensis Hust.																													+	0,2		0,2						
Alf	Be	americana Ehr.	0,2	0,2	0,2				+		+		+	0,2					+	+			+							0,2		+								
Alf	Ae	amphibola Cl.	1,6	0,2	0,8	2,0	+	+	0,6	+	0,2	+	1,2		0,2	0,4	0,3		1,4																		0,5			
Alf	Be	anglica Ralfs	+		0,6		+		0,2	0,2	+		+	0,2	+	0,2		0,2	0,2	+	+	+	+	+	0,4	+	+	+	+	+	+	0,2	+	+		0,2				
Alf		var. signata Hust.			0,2		0,2	0,6	+		+	0,2			0,2													+	+		+	0,2				0,2				
Ind		var. cf. subsalsa Grun.	0,2	+		0,2	0,2	0,6	+		0,2	+	+	0,2	0,2			+	+	+	+	+	+	+	+	+	+	+	0,2	+	+	0,2	+			+				
Ind	Be	bacilliformis Grun.	+				0,2		+	+	0,4	0,2	+		+	0,2		0,2	+	+	+	+	+	0,2	+		0,2	+	0,4	+	+	+		+						
Ind	Be	bacillum Ehr.		+		+	+		+	+	0,2	+	+	0,2	0,2	+			0,2	+	+	+	0,2	0,2	+	+	0,4	+	0,2		+	+				0,2				
		bronislaae Kaczm.			0,4				+	0,2	+			0,6	+	+		0,6	+	0,4	2,4	1,8	1,8	2,6	0,8	1,0	3,4	1,4	0,4	0,2	0,6		+	0,6		+				
Alf	Be	cincta (Ehr.) Kütz.	0,2	+		0,2	0,2		0,4	0,6	0,4	0,6	+	4,2	0,6	0,2	3,3	6,2	1,0	3,0	3,6	3,4	4,0	4,8	4,2	2,2	5,4	10,2	1,6	1,6	+	+	0,2	+		1,6	0,5			
Alb		cf. clementoides Hust.										0,2																	+											
Acf	Be	cocconeiformis Greg.									+																													
Alf	Ae	confervacea (Kütz.) Grun.							+		+									+	+	+	+	+	+				+											
Alf	Et	contenta Grun.		+																																				
Alf	Et	f. biceps Arn.				0,2																																		
Alf		costulata Grun.										0,6																		+		+	+	+						
Alf	Be	cryptocephala Kütz.				0,2				0,4		0,8	+	0,2		+		+		+	+	0,4	0,2	1,0	+	0,4	+	+	0,6	+	+	0,2	0,2			+	1,0			
Alf		var. exilis (Kütz.) Grun.									0,4	0,2					1,0			0,2	0,4	+	+	0,8		0,2	+	+		+	+	+	+							
Alf	Be	var. intermedia Grun.							+			0,2				+	0,3				0,2			+	+	0,2		+		+	0,2	+								
Alf	Be	var. veneta (Kütz.) Grun.	0,4					0,2		0,2	0,2	0,4		+		+		0,2		0,4	+	0,4	0,2	0,2	+	0,2		+		0,8	0,2	+	+							
		var. cf. veneta (Kütz.) Grun.			0,2		+	0,2		+		0,4	+		+	0,2		0,4		+	0,2		+	+	+		+	+	+	+	0,2	+	0,2	+						
Alf	Ae	cuspidata Kütz.	0,8	0,8	0,2	1,4	0,6	0,6	0,6	0,2	+	0,6	1,8	0,2	0,8	0,8	0,3	+	0,2	0,2	0,2	+	+	0,2	+	+	+	0,2	+		+	+	+	0,2			1,0			
Alf		var. ambigua (Ehr.) Cl.				+					+	+				+							+	+	+		+	+												
Alf	·	var. heribaudii Perag.				+					+	0,4							+																					
Alf	Be	dicephala (Ehr.) W. Sm.	1,4	+	1,0	0,8			0,2		0,4	0,2	0,6	0,2	0,2	0,8	0,7		2,0			+								+	+					+				
Alf	Be	var. neglecta (Krasske) Hust.											0,2			+									+	+														
Alb	Be	disjuncta Hust.													+														+	+	+	+								
Alf	Be	exigua (Greg.) O. Müll.						0,2	+						+	+		+		+				+	+	0,2		+	+	+	+	+	0,2			+				
Ind		explanata Hust.					0,2		+																				+	+										
Ind	Be	gastrum Ehr.	0,2	+	0,4	0,2	+	0,2			+	0,2	+		0,2	0,2		+	+	+	+	+	+	+	0,2		+	+	+	+	+	0,2				+				
