

ANNUAL REPORT 1983



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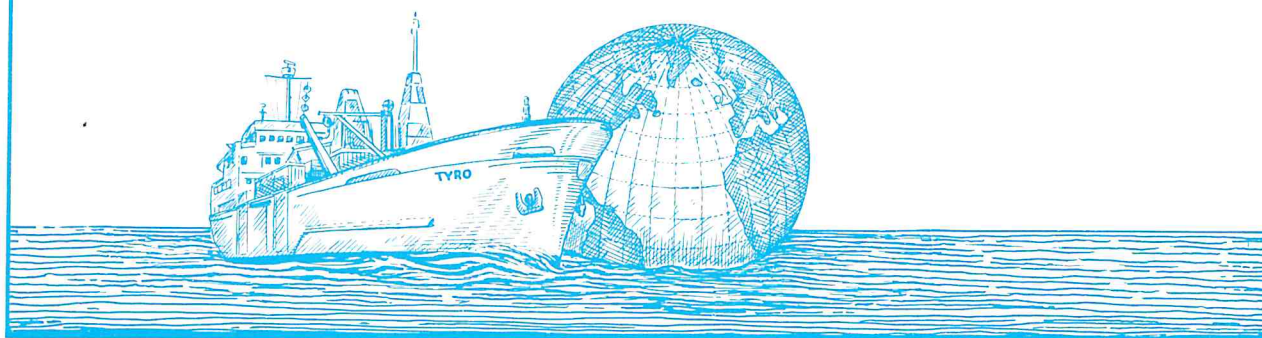
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CONTENTS

1. Scientific activity.....	3
1.1. Introduction	3
1.2. Wadden Sea and other estuarine research	5
1.2.1. Physical and chemical research	5
1.2.2. Organic matter	7
1.2.3. Contaminants	9
1.2.4. Microbiology	13
1.2.5. Benthic invertebrates	14
1.2.6. Aquatic carnivores	16
1.3. North Sea Research	19
1.3.1. Physical oceanography	19
1.3.1.1. Large-scale transport processes in the sea ...	19
1.3.1.2. Non-linear circulation in the β -plane	22
1.3.2. Sediment transport and sedimentation.....	22
1.3.3. The "stratified North Sea 81/82" programme.....	23
1.3.3.1. Small-scale turbulence, mixing layers and thermocline studies.....	23
1.3.3.2. Chemical oceanography.....	24
1.3.3.3. The pelagic system.....	24
1.3.4. The "REFLEX" programme	25
1.3.4.1. Hydrography.....	25
1.3.4.2. The pelagic system.....	25
1.3.4.3. Micro-organisms.....	26
1.3.4.4. Benthic community metabolism.....	27
1.3.5. The southern North Sea	27
1.3.5.1. The macrobenthos	27
1.3.5.2. The role of secondary producers in the benthic system	28
1.3.5.3. The role of meiobenthos	29
1.3.5.4. Sea birds	31
1.3.5.5. Pelagic predators	31
1.3.5.6. The role of carnivores in the benthic system	33
1.3.5.7. Energy budget of demersal carnivores	33
1.3.5.8. Experimental investigations on zooplankton .	34
1.4. Ocean Research	38
1.4.1. Angola Basin	38
1.4.1.1. Sedimentology and palaeoceanography.....	38
1.4.1.2. The silica cycle	41
1.4.2. North Equatorial Current	42
1.4.3. North Atlantic Ocean and Norwegian and Green- land Seas	46
1.4.3.1. Transport and sedimentation processes.....	46
1.4.3.2. Silica cycle.....	48
1.4.3.3. Distribution of pollutants	48
1.4.3.4. Optical research	49
1.4.4. Southern Ocean	49
1.4.4.1. Distribution of phytoplankton	49

1.4.5. Magnetization in sediments	51
1.4.6. Quantitative microzooplankton research	51
1.4.7. Chemical composition of marine organisms and abiotic environment	51
1.5. Special Projects	53
1.5.1. Biological Research Ems-Dollard Estuary (BOEDE) ..	53
1.5.2. Research on radioactive waste disposal	53
1.5.3. Oil Pollution Experiment	56
1.5.4. Antarctic research	56
1.6. Additional Research	57
1.6.1. Research at NIOZ by guests	57
1.6.2. Participation in national and international programmes	58
1.7. List of research projects and research workers	60
1.7.1. Hydrography (H)	60
1.7.2. Biology (B)	61
1.7.3. Special projects	62
2. Scientific outcome	63
2.1. Publication	63
2.1.1. Netherlands Journal of Sea Research and other series issued	63
2.1.2. Publications NIOZ 1983	63
2.1.3. Internal Reports NIOZ 1983	66
2.2. Lectures, etc.	67
2.2.1. Colloquia and lectures at the Institute	67
2.2.2. Lectures of NIOZ scientists given elsewhere	73
2.2.3. Advice offered	77
2.2.4. Visitors from abroad	77
3. Vervolg wetenschappelijk gedeelte	79
3.1. Inleiding	79
3.1.1. Waddenzee en andere estuaria	79
3.1.2. Noordzee	81
3.1.3. Oceaan	84
3.1.4. Speciale projecten	87
3.2. Bezochte congressen	88
3.3. Bestuursfuncties	90
3.4. Studentenonderzoek	93
3.5. Kursussen, vergaderingen en excursies	94
3.5.1. NIOZ kursussen	94
3.5.2. Andere kursussen gehouden op het NIOZ	94
3.5.3. Ontvangen gezelschappen van verwante instituten, overheidsdiensten, e.d.	94
4. Hulpafdelingen	96
4.1. Bibliotheek	96
4.2. Rekencentrum	96
4.3. Reprografische afdeling	97
4.4. Biologisch studiemateriaal	97
4.5. Werkplaatsen	97
4.6. Haven en vaartuigen	98
4.7. Logeergebouw	98
5. Sociaal jaarverslag 1983	99
6. Jaarverslag ondernemingsraad 1983	109

1. Scientific activity

1.1. INTRODUCTION

Following the procedure of the preceding annual report, the scientific portion of this report has again been arranged according to regions of research: Wadden Sea, North Sea and Ocean. The support of the Netherlands Council for Oceanic Research is again gratefully mentioned. The ships and equipment provided by this Council are important to the continuation of all ocean and some North Sea research programmes. The availability of state research platforms and advanced tools are essential to the development of modern oceanography.

In the Wadden Sea, long data series now tend to show that both phytoplankton and phytobenthos production have increased over the last one or two decades. This increase, in addition to the growing input of organic matter from both fresh water and the North Sea, supports existing evidence that eutrophication of the Wadden Sea is increasing. Research on carbon budgets of several European rivers and estuaries has provided useful additional information for a comparison of the Wadden Sea with other estuarine systems. Great changes in biomass, especially of the macrobenthos, after the severe winter of 1978-1979, once again demonstrated the large variations from year to year; such variations still obscure the emergence of long-term specific trends.

Considerable progress was made on the studies of contaminants in the Wadden Sea and the effects of metals and PCB components on the physiology of marine animals.

In the North Sea, experimental studies of large and small-scale turbulence and residual current patterns have been continued. Owing to shortages in manpower and equipment field observations have now been stopped. The available data will be analyzed and theoretical work will continue. As already mentioned, a fast growing field of research is that on the benthic-pelagic food chain. A programme on chemical and biological parameters in relation to spring plankton development was carried out in the Fladen Ground area, northern North Sea.

Work on suspended matter in the North Sea area was completed with measurements in the Skagerrak and Norwegian Channel.

A large number of biological studies were carried out both in the permanently mixed areas of the southern North Sea and in the stratified regions. The benthic fauna received special attention. In the laboratory, population dynamics and bioenergetics of important North Sea copepods were investigated.

In the field of ocean research, sedimentary and palaeoceanographical processes of the Angola Basin and the Zaire fan were studied on the basis of material collected in previous years. ^{210}Pb and ^{230}Th methods for age determination of deposits have recently become operational. A new programme was initiated to study transport and sedimentation processes over the Scotland-Greenland Ridge and how these processes have changed from past cold glacial conditions to the present situation.

Another cruise in the North Atlantic Ocean was aimed at establishing base concentration levels of trace elements and organochlorine compounds in those water masses which are the sources of deep ocean water. For these studies, very large water samples (500 l) had to be collected; special sampling techniques were developed.

One scientist from the institute participated in a German expedition to the Antarctic Ocean. Important theoretical work was continued on the relation between the chemical composition of marine organisms and that of ocean water.

A bilateral Dutch-Indonesian expedition will take place from May 1984 to July 1985 in the eastern Indonesian seas. This is a good half a century since the SNELLIUS expedition of 1929 and 1930 to this same region with the RV HMs "Willebrord Snellius". The Dutch contribution to this second SNELLIUS expedition, is being co-ordinated by the Netherlands Council of Oceanic Research. The responsibility for the scientific and technical activities of this expedition rests largely with the NIOZ scientific and technical staff. Much preparatory work has already been done in 1983. The scientific programmes are grouped into 5 themes, all of which involve NIOZ scientists and technicians: 1) Geology and geophysics of the Banda Arc and adjacent areas, 2) Ventilation of deep-sea basins, 3) Pelagic systems, 4) Coral reefs, and 5) River inputs into ocean systems.



1.2. WADDEN SEA AND OTHER ESTUARINE RESEARCH

The Dutch Wadden Sea with its extensive tidal flats, has been and continues to be, an important research area of NIOZ. Chemical and physical conditions are strongly influenced by fresh water input into the area. Research dealing with these fresh water sources (rivers Rhine, IJssel and Ems) is categorized in this section as well as studies carried out in other estuaries (for example the Scheldt in the southern part of The Netherlands; see map). Also related laboratory research is considered.

1.2.1. Physical and chemical research

H2-02

Coastal areas are characterized by considerable variability in the conditions determining the biochemical and transport processes in the water, both in time and space. Higher spectral, temporal and spatial resolution of the measurements is required than in the open sea. In order to study the spectral absorption and scattering signatures and their variability in the western Wadden Sea, measurements were performed of upwelling and downwelling (ir)radiance both in and above water. All quantities were measured in the spectral region between 400 nm and 720 nm. Simultaneously with optical measurements, surface water samples were analysed in the laboratory to determine the concentrations of total suspended matter, chlorophyll and pheophytin pigments and of yellow substance. The processed data reveal several interesting features, such as the influence of the surface reflectance of sky light (sky glitter) and shifts of maxima in the red part of the spectra (chlorophyll fluorescence). The latter effect is more pronounced in turbid waters than in the open ocean. Theoretical treatment using a two-flow model affirmed the observed shifts. These findings may have consequences for the design of future optical remote sensing instruments for the study of coastal dynamics. In this respect, participation in the activities of several working groups (European Space Agency, National Aerospace Laboratory, Scientific Committee for Oceanic Research) dealing with the development of the instruments and methods for the remote oceanic optical observations is an important part of the research programme.

H1-02

Field studies on the nitrogen cycle in recent years has been concentrated mainly on the Ems-Dollard estuary. Concentrations of nitrogen components in this area are strongly influenced by input of nitrate by the river Ems and input of ammonia by the river Westerwoldse Aa. Apart from river input, concentrations in the estuary are determined by processes such as nitrification and denitrification. To determine the rates of the ongoing processes the

results of budget studies were combined with time-scales derived from a one-dimensional mixing and flushing model of the estuary. On the basis of this model, it was argued that proliferation of nitrifying bacteria in the water-phase of the Dollard is only possible when these bacteria attach to suspended particles which accumulate inwards into the Dollard.

The development of sediment incubators was initiated in which the different processes of the nitrogen cycle can be studied under preset conditions of pH, temperature and oxygen saturation. Samples can be taken from the gas phase as well as from pore water. Preliminary experiments concerning exchange between sediment and its surrounding water indicated that the apparent diffusion coefficient of chloride ions in the incubator had increased 4 times compared to molecular diffusion of this ion. In cooperation with the Delta Institute for Hydrobiological Research, Yerseke, and with the NIOZ groups on Benthic systems and on Experimental systems, micro O₂ electrodes were successfully constructed. With these electrodes it will be possible to determine oxygen gradients in sediments, both in field and in experimental conditions, with a high degree of resolution (0.1 mm). Studies with labeled nitrogen compounds were initiated by determination of ¹⁵N compounds by emission spectrometry. First results indicate:

(1) There is a linear relationship between signal and ¹⁵N enrichment up to enrichments of about 80% ¹⁵N.

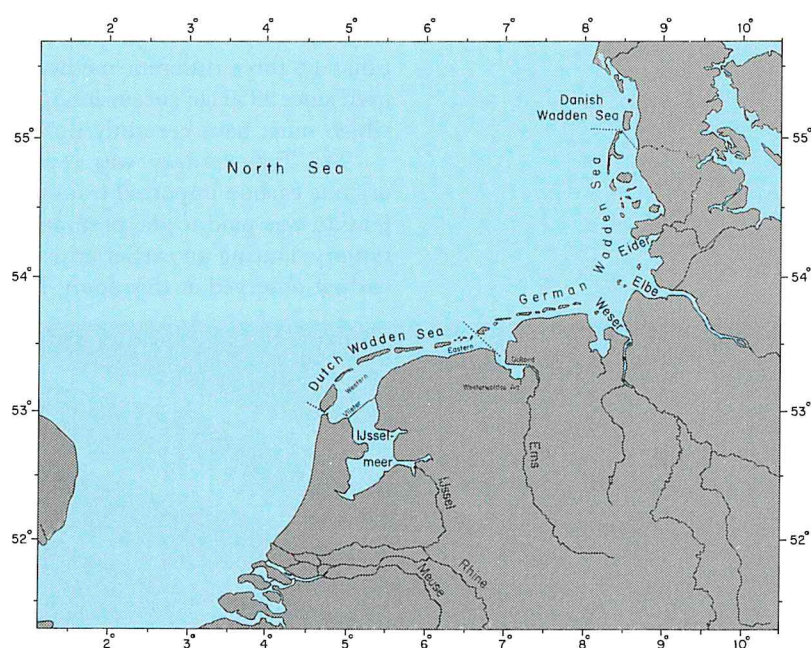
(2) This linearity may be increased by determining and utilizing the optimal spectral range in the detector. Because all ¹⁵N compounds must be present in the form of N₂ gas before measurement, much attention was paid to chemical pretreatment of samples. The Dumas-reaction, in which nitrogen compounds are burned with CuO at 550 °C, was used to convert all compounds to N₂. ¹⁵N samples were intercalibrated with mass spectrometry determinations (ITAL, Wageningen).



1.2.2. Organic matter

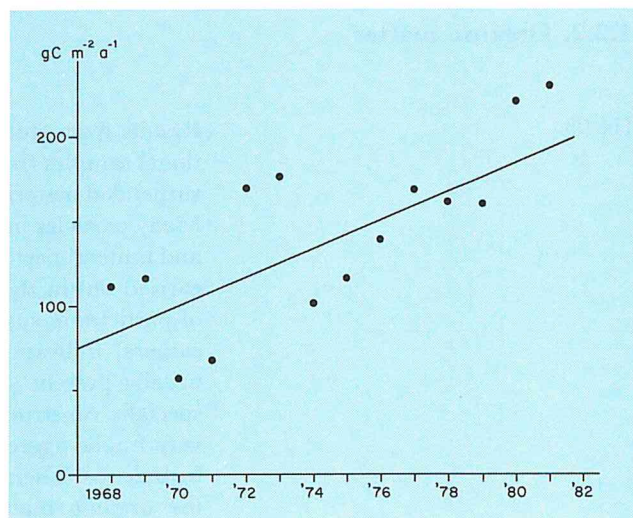
H4-03

Results from studies in the Rhine and Gironde estuaries, as well as additional samples from the Elbe, Weser and Ems, indicated that flocculation of suspended material at the contact of fresh and saline water, is not important. Many particles in fresh and in saline water are aggregates of organic matter and mineral particles. Based on these observations, a larger programme was carried out in the Ems, Rhine and Gironde estuaries. *In situ* photographs of particles in suspension were obtained with a "Benthos" *in situ* plankton camera, indicating that large particles of up to several mm diameter are usually present. Sampling of such particles by divers, with the help of a specially constructed sampling device, indicated that the large particles are very fragile aggregates, whose sizes appear to be related to the scale of the turbulence. Their formation is independent of salinity and of the origin of the organic matter. The following analyses were made on samples of suspended matter: total concentration, particle size, scanning electron microscopy, light microscope, POC, composition (X-ray diffraction, X-ray fluorescence, scanning microprobe), organic matter content and composition (pyrolysis mass spectrometry, pyrolysis gas chromatography, mass spectrometry), carbohydrates, biological activity, and $\delta^{13}\text{C}$. For water samples, analyses of dissolved oxygen, dissolved carbohydrates, DOC, nutrients, fluorescence, temperature and salinity were carried out, while at anchor stations, current velocity and direction were also measured. The sampling in the Gironde is being financed by the French GRECO-ICO programme for estuarine research.



Wadden Sea and Dutch coastal waters with geographical names mentioned in this report

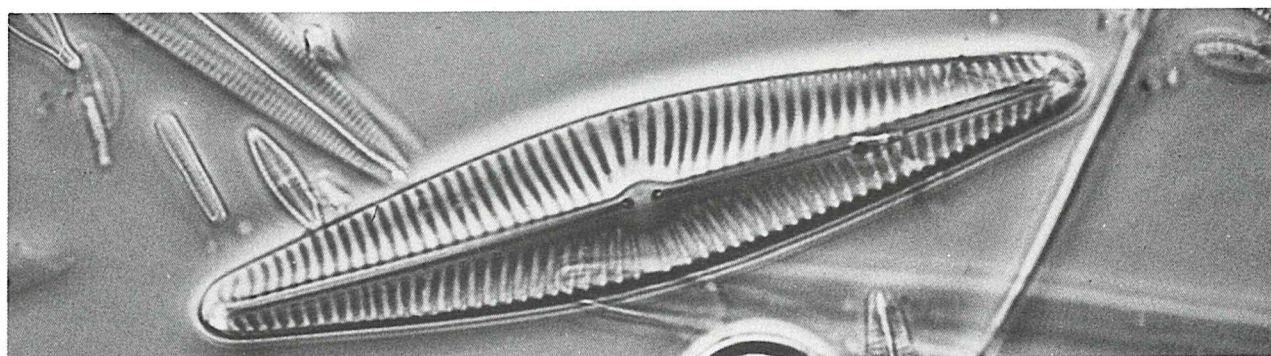
Primary production of microphytobenthos, living in a tidal flat near the Institute, has increased by a factor 2 since the start of the measurements in 1968.



B3-01

Data on primary production and import and export of organic carbon in the Wadden Sea for C-budget studies were evaluated. Long series of such data are rare but have become increasingly relevant for eutrophication problems. In this context, it is regrettable that methods for measuring organic carbon, chlorophyll and primary production have changed over the last few decades. Although such changes are, in fact, improvements, comparison with earlier data are hampered. Nevertheless, a trend indicating an increase of microphytobenthos primary production during the period from 1968 to 1981, appears to be real. Phytoplankton primary production has probably increased since 1976. Organic carbon concentrations in the IJsselmeer and western Wadden Sea probably have not increased since 1950, but unfortunately, three different methods for measuring organic carbon have been used since 1950 (in succession ignition loss, dry oxidation and wet oxidation) which must have certainly influenced the data.

The Ems estuary was revisited to evaluate the amount and fate of organic carbon imported from the Ems river to the Wadden Sea. Special attention was paid to the permanent turbidity maximum present in the Ems estuary. During an earlier cruise, not only was a peak in particulate organic carbon observed at this point, but also a peak in dissolved organic carbon.

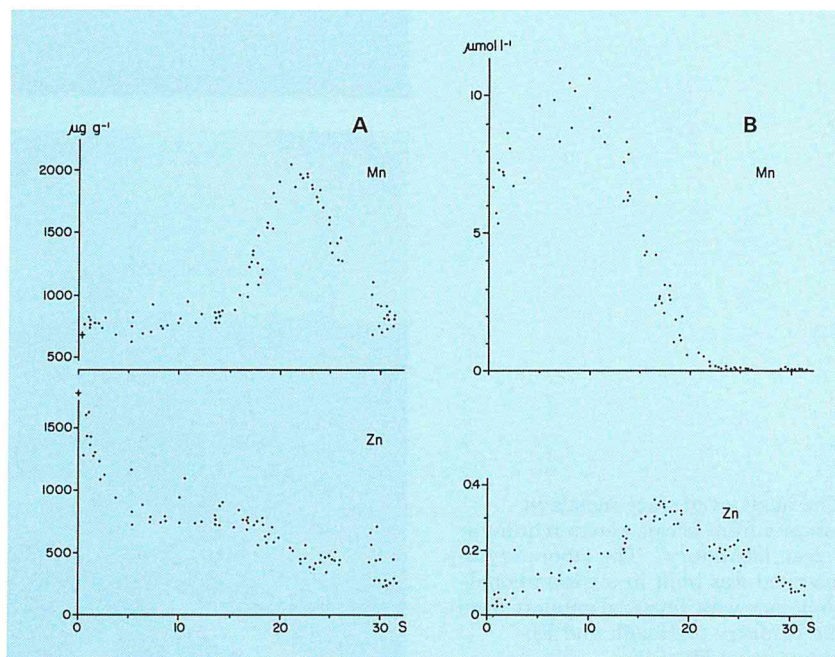


1.2.3. Contaminants

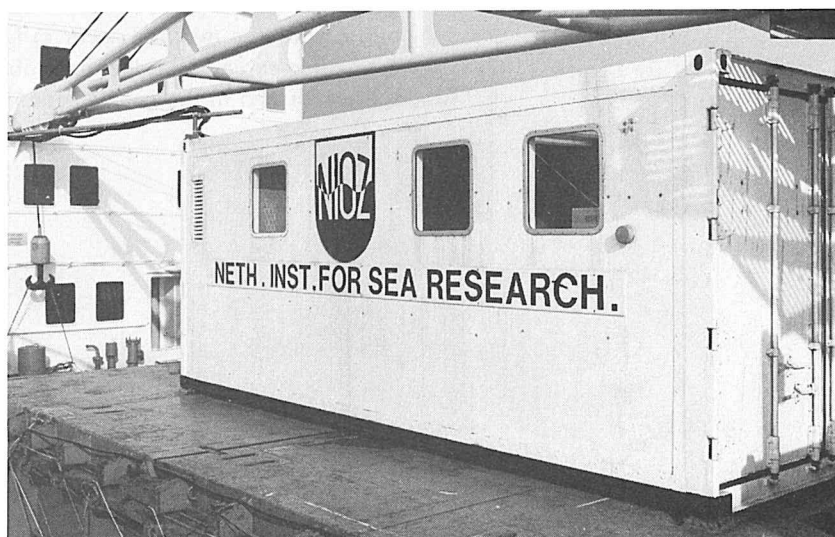
H3-01

The behaviour of Cu, Zn, Ni and Mn in relation to salinity, pH and redox conditions in the Scheldt estuary was studied. Samples were obtained at fixed positions at 1 hour intervals during complete tidal cycles in selected overlapping salinity regimes. At the same fixed positions, measurements were made of temperature, current velocity, pH, dissolved oxygen concentrations and turbidity. Resultant plots of nickel concentrations in solution versus salinity suggest conservative mixing of this substance. Manganese, cadmium and zinc plots however, show pronounced maxima, which occur at different locations and at different salinities. Dissolved manganese is produced in the low pH, low dissolved oxygen area (around salinity 10). Cadmium and zinc maxima occur at higher salinities (21 and 17 respectively). A possible explanation for those observations may be the oxidation of solid species formed in the anoxic zone into more soluble forms in the oxic zone.

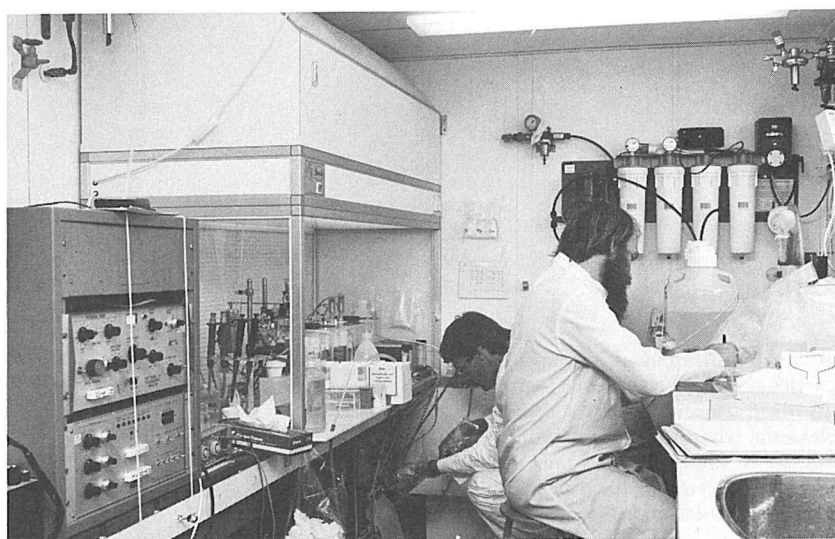
Total concentration of Mn and Zn in particulate matter (left side), and the dissolved concentrations of the same elements (right side) in relation to salinity in the Scheldt estuary in 1978, samples collected at fixed positions during the tidal cycles (+ fresh water values).



Research was continued on the speciation of trace metals in the marine environment. An investigation of the Scheldt and Ems estuaries was begun. An attempt was made to concentrate colloids from river and sea water by ultrafiltration techniques. For this purpose, a system was built in cooperation with the Technical University Twente. The importance of colloidal material in estuarine systems was shown in relation to complexation reactions, trace element and organic carbon content. The complexation capacity for copper (CC) was studied in the Scheldt estuary. It appears that a rapid decrease of the CC, especially in the upper part of the estuary, is caused by colloidal material. The CC at salinity 0.7 was about $30 \times 10^{-8} \text{ mol Cu} \cdot \text{dm}^{-3}$, decreasing to $17 \times 10^{-8} \text{ mol Cu} \cdot \text{dm}^{-3}$ at salinity 9, and then, on decreasing almost linearly to $11 \times 10^{-8} \text{ mol Cu} \cdot \text{dm}^{-3}$ at a salinity of 30. These analysis were carried out directly on board the ship.



The analyses of trace metals in samples from ocean waters require a "clean laboratory". The laboratory illustrated was built in a conventional container with financial support from the Ministry of Health and Environmental Hygienics.



S-03

The Dutch part of the Wadden Sea and adjacent North Sea was investigated for concentrations of trace metals and chlorinated hydrocarbons in sediments and in benthic organisms. The interpretation of data has been nearly completed. Background values of old sediments (> 1500 y) for trace metals were compared with recent sediments. An increase with a factor 3 for lead and zinc, 5 for cadmium and 2 for copper has been observed.

