APPENDIX

THE DIATOM FLORA OF THE STEENBRUGGE-CLAY (EEMIAN)

We received a continuous sampling of the Steenbrugge-Clay of Eemian age which was studied by J. Vandenberghe et al. (1973). A complete pollen diagram being available these authors concluded that this schorre-clay could well be correlated with the Eemian zone 4b of Zagwijn (1961). As only few diatom flora's are described from the Eemian it may be worthwhile to publish here the detailed list of the determinations and the quantitative data.

Method

For the quantitative purpose, the method given by Crommelin (1945) seemed the most suitable. From each sample a quantity of 5 g was boiled during twenty minutes in concentrated sulphuric acid to destroy the organic material. At the end potassium nitrate was added to become the whitish-gray colour. The contents of the porcelain discs in which the samples were treated, were added slowly to glasses filled with 1 l distilled water. After 24 hours of sedimentation the supernatant was carefully siphonned over, and the samples were rinced again with 1 l distilled water, after which they were stored during 24 hours for sedimentation. This treatment was repeated 5 times to remove the gypsum. At the end the residue was replenished to 0,5 l.

Before the microscopical observation the samples (0.5 l) were shaken thoroughly to become a suspension as homogeneous as possible. From each sample three drops with a volume of 0.041 ml were taken immediately. With each drop a preparation was made in which the diatoms were counted. The results of these counts are given in table I. The number of diatoms in 1 mg of fresh material is given by the formula :

$$N = 0.8\,X$$

where N = number of diatoms in 1 mg

X = the total of the numbers of diatoms counted in the three preparations.

The table I gives at the same time the list of observed diatoms.

TABLE I

Number of Observed Diatoms

Species	type (1)	D_1	D_2	D_3	D_4	D_5	D_6	D_7	D_8
CENTRALES									
Actinocyclus Ehrenbergii Ralfs	M	—	1	—	2	1	—	1	—
Actinoptychus undulatus (Bailey) Ralfs	M B	5	6	2	5	11	2	13	6
Auliscus sculptus (W. Smith) Ralfs	M	—	—	1	—	1	—	—	—
Biddulphia pulchella Gray	(M)	—	—	1	—	—	—	—	—
B. rhombus (Ehrenberg) W. Smith	M	—	4	—	2	1	—	17	2
Coscinodiscus excentricus Ehrenberg	M B	2	1	—	3	1	—	6	—
C. Kützingii A. Smith	(M)	—	—	—	1	—	—	—	—
C. radiatus Ehrenberg	(M)	—	—	—	—	—	—	1	—
Melosira sulcata (Ehrenberg) Kützing	M	44	44	29	40	33	22	68	25
Podosira Stelliger (Bailey) Mann	M	1	5	2	1	1	3	2	—
Triceratium alternans Bailey	M	—	—	—	—	—	1	—	—
T. favus Ehrenberg	M	2	12	4	4	2	1	6	—
PENNALES									
Achnantes brevipes Agardh	B M	—	1	—	1	2	—	1	3
Caloneis formosa (Gregory) Cleve	B	—	—	1	—	25	24	11	—
Campylodiscus clypeus Ehrenberg	B	—	—	—	—	—	—	1	—
C. echeneis Ehrenberg	B	—	—	—	—	1	—	—	—
Cocconeis scutellum Ehrenberg	(M)	2	—	—	—	1	—	3	—
Diploneis didyma Ehrenberg	M B	67	5	7	340	347	285	222	54
D. interrupta (Kützing) Cleve	B	—	—	—	—	—	—	1	1
D. ovalis (Hilse) Cleve)	Z B	—	1	—	3	67	224	82	5
Navicula hungarica Grunow	Z B	—	—	—	—	—	—	—	3
N. latissima Gregory	M	—	—	—	—	—	—	—	4
Nitzschia acuminata (W. Smith) Grunow	M B	—	—	—	—	1	—	—	—
N. navicularis (De Brébisson) Grnuow	B	88	11	24	211	181	133	288	33
N. punctata (W. Smith) Grnuow	B M	6	—	4	23	41	3	38	15
N. sigmoidea (Ehrenberg) W. Smith	Z B	—	—	—	—	3	2	7	1
N. tryblionella Hantzsch	B Z	—	—	—	—	—	—	3	—
Rhaphoneis amphiceros Ehrenberg	MB	5	2	—	—	1	1	—	1
Rh. surirella (Ehrenberg) Grunow	M B	—	—	1	—	—	—	—	—
Rhopalodia musculus (Kützing) O. Müller	B	1	1	—	3	—	—	1	—
Scoliopleura tumida (De Brébisson) Rabenh.	B M	—	—	—	—	—	—	4	4
Stauroneis phoenicenteron Ehrenberg	ZB	1	—	—	1	10	45	30	2
Surirella fastuosa Ehrenberg	(M)	—	—	1	80	14	11	11	—
not classified		6	5	4	11	7	5	13	10
Total		230	99	81	731	752	762	830	169
number of frustules per mg		184	79	65	585	602	610	664	135

Explanation by table I :

(1) The indication of the type of salinity-dependence is copied from A. Van der Werff and H. Huls (1957) with exception of the data between brackets. For the latter the information is based upon the other cited works.