		globosa Meister							+		+				+					+	0,2	+	0,2				+	0,2	+											
	Be	gothlandica Grun.																								+														
Alb	Be	graciloides A. Mayer	+	0,2	0,8	0,2	+	0,2	+	0,6	0,2	0,6	0,4	1,2	0,6	0,6	0,7	2,0	0,6	2,8	2,8	0,4	2,4	2,6	4,2	1,8	1,0	2,4	2,2	2,2	2,0	0,2	+	+		0,4				
		var.?							+		+		+			0,2		0,4			0,2			+	+	+			+		+					+				
Alb	Ae	grimmei Krasske							+		+		+	0,4	+	+		0,2		+	0,6	+	0,2	0,4	+	0,4	+	0,2	0,4	+										
		halophila (Grun.) Cl. f. robusta Hust.									+			+		+				0,2		+	+		+			+			+									
		hungarica Grun.																															0,2							
Alf	Be	var. capitata (Ehr.) Cl.	+	0,2		+					+	0,6	+		+	0,2			+	+	+	+	0,2	0,2	+	+	+	+	+	0,2	0,2	+		0,4						
		ignota Krasske	+		0,4																																			
Ind		interglacialis Hust.					+		+																+															
Acf	Be	jaernefeldtii Hust.	0,2	0,4	0,2		+		+						+																			+						
Alf	Be	lanceolata (Ag.) Kütz.					0,2	0,4	0,6	+	0,4	+	0,2	0,2	0,2	0,2			+			+	0,2	+	+	+	0,4	+	0,4	0,6	+					0,2				
Alf	Be	var. cymbula (Donk.) Cl.							0,2		+					0,2			+	+		+		+			+	+	+	+		+								
Alf	Be	laterostrata Hust.							0,2		+		+	+	0,2	+			+	+	+	0,8	0,2	+	0,2		0,2													+
		cf. laterostrata Hust.	0,4				+		+			0,2		0,2	+	0,2												+	+	+	0,6	0,6				0,6				
		cf. limatoides Hust.																			+											+		+						
Alf	Be	menisculus Schumann		+			+				0,6	0,8	+	0,2	+	+			+	0,2	+	+	+	0,2		0,2	0,2	0,4	0,4	+	+	0,2	+			+			2,8	
		var. menisculus (Schumann) Hust.	+				+		0,4		+		0,8		+	+				+	+			+			+	+	+		+	+	0,2							
		cf. minimoides Hanguin																														+								
	Et	muraliformis Hust.																													+	+	0,2	+						
Ind	Et	mutica Kütz.	0,4	+	0,6	0,2	+		+		0,2	0,4	0,6		0,4	1,8	0,7		1,2			+										+								
		var. gibbula Hust.																	+																					
		f. intermadia Hust.	+		0,2																																			
Ind	Et	neoventricosa Hust.		+							+		+			+			0,2																					
Ind	Ae	nivalis Ehr.	+		0,2											+																								
Alf	Be	oblonga Kütz.	1,2	0,8		1,0	0,2	0,2	1,6	0,4	1,6	1,2	3,4	1,4	2,4	1,4	0,7	0,4	3,6	0,4	+	+	+	0,4	0,2	0,2	0,2	0,2	1,4	0,8	0,4	0,8	+	+		0,2				
Ind	Ae	perpusilla Grun.										0,2					0,3		+																					
Alf	Be	cf. placentula (Ehr.) Grun.						0,2			+	+					0,3			+	+				+	+				+										
Ind	Be	protracta (Grun.) Cl.					0,2									+				+			+						+			+								
Ind		f. elliptica Gallik							+		+			+	+	+			+	0,2	+	+		+	+	+	+	+	+	+		+								
Ind	Be	pseudoscutiformis Hust.					+	0,6	+							+														+										
Ind		pseudosilicula Hust.							+		+				+																									
Alb		pseudotuscula Hust.			+	+	+		0,2		0,2	0,2	+	0,2	+	+	0,3	+		+		+	0,2	0,2	+	0,2	0,2	0,6	0,2	0,2		+	0,2			+				
