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STUDY ON POLLUTION IN THE NORTH SEA. C.I.P.S.

Mathematical Model of Marine Pollution.

First trophic level - Analyses of photosynthetic pigments and phytoplankton.

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INTRODUCTION.

According to the program, decided jointly by all participants the first phase of the study on pollution in the North Sea consists in an assessment of the existing living and non-living material within the area delimited by the mathematical model.

Obviously, the study of living organisms is fundamental when marine pollution is concerned, as the main purpose is to prevent marine life from the effects of pollutants. Moreover, the marine organisms may also be considered as a mean of accumulation, transformation and dispersion of pollutants. It is therefore essential to evaluate the biomass in the area under study and to observe its variation in function of time and space.

In addition, the conditions in which the organisms are found (cells damaged or not) and the general trend of succession of the populations during the seasons (normal succession, altered or not) might give some indications of pollution effect, keeping in mind that not "pollutant" factors may influence the results (turbulence, settling, velocity...).

The contribution of our Laboratory to the first phase of the program consists in :

- the study of photosynthetic pigments, including measurements of chlorophyll *a* and phaeophytin *a* in each sample
- the study of phytoplankton.

## RESULTS.

The results already obtained by the study of the samples of the first cruise (January, February) and the second cruise (June, July, August) lead to the following observations

### 1. Distribution of Chlorophyll a within the area delimited by the mathematical model. (Fig. 1 and Fig. 2)

The complete data concerning the chlorophyll a (SCOR) concentration at each station and at each depth sampled, were detailed in Report I and III. Taking into consideration only the results expressed as chlorophyll a concentration per m<sup>3</sup>, the results plotted on Fig. 1 and Fig. 2 represent schematically the integrated chlorophyll a concentration at each sampled station. They show clearly that the chlorophyll a concentration is higher for the stations situated along the coast and in the estuarine zone (Stat. MO2 and MO7 - first cruise; Stat. MO1, MO3, MO6, MO8, MO11, MO21 - second cruise). Moreover, a marked decrease is noticeable when the distance offshore increases. The regular decrease allows to divide the studied area in two parts : a coastal part with a chlorophyll a content higher than 3 mg/m<sup>3</sup> and an offshore part with less than 3mg/m<sup>3</sup>. The limit between the two areas follow approximately a parallel to the coast at about 20 miles.

### 2. Distribution of Phaeophytin a concentration within the area delimited by the model. (Fig. 3 and Fig. 4).

The analysis of the phaeophytin a concentration, compared to the chlorophyll a (both calculated by mean of the LORENZEN method) has revealed some similitude with the total chlorophyll a (calculated by the SCOR method), but also some interesting differences.

The detailed study of the phaeophytin a and chlorophyll a distribution of the first cruise will be the object of an annex to Report I and is summarized in Table I; those of the second cruise are reported in Report III.

Generally speaking, the distribution of phaeophytin a concentration, schematically plotted on Fig. 4 and 5, shows that the highest values are obtained nearby the coast and are more closely linked to the estuarine zone (MO1, MO2, MO5, MO6, MO7).

### 3. Distribution of Diatoms - Total abundance (Fig. 5).

From the analysis of the samples of the first cruise, a maximum abundance of Diatoms was recorded along the line delimited by Stat. M02, M07, M06, M05; a minimum abundance was found at Stat. M04 and M03, both at greater distance from the coast.

Moreover, from a preliminary population study it appears that the stations M01 and M02 (first cruise) were characterized by a large proportion of benthic forms, while Stat. M05 showed a mixed population, all other stations being composed largely by pure planktonic forms.

This observation confirms to a certain extent the limit found with the chlorophyll a and phaeophytin a concentration, between the "coastal-neretic" area and more offshore waters.

### 4. Distribution of the ratio living cells/death cells.(Fig. 6)

The computation of the ratio living to death cells has lead, for the samples of the first cruise, to some interesting observations. Indeed, this ratio shows a progressive higher value with the increasing distance from the coast and from the estuary of the Scheldt, the minimum values being restricted to the coastal and more particularly the estuarine zones.

At the first serie of stations, M02, M07, M01, the values are 0.24, 0.77 and 0.55, respectively. At the second serie of stations, M03 and M05, these values reach 2.75 and 2.83, respectively. To the third serie of stations, M04 and M05 correspond values of 4.96 and 5.01. In other words, the highest quantity of living cells is found at the greatest distance from the coast (M04 and M06), while the maximum quantity of death cells is encountered, if not at the nearest to the coast, at the nearest to the estuary (M02).