The geographical distribution of trace elements in Dutch Wadden Sea sediments (fraction $< 63 \mu\text{m}$) show a tendency for the highest concentrations of zinc, lead and cadmium to be found in the western Wadden Sea and the lowest in the Ems-Dollard area. The opposite was found for manganese and iron. Copper showed the lowest values in the Dollard, but the highest values were not in the western Wadden Sea. Adjacent North Sea areas showed a significant effect of the rivers Scheldt, Rhine and Meuse upon the sediments. North of Hoek van Holland, an increase in sediment concentrations was seen for zinc, cadmium, lead, copper and manganese. The Dutch government has been advised on subjects concerning background levels of trace components in Dutch waters, budgets of contaminants in the (Dutch) Wadden Sea and on problems related to monitoring of pollutants. New equipment such as the "clean lab" container and home-made water samplers were tested. These improved technical facilities appeared to be necessary for the control of sample contamination.



H3-04

Studies on the effects of some heavy metals (Cu, Zn, Cd) in natural concentrations on marine organisms, include three aspects:

(1) The influence of Cu on some respiratory properties of haemoglobin in the lugworm (*Arenicola marina* L.) under *in vivo* conditions; the oxygen affinity of the haemoglobin decreases at blood copper concentrations up to $40 \mu\text{g}\cdot\text{ml}^{-1}$, at physiological pH (7.0-7.4). Moreover, the influence of copper on the oxygen affinity is pH dependent. The cooperative interaction between the different subunits of the high molecular haemoglobin, determining the S-shape of the haemoglobin-oxygen diffusion curve, is only slightly influenced by the copper concentration in the blood, but seems to be pH-dependent.

(2) The uptake by and distribution in *Arenicola marina* of Cu, Zn and Cd under experimental conditions; Cu, Zn and Cd taken up by the lugworm are distributed into three body compartments: the blood, the viscera and the body-wall. Under the conditions of the experiments, copper and zinc were taken up directly from the water phase, whereas Cd was taken up from both the water phase and the sediment. The concentrations in the blood seem to most directly reflect fluctuations of heavy metal concentration in the water.

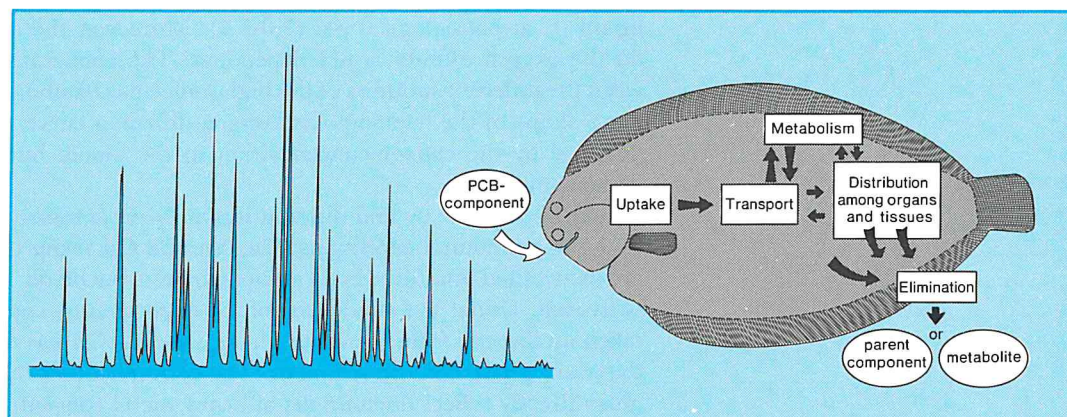
(3) A field study on the distribution of Cu, Zn and Cd in *Arenicola marina*; when the three body compartments were looked at independently, only in the blood was a significant correlation obtained between mean body weight and the concentration of Cu, Zn and Cd. In this case, a decrease of metal concentration ($\mu\text{g}\cdot\text{ml}^{-1}$) in the blood is correlated with higher body weight. Small and young individuals have higher metal concentrations in the blood, but the total amount of metal in the blood may be higher in larger individuals. No correlation was found between metal concentrations of the different sediment fractions (grain size $< 50 \mu\text{m}$, 50-100, 100-200, 200-300 and $> 350 \mu\text{m}$) and tissue concentration. A slight positive correlation of the copper concentration in the interstitial water (as measured by anodic stripping voltametry) with the blood copper concentration was found.

H3-08

Samples of the bivalve *Macoma balthica* and the polychaete *Nereis diversicolor*, were collected each month from the Balgzand area. The relationship between concentrations of PCB components and the physiological cycle of these species were studied. PCB concentrations on a lipid basis showed a distinct seasonal pattern in *Macoma*, but not in *Nereis*. In *Macoma* the concentrations were lowest when the lipid contents were highest. However, concentrations on a wet weight basis were highest when the lipid contents were highest, *i.e.* in spring and summer. The contributions of individual components to total PCB was very constant throughout the year in both species.

Samples of the three environmental compartments, water, seston-sediment and organisms, show differences in PCB patterns. In water, tri- and tetrachlorobiphenyls were present in relatively high concentrations, while in organisms, penta-, hexa- and heptachlorobiphenyls dominate. Fish species represent the highest trophic levels of gill-breathing animals in the area. If elimination of PCB components from fish is substantial (some) PCB components will be accumulated in the food chain only when passing from these fish to animals breathing with lungs, *e.g.* seals, sea birds and man. For this reason, the kinetics of PCB components in fish were studied. In the laboratory, sole (*Solea solea*) were injected with a technical PCB mixture containing mainly tri-, tetra-, and pentachlorobiphenyls (Clophen A40). Maximum concentrations of all PCB components in tissues were reached within

Capillary gaschromatogram of a technical PCB mixture, and a scheme showing the processes determining the kinetics of PCB components in organisms.



5 days after injection. Amounts taken up were proportional to their relative concentrations in Clophen A40. Higher concentrations of PCB components were found in organs having higher lipid contents. PCB concentrations in tissues decreased with an increase in growth. Elimination rates were therefore based on quantities per organ instead of on concentrations.

Two of the trichlorobiphenyls were eliminated more rapidly than most tetrachlorobiphenyls. Some pentachlorobiphenyls (containing 4, 4'-chlorine substitution) were more persistent than the tetrachlorobiphenyls.

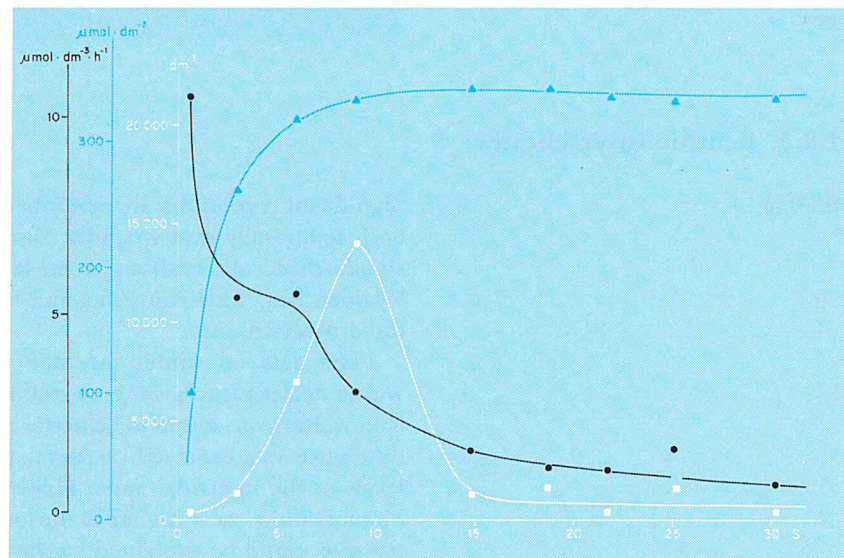
The elimination rates were similar in all organs except in the brain, where rates were faster for all components and in the gall-bladder, where initially high concentrations decreased rapidly. Decreased growth rate of PCB-injected fishes was observed, as well as a slower rate of increase of lipids in the liver.

1.2.4. Microbiology

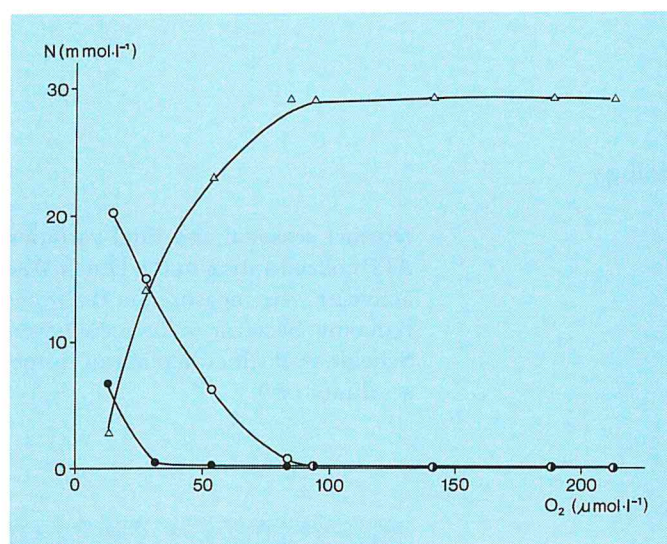
B1-03

Distinct seasonal and tidal variations were observed in ETS-activities and ATP concentration in the Dutch Wadden Sea. Longitudinal profiles of ETS-activities were measured in the western Scheldt and Ems estuaries. Sulphate reducing bacteria (*Thiobacilli*) were counted from samples taken in the Scheldt. A distinct maximum in the abundance of *Thiobacilli* was found at a salinity of 9.

Longitudinal profiles of ETS-activity ($\mu\text{mol}\cdot\text{dm}^{-3}\cdot\text{h}^{-1}$; ■), oxygen concentration ($\mu\text{mol}\cdot\text{dm}^{-3}$; ▲), and thiobacilli (dm^{-3} ; ●) as a function of salinity at high water slack, Westerschelde Estuary from Antwerp to Vlissingen, January 1983.



Nitrifying bacteria, isolated from the Ems-Dollard estuary, were cultured in batch, as well as in continuous cultures. It was shown that the ammonia-oxidizing bacteria, of the genus *Nitrosomonas*, were able to acclimate to the entire salinity range found within the estuary, although they react to salinity changes initially with an increased lag phase. At the culture conditions of 25°C and salinity of 15, the ammonia oxidizer (*Nitrosomonas*) and the nitrite oxidizer (*Nitrobacter*) had specific maximum growth rates (μ_m) and half saturation values (K_s) that are similar to those reported for non-marine conditions. For *Nitrosomonas* from the Dollard, μ_m and K_s at 25°C are 0.036 h⁻¹ and 55.4 $\mu\text{mol}\cdot\text{l}^{-1}$ ammonia respectively. For *Nitrobacter*, values of 0.064 h⁻¹ and 267.2 $\mu\text{mol}\cdot\text{l}^{-1}$ nitrite were recorded. From a mixed continuous culture of both organisms, it was concluded that below 95 $\mu\text{mol}\cdot\text{l}^{-1}$ O₂, oxidation of nitrite is inhibited, and below 32.5 $\mu\text{mol}\cdot\text{l}^{-1}$ O₂ the oxidation of ammonia is also inhibited.



Concentration ($\mu\text{mol}\cdot\text{dm}^{-3}$) of NH₄⁺ (●), NO₂⁻ (○), and NO₃⁻ (Δ) as a function of oxygen concentration ($\mu\text{mol}\cdot\text{dm}^{-3}$) in a mixed chemostat culture of *Nitrosomonas* and *Nitrobacter* at 25°C.

1.2.5. Benthic invertebrates

B3-02a

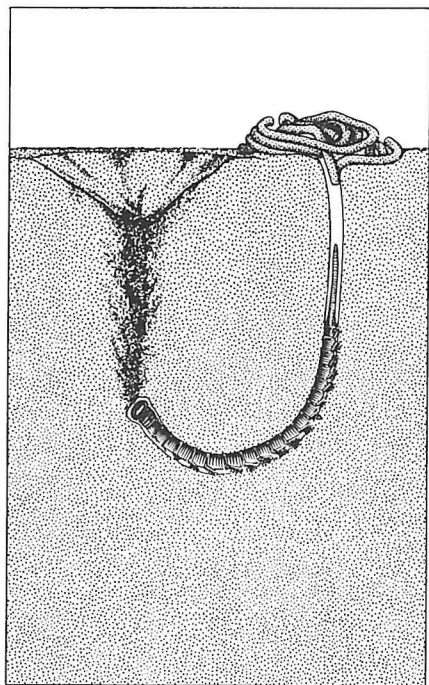
Significant variations in macrobenthic populations have been observed, both temporally and spatially; during the uninterrupted 15-year series of standardized observations at no fewer than 15 fixed sampling sites in the Wadden Sea. This is justification for the duration and the continuation of these observations.

The data on winter mortality for species which are sensitive to low winter temperatures were re-examined. In these species, survival during cold winters was found to be better at lower levels of the intertidal zone. This difference was expected, as temperatures are more extreme in the higher levels of the intertidal zone. However, total ecosystem losses, expressed in biomass units, were higher in the lower parts of the intertidal. This apparent paradox could be explained by the differential distribution of sensitive and

hardy species, with nearly all of the sensitive species having maximal densities in the lower half of the intertidal (e.g. *Cerastoderma edule*, *Nephtys hombergii*, *Janice conchilega* and *Angulus tenuis*). Thus sensitive species accounted for a greater portion of the total macrobenthic biomass in the lower areas, whereas hardy species contributed more to the total macrobenthic biomass in the higher areas.

The winter of 1978-1979 was the most severe recorded during the period of observation (1968-1983). At the end of this winter, biomass values in the higher intertidal areas were not reduced (as compared to the long-term average), but biomass losses up to about 50 percent were observed in the lower areas. Thus, the benthic community living in the more stressed environment proved to be more resistant to the severe winter conditions because it was almost completely composed of tolerant species.

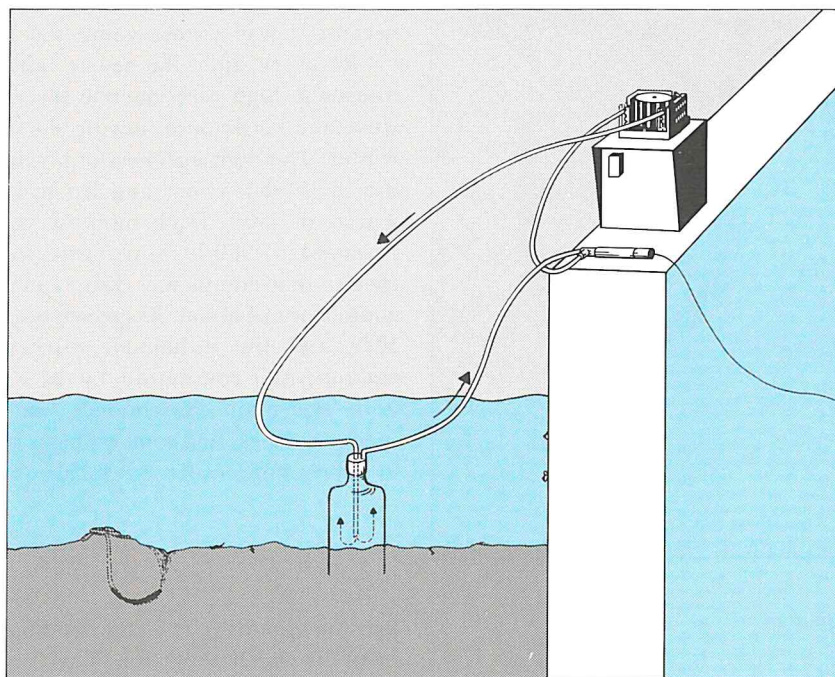
Recovery after the severe winter was rapid as a consequence of the unusually high reproductive success in many species (including both sensitive and hardy ones) during the summer immediately following the severe winter. The high numbers of juveniles which resulted, survived well during the 1979-1980 winter and led to high biomass values during the growing season of 1980. High biomass values, at a level almost double of those observed in 1969-1979, persisted from 1981 to 1983, inclusive. Among the 6 species that completely disappeared from the tidal flats during the severe winter (out of about 30 species nearly always present), 3 reappeared during 1979 and the remainder during 1980. Thus the disturbance of the macrobenthic community by the stress of a severe winter was of short duration. The main consequence was not the short and moderate decline of species richness and total biomass but rather the increase of benthic biomass to values unprecedented during the preceding 10 years.



B1-04

Benthic organisms, by their feeding and motile activities, effect the environment in which they live. This is reflected in the physical, chemical and biological characteristics of the sediment. Lugworms (*Arenicola*) rework the mud flat sediments and pump aerobic water through the tubes and shafts in which they live and feed. This effects the mineralization processes in the sediments surrounding the worm. It has been postulated, though never proven, that in this way worms partly create their own food source (gardening). If worms are capable of gardening, then the distribution of ETS activity and bacterial biomass around the tube of *Arenicola* should be greater than in undisturbed sediment. Experiments were designed to test this hypothesis. In the undisturbed sediment, ATP, chlorophyll a and ETS activity were shown to decline with depth, but in the sediment around the tube, significantly higher values of these parameters were found. Faeces collected immediately after defecation contained less bacterial biomass than the surface sediment. The higher biomass values surrounding the tubes are explained by the downward movement of enriched sediment in the feeding funnel and by the improved growth conditions for microorganisms in the aerated tail part of the tube, thus supporting the gardening hypothesis.

Data on the meiobenthos of the Balgzand area, collected in the years 1976-1977, indicated an average biomass (AFDW) of about $1 \text{ g} \cdot \text{m}^{-2}$ with nematodes being dominant in all seasons. An attempt was made to estimate metabolism of the meiofauna in the area by applying generalized equations for respiration and production to various meiofaunal groups. The metabolic activity of meiofauna in the area, about 30% of that of the macrofauna, would be considered moderate. This situation differs from that in various other coastal and offshore areas where meiofaunal metabolism is thought to equal or even surpass that of the macrofauna. This difference is explained by the relatively high biomass of the macrofauna in the Balgzand area, whereas the meiofauna show rather average densities.



Device for measuring benthic community respiration in the indoor tidal mud-flats. The bell jar is flushed by a pulsating pump. An oxygen electrode in the circuit senses the variations in the oxygen concentration in the water overlying the sediment.

1.2.6. Aquatic carnivores

B2-01

Investigations on the function of carnivores in a tidal flat benthic community (Balgzand) included studies on population fluctuations, growth, production, food intake, predation pressure and energy budgets. A few detailed studies in the field as well as in the laboratory are being continued.

Special attention has been given to the possible effect of coelenterate predation on fish larvae and, more specifically, plaice larvae entering the Wadden Sea in spring. In addition to *Pleurobrachia pileus*, a potential predator on plaice and flounder larvae, two other coelenterate species, the scyphomedusa *Aurelia aurita* and the hydromedusa *Sarsia tubulosa* are also present in fairly high numbers in the area.

In experiments, these species have been shown to prey upon fish larvae. Therefore, it was postulated that the abrupt disappearance of plaice and flounder larvae from the Wadden Sea plankton in early May, when the coelenterate densities are at maximum, could be caused by coelenterate predation. It appears, however, that of the three flatfishes exploiting the Wadden Sea as a nursery—*i.e.* plaice, flounder and sole—only flounder might heavily suffer from this predation. Most of the plaice larvae enter the area before the main coelenterate outbreak, and sole tend to enter after the outburst.

Previous studies have suggested the existence of an inverse relationship between year class success of young plaice and temperature at the spawning grounds. This led to a study on the possible effect of winter temperatures on the survival of plaice eggs in the southern North Sea. In the laboratory, the survival rate of artificially fertilized plaice eggs was estimated at incubation temperatures held constant at 2, 5, 8 and 11°C. The results of this study were not fully conclusive, but suggested a possibly higher level of egg survival at lower temperatures. The experiments will be repeated next season.

B2-06

Experiments have been carried out to estimate the combined effect of temperature and food supply on the growth of young plaice (O-group and I-group). Groups of plaice were kept at 7 different temperatures. They were fed on known amounts of mussel flesh at different time intervals ranging from once daily to once a week.

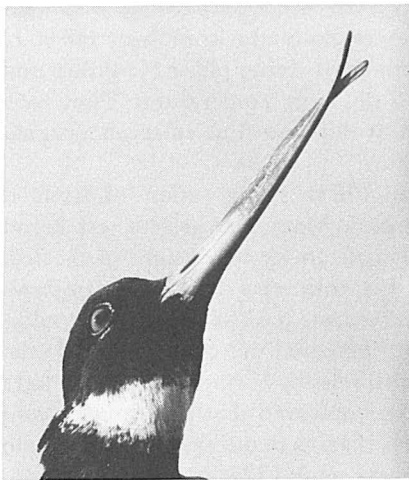
B2-06

The growth rate of young sole fed on different daily rations of dry food at different feeding frequencies was studied. Maximum growth was found at a daily dry food ration of 5% of the metabolic wet weight of the fish ($W^{0.8}$) given in two feedings. Feeding 4 or 6 times a day did not improve growth rate or conversion. Other measurements have shown that the addition of about 10% yeast to the dry food increased the growth rate of sole.

Attempts to induce spawning of captive soles by hormone injections were unsuccessful. When this was done, it was observed that ripe females contained batches of dead eggs. This suggests that, as in turbot, the eggs remain viable (fertilizable) for only during a short period (24 hr) after ovulation.

Oxygen uptake, food intake and growth was measured of sole kept at 20° C and fed on different rations of mussel flesh. These values were compared with similar measurements taken on sole which had been fed on dry food. About 33% of the energy of the mussel flesh was transferred into fish growth (gross conversion). The net conversion was estimated at about 50%. In general growth of the sole fed with mussel flesh was about 1.6× better than growth of sole fed with dry food. This is possibly related to the difference in protein content of mussel flesh (70% of dry weight) as compared to that of dry food (39% of dry weight). Estimates of oxygen uptake, food intake and growth in relation to size (wet weight, g) of the fish showed that metabolism and growth in sole is related to wet weight to the exponent 0.75 rather than the commonly used metabolic weight exponent 0.8. Maximum daily food intake of sole kept at 20° C in relation to its dry weight was calculated to be 0.046 $W^{0.75}$. Maximum growth in dry weight per day was 0.011 $W^{0.75}$ with musselmeat and 0.065 $W^{0.75}$ with dry food.

Oystercatcher with crossed mandibles. The growth of the corneous covering of the bill tip has been much larger than the wear. Ultimately such birds die if the bill tips don't snap.

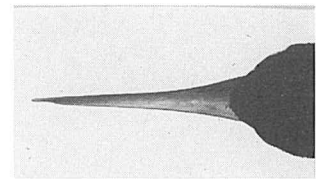
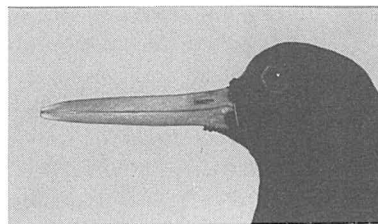
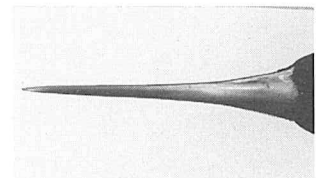
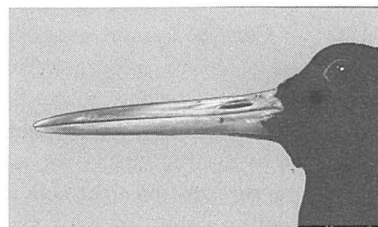
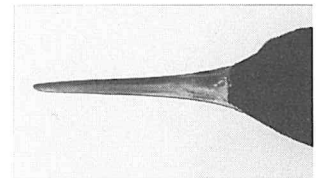
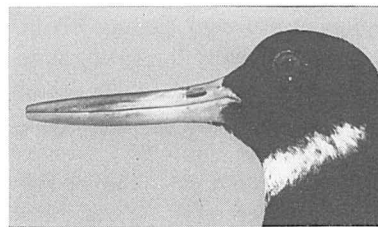


Bills of oystercatchers differ in length and shape. A strong correlation exists between feeding method and bill-form. It was found that the feeding method induces the bill form; a change in feeding method is followed by a change in bill form. The pictures give the three main forms from a lateral- and a dorsal view: blunt bills are used in opening shells by hammering, pointed bills are used for probing for soft preys hidden in the substratum, chisel-shaped bills are used for opening bivalves by stabbing.

The mean clutch size and hatching success of eiderduck populations were normal in 1983. Mortality of the earliest ducklings was nearly 100% due to poor weather conditions (high wind speeds). Those which hatched later, showed good fledging success as a result of good weather and good food conditions. As a result, 890 fledglings, as well as 209 birds of older year classes, were ringed. A survey of breeding females in the Vlieland colony indicated that the successful reproduction of the last 5 years had resulted in noticeable recruitment of first nesters that had been ringed as ducklings in previous years.

The mean quality of groups of oystercatchers foraging on various tidal flats was determined with a telescope. This is related to earlier work on quality differences of oystercatchers roosting on different sites. The age composition and average state of moult of the foraging groups differed and was related to the major food-type available. The relationship with observed differences in the mean quality of the birds between roosts is not yet clear.

Experiments showed that differences in the form of the bill tip in oystercatchers are related to individual differences in locating food and in food handling. When food conditions were changed, the morphological and behavioural characteristics of the individual bird adapted to the new food specialization within 10 to 26 days. The differences in feeding methods were found to be related to differences in food intake patterns during low water periods. This could partly explain the individual differences in food intake observed in oystercatchers foraging around the observation tower placed on a high intertidal cockle bed in the Balgzand tidal flat area.



1.3. NORTH SEA RESEARCH

1.3.1. Physical oceanography

Experimental work concentrated on larger scale transport processes in the Southern Bight of the North Sea and on small scale transport processes in different areas of the North Sea. This was complemented with theoretical work on the large scale transport processes.