Alf		pseudoventralis Hust.					+		+	0,2	+	0,2		0,8	+	0,2			+	0,4	0,8	1,4	1,2	1,6	0,2	0,4	2,0	1,0	1,4	0,8	0,2	+				0,2				
Ind	Be	pupula Kütz.	0,2		0,2	0,2	+	0,2	0,4		0,2	0,6	0,2		+	+	0,3	+	+	+	+	+	+	0,8	+	0,2		+	+	0,2	+	0,2		0,2						
Ind	Be	var. capitata Hust.					+		+		+	+			+	+			0,2	0,2	+	+		+	+	+		+	+		+	+	0,2			+				
		var. cf. pseudopupula (Krasske) Hust.	+			0,2	0,2			0,2	+	+	0,4			+			+																					
Ind	Be	var. rectangularis (Greg.) Grun.	+	0,6												+								+	+			+		+										
		cf. pupula Kütz.		+		+	+		+	0,2			+								+			+				+	+	+	+	+	0,4	+						
Alb	Be	pygmaea Kütz.																			+	+		+			+	+					+							
Ind	Be	radiosa Kütz.	0,4	1,2	0,6	0,4	0,2	0,4	+	1,0	0,8	1,4	2,4	1,2	1,2	1,8	0,3	1,2	1,0	1,6	1,2	+	0,2	0,4	+	+	0,2	+	0,4	+	+	0,2		+			0,5			
Alb	Be	reinhardtii Grun.	+				+	0,2			+	0,6	0,2		+	+			0,6	+	0,2	+	+	+	+	+		+	+	+	+	+				+				
Alf	Ae	rhynchocephala Kütz.				+	+						+						+													+								
Alf	Be	var. amphiceros (Kütz.) V. H.					+												+	+	0,2	+	+	0,2		0,2	0,4	+	0,2		+									
Alf	Be	rotunda Hust.	+				+			+																			+	+	0,2	0,8	1,0	0,4		0,2				
Alf		schönfeldii Hust.	0,2	0,4	0,6	0,2	0,2		0,4	0,2	1,0	0,4	+	1,0	1,0	0,4	0,3	1,6	0,4	3,4	2,6	2,0	3,4	1,4	3,8	1,4	2,2	2,2	2,0	3,0	0,4	0,6				2,4				
Alb	Be	scutelloides W. Sm.				+	+		+						+																					+				+
	Ae	semen Ehr.	0,2	+		0,2			+		+				+				+																					
		seminulum Grun. var. radiosa Hust.																													+									
		seminuloides Hust.					0,2		+	+	0,8	0,4		2,2	0,8	+	1,0	5,8	0,2	2,4	3,8	3,8	6,0	4,0	3,0	2,6	5,4	4,0	1,4	4,2	0,8	+		0,2		0,2				
		starmachii Kaczm.							+		+	0,2		0,2	+	0,2	0,3	1,2		0,2	1,0	1,4	0,2	0,8	0,2	0,4	0,8	1,0	0,8	2,6	0,4	+		0,8						
		subbacillum Hust.																				+																		
Alf		subhamulata Grun.																											+					+						
Alf		subocculata Hust.																									+			0,2			0,6	+						
Alf		subrotundata Hust.												0,2				0,2			0,2	0,4	+		0,2	0,2	0,2			+										
Alb	Be	tuscula (Ehr.) Grun.	0,8	0,2	0,6	0,8	+		0,8		+	0,2	+	0,2	+	+			+	0,2	+	+	+	0,2	0,2	0,2	+	+	0,2		+	0,2		0,2		+				
Alb		f. minor Hust.											+			0,2			0,2		+	+	+	+		+	+	+	0,2	+	+	+		+						
Alb		f. rostrata Hust.																		+												+								
	Ae	vaucheriae Petersen																														+								
Alf	Be	viridula Kütz.	+		0,2		0,2			+		+	+	0,2	+					0,2	+	+						+			+	+								
Alf	Be	var. capitata Mayer									+	0,4	+		+	+				+		+	+	+			+	0,2	+	+	+		+							

			16	22	27	32	36	39	41	45	48	58	60	65	68	80	83	84	86	90	98	104	111	116	120	125	138	147	160	164	166	172	178	180	186	189	192	196	200	206
Alf	Be	vitabunda Hust.		+		0,2	0,4	+	0,4	1,4	0,6	0,8	+	2,2	0,2	2,2	1,7	4,2	+	0,6	2,8	5,6	6,0	4,6	3,0	3,6	3,8	3,2	0,4	2,8	0,6	0,6	0,2			0,6	1,0			