### 5. Relation between ratio chlorophyll a/phaeophytin a and living cells/death cells. (Fig. 7)

However it is too early, on basis of the results of the first cruise and a preliminary study of the second cruise, to establish a definit conclusion on the relation between the ratio chlorophyll a/phaeophytin a and living cells/death cells, it is nevertheless apparent that a good relation does exist between the two : both ratio's increase similarly as the distance from the coast became larger and are minimum especially in the estuarine zone.

CONCLUSION.

From the results obtained by pigment analyses as well as by phytoplankton countings, a certain number of statements can be put forward :

- The chlorophyll a (SCOR) concentration is maximum near the coast, the estuarine zone included, and decreases offshore. Repeated and correlated to other factors it would probably be a valuable measurement of the extent of the area influenced by the coast.
- A similar conclusion can be given for the phaeophytin a (LORENZES) concentration with special mention for the relation with the estuarine zones.
- As far as the phytoplankton study concerns, the ratio living to death cells appears to be a value that increases as the distance offshore the coast, and more particularly the estuarine zone, increases. This observation may be an indication of unfavourable conditions but has first to be submitted to correlations with other environmental factors as turbulence, suspension of sediments.... Moreover, a positive relation exists between the ratio living cells/death cells and chlorophyll a/phaeophytin a.
- As phytoplankton populations considered as an entity (actually at study), are in fact directly <sup>a</sup>linked to environmental factors and to time, the variations observed in their composition at the different points analysed may also be a measure of some particular influences.

If, up to now, a certain number of conclusions can be suggested it seems nevertheless that some relations between biological data and environmental data are likely to be studied, especially in view to achieve a certain selection of values appropriate for the mathematical model. (Exemple : the relation between chlorophyll a and nutrients, between phaeophytin a and salinity , between the ratio living cells/death cells and turbulence).

Table I: Chlorophyll a and Phaeophytin a concentrations

(first cruise - January-February 1971).

Stations	Chl.a (mg/m3) (LORENZER)	Phaeoph.a (mg/m3) (LORENZER)
M01	1.81	1.36
M02	3	8.65
M03	1.95	0.81
M04	0.89	0.09
M05	2.24	1.30
M06	2.05	1.32
M07	2	2.08