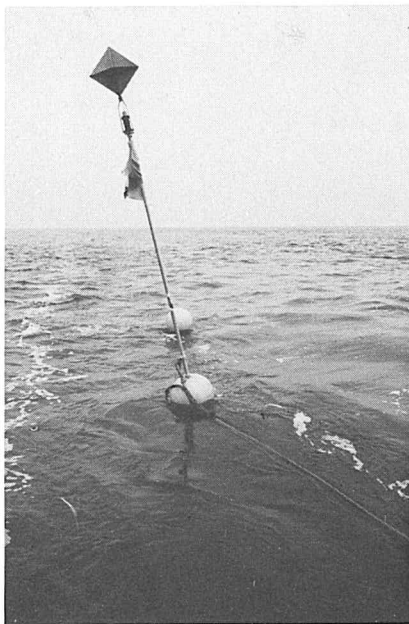
1.3.1.1. Large-scale transport processes in the sea

H2-06

The drogue displacement measurements, performed during the “Breeveertien” experiment in 1982, were analysed according to the “Okubo-scheme” which distinguished between the displacement of the centre of mass of a cluster, the linear velocity gradients, and higher order “turbulent” motions. It appeared that the displacement of the centre of mass of the cluster coincided to within 0.1% with the displacement of the mass centre of a simultaneously employed dye patch. Moreover, the displacement of the cluster could be well simulated by an Eulerian current-meter array capable of resolving scales from 2 to 32 km. For the shear matrix (the linear velocity gradients) it appeared that the Lagrangean drogue measurements showed much more time variability than the simultaneous Eulerian measurements. In particular, the ratio M_4/M_2 in the tidal signal is larger in the Lagrangean measurements. This seems to be due to spatial variability of the shear matrix.

A start was made in analysing the current-velocity measurements performed in a “small” horizontal array (maximum distance 2 km) during 2 days of the “Breeveertien” experiment. These measurements were carried out particularly to obtain information on the spatial structure of the most turbulent part of the velocity spectrum. A first analysis suggests that turbulent eddies at the site have a maximum scale of a few times the water depth. This points to an absence of quasi-2D turbulence, and that a distinction can probably be made between two types of eddy motions. One of these larger scale motions, with the larger scales, could be a structure coherent with the wavy bottom topography.

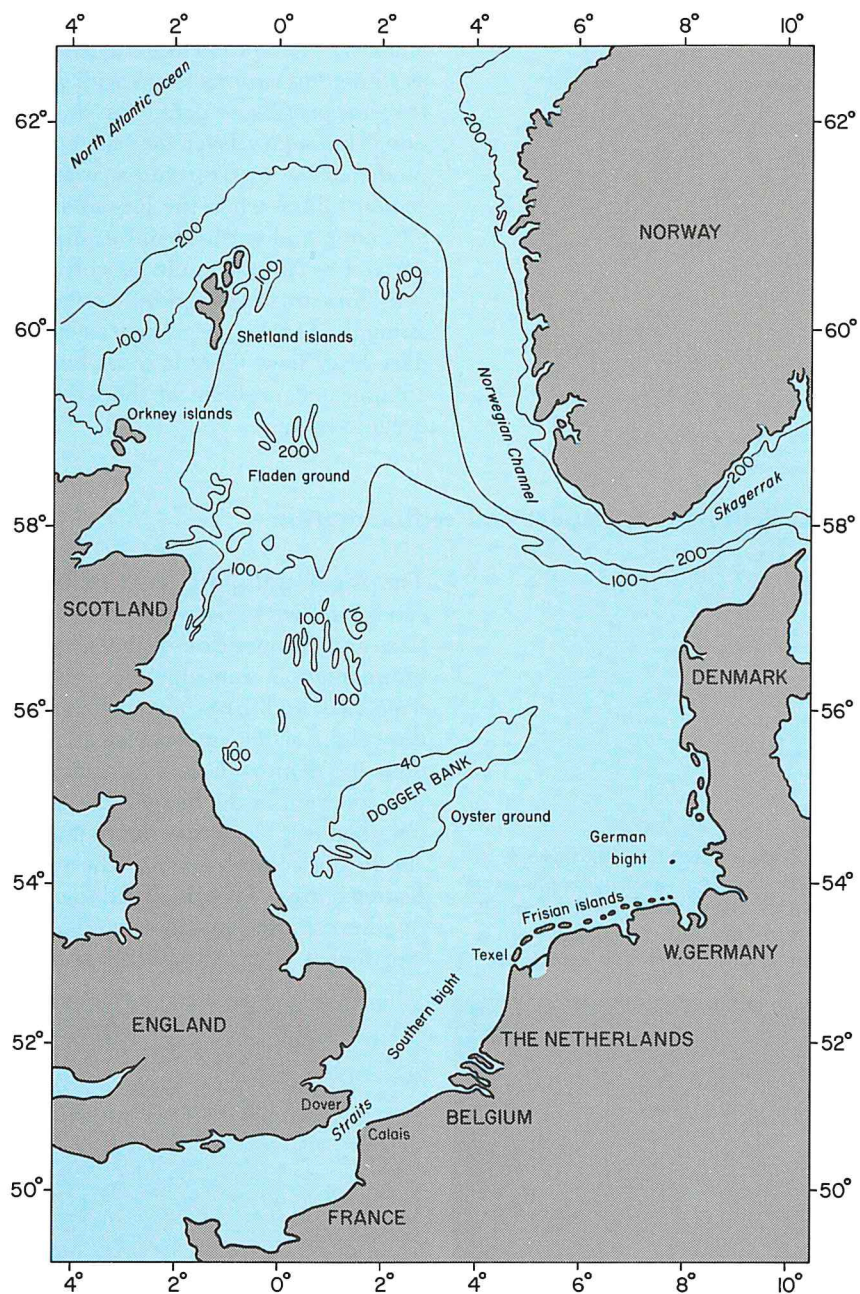
Together with the department of Oceanography of Dalhousie University, Halifax, the existing theories of dispersion by residual eddies were reviewed. It appeared that some fundamental problems concerning the relevance of the present statistical theories of eddy diffusion should be solved in order to judge their practical relevance. These problems concern the ergodicity of ensemble averaging over frozen fields and the application of an ensemble average to a single realization, as well as the question of whether or not a random residual eddy field together with an oscillatory tidal current produces random non-closed trajectories. Preliminary results indicate that simple ensemble averaging over frozen fields is a misleading concept unless



frozenness is released in some way. This may occur, for instance, by the field evolving on a time scale which is large compared with the residual circulation time, by small scale diffusion, or by the superposition of an oscillatory current. There are, however, serious doubts whether the latter process is really effective. If not, it could be that residual eddy diffusion is possible only by the concurrent existence of horizontal dispersion by vertical oscillatory shear. Though the latter is always present, it is still uncertain whether the result is quantitatively of importance.

In collaboration with the Bedford Institute of Oceanography (B.I.O.), a theoretical analysis of the vertical structure of topographically rectified tidal flow was initiated. When using a momentum-balance approach, a surprising result of the work by B.I.O. was the difference between strength of the residual currents predicted by vertically averaged models as opposed to those given by models which account for the frictional vertical structure of the flow, with vertical averaging of the final result calculated afterwards. A preliminary analysis, from the viewpoint of the vorticity balance, seems to give the solution to the apparent paradox. It appears that rotation of the horizontal vorticity vector by horizontal shear of the vertical current velocity, absent in vertically averaged models by definition, is of some importance as vorticity advection. Therefore, the rotation is responsible for an extra driving force of the residual circulation in models which allow for vertical structure. This observation stimulated the application of the same approach to study another effect, that which involves the vertical structure of residual flow, *viz.* the baroclinic effects in a stratified medium. This problem has now been analyzed in conjunction with the Institute of Meteorology and Oceanography of the University of Utrecht (IMOU). It shows that generation, propagation and dissipation of forced internal tides and of residual currents in a shallow shelf sea are two aspects of essentially the same problem.





North Sea with geographical names mentioned in this report.

1.3.1.2. Non-linear circulation in the β -plane

H2-08

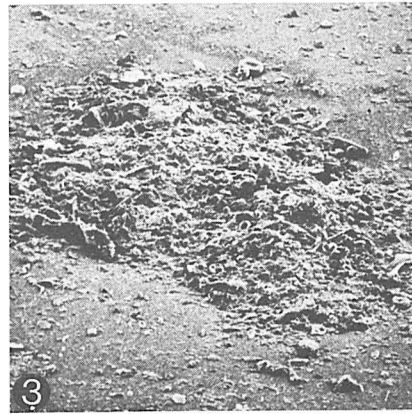
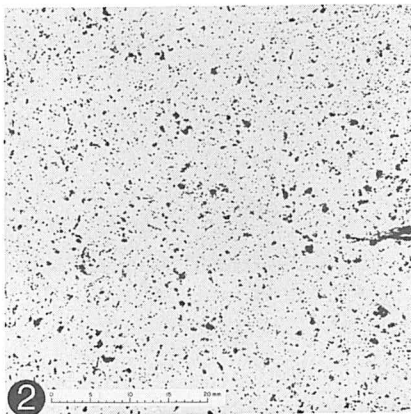
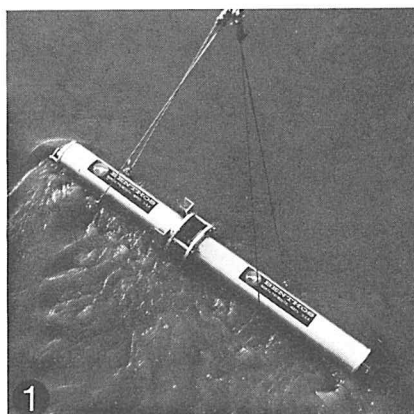
In order to look for a useful renormalization method for inertial boundary flow in a β -plane ocean, the simpler problem of non-linear velocity advection in a tidal basin with lateral frictional sidewall boundary layers was analysed. The problem actually belongs to the theory of tidal rectification as studied in various forms with the "Breeveertien" experiment (see 1.3.1.1). It seems possible to define the so-called "global renormalization" of the frictional boundary layer flow such that the laterally integrated vorticity flux predicted by a perturbation approach to the non-linear vorticity equation remains finite when the Reynolds number, measuring the ratio of vorticity advection and vorticity diffusion, grows. By this approach, previous results derived by Yasuda could be corrected, *viz.* the strength of the residual circulation grows exponentially rather than quadratically with the tidal current strength. As this type of approach seems to work for the simple type of boundary layer flow, there is some hope that it can also be applied to the more complicated problem of the western boundary layers in the circulation of oceanic basins.

1.3.2. Sediment transport and sedimentation

H4-01

The origin, transport, and deposition of suspended matter in the North Sea can be studied in two ways: (a) by determination of the distribution, particle size, and composition of the suspended material and determination of the sedimentation rate in the areas where suspended material is being deposited, and (b) by using chemical and mineralogical means to determine the origin of the material in suspension. Until recently most of the work done has dealt with the first approach. In June 1983 a final series of samples was collected in the Skagerrak and the Norwegian Channel. From the data obtained it is clear that the highest concentrations of suspended matter occur in the coastal areas of the southern North Sea and in the Skagerrak-Kattegat area. This is related to concentration mechanisms occurring in the Southern Bight and the German Bight, and on a much larger scale in the Norwegian Channel and Skagerrak.

1. Plankton camera. 2. Photograph of suspended matter taken with plankton camera. 3. SEM-micrograph of small aggregates and mineral grains from a decomposed larger fragile aggregate.



1.3.3. The “stratified North Sea 81/82” programme

In the spring, summer and autumn of 1981 and 1982 a series of experiments were carried out to study the structure and evolution of the seasonal stratification in the central North Sea under the influence of tidal streams, atmospheric forcing and season (see also Annual Report 1982).

1.3.3.1. Small-scale turbulence, mixing layers and thermocline studies

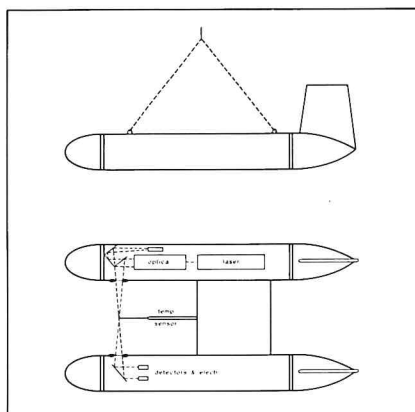
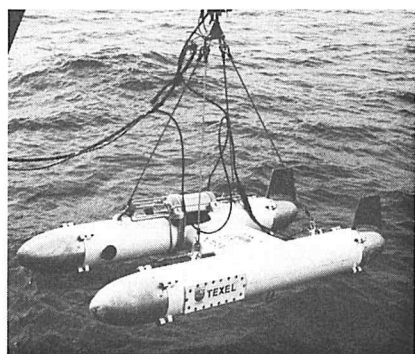
H2-07

The observational data, collected during the campaign “Stratified North Sea 81/82” are being processed and interpreted.

The study of the small-scale turbulence, measured with the laser-doppler velocimeter system, has given a number of results. A relationship has been found between the wind force and the turbulence in the wind-mixed layer. This relationship has been used in a model developed by the IMOU that describes stratification and is an extension of the Ekman-theory for wind-driven currents. More complicated models do not seem to give any better correlations with the measured turbulence data.

The turbulence spectra in the stratified parts of the water column are very different from spectra measured in homogeneous parts of the column. The spectra from the stratified areas fall into one of two main groups: (1) spectra from turbulence generated by interfacial shear between two density layers—these spectra appear to have a spectral slope described by the Monin-Bolgiano theory—and (2) spectra from turbulence in areas with a weak density gradient where the turbulence is not generated locally but transported by turbulent diffusion from sources outside this region—these spectra seem to behave according to the Lumley-Shur theory.

Based on the small-scale turbulence measurements performed during the project “Breeveertien” (1982) and additional measurements made in 1983 to obtain better understanding of the turbulence shortly after the turn of the tide, it is now possible to give a more or less complete description of the turbulent structure in a tidally mixed water column of the Southern Bight of the North Sea. A model based on the balance equation of turbulent kinetic energy and a simple expression for the shape of the velocity profile of the tidal current is in good agreement with the measured turbulence properties. By making reasonable assumption on the intermittency of turbulence in the growing turbulent boundary layer shortly after the turn of the tide, measurements made close to slack water can also be brought within the reach of the model.



Laser-doppler velocimeter system. Turbulent velocity fluctuations are determined by measurement of the doppler-shift of laser light scattered by suspended particles in sea water. The system is constructed to determine two orthogonal velocity components simultaneously.

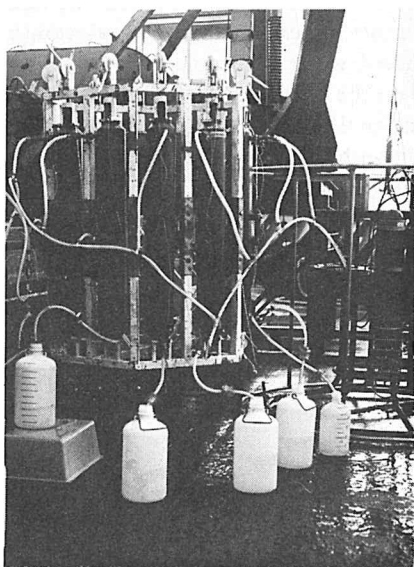
1.3.3.2. Chemical oceanography

H1-01

The upper-layer advection, deduced from the subsurface drifter trajectories in the Oyster Ground was $0.04 \text{ m}\cdot\text{s}^{-1}$ in the direction N to E regardless of wind direction. The temperature and salinity observations of the bottom water layer provided trajectories agreeing with the assumption of a stagnant bottom water layer. The grid hydrographic observations, referred to in the preceding sections on physical studies, contributed essentially to this interpretation. The oxygen regime in the water column during the spring and summer of 1981 was compiled. The mean primary oxygen production of $77\cdot 10^{-3} \text{ mol}\cdot\text{m}^{-2}\cdot\text{d}^{-1}$ (about $600 \text{ mg C}\cdot\text{m}^{-2}\cdot\text{d}^{-1}$) as calculated from *in situ* oxygen concentration changes, was low compared with ^{14}C estimates ($\sim 1000 \text{ mg C}\cdot\text{m}^{-2}\cdot\text{d}^{-1}$). A strong variability in oxygen content was probably caused by a patch distribution of phytoplankton. A two-layer oxygen budget was computed. From May to October the oxygen flux to the atmosphere was twice the rate of oxygen concentration decrease in the water column. A net community carbon production of $260 \text{ mg C}\cdot\text{m}^{-2}\cdot\text{d}^{-1}$, averaged over the three periods of observation in May, July and September, was found.

1.3.3.3. The pelagic system

B4-02



The processing of plankton samples collected from the three cruises to the central North Sea during 1981, has been completed. The data indicate an annual primary production of $\sim 250 \text{ g C}\cdot\text{m}^{-2}$, and a copepod production of $\sim 10 \text{ g C}\cdot\text{m}^{-2}$. These results are produced by averaging the estimates from the periods of observation in May, July and September, and by making allowances for the duration of the growth season. Echinopluteus larvae added another $3 \text{ g C}\cdot\text{m}^{-2}$ during the summer months, and appeared to be the primary grazer of dense *Ceratium* patches observed in July around the thermocline. The phytoplankton was dominated by Cryptophyceae in spring and by dinoflagellates in July. Copepod growth was reduced, probably due to low food levels. Most copepod species had a generation time of 6 to 9 weeks. Although the copepodites did grow, the measured rate of their respiration exceeded the estimated ingestion rate based on gut fluorescence resulting from grazing and on labelled food.

The regression method for estimating growth and mortality in copepods from field data was theoretically evaluated and improved. Also growth rates derived from field data were compared with growth in laboratory cultures at similar food levels after correction for temperature differences. Both approaches yielded essentially the same results, with the exception that the spring growth rates in the field situation seemed to be higher than expected from the experimental results.

1.3.4. The "REFLEX" programme

During the REFLEX (Repeated Fladen Ground Experiment) cruise of April-May 1983, plankton ecology was studied, especially the dynamics of *Calanus finmarchicus* in relation to the phytoplankton spring bloom.

1.3.4.1. Hydrography

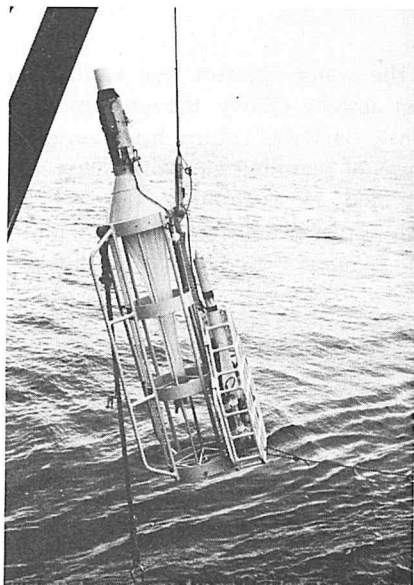
H1-04

Vertical CTD measurements and water samples to the bottom (150 m) were taken at 58°42'N and 0°30'E. A subsurface drifter was also launched at this location. The surface layer was advected 45 n.m. N in four weeks ($0.04 \text{ m} \cdot \text{s}^{-1}$). The surface temperature increased from 6.7 to 9°C over the same time period, while bottom temperatures remained at 6.4°C. The salinity within the water column varied only about 0.1. From 28 April to 14 May, the oxygen concentration in the upper 10 m varied between 107 to 118%. Thus, an important oxygen flux to the atmosphere could be expected under the prevailing wind conditions. From 15 to 20 May, a steep rise of oxygen concentration to 135% occurred in the upper 5 m followed by an even steeper decrease towards 23 May. Below 50 m, undersaturation of oxygen occurred, with concentrations down to 95%.

1.3.4.2. The pelagic system

B4-02

The spring diatom increase was in progress when sampling was started at the end of April. The initial *Chaetoceros* bloom declined before May 10 and was succeeded by other diatom species (*e.g. Thalassiosira*). The predominant alga between 15 and 25 May was the colony-building microflagellate *Corymbellus aureus* which has a characteristic type of fucoxanthin. The various species observed during this succession did not disappear from the upper 50 m of the water column by sedimentation: at 65 m only diatoms of the *Nitzschia* group were found. Consumption by pelagic organisms seems a more probable cause of diatom mortality. The observed levels of phaeophorbide indicated the grazing activity of copepods.



The funnel-shaped "Kiel-type" sediment trap was used in a free-floating manner during REFLEX.

Open-sided, towed zooplankton sampler with opening and closing device in front and sensors for depth, temperature, fluorescence, and turbidity protected in a cage on the back.



B3-01

POC and DOC were measured and the downward flux of primary produced organic carbon from the euphotic zone was estimated from material collected with sediment traps. The results clearly show that the flux to deeper water, and eventually the bottom, consisted largely of large faecal pellets of euphausiids. The presence and role in the food chain of living chlorophyll-containing benthic diatoms in bottom samples from a depth of 120 m and more in the Fladen Ground area remains an enigma.

B4-02

On the last day of the cruise, plankton samples were collected at both ends of the 45 mile drifter path and at the former FLEX central station, situated about halfway between these positions. The results of these samples indicated a *Calanus* density gradient: an increase in biomass from north to south. When compared with the 1976 results, the conclusion was reached that *Calanus* production and the role of grazing was overestimated on the fixed station due to immigration from the south into the FLEX area.

Three methods for the measurement of grazing were used to study the metabolism of *Calanus*. Variations in gut fluorescence were recorded over 24-hour periods, showing marked diurnal variations in chlorophyll pigment concentrations in the larger developmental stages. The highest fluorescence values were noted in stage V and adult females with lower values found in stage IV and adult males. This "*in situ*" method was supplemented with two grazing experiments carried out on board. The ^{14}C method showed that grazing by day was often at a minimum, which supports the gut fluorescence results. An experiment, using a particle counter, was designed to measure faecal pellet production. Preliminary results indicate that a sharp drop in faecal pellet production coincides with the decline of the diatom bloom. Following this drop, coprophagy was probably very common which may explain why *Calanus* faecal pellets were nearly absent in the sediment traps.

1.3.4.3. Micro-organisms

B1-03

The activity of micro-organisms in the water column was studied by measuring the potential mineralization activity (ETS). Bacterial biomass was estimated from ATP measurements, bacterial counts from acridine-orange stained preparations and analysis of scanning electron microscope photographs. These studies were aimed at evaluating the role of microorganisms in the carbon cycle. In addition an attempt was made to characterize certain water masses by the frequency distributions of different types of bacteria.

Seasonal variations in mineralization activity and bacterial biomass, were observed to be related to an increased input of organic matter during the spring bloom and an increasing temperature. Daily variations, however, were beyond the present levels of detection, although distinct daily variations (related to the tide) were observed in the Dutch Wadden Sea with these methods (1.2.4).

1.3.4.4. Benthic community metabolism

B1-05

During the REFLEX cruise, studies on the benthic system of the northern North Sea were also carried out. For these studies, box core samples were used. Of the total average biomass value of about $11 \text{ g AFDW} \cdot \text{m}^{-2}$, about 8 g was contributed by large bivalves (*Cyprina*, *Astarte*, a.o.). The observed biomass was restricted to the upper 10 cm sediment layer, whereas in the central North Sea (Oyster Ground) living organisms were commonly found down to a depth of 35 cm. At a number of stations, shipboard incubated sediment respiration and *in situ* sediment respiration were measured. For this, a benthic chamber recently developed at NIOZ was used. Simultaneously, a completely new method for the launching and recovering of the measuring equipment was introduced. At sea, the heavy measuring device is suspended from an air-filled recovery balloon, which was originally developed for offshore activities. By letting air escape from the balloon, the device sinks down to the sea bed. When the measurements are finished, the balloon is reinflated, using a long floating air tube. This returns the equipment to the surface. Preliminary examination of the results suggests that the carbon flow entering the bottom in these deeper waters has been previously underestimated.

1.3.5. The southern North Sea

1.3.5.1. The macrobenthos

B2-02

The study of North Sea epifauna (beam trawl surveys), was expanded in 1981 to include the investigations of the infauna (box core samples). The Dutch offshore waters are characterized by a gradient in tidal current velocity, decreasing from south to north. This results in a gradual decrease of grain size of the sediment from south to north and in the occurrence of mud in the north. On this basis, the investigated area is divided into three sectors: (a) a turbulent and sandy sector in the south with well-mixed water throughout the year and a poor infauna, (b) a calm and silty sector in the north (Oyster Ground) with a summer stratification and a rich infauna and (c) a transition zone with very muddy sediments and an extremely rich infauna (biomass about $25 \text{ g AFDW} \cdot \text{m}^{-2}$).

The question arose as to whether the increased biomass in the transition zone can be attributed to increased primary production in the overlying water at the frontal zone that separates summer-stratified and well-mixed water, or whether it is enriched by the deposition of organic matter from adjacent, more turbulent areas. Temperature and chlorophyll *a* sections were measured across the enriched zone throughout the year (July 1982 to November 1983). These studies revealed a persistent chlorophyll *a* maximum just above the enriched zone, irrespective of the presence or absence of a front. This chlorophyll *a* maximum is, therefore, attributed to the accumulation of organic matter which is mineralized in that enriched zone and mixed with the overlying water masses.

An attempt is being made to analyse the energy flow through the benthic fauna of the different sectors. These analyses are being carried out via three separate subprojects. In subproject "Role of carnivores in the benthic system" (1.3.5.6) the predatory pressure (density and growth) per square meter is estimated. In subproject "Energy budget of demersal carnivores" (1.3.5.7), the food requirements of different species of demersal predators, such as sea stars, crabs and fishes, are estimated with the aid of laboratory experiments. In subproject "Role of secondary producers in the benthic system" (1.3.5.2), the secondary production is estimated through biomass and growth measurements.

The primary production in overlying water masses is the food source of the benthic system, but will be partly consumed by the pelagic system. Some information on pelagic consumption will become available after analysis of plankton surveys carried out at the same stations.

B1-05

At 3 selected META (= METAbolism) stations considered representative of the 3 major benthic habitats (sandy bottoms in the Southern Bight, the rich frontal zone at the 30 m contour-line, and the muddy areas of the Oyster Ground) the composition and biomass of the benthic fauna was followed throughout the year. Simultaneously the activity of the benthic system was estimated from sediment respiration of incubated sediment cores and from *in situ* measurements in respiration chambers. The O₂ uptake values obtained *in situ* were 2 to 4 times higher than those from shipboard incubations. Distinct seasonal variations, partly independent of temperature, indicate to a seasonal inflow of carbon from the water column.

Shell International Research Company provided financial support for a further improvement of the *in situ* respiration chambers. In July and September a new instrument was tested at the META-stations and a series of useful data was collected.

1.3.5.2. The role of secondary producers in the benthic system

B2-02e

Macrobenthic surveys, using a Reineck's box sampler, were continued in 1983 during six cruises along a north-south transect (from 53°00'N; 4°00'E to 54°30'N; 4°30'E). Special emphasis was given to the three META stations where community respiration is also being measured (see 1.3.5.1). The measurements and observations include densities, biomass, growth, and, for some species, (*Amphiura filiformis*, *Echinocardium cordatum*) spatfall.