Alf	Be	vulpina Kütz.																														+								
		wittrockii (Lagst.)A.Cl.var. fennica A.Cl.														+				+																				
		sp. 1																														+								
		sp. 2												0,2				0,2				+	+	+		+	+	+	+	+										
		sp. 3					+								+	+				0,4	1,2	+	0,2	0,2	+	0,4	0,2	0,6	0,8			+								
		sp. 4	+			+								0,4						0,2	+					+			+	0,2	+									
		sp. 5										0,2														+			+	0,2	+									
		sp. 6	0,2					+	+	0,4			0,4		+	+						+	+	+		+			+	+	+		0,2							
		NEIDIUM																																						
Ind	Be	affine (Ehr.)Cl. f.hercynica (Mayer)Hust.	0,2	+		+					+	0,2	+		+	+	0,3																							
Ind		var. amphirhynchus (Ehr.) Cl.		0,2		+																																		
		amphirhynchus (Ehr.)Pfitz.var.majus (Cl.) Meist.	+										+						+			+						+												
		var. undulatum (Grun.) Meister													+																									
Ind		binodis (Ehr.) Hust.							+																			+	+											
Ind	Ae	bisulcatum (Lagst.)Cl.var.lineare (Ostr.) Cl.			0,2				+				+						+																					
		calvum Ostr.													+																									
Ind		distincte-punctatum Hust.									+					+																	0,2							
Ind	Be	dubium (Ehr.) Cl.	+				+				+		+		+	+				+		+	+	+			+		0,2	+	+	0,2								
		f. constricta Hust.							+		+												+					+	+			+	+							
		var. major Foutel																						+																
Ind	Be	iridis (Ehr.) Cl.	1,4	0,6	0,2	1,2	0,6	0,4			1,2	0,2	1,0	0,4	0,4	0,2			+				+	0,2	+	+	+	+	0,2			+				+				
Ind		f. vernale Reich.	+		+	+		+	+		0,4	0,8	0,2		0,4	0,2	0,3		0,2		+	+	+			+	+			+	0,2									
Ind		var. ampliatum (Ehr.) V. H.									+		+										+	+	+		+		+	+		+								
Acf	Be	productum (W. Sm.) Cl.																									+													
		NITZSCHIA																																						
		acicularis W. Sm.																																	0,2					
Alf	Ae	amphibia Grun.	0,2	+	0,6	0,2	+	0,2	+	0,6	0,2	0,2	0,4	+	0,4	0,4		0,2	0,2	1,2	0,6	0,4	0,2	0,6	0,2	0,4	+	+	0,2	+	0,4	0,2	+	0,6	+	+				
Alf	Be	angustata (W. Sm.) Grun.	+	0,2					+		+	+		0,2	+	+	0,3		0,4	+	0,2	+	+	0,2	0,2	+	0,2	+	+	+	0,2	0,2	+	+		+				
Alf		var. acuta Grun.											+								+	+		+		+								+						
Alf	Be	apiculata (Greg.) Grun.											+							+														+						
Alf	Be	frustulum (Kütz.) Grun.												0,2																	+		0,2	+						
Alf	Be	var. perminuta Grun.																											+		+									
Alf		heufleriana Grun. var.?										0,4	+									+					+	+	+		+									
Ind	Be	palaea (Kütz.) W. Sm.							+							0,4				+		+											+							
Alf		parvula Lewis			0,2	+								+	+	+																								
		f. terricola Lund									+																													