Fig. 2

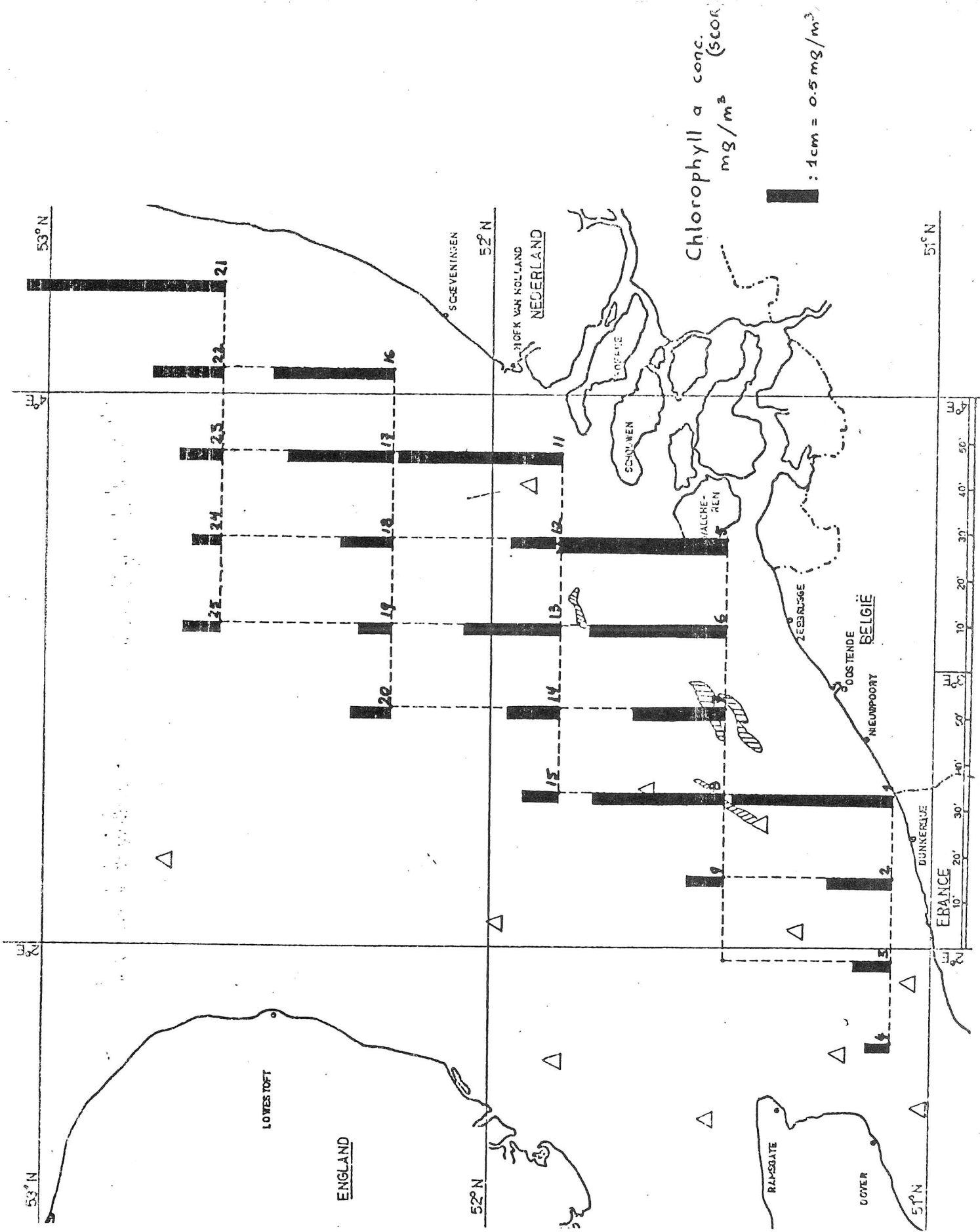


Fig. 3