On the basis of age determination, growth curves were computed for *Echinocardium cordatum*, *Tellina fabula* and *Mysella bidentata*. With the Petersen method, growth curves were constructed for *Callianassa subterranea*, *Chaetopterus variopedatus*, *Glycera rouxi* and *Gattyana cirrosa*. In the latter two species the length of the jaws were used as the most reliable measure. For all of these species the length-weight (AFDW) relationships were determined.

During two sampling periods, a large number of cores (18 or 30) were taken at the three community respiration stations to check the reliability of the sampling method. These samples were analysed with special reference to the total AFDW of the infauna.

Apart from these field studies, laboratory observations were initiated on the feeding behaviour, food intake and growth of two dominant species, *Callianassa subterranea* and *Echinocardium cordatum*. These species were successfully captured and kept alive in the laboratory. *Callianassa* is being kept in flat containers 38 cm deep, 22 cm wide and 1½ cm thick filled with natural silty sediment, where it immediately makes an extensive system of burrows and apparently feeds on detritus. The mechanism by which the animal introduces the detritus (or plankton?) into the burrows is still undetermined as well as whether or not "gardening" takes place in the burrows.

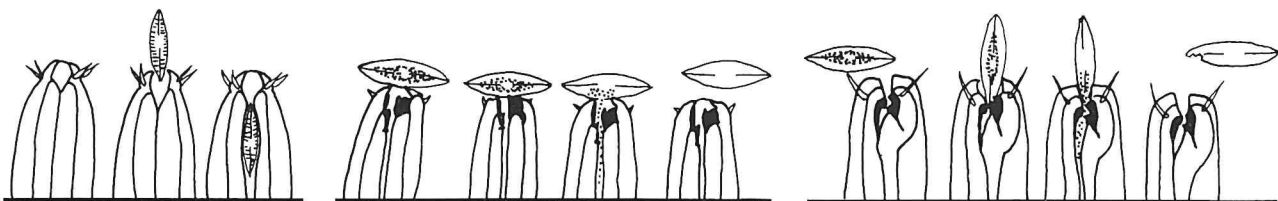
In the laboratory, *Echinocardium cordatum* has been seen feeding on deposited phytoplankton at the surface of the sediment. To this end it extends special tube-feet on to the surface of the sand. A problem concerning *Echinocardium* is the difference in maximum length observed in different types of sediment: in muddy sediments the test lengths rarely exceed four cm whereas in sandy sediments lengths up to 6 cm were recorded.

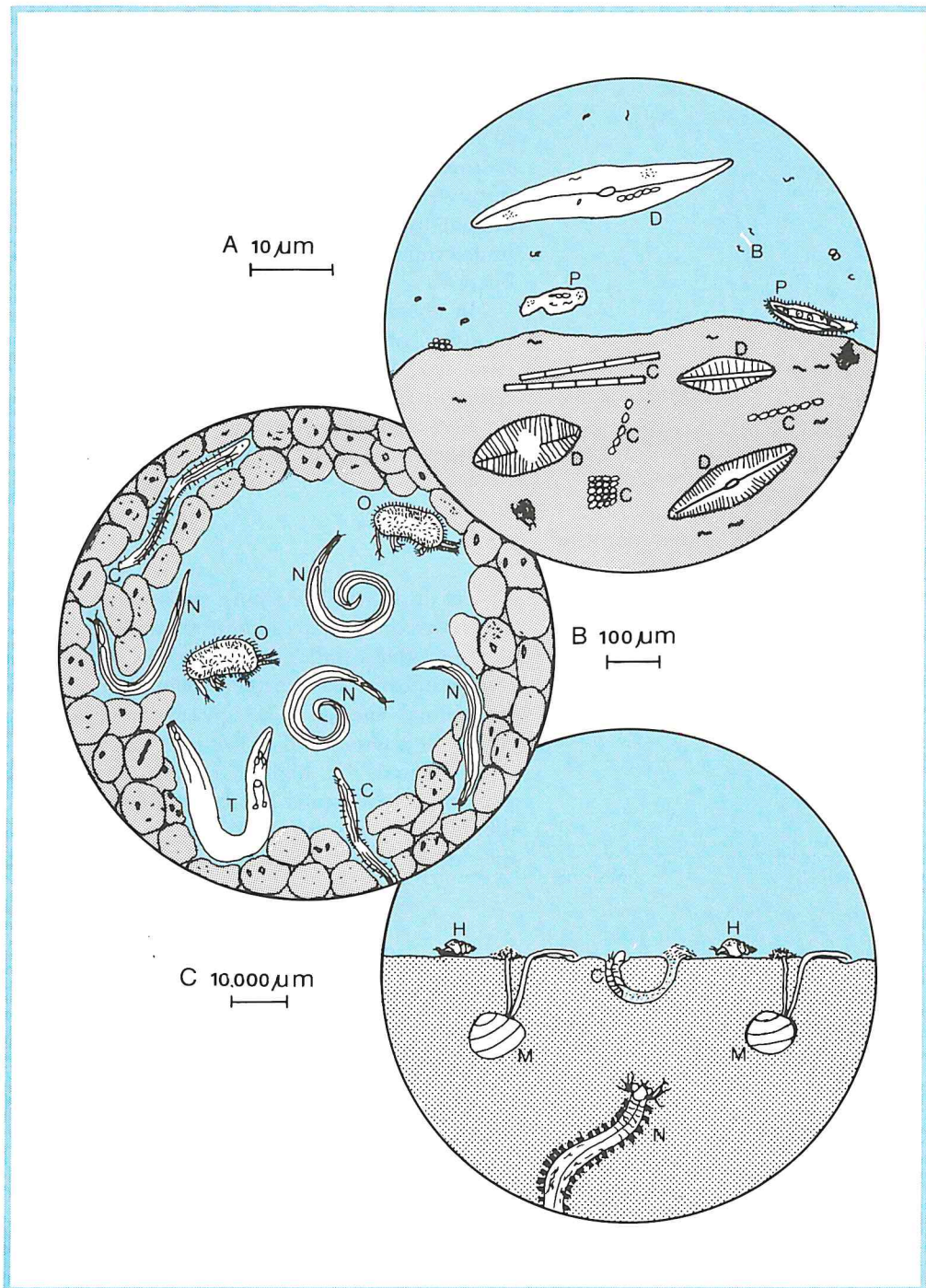
1.3.5.3. The role of meiobenthos

B2-02e

Also at the 3 META stations, the number of individuals of each meiofaunal group was counted to estimate the total biomass in terms of dry weight. The sandy southern station proved to be poorest in species number as well as in total numbers. The northern silty area contained the highest number of meiofaunal species. The greatest abundance and biomass of benthic copepods is also found in this part. The very muddy area in the transition zone showed the highest nematode abundance. All meiofaunal taxa penetrated to a greater depth in the sandy habitat as compared to the mud-dier habitats. On the muddy station (transition zone) the meiofauna, with the exception of the nematodes, is restricted to the upper few centimetres.

Different methods of attack on diatoms
by Nematods.





Examples of some common bottom-dwelling organisms. A: microflora and microfauna, bacteria (B), bluegreen algae (C), protozoa (P), and diatoms (D). B: meiofauna, nematods (N), oligochaetes (C), flatworms (T), and ostracods (O). C: macrofauna, *Hydrobia* (H), *Macoma* (M), *Nereis* (N), and *Corophium* (C).

1.3.5.4. Sea birds

B3-04

A study on the distribution of pelagic birds in and around the frontal system in the North Sea north of Texel has been initiated. Results show that the number of auks is higher near the front and near the shore than in the area in between. The numbers observed during the breeding season were much lower than in the winter, probably as a consequence of a congregation around remote nesting places.

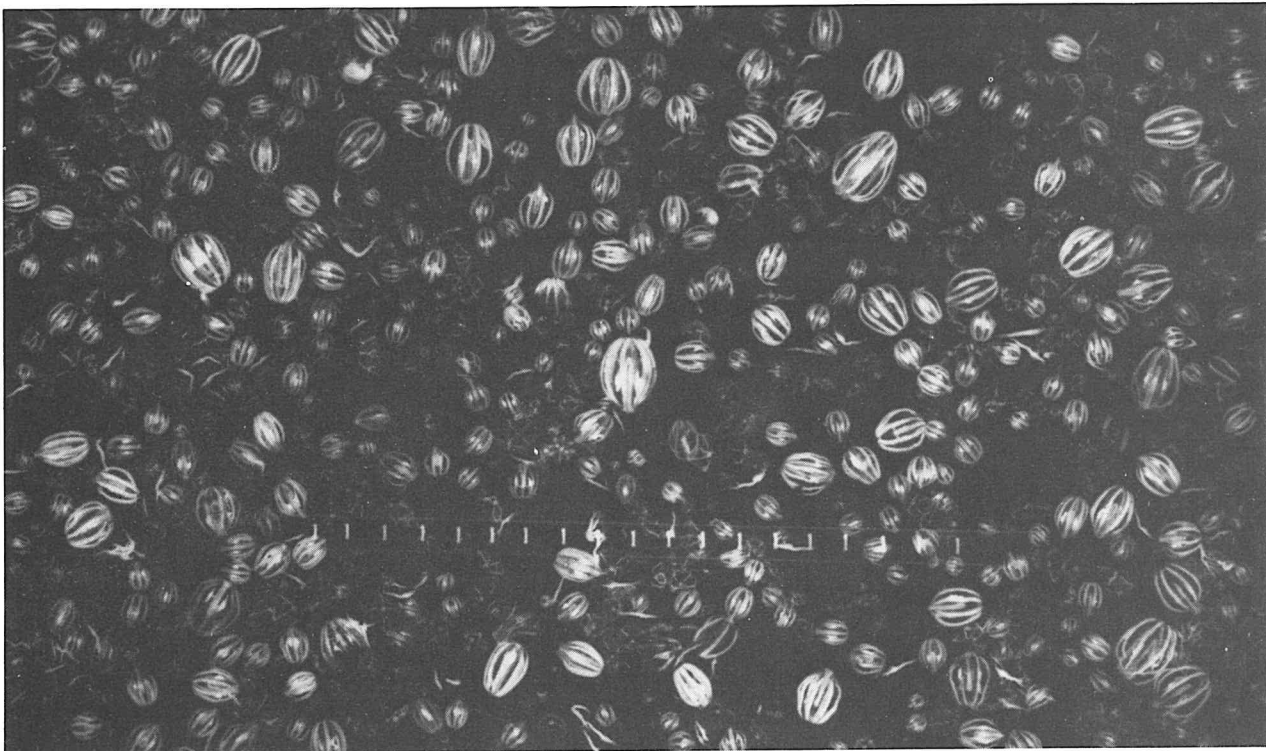
1.3.5.5. Pelagic predators

B2-03

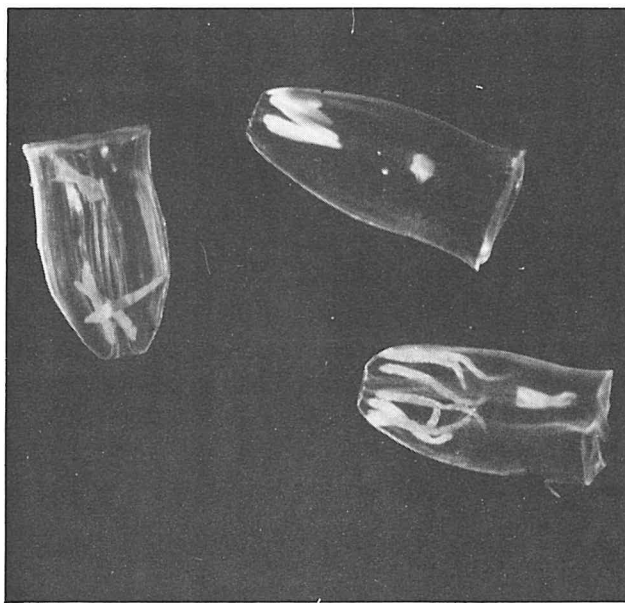
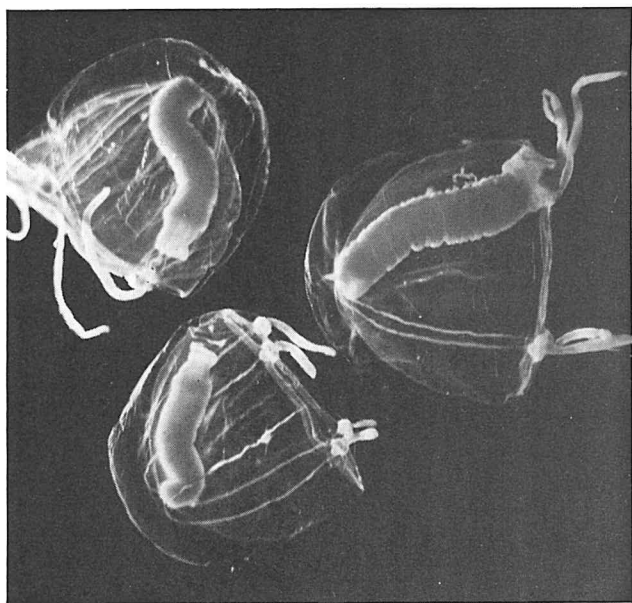
A detailed study on the effects of predation by *Pleurobrachia pileus* on zooplankton in the coastal North Sea near Texel shows that, even though there are several considerable peaks in density during April-June, *Pleurobrachia* predation should not be regarded as a key-factor in the control of copepod numbers in spring.

Sampling of pelagic predators in the southern North Sea was restricted to 24 stations north of Texel. All stations were visited 7 times. Hauls were made with the Isaacs-Kidd net (2 mm) and an attached 300 μ m and a 50 μ m plankton torpedo. The preliminary results confirm the 1982 findings on the insignificant role of Scyphozoa as zooplankton predators. The main macroplanktonic groups preying on herbivorous zooplankton in the area investigated are Hydromedusae, mysids, euphausiids and fish larvae.

Sample containing many species of the Ctenophore *Pleurobrachia pileus* and the Hydromedusa *Phialidium hemisphaericum*.



Time-consuming job of sorting macroplankton samples. *Sarsia tubulosa* (Hydromedusae) is typical of North Sea coastal waters; *Aglantha digitale* is an example of a Hydromedusa found in the open North Sea.



B4-01

Research on the role of pelagic predators on the regularly observed summer decline of copepods, started in November 1982. Predators and prey were collected during 7 cruises between April and October, on a 200 km long transect to the north-west of Texel. The samples from plankton nets and Isaacs-Kidd net have been partly analysed. During the same months, tidally integrated, samples were obtained weekly from the Texelstroom. In the coastal region, it was found that the Hydromedusae of the genera *Sarsia* and *Eutonina* occurred from April to mid-June at a relative constant density of 1 to 150 m⁻³. Thereafter they were replaced by *Bougainvillea*, which showed a short density peak of 60 m⁻³ in July. The other common genera occurred throughout the year but peaked in summer (*Phialidium* up to 3000 m⁻³ in aggregations in July, *Eucheilota* up to 10 m⁻³ in August). An experimental procedure for diet studies and the measurement of food uptake was started. Several coelenterate species were kept in incubators to study their capacity as predators on copepods.

1.3.5.6. The role of carnivores in the benthic system

B2-02a-c

In addition to the study of predatory pressure of demersal carnivores (sea stars, crustaceans and fishes) as a group, the food composition of those predators has also been determined in the field. The food of carnivores consists mostly of a variety of animals belonging to several different trophic levels. Therefore, for each predator species, an attempt will be made to estimate the mean length of the food chain and the energy costs of the biomass of these species in terms of secondary production.

1.3.5.7. Energy budget of demersal carnivores

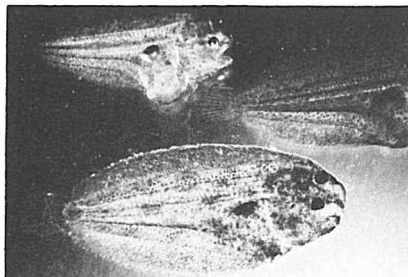
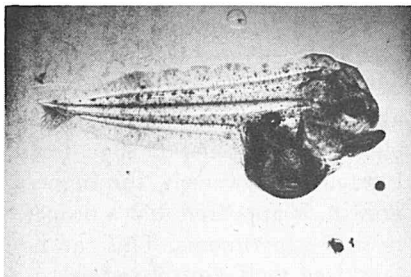
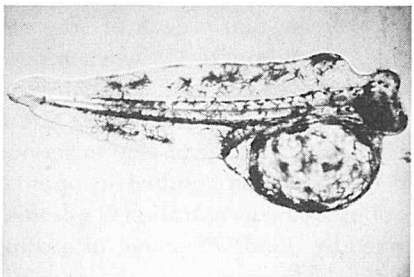
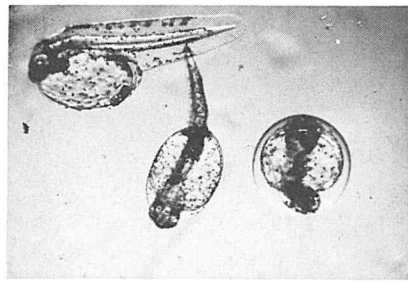
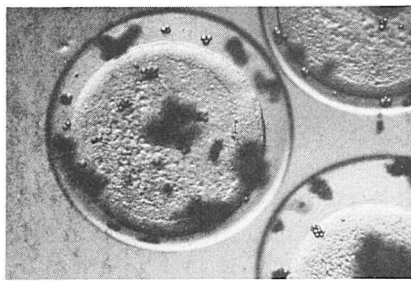
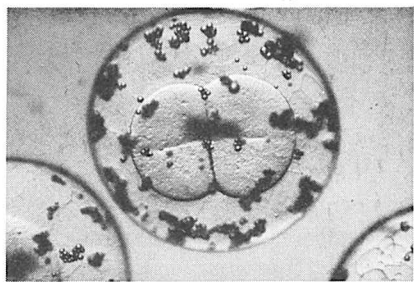
B2-02d

Measurements of daily food intake and growth for some of the most common benthic predators (such as *Asterias rubens*, *Pagurus bernhardus*, *Limanda limanda*, *Callionymus lyra*) are in progress.

Daily oxygen consumption, food intake, and growth were measured for young gadoids (14-26 cm, such as whiting, *Merlangius merlangus*; bib, *Trisopterus luscus* and cod, *Gadus morhua*) at 5° and 15°C.

All values of food intake and growth were calculated in wet weight, dry weight and in calories. The dry weight and the caloric value of 77 whittings (*Merlangius*) was estimated in relation to their length (L , cm) and wet weight (W , g) as: $W_{\text{dry}} = 0.92 L^{-1.22} W^{1.51}$.

The development of artificially fertilized sole eggs up to metamorphosis: a. 4-cell stage; b. germ-ring; c. hatching; d. newly hatched larva; e. late larval stage; f. developing asymmetry.



The respiration measurements suggested that daily oxygen consumption in whiting and bib was related to fish weight to the exponent 0.6 ($W^{0.6}$) rather than the commonly used metabolic weight exponent 0.8. For comparative reasons however, all measurements of respiration, food intake and growth were expressed as a proportion of the "metabolic wet weight" of the fish: $W^{0.8}$. This leads to the following preliminary approximations for whiting and bib: respiration R (mg $O_2 \cdot d^{-1}$) ranges from $R_{\min} = 1.8 e^{0.1T} \cdot W^{0.8}$ (starvation) to $R_{\max} = 2.7 e^{0.1T} \cdot W^{0.8}$ (full feed). The maximum daily intake of musselmeat ($D_{\max}$) for these species was $D_{\max}$ (mg dry weight) = $5.5 e^{0.1T} \cdot W^{0.8}$. For cod, this value was higher, by a factor of almost 2.

With maximum rations at 15°C, about 32% of the food energy was transferred into energy for growth (gross conversion). Net food conversion was calculated from the relation between the energy for growth (g) and food intake (F) at different rations according to $g = -a + bF$, where a is the energy loss at starvation. This resulted in an estimated value for the net food conversion coefficient of $b \approx 0.45$.

The extra oxygen consumption for digestion of food (Specific Dynamic Action or SDA of the food) was measured for fish given single meals, both at 15° and 5°C. The SDA appeared to be more related to meal size than to temperature.

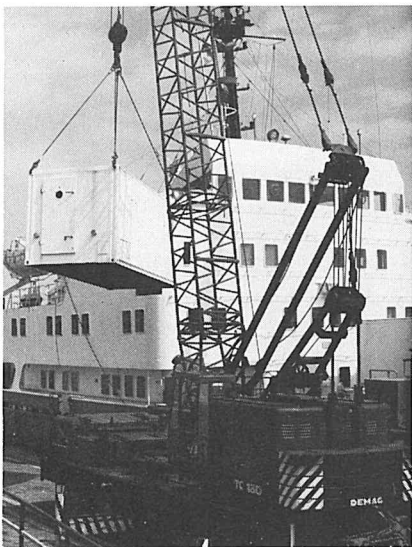
1.3.5.8. Experimental investigations on zooplankton

B4-04

Population-dynamics and bioenergetics of important copepods from the North Sea were investigated in experiments in which several generations could be cultivated in succession.

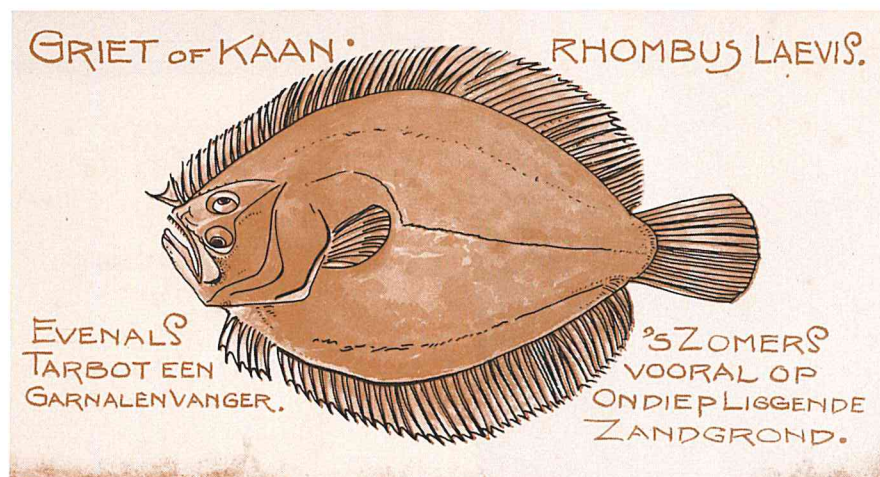
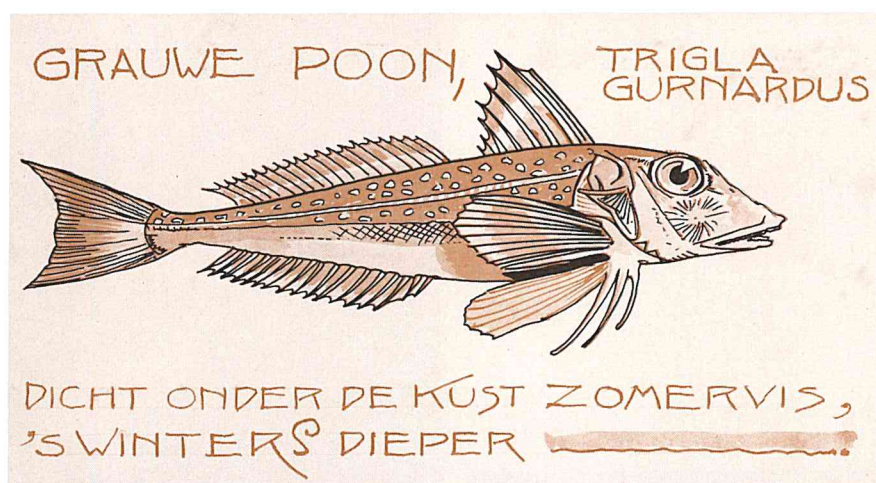
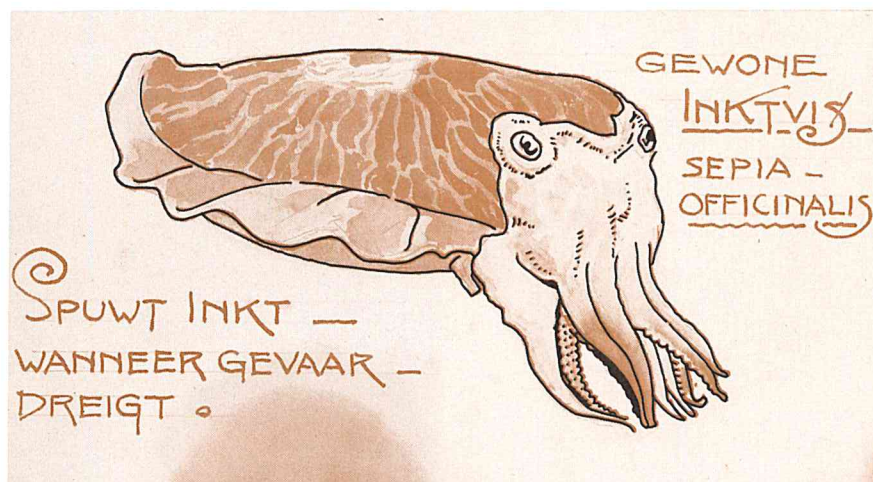
Some serious cultivation problems experienced last year were fully overcome. These problems were most probably caused by toxicity produced by *Oxyrrhis marina*, an essential organism in the cultures.