Alf	Be	sinuata (W.Sm.) Grun.v.tabellaria Grun.																											+		+	+		0,2						
Alf	Be	thermalis Kütz.																								+														
		sp. 1																			+					+		+	+				+		+					
		sp. 2	0,2	+	0,2		0,2	0,2	0,2	0,2	0,2		0,2	0,2	+	0,2		+	+	+	+	+			+	0,4	+	+	+	+	+	+	+	+		0,2				
		OPEPHORA																																						
Alf	Ep	martyi Herib.	+	0,2	0,4	0,2	+	1,8	+	0,4	+	1,2	2,2	0,4	0,2	0,6			0,4	0,4	+	0,6	+						+			0,4	0,2		1,2	+				
		PINNULARIA																																						
Alf	Be	acrosphaeria Bréb.			+						+					+																								
Ind	Ae	appendiculata (Ag.) Cl.		0,2		+					+										+	+		+				+				+								
Ind	Et	borealis Ehr.	4,8	1,6	1,8	3,2	0,2	0,4	0,2	0,6	0,6	0,2	2,2	0,4	1,6	7,8	1,3		1,2															+	0,2	+		2,0		
Acf	Be	brevicostata Cl.																						+								+								
Acf	Be	cardinalis (Ehr.) W. Sm.			0,2						+																													
Ind	Ae	gentilis (Donk.) Cl.																										+												
Ind	Be	gibba Ehr.		+		0,6			+	0,2	0,2	+			+	+				+																				
Acf		f. subundulata Mayer									+																													
Ind		var. linearis Hust.	+	+			+								+	+								+																
Ind	Ae	intermedia Lagerst.	0,4	+			+				+	0,4	+		+	0,2			0,2																					
Acf	Be	interrupta W. Sm.				+							0,4																+											
		lagerstedtii (Cl.) A. Cl.		+		+			+		+		+		+	+			+																					
		lata (Bréb.)W.Sm.var. costata (Ehr. et Herib.) Meister	+	0,2	+	+			+		+																													
Acf		legumen Ehr.																				+				+														
Ind	Be	mesolepta (Ehr.) W. Sm.	+			+					+		+		+	+			+					+				+	+			+								
Ind	Be	microstauron (Ehr.) Cl.	0,2	+	+	0,8	+	+	+		0,2	1,2		0,2	0,2	0,2		0,2	0,2	+	+	+	+	+	+		+	+	+	+	+	+	+					2,0	3,6	
Ind		var. brebissonii (Kütz.) Hust.		0,2		+	+		+		0,2		+		+	0,4			+				+	+			+	+			+	+		+					1,8	
Ind		f. diminuta Grun.			+										+															+									1,8	
		cf. microstauron (Ehr.) Cl.				+																										+								
Ind	Et	molaris Grun.														+																								
Acf	Be	nobilis Ehr.										+			+																									
Ind	Be	nodosa Ehr.	+	0,2		0,2	+		+		+	0,2																												
Ind	Be	pulchra Ostr.	1,0	0,6	1,8	1,0			+		0,8	0,4	+		1,4	+	0,3		0,6												+									
		streptoraphe Cl.	+																																					
Acf	Be	subcapitata Greg.		+	0,2	0,2							+			0,2																								
Ind	Ae	viridis (Nitzsch.) Ehr.	5,8	6,0	2,6	6,8	0,8	0,4	1,2	0,8	1,4	3,0	5,4	0,2	2,8	2,2	1,4		2,2	+	+	+	+	0,4	+	+	+	+		+	+	0,2	0,4	+	+	0,6	3,0			
		var. comutata (Grun.) Cl.	2,0	3,4	0,8	0,4		+				1,6	+	0,4	+	+	1,0		0,2	+												+					0,5			
		var. elliptica Meister																																						