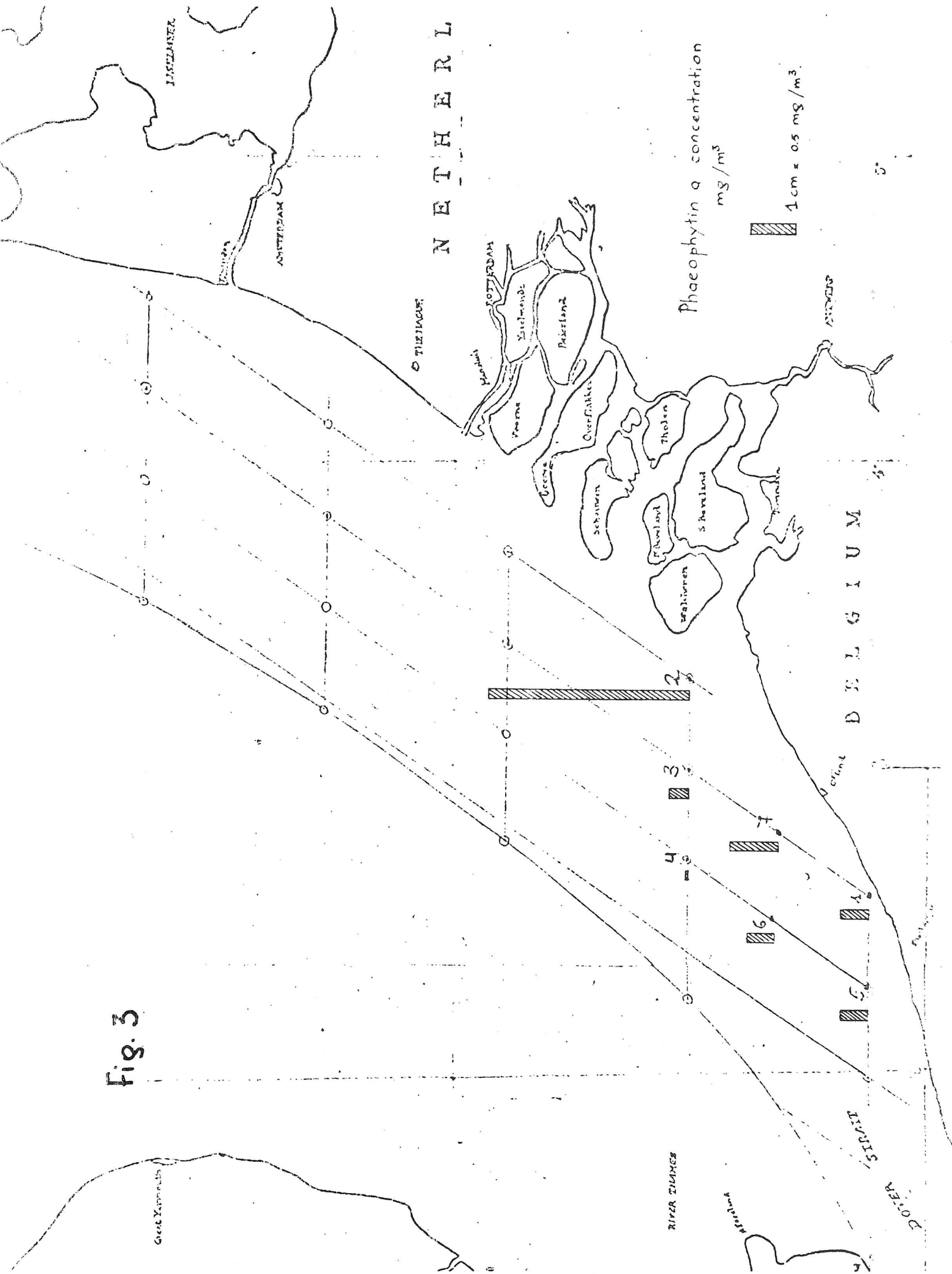




Fig. 4

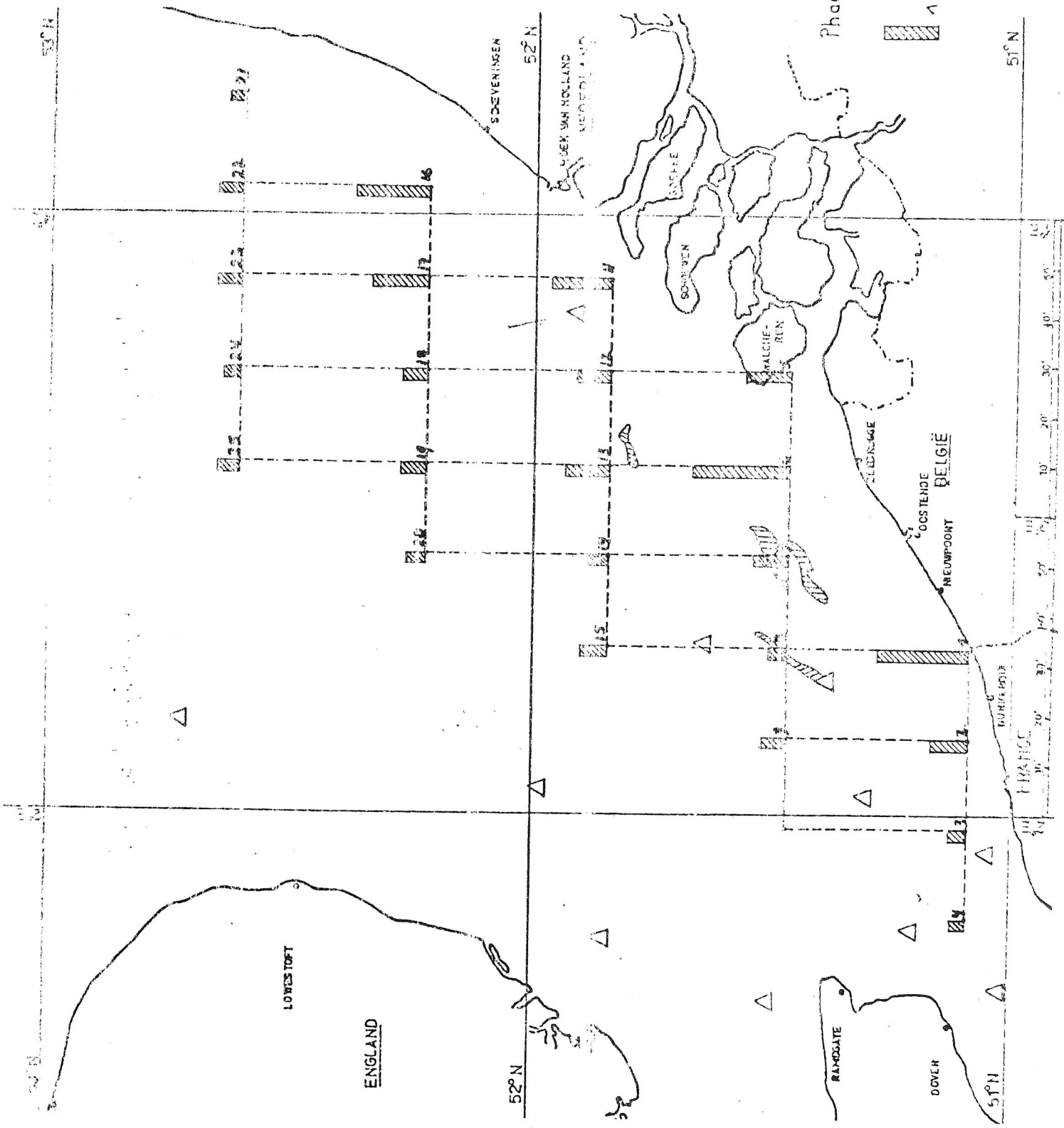