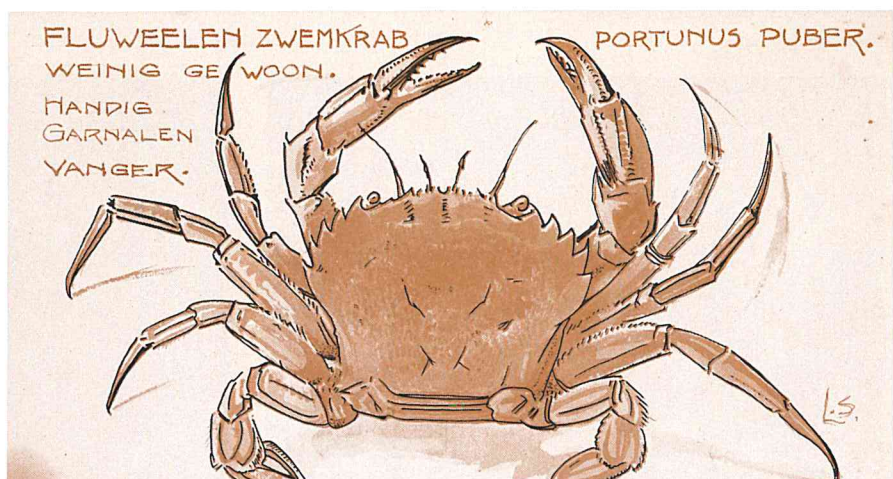
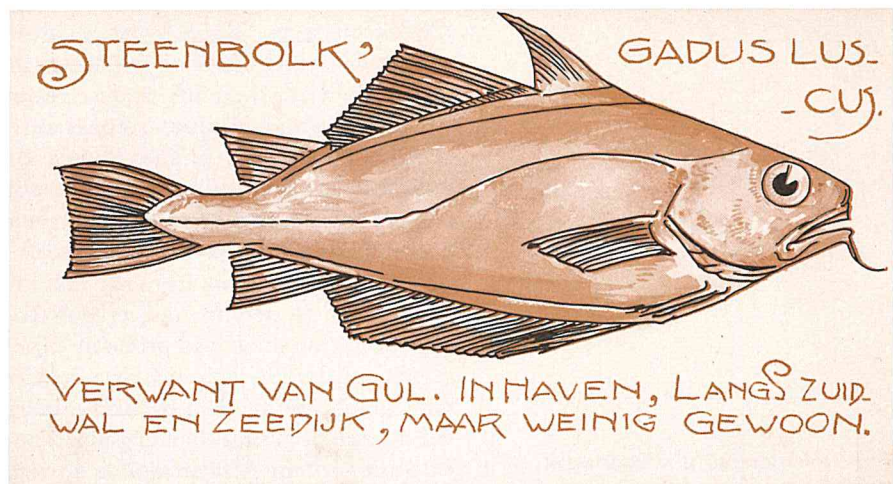
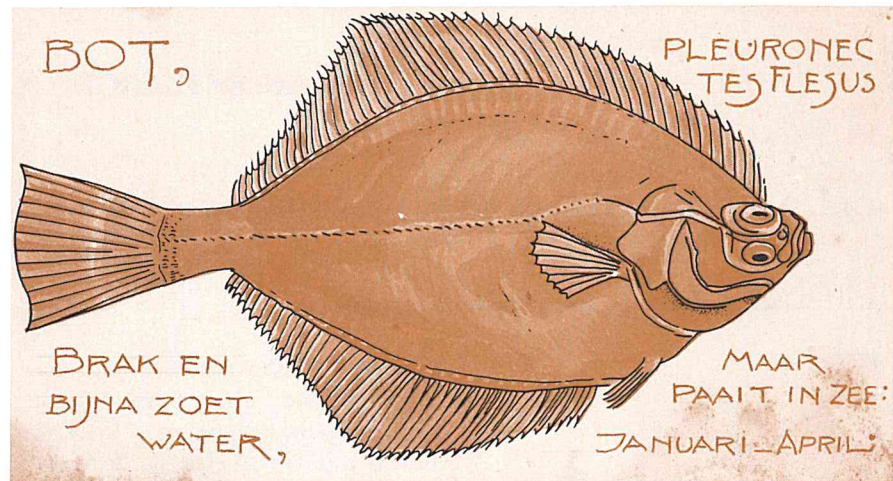
The influence of temperature, food concentration, and the interaction of these two factors on growth of *Temora longicornis* was studied. Four successive generations were bred from egg to adult using combinations of 4 different temperatures (5°, 10°, 15° and 20°C) and 4 different food concentrations. Preliminary results of these experiments indicate that growth of *Temora* is greatly accelerated with a temperature increase from 5 to 15°C, whereas at 20°C growth is only slightly higher than at 15°C. The food concentration also importantly influenced the rate of growth of *Temora*. At the lowest ration offered, the population sometimes hardly came to maturity, due to serious mortality. Conversely, the highest food concentration resulted in optimal growth. It appeared that a proper control of food concentration is essential in such experiments. This can be obtained by the development of a computerized food control system.



RV "Tyro".

Sepia drawings, mainly after drawings from the literature mentioned, prepared by the artist Leon Senf (1880-1940) using ink from the ink-sac of *Sepia officinalis*. These drawings are from a series, originally used in 1934 as a legend to identify the animals displayed in a small public aquarium at the Institute in Den Helder.





1.4. OCEAN RESEARCH

1.4.1. Angola Basin (eastern South Atlantic Ocean)

1.4.1.1. Sedimentology and palaeoceanography

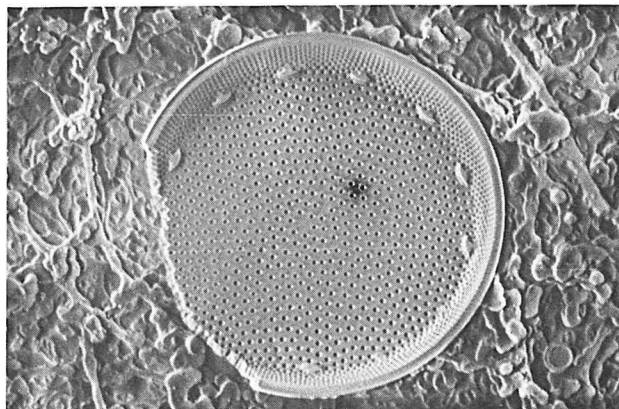
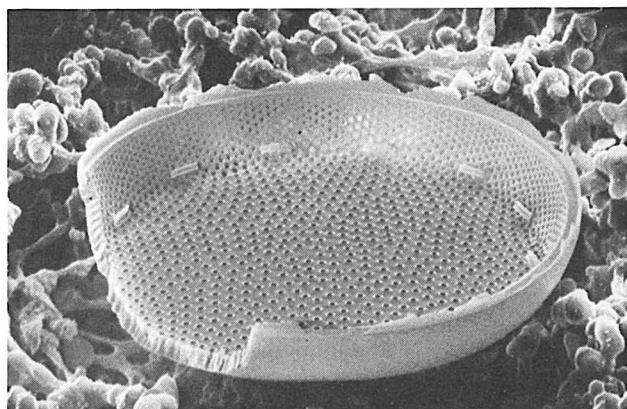
H4-03

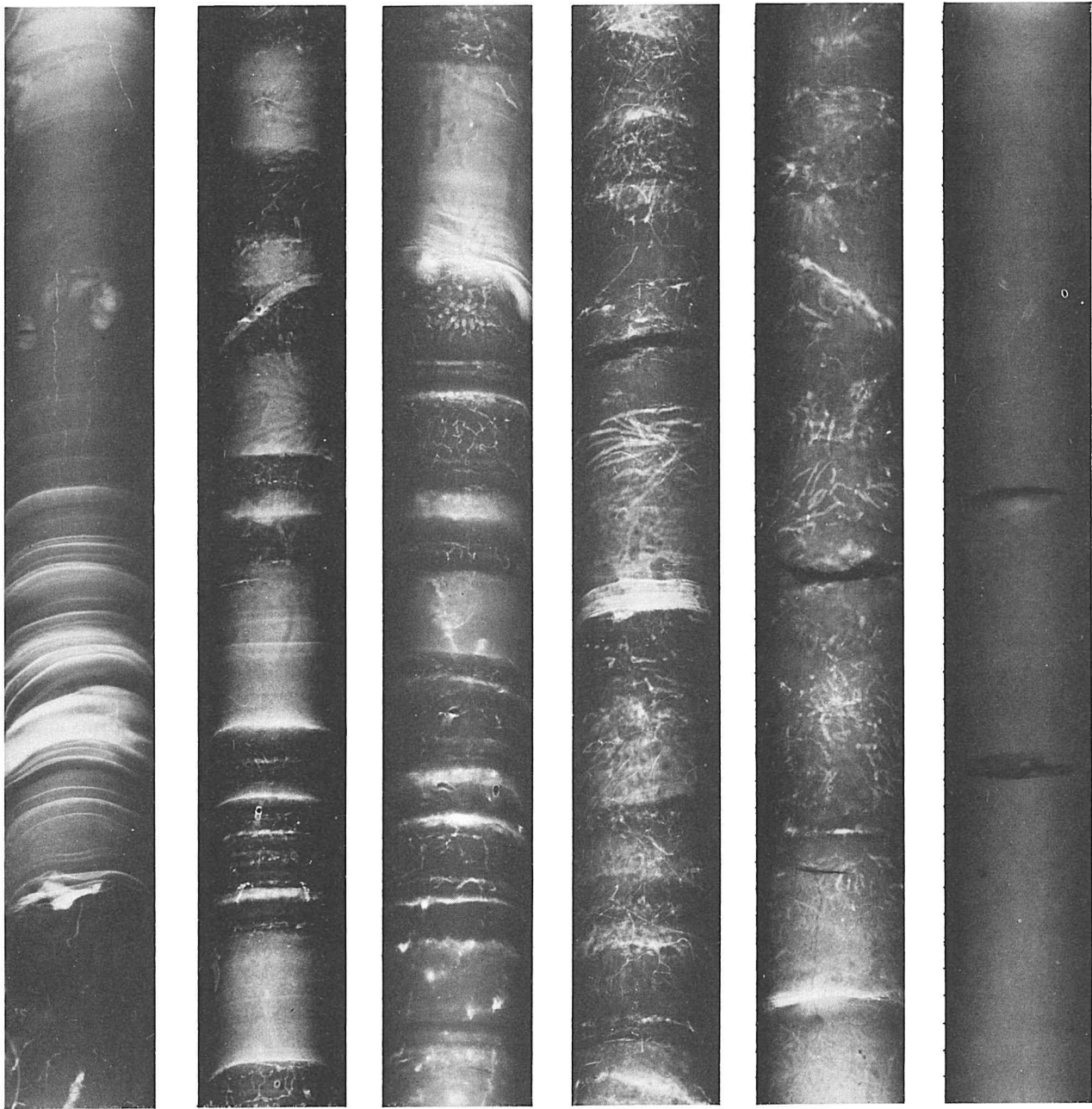
The work of the last few years has resulted in a good insight into the character and importance of the various sedimentary and palaeo-oceanographical processes of the Zaire deep-sea fan. This now allows us to study a number of essential features in detail.

In the sediments of the continental shelf and slope regression levels occur which are correlated with assumed ocean wide, low sea levels of Tertiary and Cretaceous ages. These levels separate seismic units of different tectonic characters, recognized in sediments in a large part of western equatorial Africa, and are therefore themselves at least partly of tectonic origin.

Thorium and uranium isotopes were successfully used for determination of Quaternary ages in the Angola Basin (H4-11). The Quaternary fan sediments are built up by various combinations of different terrigenous, shelf and oceanic components. The terrigenous and shelf material is mainly composed of clay minerals: kaolinite, poorly crystallised smectite, some illite and also quartz originating from the Zaire river; highly crystalline smectite and admixtures of zeolite and cristobalite coming from Tertiary opal-rich deposits at the shelf; and probably illite coming from African deserts. Sediment contribution from the river is large in interglacial sediments. Also the high proportion of shelf derived minerals deposited during glacial periods is evidence of glacial shelf erosion. The downcore illite distribution reflects expansions of the African deserts during glacial stages. A decrease in deposition of shelf minerals coincides with a general decrease in sedimentation rates ~350 000 years ago, which suggests that a long-term rise in sea level and climate warming occurred at that time.

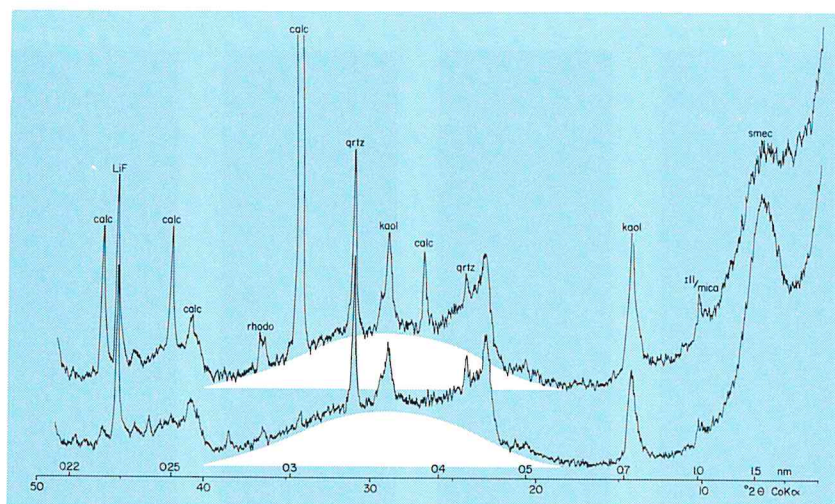
SEM micrographs of a frustule of *Actinocyclus normanii* (Greg.) Hust. f. *normanii*, a marine to brackish-water diatom from the Angola Basin sediments.





X-ray photographs of deep-sea core sections from the Angola Basin, showing a gradual transition from fast to slow sedimentation. The horizontal lamination (turbidites) indicates fast sedimentation (left); reduced sedimentation rates allow benthic organisms to form burrows (middle), which may even result in a completely homogenized sediment when sedimentation is very slow (right).

X-ray diffraction patterns of two sediment samples from the Zaire deep-sea fan, showing smectite (smec) badly-crystallized (above) and well-crystallized (below). The shaded area represents biogenic opal.



H4-11

The very large opal content of the sediments (up to 60%) show maxima in glacial periods and indicate both a high ocean fertility as well as conditions conducive to opal preservation.

Manganese is concentrated in recent subsurface Mn spikes and in fossil spikes buried by subsequent turbidites. Mn burial rates are high in glacial periods, owing either to climate controlled variations in the composition in the accumulating sediments or to a change in the redox processes in the sea bottom. A portion of the Mn in the cores is fixed as MnCO_3 .

The investigation of the diatom frustules in the pelagic Quaternary sediments shows alternations of more tropical species with more subtropical species reflecting the alternating interglacial-glacial periods. In the hemipelagic deposits found closer to the coast, brackish water forms appear, as well as species which are generally used as markers of nutrient richness. The presence of resting spores of *Chaetoceros* could possibly indicate the importance of the river induced upwelling area off the river mouth.

Semi-quantitative X-ray diffraction analyses demonstrate that, in all samples, the clay mineral composition is controlled by an unmeasurable factor, related to the crystallinity of the smectites. It follows therefore, that the clays of the Zaire fan are greatly dominated by the nearly undetectable, poorly crystallised smectite.

The investigations of the Angola Basin are being carried out in co-operation with research workers from outside this institute.

H4-05

Some work has also been done on poorly crystallised smectite in lateritic soils. The presence of smectite strongly influences soil mechanical properties, a feature of vital importance for many clayey deposits in the world. However, since it cannot be traced with conventional techniques it is often supposed absent.

A project has been initiated with Dr R.A. Kühnel (TH Delft) to study the various members of the smectite family found in sediments, which may provide information on their origin. At constant relative humidity, the members of the smectite group, depending on the charge caused by isomorphous substitution, hold different numbers of water molecules in their interlayer.

1.4.1.2. The silica cycle

H4-02

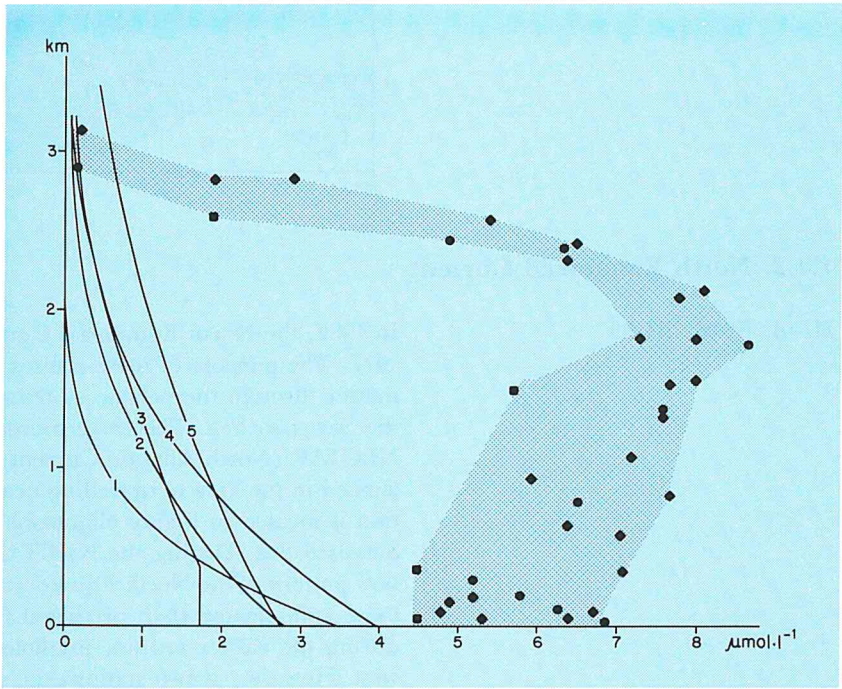
From profiles of interstitial waters, determined during expeditions to the Angola and Guinea Basins in 1979 and 1980, and to the Norwegian Sea in 1981, the upward diffusive flux of dissolved silica was calculated (see also 1.4.3.2).

	Interstitial water concentration ($\mu\text{mol. l}^{-2}$)	Bottom water concentration ($\mu\text{mol. l}^{-2}$)	Upward diffusive flux ($\mu\text{mol. cm}^{-2} \text{ y}^{-1}$)
Guinea and NE Angola Basin	300-400	52-62	3-4
S Angola Basin	90-140	55-70	0.2-0.5
Norwegian Sea	~ 150	13.5	2.5

The variations in the flux rates are primarily caused by the large range in interstitial concentrations; variations in porosity and bottom-water concentrations play a secondary role. The concentration gradients from interstitial water to bottom water had to be corrected for core shortening, and the choice of the appropriate coefficients for diffusion out of the sediments and dispersion throughout the water column is subject to a number of assumptions. Nevertheless, the modeling of the slight increase in concentration of dissolved silica due to the flux from the bottom, markedly improves the use of dissolved silica as a tracer for water mass distribution patterns in the Atlantic Ocean.

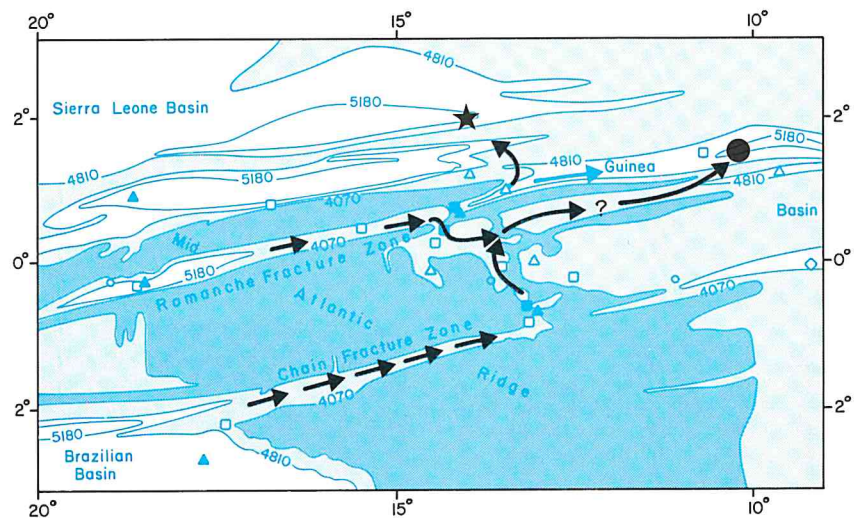
curve	t (y)	D_e ($\text{cm}^2 \text{ s}^{-1}$)	J ($\mu\text{mol. cm}^{-2} \text{ y}^{-1}$)
1	50	2	3.5
2	80	5	3.5
3	80	5	3.5
4	80	5	5
5	150	10	3.5

Excess of dissolved silica in the central Angola Basin as a function of distance to the bottom (~ 5000 m). The shaded area gives the excess relative to the inflowing waters near the equator. The 5 curves on the left give the excess as calculated from the diffusive flux out of the sediments. Each of the 5 curves represents the application of a different set of boundary conditions.



Two examples were analyzed. For the Angola Basin, the deep and bottom waters enter from the north over sills in the Romanche and Chain fracture zones. Because the bottom topography in this region is very complicated (see figure), the route of bottom water flow is still not exactly known. However, two selected stations describe the entering waters with sufficient accuracy for analysis. The increase in dissolved silica can be derived in either of two ways: by comparing the concentrations at the inflow with stations further south in the Angola Basin, or by modeling the flux from the bottom. If a steady state is assumed, it is impossible to explain the increase of the silica due to flux from the bottom. This implies that the waters now entering are different from those entering in the past. This surprising result suggests that the changes in deep North Atlantic water masses, caused by climatic changes in the Arctic, are already detectable at the equator. Determination of the time lags in the coupling between climatic changes and deep water circulation will be an important task for the oceanographic community in the near future.

Bathymetry of the sills in the Romanche and Chain Fracture Zones. Arrows indicate flow paths along the bottom, as derived from the gradual increase of potential temperature. Inflowing water is characterized at 2 selected stations Geosecs 111 (★) and NIOZ 79-11 (●).



1.4.2. North Equatorial Current

H1-01, B1-03, B4-03

In 1982, the North Equatorial Current was visited for the third time since 1977. The purpose of these cruises was to study the rate of flow of organic matter through the pelagic system in the region between West Africa and the Sargasso Sea. The easternmost station of the east-west section of the NECTAR (North Atlantic Current Trans Atlantic Research) programme is located in the area of upwelling near Cap Blanc while the westernmost station is located in highly oligotrophic water near the eastern border of the Sargasso Sea. During the NECTAR III expedition in 1982, the observed flow pattern of the North Equatorial Current's surface water appeared to be more complicated than predicted from the model. This model, conceived during the earlier cruises, predicted a water mass travelling from east to west. However, at two stations the subsurface drifters moved in a direction

opposite to that expected. Hydrographic data suggest a more southerly extension of the North Atlantic Gyre in 1978 and 1982, as compared with 1977; since salinity was higher and the depth of the mixed layer greater. Due to the season (March) the temperature of the mixed layer was 3°C lower than in 1977 (September) or in 1978 (November). Concentrations of phosphate, nitrate and ammonia were low throughout the mixed layer at the oligotrophic stations. Only silicate was present at higher concentrations than during the earlier cruises. As was the case during the previous cruises, nutrient concentrations increased sharply from the bottom of the mixed layer downwards. In this nutricline, a nitrite maximum was found, as well as a deep chlorophyll maximum layer. These maxima were located at roughly the same depth as observed during the first 2 NECTAR cruises, ranging down to 130 m at the westernmost station, near the Sargasso Sea.

The deep chlorophyll maximum layer was only found in the oligotrophic part of the section. In the upwelling region near West Africa, all phytoplankton (dominated here by diatoms and green algae) occurred in the upper 40 m of the water column, with most of the chlorophyll being associated with particles larger than 8 μm . The larger forms of phytoplankton found at the western oligotrophic stations were dominated by coccolithophorids and (at the westernmost station near the Sargasso Sea) the cyanobacterium *Trichodesmium*. At these stations, however, most of the algal crop was nanophytoplankton: 75% of all algal cells were smaller than 3 μm with 50% of the crop in the mixed layer even smaller than 1 μm . The species composition of the phytoplankton at the depth of the deep chlorophyll maximum layer (near the bottom of the euphotic zone) was not the same as in the mixed layer. In this layer, the phytoplankton was dominated by coccoid cyanobacteria, while the dominant algal groups were green algae and fucoxanthin-containing groups. This taxonomic difference was revealed by pigment analysis with high-performance liquid chromatography (HPLC). With ^{14}C -labelling of chlorophyll a (Redalje-Laws method) it could be shown that the deep-dwelling phytoplankton contained most chlorophyll per unit biomass.



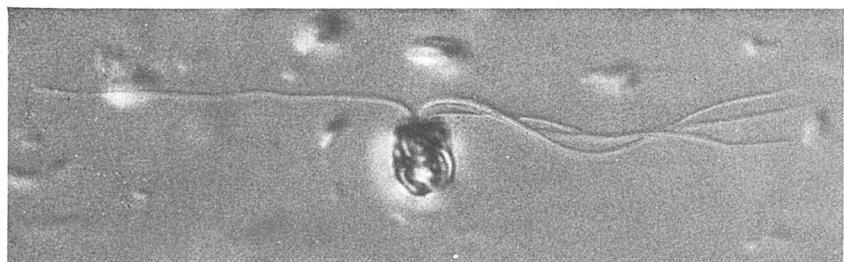
Interior and exterior of the newly built shed for construction and storing ocean equipment.



Primary production was measured with an ultra-clean version of the ^{14}C method and of the oxygen light-and-dark bottle method. Results were compared with primary production estimates obtained in two other ways: by measuring diurnal fluctuations of oxygen and of particulate organic carbon (POC) *in situ*. During the cruise of 1978, large discrepancies were found in the production estimates obtained from such different methods; the values obtained with the POC method especially, were far higher than those based on the ^{14}C and oxygen methodology. In 1982, however, all methods gave primary production values that were of the same order of magnitude: $800 \text{ mg C}\cdot\text{m}^{-2}\cdot\text{d}^{-1}$ at the oligotrophic stations in the North Equatorial Current, and 1000 to 2000 $\text{mg C}\cdot\text{m}^{-2}\cdot\text{d}^{-1}$ at the station in the upwelling near West Africa. During daylight, much of the POC production in oligotrophic water appeared to consist of carbohydrates that were consumed during the ensuing night.