		var. cf. leptogongyla (Ehr.? Grun.) Cl.	1,2	1,4	1,4	1,2			1,2	0,6	2,0	1,2	2,8	0,6	2,0	1,6	0,7	+	1,0	+	+		+	+	+			+	+	+	0,2		+							
Acf	Be	var. minor Cl.		0,4	0,4	0,6			+	+	+	+	+	+	+	+			0,2																					
		RHOPALODIA																																						
Alb	Ep	gibba (Ehr.) O. Müll.	+	0,6	0,2	0,2	+		+	+	0,2	0,2	+	0,2	0,2	0,2		0,2	0,6	0,2	0,2	0,2	0,2	0,2	0,2	0,4	+	+	0,2	0,2	0,8	0,2	+	0,2		+				
Alb	Ep	var. ventricosa (Ehr.) Grun.	0,4	+		+			+		+		+		+	+			0,2	+	+	+	+	+	+	+	+	+	+		+	+				+				
Alf	Be	parallela (Grun.) O. Müll.									+																													
		RHOICOSPHENIA																																						
		sp.																				+																		
		STAURONEIS																																						
Alf	Be	acuta W. Sm.	0,2	+		+	+		+		+		+		+	+			+		+			+				+	+			0,2		0,2		+				
Ind	Be	anceps Ehr.	3,2	0,6	0,2	0,6	0,2	0,2	0,2		0,4	+	0,4	0,2	0,6	0,6	1,0	+	+				+			+			0,2			+	0,2							
Ind	Ae	f. gracilis (Ehr.) Cl.	0,2	+	0,4	+	+	0,2	0,2	0,2		0,2	+		+	+	0,3		+										+	+										
		f. linearis (Ehr.) Cl.																																						
		laurenburgiana Hust.	0,2	0,2				0,2	+		+	0,2	0,2		+	0,2			0,2										0,2										1,8	
Ind	Be	legumen (Ehr.) Kütz.												+					+						+															
Ind	Be	phenicenteron (Nitzsch.) Ehr.	0,6	1,0	0,2	1,0	+	+		+	0,2	+	0,4		0,4	0,4			0,6	+	+	+	+	+	+	+		+			+	0,2	+							
Alf	Be	smithii Grun.							+			0,2			+	+			0,2	+	+					+	0,2		+		+	+								
Alf		var. borgei (Mang.) Hust.							+						0,2									+	+	+	+	+	+	+			0,6	0,2						
Alf		var. sagitta (Cl.) Hust.					+		+			0,4																				+	0,2	+						
		STEPHANODISCUS																																						
		astraea (Ehr.) Grun.										0,2																									1,5			
		var. intermedia Fricke	+																										+			+								
Alb	Pl	var. minutulus (Kütz.) Grun.		+	0,2		+	0,2	0,4	0,6	+		0,2	0,2	+	+			+		+	+	+	0,2	+	+	+	+	+	1,0	19,6	2,2	0,8	0,4		+	0,5			
Alb	Pl	dubius (Fricke) Hust.	0,2	0,2	0,2	0,2	+		+		+		+		+	+			+																					
		SURIRELLA																																						
Ind	Be	biseriata Bréb.					+													+	+		+	+				+	+											
		f. punctata Meister		+			+	+		+	+							+	+		+	+	+	+	+		+	+	0,2	+		+	0,2	1,4						
Ind	Be	linearis W.Sm.var.constricta (Ehr.)Grun.																										+												
	Be	cf. turgida W. Sm.	+																													+		+		+				
		sp.	+	0,2	0,2	0,2		+		0,2	+		0,2		0,2	0,4			+													+		+		+				
		SYNEDRA																																						
Alb	Lp	acus Kütz.var. radians (Kütz.) Hust.					0,2				+		0,2						+	0,4	+	+	+	0,4	+	0,2	+	+	0,2		2,8	0,2		0,2		0,2				
Alf	Ep	capitata Ehr.	0,2	0,4	0,8	0,6	+	0,2			+	0,2	0,4	0,4	0,4	0,4	0,3	0,4	0,2	0,2	+	0,2	0,2	0,2	0,2	0,2	+	0,2	0,8	0,2	1,0	+	+	+		0,4				
Alf	Ep	parasitica (W. Sm.) Hust.					0,2	0,2	+	0,2	+	0,2	+	0,2	+	+		0,2	0,2	0,6	0,4	0,4	0,2	0,6	+	0,6	0,6	1,0	0,4	0,2	+	+	1,2	0,2						