fig. 5

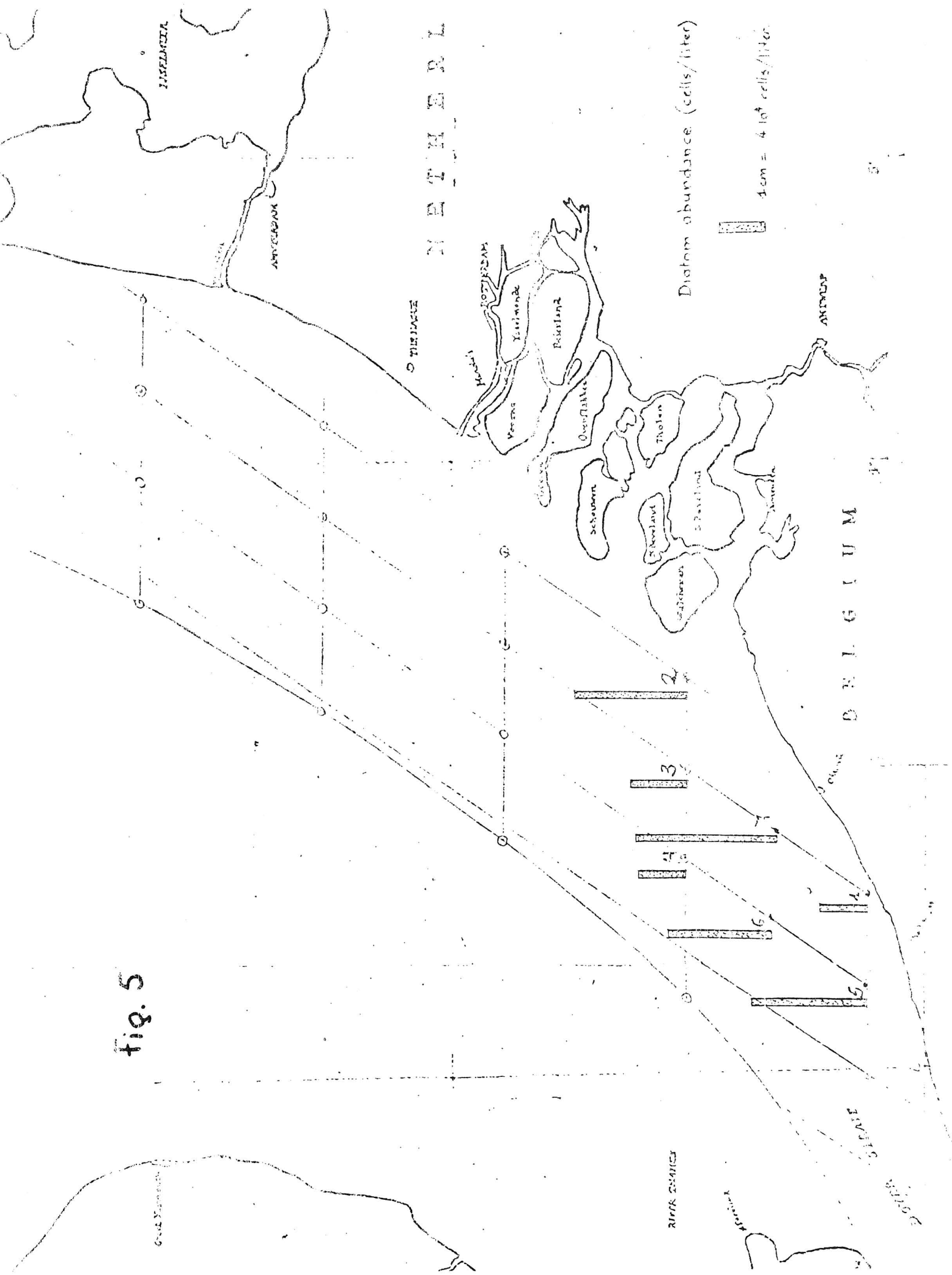