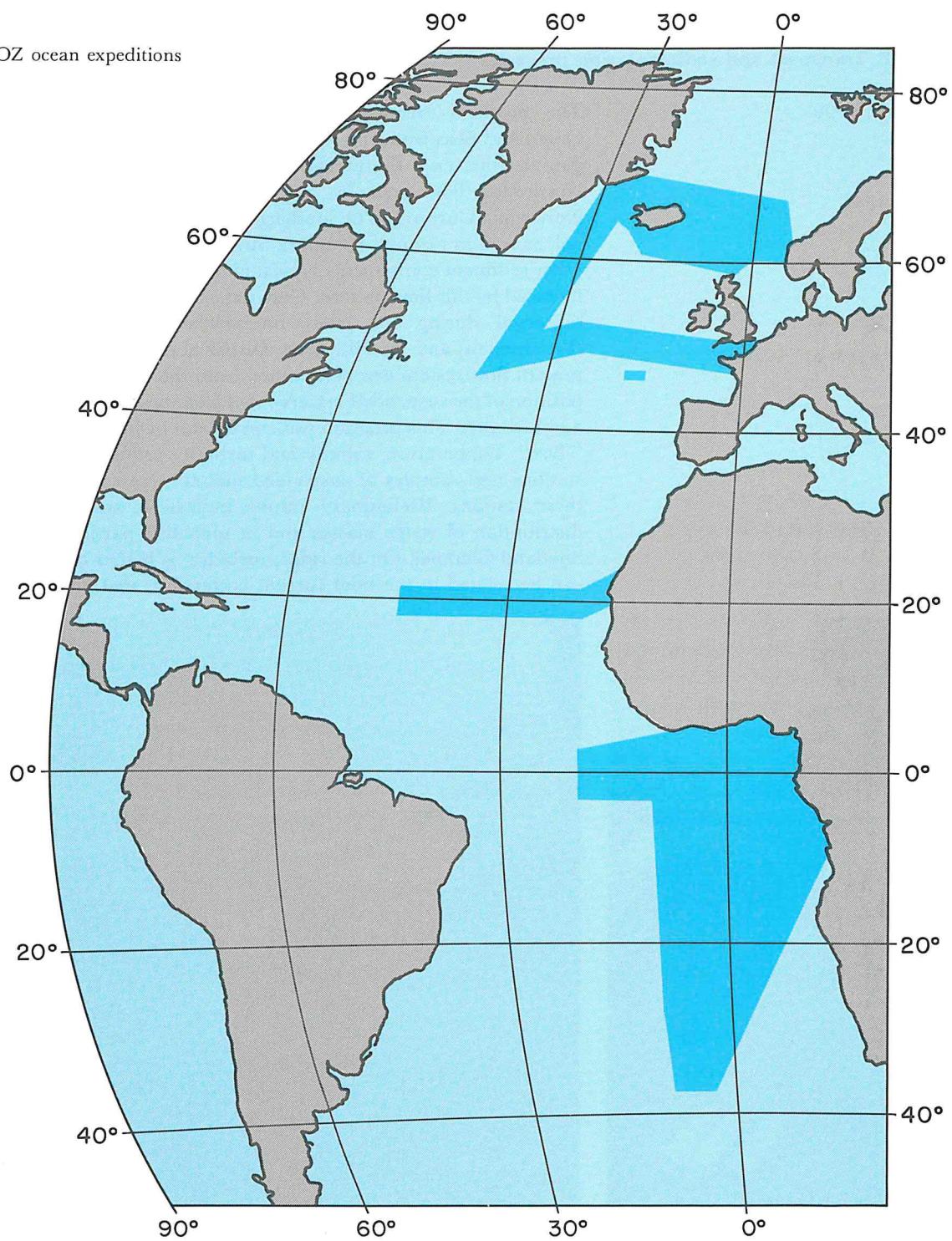
Bacteria, by far the most abundant component of the biomass numerically, dominated at depths below the mixed layer. In the mixed layer, bacteria and algae contributed equally to the total living biomass. Of the larger heterotrophs, tintinnids were less abundant in 1982 than in 1978 while copepod nauplii and copepodites were present in equal numbers. Surprisingly, the maximum density of nauplii was observed at the depth of the chlorophyll maximum. At the station near Cap Blanc, where no such maximum was present and all phytoplankton was found in the upper 40 m, a clear diurnal feeding rhythm was observed in copepods. At the oligotrophic stations to the west, the same copepod species were also found feeding actively during the hours of daylight. It is remarkable that the chlorophyll concentration in copepod stomachs was sometimes highest at the oligotrophic stations. Here, the activity of digestive enzymes was not clearly related with food uptake, while at the station near Cap Blanc this relationship was obvious.

A double Deep Scattering Layer (DSL), caused by deep-living organisms, was present in the oligotrophic North Equatorial Current: one at 150 m and one at 500 m depth. This layering has also been observed in other parts of the oligotrophic ocean. Throughout the area, the mesopelagic fish fauna was more abundant in 1982 than during the foregoing cruises. This increased abundance could possibly be related to the southern displacement of the North Atlantic Gyre in 1982. As in 1977 and 1978, the highest biomass of small fishes was found in the central part of the area studied, not near Cap Blanc. Part of the fish fauna, namely the Myctophids (lantern fishes), migrated vertically from 400-1000 m during the day to 0-100 m in the night.



A flagellate, perfectly preserved with picric acid (probably *Pyramimonas*, Cryptophyceae).

Areas of NIOZ ocean expeditions

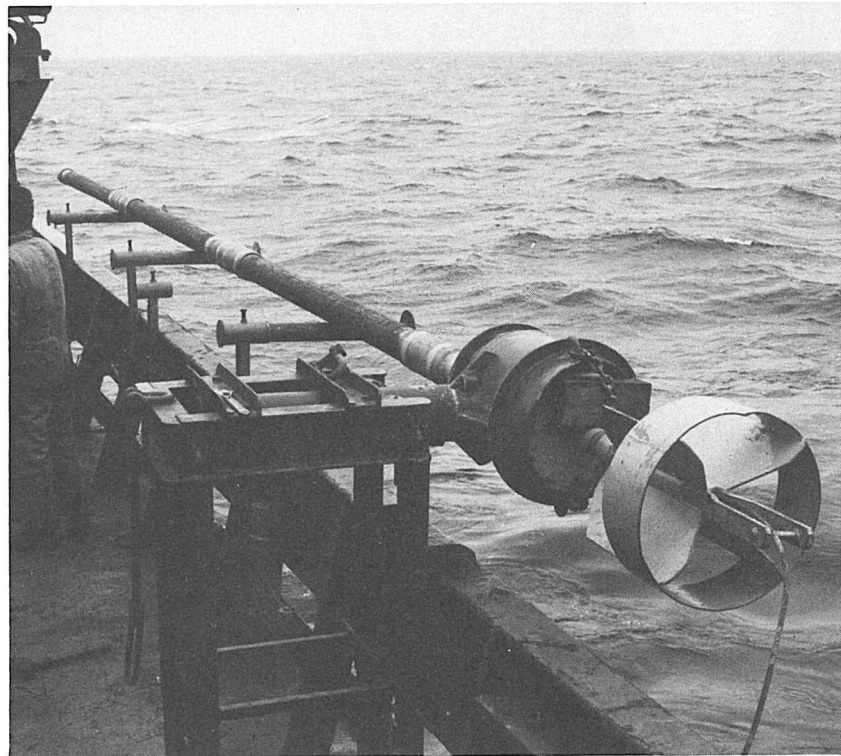
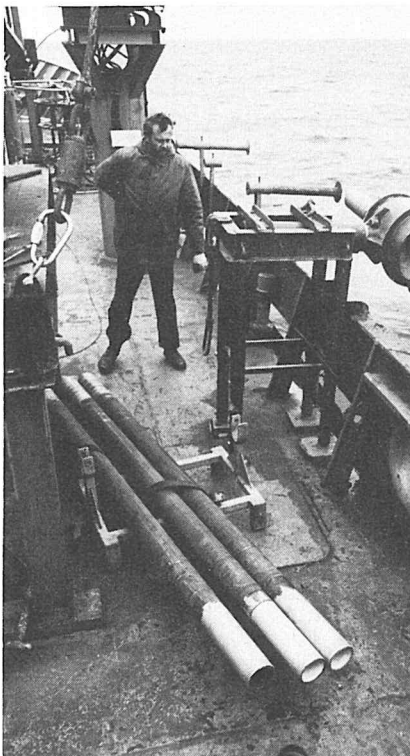


1.4.3. North Atlantic Ocean and Norwegian and Greenland Seas

1.4.3.1. Transport and sedimentation processes

H4-05, H4-06

The Scotland-Greenland Ridge, which separates the Norwegian and Greenland Seas from the North Atlantic Ocean, is 300-500 m deep with a gap at either end: the Faeroe-Shetland Channel and the Denmark Strait. Northward flow goes by way of the Faeroe-Shetland Channel (the Norwegian Current). The southern return flow also goes through this channel, as well as through Denmark Strait. The dispersal of clay minerals and other sediment components typical of the Faeroe-Iceland area is strongly influenced by this flow pattern. Core data show how these minerals have been dispersed during the latest interglacial (Eemian), the latest glacial (Weichselian) and the Holocene. Dispersal of sediment components by the present flow system was determined from the total concentration and composition of the suspended material and from profiles of temperature, salinity and turbidity. This program was carried out in June-July 1983, with the RV "Tyro". Temperature, salinity and turbidity profiles were measured at 290 stations and samples of suspended matter were collected at about half of these stations. Preliminary results indicate a strong variability in the distribution of water masses and in turbidity, particularly in the Faeroe-Shetland Channel. On the ridge, turbidity is higher near the bottom. This can be related to the tidal current patterns in that area.



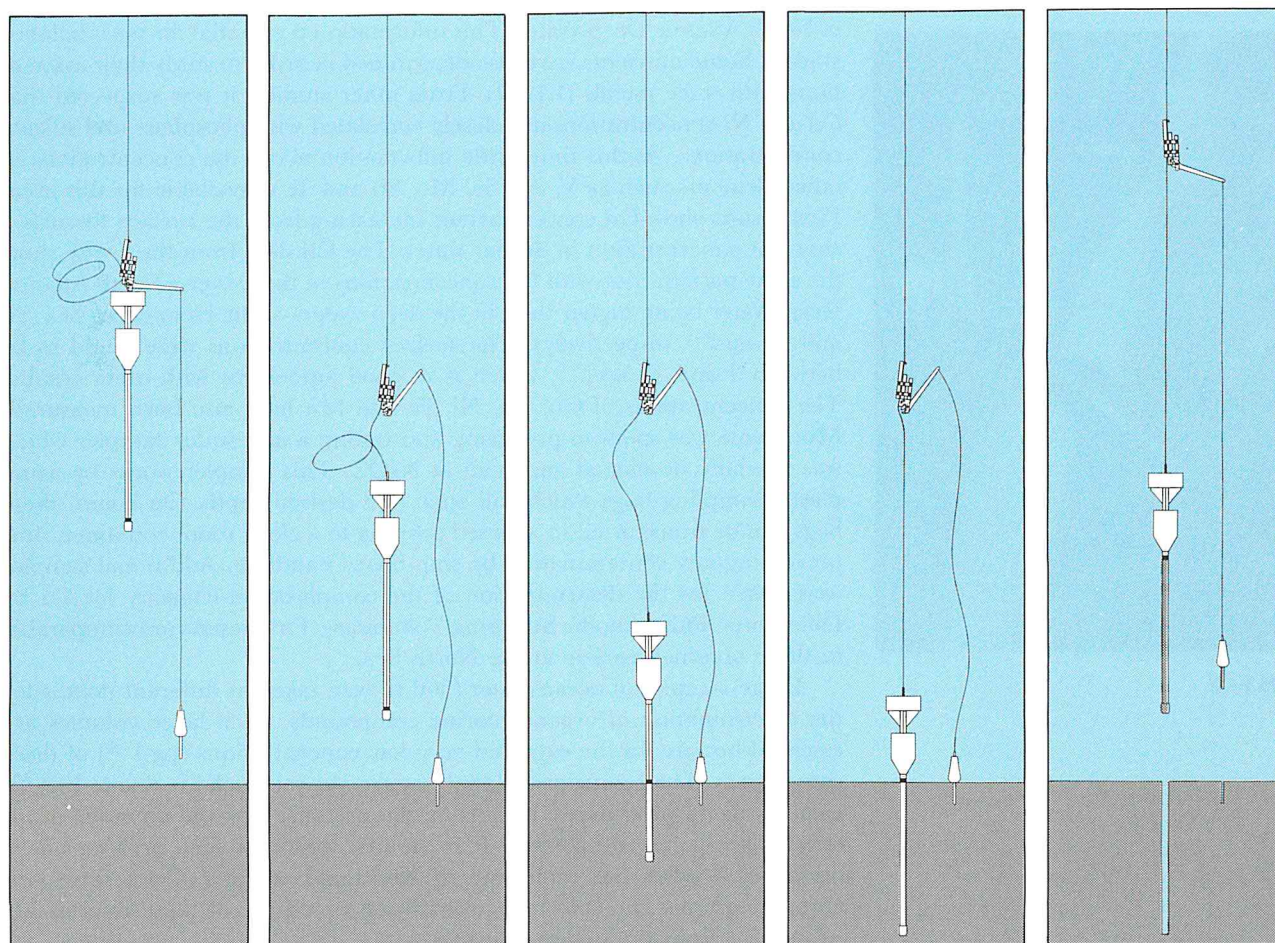
H4-07

The processes that cause transport of material over the edge of the continental slope of the North Sea and deposition of this material in the Faeroe-Shetland Channel are being studied. Cores collected in this area were analysed for ^{14}C , $^{16}\text{O}/^{18}\text{O}$, foraminifers, diatoms and organic C. The results show a transition from cold glacial conditions to the present situation.

H4-05

The cores of the Faeroe-Shetland Channel contain notable amounts of the clay mineral vermiculite. The same is true for cores from the Skagerrak (North Sea). The natural conditions of the alteration of this unstable mineral into other clay minerals were studied in laboratory experiments. It appears that vermiculite does not survive a dry environment. It originates from mechanically crushed biotites of the Skandinavian shield. During the entire process, from its formation to final deposition in the marine environment, it remains unchanged under wet conditions. The vermiculites from the Faeroe-Shetland Channel are more stable than those in the Skagerrak. Minerals with comparable swelling properties, were found in samples of Lamont cores from the Norwegian Sea. They could not be identified as vermiculite, however because of the dessicated state of the samples (see also 1.3.3).

Handling and operation of piston-corer.



1.4.3.2. Silica cycle

H4-02

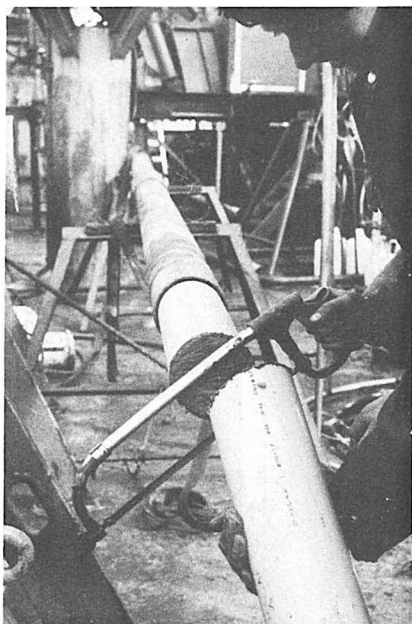
The increase in dissolved silica found in the bottom waters of the Norwegian Sea could be explained by the flux from the bottom; apparently deep water formation in that basin has been a stationary process during the last century. On the other hand, deep water formation in the Greenland Sea was found to be more complicated than previously thought. Probably, shelf water from the Barentz Sea is involved here.

New data on dissolved silica, phosphate, and aluminium were collected from the deep water passages and basins around Iceland. They form a valuable connection between the results obtained in the Southern Ocean and equatorial Atlantic Ocean (see also 1.4.1.2 and 1.4.3.3).

1.4.3.3. Distribution of pollutants

H3-01, H3-03

Splitting a piston core into sections



H3-02

A cruise was carried out with RV "Tyro" by NIOZ and ECN in the North Atlantic Ocean during the summer of 1983. The aim of the cruise was to establish the concentration levels of several trace elements and organochlorine compounds in water masses contributing to the formation of North Atlantic Deep Water. This information is essential for mass balance studies. Some nutrients were also determined in order to study their associations with trace metals (1.4.3.2). From other studies, it was suspected that Cd and Ni concentrations are closely correlated with phosphate and silicate concentrations. At this time, little information about the concentrations of other elements such as V, As, Se, Mo, Sb and Te is available for this area. First results show Cd concentrations increasing from the surface towards a constant concentration in deeper water. The Cd data from the cruise show the same pattern, but with Cd concentrations in the western North Atlantic Deep Water being higher than in the deep waters of the Norwegian Sea (30 and 20 $\text{ng}\cdot\text{l}^{-1}$ respectively). The surface concentrations were found to be between 3 and 17 $\text{ng}\cdot\text{l}^{-1}$, which is in good agreement with other results. The concentrations of Cu, Zn, Ni, Fe and Mn have also been measured. Much time was spent in preparing and testing a new water sampler which was specially developed and built at NIOZ. This sampler works by using plastic sampling bags which will open at a desired depth. On board, these bags can be transported in a closed position to a clean room container, thus preventing any contamination by ship-board handling. Additional samples were taken for the determination of the complexation capacity for Cu by Differential Pulse Anodic Stripping Voltametry. First results are comparable to those obtained earlier in the North Sea.

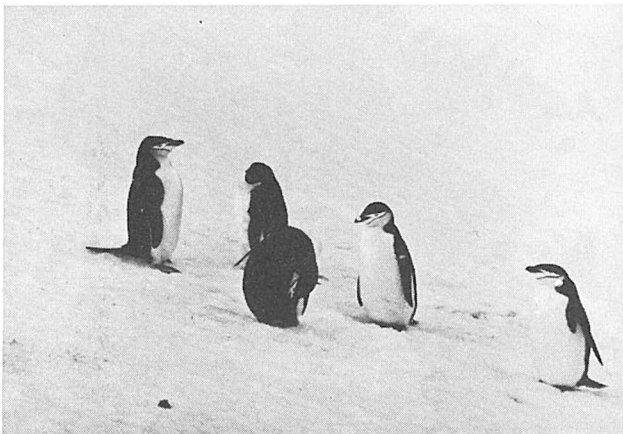
Large samples of ocean water (500 l) were taken at different depths for the determination of organochlorine compounds. Such large volumes are essential because of the expected very low concentrations ($\text{pg}\cdot\text{l}^{-1}$) of these compounds. The results of the analyses are not yet available due to insufficient clean-up procedures, caused by the presence of large amounts of interfering organic compounds. It is the first time that such problems have occurred. Studies are underway to determine whether Gel-permeation-chromatography can solve the problem of separation of these interfering substances from the organochlorines.

1.4.3.4. Optical research

H2-01

Radiative transfer in eutrophic and oligotrophic oceanic waters was investigated with the aim to interpret satellite imagery in terms of chlorophyll distribution patterns in the open sea. A previously developed two-flow model was employed. Special attention was paid to the fluorescence effects of algal chlorophyll and of artificial optical tracers. The quantity and quality of the suspended matter, as well as its vertical distribution, were also considered. The influence of water column stratification on fluorescence emission was studied. The detection of the emission maximum in the red part of the reflectance spectrum appears to be applicable to the remote sensing of chlorophyll in concentrations above $1 \text{ mg} \cdot \text{m}^{-3}$. The position of the peak and the relationship between its height and the concentration depend on the algal population. Unfortunately, the planned international Marine Optical-Biological Expedition (MOBIX 83) to the eastern Atlantic Ocean, including our participation, could not take place due to a strike by the crew of the French research vessel involved.

Antarktis II expedition

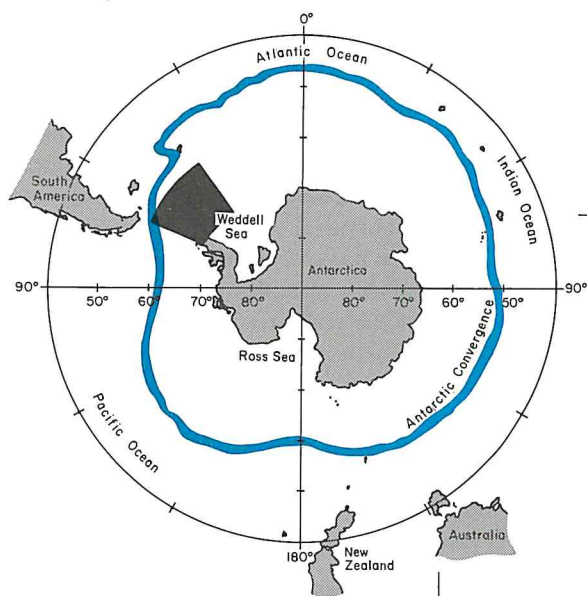


1.4.4. Southern Ocean

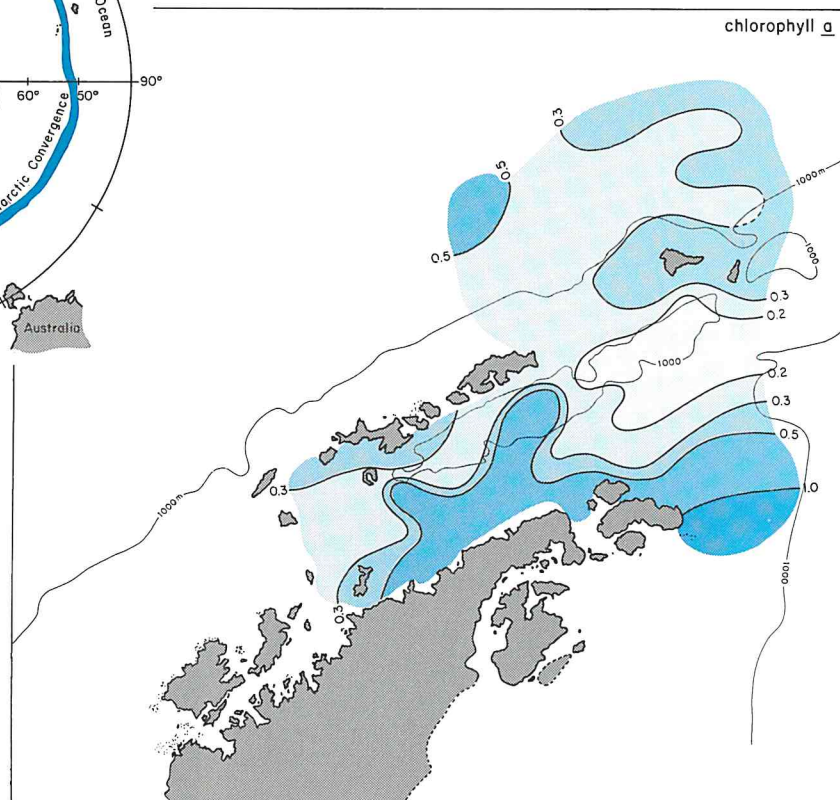
1.4.4.1. Distribution of phytoplankton

B4-02

During October-November 1983, a German expedition (Antarktis II) to Antarctic waters took place using the RV "Polarstern". The NIOZ contribution to the programme was a study of the horizontal and vertical distribution of chlorophyll between the Antarctic Peninsula and the Scotia Sea in October-November 1983, and the contribution of phytoplankton to spectral light absorption in this region. The horizontal distribution of chlorophyll was based on measurements of acetone extracts of the suspended matter from samples taken at a depth of 5 m. The chlorophyll concentrations were surprisingly low throughout the area surveyed, except just north of the pack-ice border. This border was encountered east of the eastern tip of the Antarctic Peninsula (Joinville Island).



Chlorophyll a concentrations ($\text{mg} \cdot \text{m}^{-3}$) near the surface in Bransfield Strait and Scotia Sea.



An impression of the vertical distribution of chlorophyll was obtained by lowering an *in situ* fluorometer to depths as deep as 140 m. The vertical fluorescence profiles suggest that algae are present at roughly the same density throughout the water column to at least 100 m depth. This is well below the euphotic zone. However, the vertical distribution was different at the stations which had their highest concentration of chlorophyll near the surface. At these stations, the bulk of the phytoplankton was found between 0 and 60 m. Small-scale patchiness was registered at all stations with repetitious AquaTracka profiling.

Diatoms were dominant (more than 80% of algal biomass) throughout the area, except in the northwestern part (Drake Passage), where nanoplankton (algae smaller than $8 \mu\text{m}$) was the largest contributor to the biomass. The overall high level of light absorption by phytoplankton, and the strong gradients in horizontal distribution of phytoplankton, make these waters an ideal region for exercises in remote sensing for the purpose of synoptic mapping of algal biomass.

1.4.5. Magnetization in sediments

H4-04

Magnetization processes in sediments were investigated with a series of experiments under several different artificial sedimentary conditions. The experiments show that the re-orientation capacity of magnetic particles in unconsolidated sediments depends on the colloid-chemical bond between the sediment particles and the pore space available. Bioturbation strongly influences the remanent magnetization. In sediments settled from suspension in the earth's magnetic field the magnetization is generally notably weakened by bioturbation.

1.4.6. Quantitative microzooplankton research

B2-05

The effect of various fixatives upon microzooplankton preservation was studied, with most emphasis placed on the method of introducing the fixative into the sample. Only a small portion of the organisms remained in a more or less recognizable shape. In all experiments a small portion of the organisms was always perfectly preserved, showing the natural shape with the flagellae still attached. This means, that without a quantitative control, it may be easily inferred that the sample was adequately preserved. On the other hand, these few excellently fixated cells suggest that with the techniques used a good preservation may be possible. We were unable, however, to establish the factors which determine whether a cell will or will not be well preserved. Even if more insight might be gained in that regard, it remains improbable that we can control these factors in such a way that reliable preservation could be consistently achieved aboard ship.

1.4.7. Chemical composition of marine organisms and abiotic environment

B3-05

The elemental composition of marine organisms is closely related to that of their environment by a continuous turnover of various substances through their food or via the respiratory or excretory surfaces. The concentrations of 32 chemical elements in a large number of marine finfish, molluscs, and crustaceans were subjected to a closer analysis in order to establish several statistical characteristics as well as to search for interspecific relations between the concentrations of the various elements.

- For each element, the concentrations in the organisms analysed usually show asymmetric frequency distributions; except for H and O, all median concentration values were lower than the average concentrations. The observed variations in element concentrations are best represented by log-normal frequency distributions.

- In the various animal species studied, significant interspecific relationships were only found in the concentrations of 46 element pairs. It seems more plausible that the various elements in living matter occur in constant ratios. These ratios are not rigidly fixed but may show a fairly large intra- and interspecific variation.

- A distinction between essential, neutral, and toxic elements is not confirmed by the available data. The biological concentration factors (the ratios between the biological concentration and the environmental concentration) of various elements increase with lower environmental concentrations. The biological use of various elements is probably mainly determined by their functional properties and only slightly affected by their environmental availability.

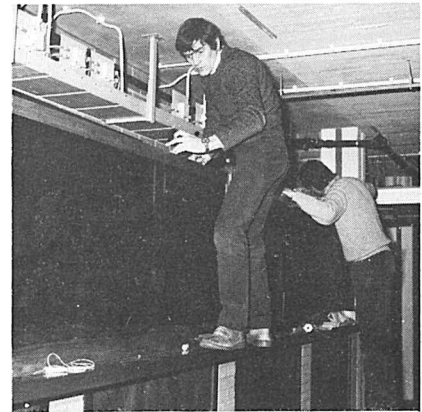
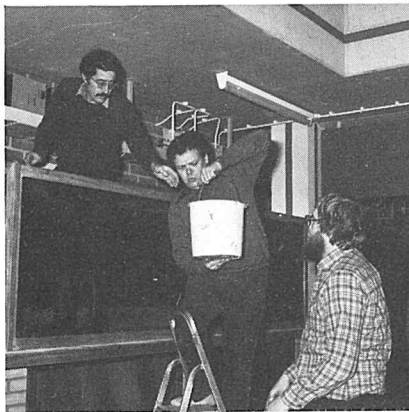
The average abundances of chemical elements in crustal rocks, river water and biological material were also compared with the most primitive abundance distribution of the elements (the Suess-Urey distribution), yielding the following results:

- Crustal rocks may be considered to still have the most primitive elemental composition, whereas sea water shows the largest deviations from the cosmic Suess-Urey element distribution. Biological material ranks between river water and sea water; continuing to show primitive characteristics.