The symbols mean :

M = marine

MB = marine-brackish

BM = brackish-marine

B = brackish

BZ = brackish-fresh

ZB = fresh-brackish.

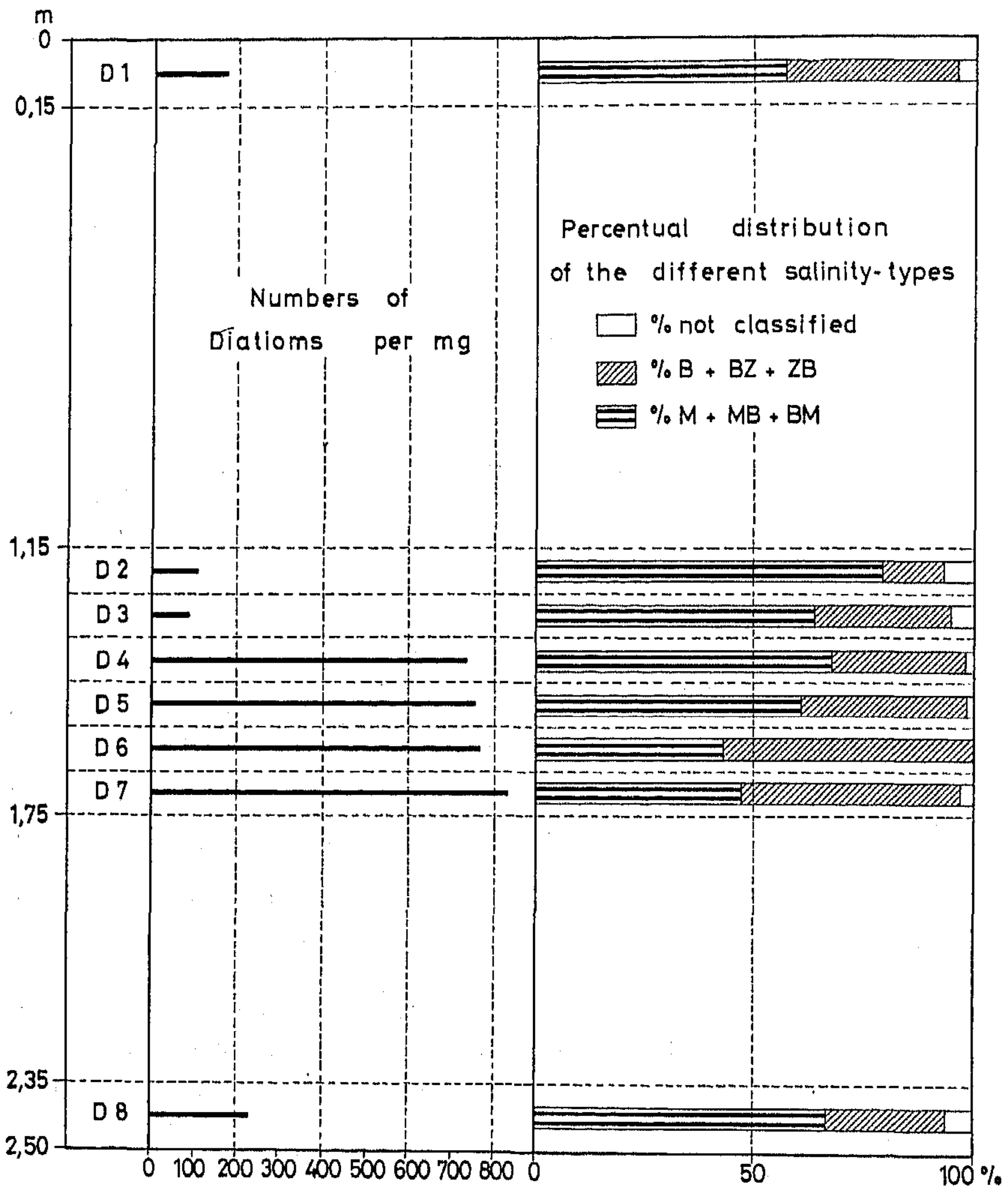
DISCUSSION

1. *The total number of diatoms per mg*

In comparison with some literature data the totals given in table I seem rather low. For this fact two explanations are acceptable :

1° The samples contain a relatively high quantity of organic material.

2° A great number of frustules are broken and it is impossible to make an estimation of the number of complete frustules represented by the fragments. Anywhere, most of the fragments could be identified as



belonging to the cited species. The number of fragments was moreover in proportion with the number of complete frustules so that at any rake a comparison can be made between the different results.

By comparison of the results (fig.), it is clear that the samples can be divided in two groups : the totals in D_7, D_6, D_5 and D_4 are strikingly higher than in D_1, D_2, D_3 and D_8. The high values are mainly due to the marine-brackish species *Diploneis didyma* and the brackish species *Nitzschia navicularis*. The fresh-brackish species *Diploneis ovalis* reach a climax in D_6.