Fig. 6

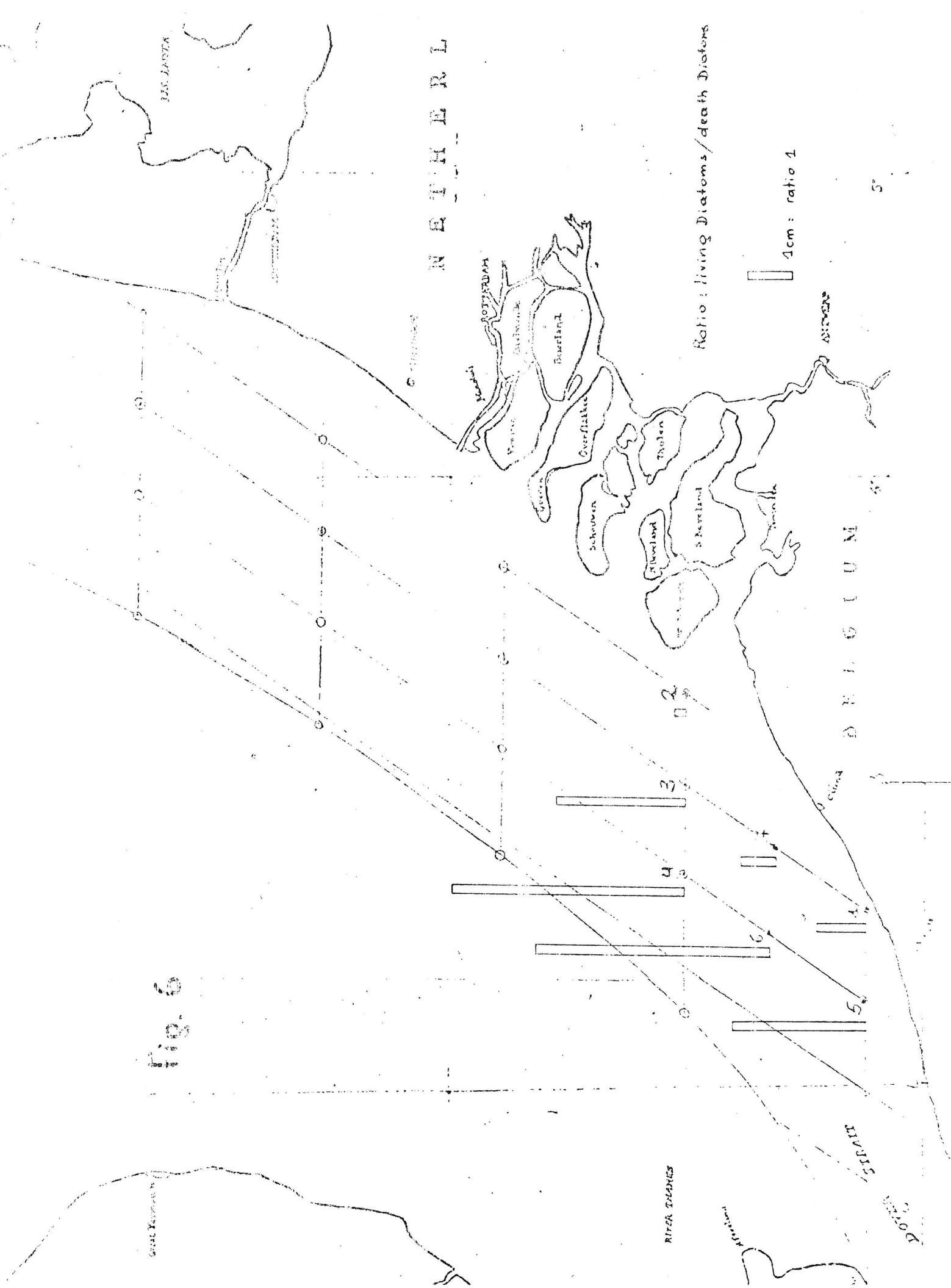


Fig. 7.