- The chemical composition of biological material is more closely related to river water than to sea water; the concentration ratios of the quantitatively most important elements in living matter (C, N, and P) are almost equal to those in river water; the concentration factors of other elements are also less variable than those in sea water. Biological concentration factors in sea water are inversely related to sea water concentrations; to attain biological concentration levels, the elements with lower sea water concentrations are more strongly concentrated. This differential concentration cannot be obtained by evaporation.

- The similarity with the primitive Suess-Urey distribution and the stability of the composition of biological material, even in species of widely diverging evolutionary development, suggest that life arose very early in the earth's history.

- Although the composition of recent sea water carries still some primitive characteristics, it is unlikely that the elemental composition of the ocean water has been constant during the course of time. Physico-chemical processes, as well as the development of living organisms, have caused a selective fractionation of elemental distribution, which ultimately led to the present-day oceanic (and atmospheric) composition.



Furnishing aquaria in the main corridor of the Institute.

1.5. SPECIAL PROJECTS

1.5.1. Biological Research Ems-Dollard Estuary (BOEDE)

S-01

The BOEDE project started in 1972 and officially ended on 1 July 1983. The project originated from plans to construct a pipe line for sea water treatment. This pipe line was necessary to solve the problem of water pollution of inland canals created by waste from the potato-processing industry. The amount of organic waste produced by the industry was estimated at 22×10^6 inhabitant-equivalents. It was supposed that the Ems-Dollard estuary could be used as a purification plant. The aim of the BOEDE project was:

(a) The description of factors which determine the structure and function of the estuarine ecosystem in the Ems-Dollard area. A qualitative and quantitative description of the present ecosystem had to be given both in terms of organisms and of processes.

(b) The study of changes in the ecosystem of the estuary and the possibility to predict such changes resulting either from changes in discharge, or from changes in the management of the estuary.

(c) To make the knowledge, obtained from (a) and (b), available for a proper management of the Ems-Dollard estuary and, if possible, for comparable areas.

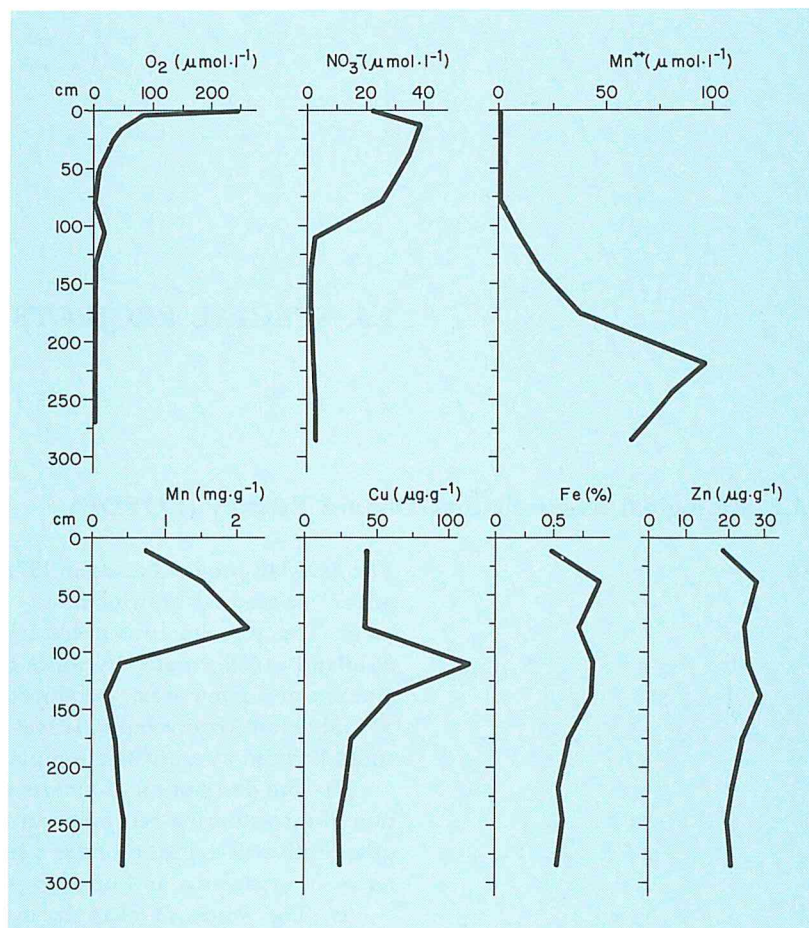
The project was completed this year with the publication of a final report aimed at government officials at all levels of decision making. At present, the group is engaged in writing a description of a mathematical ecosystem model that has been developed as a result of this project.

1.5.2. Research on radioactive waste disposal

S-02

The DORA (Deepsea Research on Radioactive Waste) project began in 1982. Its purpose is to investigate geochemical and biological characteristics of the NEA (Nuclear Energy Agency) dumpsite for low level radioactive waste located in the NE Atlantic Ocean. Samples obtained during the first expedition to this site (summer 1982) have been analysed. A second expedition to the dumpsite is scheduled for spring 1984.

Depth profiles of oxygen, nitrate and manganese in the pore water (upper part) and of 1 N HCl extractable manganese, copper, iron, and zinc in the sediment (lower part) of a gravity core (46°0.9'N, 7.9'W; water depth 4725 m). Mn and Cu are redistributed by redox processes; changes in values for Fe and Zn are related to changes in CaCO_3 content.



Geochemical study.—Continuous echosounding recording during the expedition showed that steep abyssal hills occur at the dumpsite, especially in the eastern part. All 3 gravity cores contained several turbidites or slumped beds. Interstitial nitrate contents in, and ^{210}Pb dating (H4-11) of a buried layer indicate that a slump occurred during the past few years. It is possible that this slump has been triggered by a dumping operation.

In the bottom sediments, oxygen, manganese and nitrate are successively used for the mineralization of organic matter. Due to a low supply of organic matter, this succession is distributed over a depth of one to several metres. The mobilization of Mn, observed at a depth of 15 to 100 cm, coincides with the depth of oxygen depletion (see figure) and can be assumed to be associated with a mobilization of trace elements.

Another aspect of the early diagenesis is the dissolution of CaCO_3 . This is a result of contact with bottom water below the lysocline (located at ~4700 m) and as a result of the production of acidity by mineralization of organic matter in the sediment. The elemental composition of the sediment has been determined by neutron activation analysis (ECN, Petten), X-ray fluorescence and after selective extraction procedures, by atomic absorption spectroscopy. Nearly all elements showed a good linear correlation (negative,

except for Sr) with CaCO_3 . This means that their distribution can be described by conservative mixing of a carbonate and a non-carbonate fraction. In addition to Ca and Sr, rare earth elements (La, Sm, Lu, but not Ce) were also present in the CaCO_3 fraction, and could thus be mobilized upon dissolution of CaCO_3 .

Biological study.—Meiofauna ($> 50 \mu\text{m}$ and $< 1 \text{ mm}$) was isolated from box cores collected at 9 stations. It was comprised of Foraminifera, Nematoda, Polychaeta, Oligochaeta, Kinorhyncha, Tardigrada, Copepoda, Ostracoda, and probably a member of the Loricifera (a recently discovered new phylum). Nematoda were the most important group in terms of density (up to $990\,000 \text{ m}^{-2}$) and also in terms of biomass (up to 92%). Copepoda, including nauplii, were second in importance. About $\frac{3}{4}$ of the Nematoda live in the upper 3 cm of the sediment. The average total meiofauna biomass was $\sim 26 \text{ mg}\cdot\text{m}^{-2}$ ADW.

The macrofauna of the box cores included specimens of Komokiacea, Porifera, Cnidaria, Nematoda, Oligochaeta, Polychaeta, Sipunculida, Bivalvia, Copepoda, Amphipoda, Cumacea, Tanaidacea, Isopoda, Ectoprocta, Brachiopoda, Crinoidea, Ophiuroidea, Holothuroidea and Tunicata. The macrofauna mean density was 171 m^{-2} , of which the Polychaeta represented the largest part. Of the total macrofauna biomass of $\sim 100 \text{ mg}\cdot\text{m}^{-2}$, the Sipunculida (53%) dominated. In the upper 3 cm animal abundance was twice that in the rest of the sediment, although the biomass was $\frac{1}{3}$ as high.

Bioturbation.—Burrows of benthic fauna were visible on X-radiographs of box core samples. Analyses of the distribution of ^{210}Pb by (J.N. Smith, Bedford Institute of Oceanography, Canada) and $^{239+240}\text{Pu}$ (by V.E. Noshkin, Lawrence Livermore Laboratory, U.S.A.), were made to quantify bioturbation. The results systematically showed a subsurface maximum at 4 to 6 cm depth. At this depth small but distinct maxima in ETS activity and organic carbon content were frequently observed. This indicates to a net transport of surface sediment downwards to that depth. These subsurface maxima may be caused by Sipunculida. These worms burrow to a depth of 15 cm, are deposit feeders and have a mean density of 13 m^{-2} . The form of the burrows supports the idea that they do not deposit their faeces on the surface but deeper in the sediment.

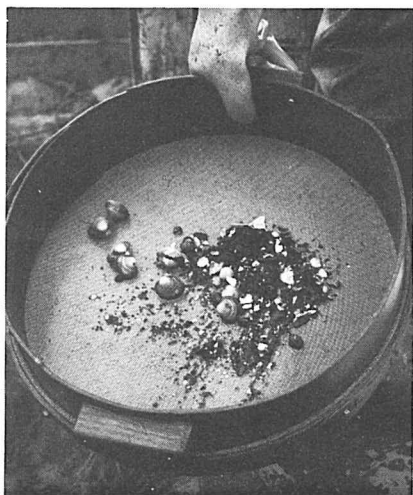


A representative of Tanaidacea, found living in the bottom of the deep-sea NEA-dumpsite for radioactive waste (length 13 mm).

1.5.3. Oil Pollution Experiment

S-04

Under the umbrella of OPEX (Oil Pollution Experiment), TNO-Den Helder, NIOZ and RIN-Texel carried out a series of experiments to test the use of MOTIFs (Model Tidal Flat) for ecotoxicological research. This work is supported by the European Community, the Ministry of Public Works and Shell Oil. A running experiment in 2 MOTIF tanks on the effects of oil spills has ended. The population densities and growth of the organisms present were compared to similar data for 2 unpolluted tanks. The results were presented in a final form. Another 4 tanks were built and a second set of experiments in 8 similarly arranged tanks has begun. Here the main aim will be to investigate "natural" fluctuations occurring in such experimental systems during the course of the year. The high summer temperatures of 1983 did not harm the adult populations, however the settlement of juveniles and of "summer animals", was poor and rather variable.



Macrofauna sampling OPEX.



1.5.4. Antarctic research

S-05

The Netherlands Council of Oceanic Research, with some support from NIOZ, initiated a study to review the possibilities for Dutch participation in Antarctic research. First, a literature study was made concerning the geological, meteorological, oceanographical and ecological structure of the Antarctic. Second, the present organization of the international Antarctic research was described giving indications of the expected developments in both national and international research. Third, a summary was assembled of interviews with Dutch scientists about their present interests regarding participation in Antarctic research.

Based on this information, possibilities for the participation in Antarctic research are presented. Finally, a number of scenarios are given indicating the consequences (financial and organizational) of different research structures. The final report will be published by the Council.

1.6. ADDITIONAL RESEARCH

1.6.1. Research at NIOZ by guests

Mr C. Costopoulos (University of Athens, Greece) has carried out laboratory experiments on the combined effects of temperature and food ration on growth and condition of young plaice.

Mr B. Das (Geological Survey of India) took part in research on trace elements in water and suspended matter of the Wadden Sea and North Sea.

Miss U. Gaedke (University of Oldenburg, F.R.G.) studied the spring development of the *Pleurobrachia* population and its impact on the herbivore zooplankton in Dutch coastal waters.

A.F.C. Gerritsen (State University, Leiden) studied the possible influence of chemoreception on the foraging behaviour of the knot and the purple sandpiper. In both species, the role of the sense of taste in discovering a hidden prey in beach sediments was found to be less important than observed from earlier tests in dunlin and sandpiper.

Y.M. van Heezik (University of Otago, New Zealand) conducted experiments on the role of taste as a tool in prey selection in the oystercatcher. These birds were found to be able to rank prey value according to taste. They prefer the flesh of mussels and cockles that live low in the intertidal over that from prey of the same species living high in the intertidal which have lower percentages of glycogen.

E.T. van Ierland worked on *in vivo* light absorption spectra of suspended matter. A method to determine light absorption spectra of suspended matter on glassfibre filters was developed. It appears to be a simple method to measure chlorophyll and suspended matter content of a water sample. Relationships with *in situ* light measurements are under investigation.

Dr M.I. Jenness (associate professor on sabbatical leave from Davis & Elkins College, Elkins, West Virginia, U.S.A.) participated in a study on feeding and growth of the heart urchin *Echinocardium cordatum* in the benthic system of the southern North Sea.

Dr K.T. Jensen from Århus University (Denmark) started laboratory experiments on ammensalistic relations between the large macrofauna organisms (*Cerastoderma*, *Arenicola*) and *Corophium*.

Dr B. Meehan (Virginia Institute for Marine Science, U.S.A.) was guest scientist at NIOZ for 2 months to study iso-enzyme patterns in *Macoma balthica* collected from several places in Europe. The purpose was to evaluate what genetic differences occurred between populations of this species on either side of the north Atlantic.

Dr J.C. Miquel (Chile) studied methods of zooplankton research, enabled by a UNESCO Advanced Training Fellowship. Particular emphasis was laid on the determination of biomass, production and productivity. He participated in the sampling programme in the Fladen Ground area of the North Sea (REFLEX 1983, B4-01), and in the analysis of samples and data collected in the central North Sea in 1981. His work on the estimation of copepod growth rates by extrapolation of laboratory data to field conditions, contributed to the conclusion that the production of copepods in the central North Sea was low in 1981 (about $10 \text{ g C} \cdot \text{m}^{-2}$).

Dr I. Ružić (Rudjer Bosković Institute, Center for Marine Research, Zagreb, Yugoslavia) was invited to the NIOZ to investigate a theoretical approach to improve the description of titration results and the kinetics effecting the titration of natural waters.

Mr Abdallah Srour (Institut Agronomique et Vétérinaire Hassan II, Rabat, Marocco) took part in growth experiments with flounder.

Dr C.G.N. de Vooy studied the biology of the cockle, *Cerastoderma edule* L., with special relation to its position in the ecosystem. A storm surge barrier, being constructed in the entrance of the Oosterschelde includes large sluices which will normally be open, but which can be closed when storm high waters are predicted. As a result of this construction, the ecosystem of the enclosed sea arm will be influenced by altered current velocities and tidal levels. *Cerastoderma edule* occurs in numbers that are of interest for commercial fishery. In the near future the Deltadienst of RWS will initiate an investigation on the possible effects of the dam on the cockle and its associated fishery. As a first step, a literature survey was carried out at the NIOZ, financed by the department "Delta Dienst" of the Ministry of Public Works.

Dr C.G.N. de Vooy, during a 3 weeks stay at the Stazione Zoologica at Naples, carried out experiments on the adaptation of the mussel *Mytilus galloprovincialis* Lam to decreasing salinities. Also, changes in pH in the haemolymph were measured after the animals had been kept dry under a nitrogen atmosphere. Various organs were frozen in liquid nitrogen and transported to the Laboratory of Chemical Animal Physiology, State University of Utrecht. Analyses were carried out there, especially on the properties of the enzyme pyruvatekinase which has a key position in the transition from aerobic to anaerobic metabolism.

Prof. Dr A.J.B. Zehnder (Technical High School, Wageningen) worked for a short time on microbial processes in tidal flat bottoms.

1.6.2. Participation in national and international programmes

Part of Project B3-02a is incorporated in the EC-project COST-47, an international long-term programme to assess fluctuations in numerical densities of selected benthic species in European coastal seas. The aim of this monitoring programme is to detect factors, such as climatic and hydrographic events, which operate on a broad geographical scale. The effects of such factors cannot properly be studied by local investigations.

During a first workshop of the intertidal-soft-bottom section of COST-47, a sampling programme was agreed upon that involved taking standardized samples semi-annually of 10 key species. During a second workshop, preliminary results were presented. A comparison was made of benthic populations in 2 areas of the Dutch Wadden Sea (NIOZ and RIZA data). This showed, that over a period of 14 years, fluctuations occurred which were more or less parallel in populations of several species of the two locations about 150 km apart).

In cooperation with a number of Government institutes (RIJP, RIZA, RIN and RWS-ADH) a study of the benthic macrofauna, in relation to sediment composition in the subtidal part of the western Wadden Sea, was continued. A survey of the macrozoobenthos of the area was also completed. Data are available from 454 sampling stations situated along 45 transects. The benthic fauna of the subtidal area proved to be similar, both in species composition and in biomass, to that of the intertidal flats. The share of the various species differed, however. The contribution of the edible mussel, *Mytilus edulis*, was particularly outstanding in the sublittoral.

Pigment analyses by High Performance Liquid Chromatography (HPLC) were carried out at NIOZ on behalf of the University of Amsterdam, the Delta Institute for Aquatic Research, Yerseke, and the Sprenger Institute, Wageningen (chlorophyll concentrations in flower bulbs).

D. Eisma took part in a sampling programme of the Gironde within the framework of GRECO-ICQ, a French programme for estuarine research. A second sampling cruise is planned for 1984.

Bottom sediments were sampled for the Rijkswaterstaat (RIZA) in the coastal area off Scheveningen and Hoek van Holland. These samples were used to study sedimentation processes in the area by determining sediment structures and ^{210}Pb contents. Pore water concentrations of nutrients and organic carbon contents were also measured.

As a consultant for UNESCO, D. Eisma participated for 10 days in a research programme in the estuary of the river Tejo, Lisboa, Portugal.

The SCOR/UNESCO/IABO Working Group 65 "Coastal-offshore ecosystem relationships" had a meeting at NIOZ from 12-15 September. The meeting was attended by seven members from the U.S.A., U.K., Sweden, F.R.G. and The Netherlands.

J.T.F. Zimmerman visited the Department of Oceanography, Dalhousie University, Halifax, Canada, from June to August. He worked (in cooperation with Prof. C.J.R. Garrett) on problems of dispersion by residual eddies.

T.C.E. van Weering visited Woods Hole Oceanographic Institution, U.S.A. for a three months study of the influence of abyssal currents on the sediments of the continental shelf.

Since 1982, NIOZ has been acting as a consultant to the Government of India regarding the design and purchase of two coastal research vessels. These vessels will be used for the geological survey of India. Following a visit to NIOZ by an Indian delegation to finalize the design and specifications of the vessels, NIOZ consultants made a return visit to India. During this visit, the existing shore facilities were evaluated, equipment to be installed on board the vessels was agreed upon and a training programme for technicians (3 months) and scientists (9 to 12 months) was developed. This training was begun at NIOZ following approval by the Ministry of Foreign Affairs.

In cooperation with a number of French marine biologists, a comparative study of some characteristics in the life-history of the bivalve *Macoma balthica* at different latitudes was started (Bay-de-Somme, Seine estuary and Bay-Mt-St-Michel). The study of latitudinal variation in growth rates and in shell characteristics of *Macoma balthica* was continued by sampling in Denmark and Sweden. Samples from Finland and Norway were obtained from colleagues in these countries.

During the "ICES Fifth round intercalibration for trace metals in sea water", it was reported that all filtration systems studied, including our system, generally gave contamination-free filtrates for copper, nickel, cobalt, iron and cadmium. Although all systems also gave reasonable results for zinc and lead, the levels for these elements were somewhat elevated. The following is a comparison of NIOZ results to the overall results:

Cd: 25 labs out of 48 found $21 \pm 4 \text{ ng}\cdot\text{l}^{-1}$; we found $21 \pm 0.9 \text{ ng}\cdot\text{l}^{-1}$.
Cu: 20 labs out of 46 found $117 \pm 17 \text{ ng}\cdot\text{l}^{-1}$; we found $214 \pm 6 \text{ ng}\cdot\text{l}^{-1}$.
Pb: 12 labs out of 40 found $40 \pm 8 \text{ ng}\cdot\text{l}^{-1}$; we found $49 \pm 10 \text{ ng}\cdot\text{l}^{-1}$.
Zn: 12 labs out of 39 found $398 \pm 73 \text{ ng}\cdot\text{l}^{-1}$; we found $368 \pm 29 \text{ ng}\cdot\text{l}^{-1}$.
Ni: 15 labs out of 29 found $208 \pm 39 \text{ ng}\cdot\text{l}^{-1}$; we found $145 \pm 6 \text{ ng}\cdot\text{l}^{-1}$.

The results of the trace metal analyses in sea water were also compared with the results obtained by isotope dilution mass spectrometry. For this comparison, only the values of laboratories were used that were within $\pm 33\%$ of the value obtained by isotope dilution mass spectrometry. NIOZ results compare favourably with the mean results.

1.7. LIST OF RESEARCH PROJECTS AND RESEARCH WORKERS

1.7.1. Hydrography (H)

Chemical Oceanography department (H. Postma)

- H1-01 Nutrient, oxygen and carbon investigations in Wadden Sea, North Sea and open ocean (S.B. Tijssen, H. Postma, assistants F. Wetsteyn, J.W. Rommets, R.T.P. de Vries)
- H1-02 Nitrogen cycle in the Dutch Wadden Sea and Ems-Dollard estuary (W. Helder, assistant R.T.P. de Vries)
- H1-03 Redox-reactions of inorganic nitrogen compounds (as above)
- H1-05 Macro-ion concentrations in seas and estuaries (S.B. Tijssen, assistant F. Wetsteyn).

Physical Oceanography department (J.T.F. Zimmerman)

- H2-01 Marine optics of the euphotic zone in North Sea and ocean (D. Spitzer, assistant M.R. Wernand)
- H2-02 Marine optics, Remote Sensing of Dutch coastal waters (D. Spitzer, assistant M.R. Wernand)
- H2-05 Heat-balance, Wadden Sea (J.T.F. Zimmerman)
- H2-06 Large-scale water transport (J.T.F. Zimmerman, R. Mulder, C. Veth, assistant M.W. Manuela)
- H2-07 Small-scale turbulence, mixing layer and thermocline studies (C. Veth, assistant M.W. Manuela)
- H2-08 Non-linear circulation on the β -plane (J.T.F. Zimmerman)

Marine Pollution department (J.C. Duinker)

- H3-01 Behaviour of metals in the marine environment (J.C. Duinker, assistant R.F. Nolting)
- H3-02 Identification and behaviour of organochlorines (J.C. Duinker, assistant M.T.J. Hillebrand)
- H3-03 Chemical forms of metals in sea water (C.J.M. Kramer, assistant R.F. Nolting)
- H3-04 Sublethal effects of heavy metals on marine organisms (J.M. Everaarts)
- H3-05 Organic compounds in the Sea (J.W. Rommets)
- H3-07 Accumulation of contaminants in the Wadden Sea (C.J.M. Kramer)
- H3-08 Organochlorines in marine organisms (J.P. Boon)

Marine Geology and Geochemistry department (D. Eisma)

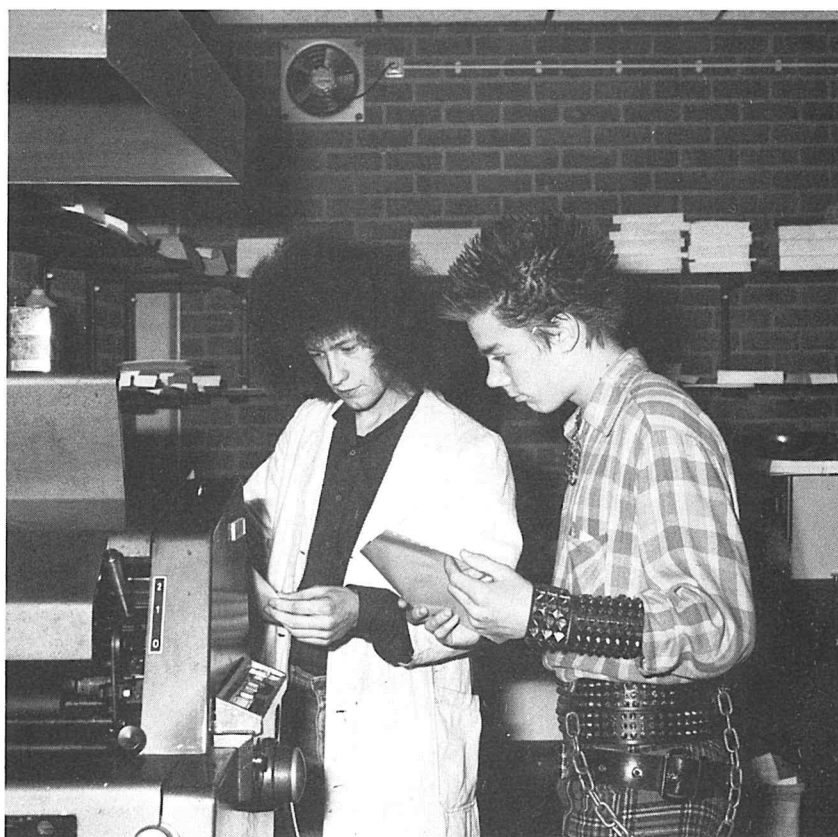
- H4-01 Sediment transport and sedimentation in the North Sea (D. Eisma, A.J. van Bennekom, J.H.F. Jansen, T.C.E. van Weering, assistants G.W. Berger, S.J. van der Gaast, J. Kalf, R. Gieles-Witte, J. van Iperen)
- H4-02 Marine silica cycle (A.J. van Bennekom, assistant G.W. Berger)
- H4-03 Aggregation, deaggregation, flocculation and formation of particles in estuaries (D. Eisma, assistants J. Kalf, R. Gieles-Witte)
- H4-04 Palaeomagnetic research on sediment cores (M.J. van Vreumingen)
- H4-05 Conversion of clay minerals in the sea (S.J. van der Gaast, assistants A.J. Vaars, R. Gieles-Witte)
- H4-06 Transport and sedimentation of suspended matter under influence of the Scotland-Greenland Ridge system (D. Eisma, S.J. van der Gaast, assistants R. Gieles-Witte, J. van Iperen)
- H4-07 Sedimentation processes along continental margins (T.C.E. van Weering, assistants S.J. van der Gaast, R. Gieles-Witte, J. van Iperen)
- H4-08 Sedimentology of the Angola Basin and Zaire deep sea fan sediments (D. Eisma, A.J. van Bennekom, J.H.F. Jansen, assistants G.W. Berger, S.J. van der Gaast, J. Kalf, R. Gieles-Witte, J. van Iperen)