Alf	Ep	var. subconstricta Grun.							0,2		+		0,6		+																	+	0,2	+		+				
Ind	Lp	tenera W. Sm.																													+									
Alf	Ep	ulna (Nitzsch.) Ehr.	0,6	0,6	1,0	0,8	0,4	0,2	0,6	0,2	1,4	0,4	1,0	0,6	0,4	0,4	0,7	0,2	1,0	+	0,4	+	0,2	0,2	+	0,2	+	+	+		1,6	0,2	0,2	+	0,2	+	1,0			
Alf		var. aequalis Hust.									+								+																					
Alf	Sp	var. amphirhynchus (Ehr.) Grun.			0,8	0,2	+	+		0,2	0,2	0,6			+	0,2					+		+	+	+	+	+	+	+		0,2									
Alf	Ep	var. biceps (Kütz.) v. Schönf.	0,2	+	0,6	+		+	+	+	+	+	+	0,4	1,0	+	0,3		0,4	+	+	+		+	+	+		+	0,2	+		+	+	+						
Alf		var. spatulifera Grun.																													+									
		TABELLARIA																																						
Acf	Lp	fenestrata (Lyngb.) Kütz.			0,2	+				0,2	+		0,2		0,2	+			0,4									+	0,4	+	+	+		+						
Acf	Lp	flocculosa (Rabh.) Kütz.																																						
		TERTIARY DIATOMS																																						
		Actinocyclus Ehr.? sp.		+																																	+			
		Actinoptychus Ehr.? sp.											+				+																	+			+			
		Auliscus cf. caelatus Bail.							+							+																								
		Biddulphia Gray? sp.																																			+			
		Caloneis cf. blanda (Schmidt) Cl.																														+								
		Campylodiscus clypeus Ehr.					+		+				+																											
		Coscinodiscus Ehr. sp. 1														+																					+			+
		sp. 2									+				+																									
		sp. 3		+																													+			+	+		+	
		Cyclotella striata var. bipunctata Fricke					+		+		+				+				+																					
		Diploneis didyma Ehr.							+		+					+																								
		Diploneis interrupta (Kütz.) Cl.					+		+				+																											
		Gramatophora Ehr.? sp.				+																																		
		Hyalodiscus Ehr.? sp.																																			+			
		Melosira ornata Grun.					+						+				+		+													+		+		+	+			+
		Melosira sulcata (Ehr.) Cl.				+	+		+		+		+		+	+			+													+					+			+
		Nitzschia navicularis (Bréb.) Grun.							+						+																									
		Plagiogramma Grev.? sp.				+									+																						+			
		Pyxilla Grev.? sp.																																			+			
		Raphoneis amphiceros Ehr.					+		+		+					+			+																					
		Stephanopyxis Ehr.? sp.	+						+		+		+			+			+													+		+		+	+			+
		Surirella cf. striatula Turp.							+																															
		Trinacria Heib.? sp.																																			+			
		CYSTS of CHRYSOPHYCEAE	40,4	24,4	16,0	28,0	15,4	10,8	14,2	5,8	6,2	5,8	6,2	5,6	20,4	20,4	15,0	1,8	18,2	1,0	1,2	0,8	0,6	0,6	0,4	0,8	1,0	2,2	1,6	4,0	4,6	4,2	6,0	10,6	7,2	13,2	264,5	44,0	11,8	473,0