If one takes into account that fresh water contains more phytoplancton than brackish water and brackish more than seawater (Louis and Clarysse, 1971, p. 312), the samples D_7, D_6, D_5 and D_4 must be considered as brackish sediments, and the samples D_1, D_2, D_8 and D_1 as marine (littoral) sediments. The most striking difference lies between samples D_4 and D_3, where in a distance of only 10 cm the picture of the diatom population is completely altered.

2. *Salinity dependence*

For each sample the observed diatom frustules are added up per type. The values are converted to become the percent of each type of the total population. To make a separation between the fresh water and the sea water influence the contributions of the marine, marine-brackish and brackish-marine types are added up on the one side, the brackish, brackish-fresh and fresh-brackish on the other side.

TABLE II

Percentual distribution of the different salinity-types

Type Sample	M %	MB %	BM %	Sub-total %	B %	BZ	ZB %	Sub-total %	Unclas-sified %
D_1	21	34	3	58	39	—	—	39	4
D_2	66	14	1	81	12	—	1	13	5
D_3	47	12	5	64	31	—	—	31	5
D_4	18	48	3	69	29	—	11	30	2
D_5	7	48	6	61	27	—	11	38	1
D_6	5	38	—	43	21	—	36	57	1
D_7	13	29	5	47	36	—	14	50	2
D_8	18	36	13	67	20	—	7	27	4

The results are given in table II (see also figure).

The fresh water influence reaches a climax in sample D_6 and the marine influence in D_2. A more profound knowledge of the ecological characteristics of the different species should make further interpretations possible.

3. *Comparison between the observed species and the actual diatom populations at the Belgian Coast*

Because there is a very great periodical and geographic variability in the occurrence of diatom populations, even on a small scale; it is rather difficult to compare the observations, given in this paper, with the actual situation. A great part of the species correspond with those observed by Brockmann (1928) in Eemian sediments. However, most of these species are living nowadays in our littoral and brackish waters (Van Heurck, 1899; Allaerts, 1967; Van der Wielen, 1967; De Pauw, 1969; Louis en Clarysse, 1971; Petes, 1972; Ramboer, 1972).

In this respect, it is not obvious to speak of a „fossil vegetation''. Further conclusions may be based upon larger series of investigations.

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REFERENCES

ALLAERTS, E., „Etude floristique et écologique de la population algale de trois biotopes d'eau marine et saumâtre de la Côte Ouest Belge". Licentiaatsverhandeling U.C.L., 1967.

BROCKMANN, C., „Die Diatomeen im marinen Quartär Hollands" 1928, *Abh. der Senkenb. Naturf. Gesellschaft;* **43**, 3.

CROMMELIN, R. D., „Quantitatieve bepaling van diatomeeën in sedimenten en de betekenis ervan voor de Kwartair-Geologie" 1944-45, *Verhand. Geol. Mijnb. Genootschap voor Nederland en Koloniën, Geol. Serie,* Deel XIV, 125-135.

DE PAUW, N., „Contribution à l'étude du plancton dans le port d'Ostende", *Biologisch Jaarboek Dodonaea,* 1969, **37**, 186-261.

HUSTEDT, F., „Die Diatomeenflora des Flusssystems der Weser im Gebiet der Hansestadt Bremen" 1957, *Abh. Naturw. Ver. Bremen* **34**, **3**, 181-440.

HUSTEDT, F., „Die Kieselalgen Deutschlands, Österreiches und der Schweiz", Teil I in Rabenborst's Kryptogramen-Flora, Ak. Verlaggesellschaft m.b.H. Leipzig 1930.

LOUIS, A. et CLARYSSE, R., „Contribution à la connaissance du phytoplancton de l'Atlantique Nord-Est et de la Mer du Nord", *Biologisch Jaarboek Dodonaea,* 1971, **39**, 261-337.

PETES, J., „Algologische analyse van de bovenste waterlagen van de Noord-Oost Atlantische Oceaan en de Noordzee". Licentiaatsverhandeling K.U.L., 1972.

RAMBOER, T., „Algologische studie van de oppervlakkige waterlagen van de Noord-Oost Atlantische Oceaan en de Noordzee", Licentiaatsverhandeling K.U.L., 1972.

SIMONSEN, R., „Untersuchungen zur Systematik und Ökologie der Bodendiatomeeën der westlichen Ostzee", 1962, Internationale Revue der Gesamten Hydrobiologie. Systematische Beihefte I. Akademie-Verlag, Berlin.

VAN DER WERFF, H. and HULS, H., „Diatomeeënflora van Nederland", 1957.

VAN DER WIELEN, C., „Observations floristiques et écologiques concernant la florule algale au Littoral Belge". Licentiaatsverhandeling U.C.L., 1967.

VAN HEURCK, H., „Synopsis des Diatomées de Belgique", Antwerpen, uitgegeven door de schrijver in 1885.

VAN HEURCK, H., „Traité des diatomées", Antwerpen 1899.

ZAGWIJN, W. H., „Vegetation, climate and radiocarbon datings in the Late Pleistocene of the Netherlands, Part I : Eemian and Early Weichselian, Med. Geol. Stichting, n.s., 1961, n° **14**, p. 15-45.