1.7.2. Biology (B)

- Experimental systems (P.A.W.J. de Wilde)
- B1-01 Experimental systems (J.H. Vosjan, B. van der Werf, P.A.W.J. de Wilde, assistants E.M. Berghuis, A. Kok, E. Pauptit)
 - B1-02 Structural identification of organic matter in marine ecosystems (J.H. Vosjan, P.A.W.J. de Wilde, assistants A. Kok, E.M. Berghuis, E. Pauptit)
 - B1-03 Activity of microorganisms (J.H. Vosjan, B. van der Werf, P.A.W.J. de Wilde, assistants E. Pauptit, A. Kok, E.M. Berghuis)
 - B1-04 Bioturbation as environmental factor (P.A.W.J. de Wilde, J.H. Vosjan, assistant E.M. Berghuis)
 - B1-05 Energy consumption and production in dominant faunal elements; community metabolism (P.A.W.J. de Wilde, J.H. Vosjan, B. van der Werf, J. de Vlas, assistants E.M. Berghuis, A. Kok, E. Pauptit)
- Autecology (F. Creutzberg)
- B2-01 Role of carnivores in the tidal area (assistants P. van der Puyl, J.I.J. Witte)
 - a Density-dependent mortality in juvenile plaice (J.J. Zijlstra, H.W. van der Veer)
 - b Food intake and growth (B.R. Kuipers)
 - c Energy budget and growth experiments (M. Fonds)
 - B2-02 Role of carnivores in the benthic system of the southern North Sea (assistants G.J. van Noort, P. van der Puyl, R. Dapper)
 - a Distribution ecology (F. Creutzberg)
 - b Population research (F. Creutzberg, B.R. Kuipers)
 - c Feeding and growth (B.R. Kuipers, F. Creutzberg)
 - d Energy budget (M. Fonds)
 - B2-03 Carnivores in the pelagic system (B.R. Kuipers, assistant R. Dapper)
 - B2-04 Vision in Odontocetes (A.D.G. Dral)
 - B2-05 Quantitative investigation of microzooplankton (A.D.G. Dral)
 - B2-06 Mariculture (M. Fonds, assistant P. van der Puyl)
- Benthic systems (J.J. Beukema)
- B3-01 *In situ* production and input of organic matter (G.C. Cadée, assistant J. Hegeman)
 - B3-02 a Production and dynamics of macrozoobenthos in the Wadden Sea and adjacent North Sea (J.J. Beukema, assistants W. de Bruin, J. Zuidewind)
 - b Ecology of macrozoobenthos in coastal waters of western Europe (J.J. Beukema, assistants W. de Bruin, J. Zuidewind)
 - B3-04 a The role in the food chain and population dynamics of seabirds in the Wadden Sea and adjacent North Sea (C. Swennen, assistants P. Duiven, J. Zuidewind)
 - b Food of sea birds in tropical tidal areas (C. Swennen, assistants P. Duiven, J. Zuidewind)
 - B3-05 Relation between chemical composition of sea water and of marine organisms (D.H. Spaargaren)
- Pelagic systems (H.G. Fransz)
- B4-01 The pelagic system of the non-stratified shelf sea (H.G. Fransz, W.W.C. Gieskes, assistants G.W. Kraay, S.R. Gonzalez)
 - B4-02 The pelagic system of the semi-permanently stratified sea (H.G. Fransz, W.W.C. Gieskes, assistants G.W. Kraay, S.R. Gonzalez)
 - B4-03 The pelagic system of the permanently stratified sea (W.W.C. Gieskes, M.A. Baars, J.J. Zijlstra, assistants G.W. Kraay, S.S. Oosterhuis, J.I.J. Witte)
 - B4-04 Population dynamics and bioenergetics in experimental pelagic ecosystems (W.C.M. Klein Breteler, assistant S.R. Gonzalez)

1.7.3. Special projects

- S-01 Biological Research of Ems-Dollard Estuary (BOEDE). M.A. van Arkel, J.W. Baretta, R.W.P.M. Laane, P. Ruardij, A. Stam, P. de Wolf, assistants: H. Malschaert, M. Mulder (Ministeries of Cultuur, Recreatie en Milieu, Onderwijs en Wetenschappen, Ruimtelijke Ordening, Volksgezondheid en Milieuhygiëne, Verkeer en Waterstaat).
- S-02 Biological and geochemical investigations in relation to the deep sea dumping of low-level radioactive waste (DORA). M. Lavaleye, M.M. Rutgers van der Loeff, assistants: D. Waaijers, G.J. Zigterman (EC Brussels, Energie Centrum Nederland).
- S-03 Marine pollution in the Wadden Sea. C.J.M. Kramer (Ministerie van Volksgezondheid en Milieuhygiëne).
- S-04 Oil Pollution Experiments (OPEX). M.J.N. Bergman, P.A.W.J. de Wilde, assistant(s): E.M. Berghuis, A. Kok (EC Brussels, Rijkswaterstaat Directie Noordzee, Nederlandse Aardolie Maatschappij, Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek afdeling Den Helder, Rijksinstituut voor Natuurbeheer afdeling Texel, Nederlands Instituut voor Onderzoek der Zee).
- S-05 Antarctic research. M.J.N. Bergman.
- S-06 Coral reefs. R.P.M. Bak (on the staff of the Caribbean Marine Biological Institute, Carmabi, Curaçao).



Printing of the Annual Report 1982
(price-winner of a NIOZ photo
exposition).

2. Scientific outcome

2.1. PUBLICATION

2.1.1. Netherlands Journal of Sea Research and other series issued

The NIOZ is the publisher of the Netherlands Journal of Sea Research. The Journal publishes papers dealing with the various fields of marine science, primarily those concerned with pure science. It comprises contributions from Dutch and foreign institutes. Since 1973 one volume a year did appear, each volume consisting of 4 issues.

For 1983 the issues 2, 3 and 4 of volume 17 were combined to contain a specific theme about the Angola Basin and the Zaire Deep-Sea Fan.

Netherlands Institute for Sea Research Publication Series is a separate series appearing supplementary to the Netherlands Journal of Sea Research. It appears when needed and is therefore irregular. The numbers are produced by the NIOZ Reprographic Department. In 1983 only the Annual Report 1982 was issued in the Series.

Internal Reports NIOZ. These reports on results of studies carried out at the Institute are for internal use and are not considered publications; they are mostly written in Dutch (see 2.1.3).

2.1.2. Publications NIOZ 1983

Listed are papers published in the year 1983 unless specified otherwise (1982). Each publication is given only once in an Annual Report.

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- BAK, R.P.M. Neoplasia, regeneration and growth in the reef-building coral *Acropora palmata*.—Mar. Biol. **77**: 221-227.
- BAK, R.P.M., R.E. DODGE, T.D. JICKELLS, A.H. KNAP & S. BOYD. Reef-building coral skeletons as chemical pollution (Phosphorus) indicators.—Mar. Pollut. Bull., NS (in press).
- BENNEKOM, A.J. VAN & G.W. BERGER. Hydrography and silica budget of the Angola Basin.—Neth. J. Sea Res. **17**.
- BENNEKOM, A.J. VAN & J.J. ZIJLSTRA. Antarctica—Schatten in niemandsland?—Natuur Tech. **51**: 392-411.
- BEUKEMA, J.J. (1982). Calcimass and carbonate production by molluscs on the tidal flats in the Dutch Wadden Sea: II. The edible cockle, *Cerastoderma edule*.—Neth. J. Sea Res. **15** (3/4): 391-405.
- BJÖRKLUND, K.R. & J.H.F. JANSEN. Radiolaria distribution in Late Quaternary sediments and palaeoceanography in the eastern Angola Basin.—Neth. J. Sea Res. **17**.
- CADÉE, G.C. Particulate and dissolved organic carbon and phytoplankton in the Zaire river, estuary and plume.—Neth. J. Sea Res. **17**.
- . Wonderbonen, *Ricinus communis*, in aanspoelsel; een vraag om meer gegevens.—Zeepaard **43** (4): 141-148.
- . Dark fixation. In: F. COLIJN, W.W.C. GIESKES & W. ZEVENBOOM. The measurement of primary production: problems and recommendations.—Hydrobiol. Bull. **17** (1): 39-40.

- CADÉE, G.C. & R.W.P.M. LAANE. Behaviour of POC, DOC and fluorescence in the freshwater tidal compartment of the river Ems.—Mitt. geol. paläont. Inst. Univ. Hamburg SCOPE/UNEP Sonderbd. (in press).
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- CREUTZBERG, F. Biological activity in an area with a tidally-influenced front. ICES C.M. 1983/L 4: 1-13.
- DRAL, A.D.G. An issue on eye and vision in aquatic mammals (editorial).—Aq. Mammals 10 (2): 33.
- . The retinal ganglion cells of *Delphinus delphis* and their distribution.—Aq. Mammals 10 (2): 57-68.
- DRONKERS, J. & J.T.F. ZIMMERMAN (1982). Some principles of mixing in tidal lagoons.—Oceanol. Acta 4 (spec. vol.): 107-118.
- DUINKER, J.C. Effects of particle size and density on the transport of metals to the oceans. In: C.S. WONG. Trace metals in sea waters. NATO Conference Series IV, Marine Sciences: 209-227.
- DUINKER, J.C. & M.T.J. HILLEBRAND. Composition of PCB mixtures in biotic and abiotic marine compartments (Dutch Wadden Sea).—Bull. env. contam. Toxicol. (U.S.) 31: 25-32.
- . Characterization of PCB components in Clophen formulations by capillary GC-MS and GC-ECD techniques.—Environ. Sci. Technol. 17 (8): 449-456.
- . Determination of selected organochlorines in seawater. In: K. GRASHOFF, M. EHRHARDT & K. KREMLING. Methods of seawater analysis. Verlag Chemie, Weinheim, F.R.G.: 224-261.
- DUINKER, J.C., M.T.J. HILLEBRAND & J.P. BOON. Organochlorines in benthic invertebrates and sediments from the Dutch Wadden Sea; identification of individual PCB components.—Neth. J. Sea Res. 17 (1): 19-38.
- DUINKER, J.C., R.F. NOLTING & D. MICHEL. Effects of salinity, pH and redox conditions on the behaviour of Cd, Zn, Ni and Mn in the Scheldt estuary.—Thalassia jugosl. 18: 191-201.
- EISMA, D. Exploitation of mineral resources in the Wadden Sea area. In: M.F. MÖRZER BRUYNS & W.J. WOLFF. Nature conservation, nature management and physical planning in the Wadden Sea area. Report 11. Balkema, Rotterdam: 88-94.
- . Duinen op de Waddeneilanden.—Waddenbull. 83 (2): 31-34.
- EISMA, D. & S.J. VAN DER GAAST. Terrigenous Late Quaternary sediment components north and south of the Scotland-Greenland Ridge and in the Norwegian Sea. In: M.H.P. BOTT, S. SAXOV, M. TALWARI & J. THIEDE. Structure and development of the Greenland-Scotland Ridge. Plenum Press: 607-635.
- EISMA, D. & J. KALF. Dispersal of Zaire river suspended matter in the estuary and the Angola Basin.—Neth. J. Sea Res. 17.
- EVERAARTS, J.M., C. SWENNEN & E. PAUPTIT. Heterogeneity in blood proteins and egg albumen proteins of the eiderduck *Somateria m. mollissima* (L.).—Comp. Biochem. Physiol. 76B (1): 79-85.
- FRANSZ, H.G. & S.B. TIJSSSEN. Horizontal drift and local development of *Calanus finmarchicus* during spring in the Fladen Ground area of the northern North Sea. ICES C.M. 1983/L 13.
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- GIESKES, W.W.C. & G.W. KRAAY. Unknown chlorophyll a derivatives in the North Sea and the tropical Atlantic Ocean revealed by HPLC analysis.—Limnol. Oceanogr. 28 (4): 757-766.
- . Dominance of *Cryptophyceae* during the phytoplankton spring bloom in the central North Sea detected by HPLC analysis of pigments.—Mar. Biol. 75: 179-185.
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- HEEZIK, Y.M. VAN, A.F.C. GERRITSEN & C. SWENNEN. The influence of chemoreception on the foraging behaviour of two species of sandpiper, *Calidris alba* and *Calidris alpina*.—Neth. J. Sea Res. 17 (1): 47-56.

- HELDER, W. Aspects of the nitrogen cycle in the Wadden Sea and Ems-Dollard estuary with emphasis on nitrification. Thesis University of Groningen.
- HELDER, W. & R.T.P. DE VRIES. Estuarine nitrite maxima and nitrifying bacteria (Ems-Dollard estuary).—Neth. J. Sea Res. 17 (1): 1-18.
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- JANSEN, J.H.F., P. GIRESSE & G. MOGUEDET. Structural and sedimentary geology of the Congo and southern Gabon continental shelf, a seismic and acoustic reflection survey.—Neth. J. Sea Res. 17.
- JANSEN, J.H.F., T.C.E. VAN WEERING, R. GIELES & J. VAN IPEREN. Middle and Late Quaternary paleoceanography and climatology of the Zaire-Congo fan and the adjacent eastern Angola Basin.—Neth. J. Sea Res. 17.
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- LIEWES, E. & M. FONDS. De zeeforel, zijn biologie en betekenis voor de kust- en binnenvisserij.—Visserij Nieuws 3 (45): 24-27.
- MARTEIJN, E.C.L. & M.F. LEOPOLD. Waarneming van een melanistische scholekster.—Vogeljaar 31: 30.
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- . Osmotically induced changes in copper and iron concentrations in three euryhaline crustacean species.—Neth. J. Sea Res. 17 (1): 96-105.
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- SWENNEN, C. & P. DUIVEN. Over het gedrag van een Noorse pijlstormvogel *Puffinus p. puffinus*.—Limosa 55: 140-141.
- . Characteristics of oystercatchers killed by cold-stress in the Dutch Wadden Sea area.—Ardea 71: 155-159.
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- WEERING, T.C.E. VAN. Acoustical reflection profiles, sediments and late quaternary history of the Norwegian Channel north of Bergen.—Geologie Mijnb. **62** (2): 319-328.
- WEERING, T.C.E. VAN & G.B. QVALE. Recent sediments and foraminiferal distribution in the Skagerrak, northeastern North Sea.—Mar. Geol. **52**: 75-99.
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2.1.3. Internal Reports NIOZ 1983

- KNOL, E. Over de groei van nonnetjes (*Macoma balthica*) op het Balgzand. No. 1983-1.
- DUPOUY, C., D. ARIEF & D. SPITZER. Optical remote sensing of waters and tidal flats in the western Wadden Sea. No. 1983-2.
- NOORT, G.J. VAN, F. CREUTZBERG & R. DAPPER. "Aurelia"-cruise reports on the benthic fauna of the southern North Sea. Report 7: Trawl survey February-March 1976. No. 1983-3.
- TIJSSEN, S.B. & F. WETSTEYN. Temperature, salinity and oxygen graphs and data, obtained near a subsurface drifter in the central North Sea in May, July and September 1981. No. 1983-4.
- GLAZENBURG, B. Een experimenteel onderzoek naar de groei van O-groep schol en bot in relatie tot de watertemperatuur. No. 1983-5.
- LANGE, G.J. DE. Preliminary research on the clay mineral composition of some sediment samples in the Zaire estuary and fan. No. 1983-6.
- RESINK, J.W. De ontwikkeling van een kunstvoer, geschikt voor de afkweek van tong, *Solea solea*. No. 1983-7.
- BEUSEKOM, J.E.E. VAN. Opgelost silicaat en aluminium in de Groenlandzee, Noorse Zee en IJslandzee. No. 1983-8.
- VEER, H.W. VAN DER. Een model voor de schatting van de watermassa met hoogwater aanwezig op de platen van het Balgzand. No. 1983-9.
- EYSINK, G.E.J. A. Onderzoek over verbeteringen van de kwaliteit van een droogvoer voor tongkweek. B. Metingen van voedselopname, groei en zuurstofconsumptie van tongen gevoerd met mosselvlees. No. 1983-10.
- Biologisch Onderzoek Eems Dollard Estuarium, BOEDE Publikaties en Verslagen 1983-1: 1-267.

2.2. LECTURES, etc.

2.2.1. Colloquia and lectures at the Institute

(titles translated)

- 14 January C. Dupuoy (NIOZ): Optical remote sensing of water and tidal flats in the western Wadden area.
- 21 January R.S.C. de Ruiter (student University of Amsterdam): (Fossil silicoflagellates of the Angola Basin).
J.E.E. van Beusekom (student University of Groningen): (Silicate and aluminium in the Norwegian and Greenland Seas (Travel report 'Meteor' to Spitsbergen)).
B. Enbreghof (student University of Amsterdam): (Sedimentary structures and circulation patterns in the Faeroe-Shetland Channel).
- 4 February W.H. Dudok van Heel (Netherlands Foundation on water mammals): (Acoustic research on dolphins in the Netherlands).
C. Kamminga (Lab. voor Informatietheorie TH Delft): (Sonarsignals and sonaranalyses in dolphins and related species).
W.H. Dudok van Heel (Netherlands Foundation on water mammals): (Why are there no mass-strandings of most dolphin species?).
J.D. van der Toorn (University of Utrecht): (Research on two-way communication possibilities with a killer whale).
- 18 February (Physical research in the stratified central North Sea in 1981-1982)
H.M. van Aken (University of Utrecht): (Hydrographical research of the area).
E.J.A. Kleverlaan (University of Utrecht): (Meteorological circumstances during the project).
H.W. Riepma (KNMI, De Bilt): (First results of current velocity measurements).
C. Veth (NIOZ): (Laser-doppler turbulence measurements in the unstratified parts of the water column).
M.B.A.M. Scheffers (University of Utrecht): (Laser-doppler turbulence measurements in the stratified parts of the water column).
L.R.M. Maas (University of Utrecht): (Research on internal tides in the area).
H.M. van Aken (University of Utrecht): (Mixed layer model for simulation of stratification in the area).
- 25 February J. de Vlas (Staatsbosbeheer, Groningen): (On the meaning of *Macoma* siphons in food chains: observations and calculations of production of siphons by *Macoma* and their consumption by predators).
R. Dekker (RIN, Texel): (Results of bottom fauna survey in the sublittoral part of the western Wadden Sea).
E. Knol (student University of Groningen): (Yearly variations in the start of the growth season of *Macoma balthica* in the Balgzand area).
K. Essink (RIZA): (Dynamics and distribution of *Nereis diversicolor* in the SE Dollard tidal flats).
M.A. van Arkel (BOEDE): (Estimations of macro zoobenthos production in the Ems-Dollard estuary).

- 4 March (Biogeography of marine algae)
 C. van den Hoek (University of Groningen): (Introduction, biogeography of marine algae).
 H. Rietema (University of Groningen): (Regulation of the life cycle of the rhodophyte *Dumontia contorta* by day length and temperature in different areas).
 A.M. Breeman (University of Groningen): (Regulation of procreation of *Rhodochorton* at different littoral depths).
 W.T. Stam (University of Groningen): (DNA - DNA hybridization in pro- and eucaryotic algae).
- 11 March (Research on Medusae in the southern North Sea)
 B.R. Kuipers (NIOZ): (Introduction, background and results of the 1982 surveys).
 U. Gaedke (University of Oldenburg): (Spring development of *Pleurobrachia*).
 R. Daan (NIOZ): (Background and future research plans on Medusae in a summer situation).
- 18 March (Long term observations of temperature, salinity and faunal distributions)
 P.C.T. van der Hoeven (KNMI, De Bilt): (On the intrinsic value of data series).
 H.D. Rakhorst (RW, Adviesdienst Hoorn): (Compilation of salinity data from the Wadden Sea).
 G. van de Kamp (RIVO): (Development in standing stock of shrimp in Dutch coastal waters since 1969).
- 8 April
 W. Helder (NIOZ): (Sediment-water exchange of nutrients in the Bay of Fundy intertidal).
 H.J. Lindeboom (DIHO, Yerseke): (Diffusion coefficients and bioturbation processes in sandy sediments. Results from micro-electrode measurements).
 M.M. Rutgers van der Loeff (NIOZ): (Temperature dependence of sediment-water silicate fluxes).
- 22 April
 E.T. van Ierland (DIHO, Yerseke): (Separation of seston on density gradients and densities of some diatom species).
 R. Kloosterhuis (NIOZ): (Method for the determination of total sugars in suspended matter (applied on NECTAR III samples)).
- 11 May
 K. Voss (Texas A & M University, U.S.A.): Polarization matrix of ocean water.
 G. Borstad (Institute of Ocean Sciences, Sidney B.C., Canada): Remote sensing of chlorophyll.
- 15 July
 C. Sancetta (Lamont-Doherty Geological Observatory, New York, U.S.A.): Changes in the fossil diatom population of subarctic Pacific sediments and their relevance to late Pleistocene oceanography.
- 16 September
 U. Gaedke (University of Oldenburg, F.R.G.) and L. Enserink (University of Utrecht): (Food uptake and carbon balance of *Pleurobrachia pileus*. A discussion on the importance of this species as copepodal predator).
- 14 October
 J.J. Beukema (NIOZ): Variation in some shell properties and growth rates of *Macoma balthica* populations living at different latitudes in Europe.
 B. Meehan (Virginia Institute of Marine Science, U.S.A.): A comparison of iso-enzymes of *Macoma balthica* along the east and west north Atlantic ocean.
- 28 October (General information concerning the SNELLIUS II expedition)
 D. Eisma (NIOZ): (Geology and geophysics of the Banda arc).
 H. Postma (NIOZ): (Ventilation of deep sea basins).
 J.J. Zijlstra (NIOZ): (Pelagic systems).
 J.M. Everaarts (NIOZ): (River input into ocean systems).

11 November	J.M. Everaarts (NIOZ): (Uptake and partitioning of copper in <i>Arenicola marina</i> and its effects on oxygen affinity of haemoglobins). J.P. Boon (NIOZ): (Uptake, partitioning and elimination of individual PCB components of Clophen A40 in young sole and effects on growth). B. Sundby (University of Quebec, Canada): Biogeochemistry of the benthic boundary layer.
22 November	M. Orfen (University of Cape Town, S.A.): Current marine chemical research at the University of Cape Town.
25 November	B. Lyons (University New Hampshire, U.S.A.): The biogeochemistry of estuarine and continental margin sediments in New England.
2 December	M. Ewald and P. Berger (Université de Bordeaux, France): Fluorescence of dissolved organic matter in estuaries: a photochemical approach.

Complexation of trace metals in natural waters

An international symposium was organized (May 2-6) under the title "Complexation of trace metals in natural waters". The goal of the symposium was to conduct an evaluation of the analytical techniques and theoretical approaches governing the complexation of trace metals and the complexation capacity in natural waters. About 80 scientists from 15 countries participated in discussions concerning organic liquids, interactions with colloids/solid particles, kinetics, stability constants, biological response, modelling, and analytical methods and techniques related to the subject. The symposium was sponsored by the Commission of the European Communities (Directorate General for Science, Research and Development), the Royal Netherlands Academy of Arts and Sciences and the NIOZ. Proceedings of the symposium will be published in 1984.

Lectures:

- W.F. Jardim (Department of Botany, University of Liverpool, England) & H.E. Allen (Illinois Institute of Technology, Pritzker Department of Environmental Engineer, Chicago, U.S.A.): Measurements of copper complexation by natural occurring ligands - a comparison of experimental techniques.
- D.J. Mackey (Division of oceanography, CSIRO Marine Laboratories, Tasmania, Australia): An investigation of metal-organics in seawater using HPLC with multichannel atomic fluorescence detection.
- R.J. Stolzberg (Department of Chemistry, University of Alaska, Fairbanks, U.S.A.): Chromatographic measurement of strong and moderately strong complexing capacity of lake water.
- H.W. Nürnberg (Institute of Applied Physical Chemistry, Nuclear Research Center (KFA), Jülich, Western-Germany): Potentialities of voltametry in the study of physicochemical aspects of heavy metal complexation in natural waters.
- L.A. Nelson & R.F.C. Mantoura (Institute for Marine Environmental Research, Natural Environment Research Council, Plymouth, England): Voltametry of copper species in estuarine waters.
- M. Branica & G. Branica (Centre for Marine Research Zagreb, Yugoslavia): Direct determination of metal complexation.
- B.T. Hart & M.L. Jones (Water Studies Centre, Caulfield Institute of Technology, Caulfield, Australia): A comparison of methods for determining the copper complexing capacity of natural waters.

- C.M.G. van den Berg (Department of Oceanography, University of Liverpool, England): Determination of complexation capacity and conditional stability constants using ion exchange techniques.
- C.J.M. Kramer (NIOZ, Texel): The role of humic substance and colloids in complexation capacity for copper of several marine compartments.
- W. Haekel (Chemical Department, GKSS Research Center, Geesthacht, Western-Germany): Investigations on the complexation of heavy metals with humic acids in estuaries.
- C.H. Langford (Department of Chemistry, Concordia University, Montreal, Canada): Kinetic spectroscopy of metal fulvic acid complexes.
- J. Buffle (Department of Analytical Chemistry, Sciences II, Genève, Switzerland): Interpretation of potentiometric and voltammetric data in studies of reactions between trace metals and fulvic compounds.
- P.G.C. Campbell & A. Tessier (Université de Québec, INRS-EAU, Ste-Foy, Québec, Canada): Evaluation of the copper (II) solubilization method for the determination of the complexation capacity of natural waters.
- B. Raspor, H.W. Nürnberg*, P. Valenta* & M. Branica (Center for Marine Research, Zagreb, Yugoslavia, *Institute of Applied Physical Chemistry, Nuclear Research Center (KFA), Jülich, Western-Germany): Significance of dissolved humic substances for heavy metal speciation in natural waters.
- W. Stumm, L. Sigg & B. Zinder (Institute for Water Resources and Water Pollution Control, Swiss Federal Institute of Technology, Zurich, Switzerland): Chemical processes at the particle-water interface; implications concerning the form of occurrence of solute and "absorbed" species.
- T.H. Sibley, J.R. Clayton, A.L. Sanches & J.J. Alberts* (College of Fishery and Ocean Sciences (WH-10), University of Washington, Seattle, U.S.A., *Savannah River Ecology Laboratory, Aiken, U.S.A.): Effect of organic ligands on sediment: water partitioning of transuranic elements.
- A.C.M. Bourg (Geochemical Processes Group, National Geological Survey, Orléans, France) & C. Mouvet (Laboratory of Ecology, University of Metz, France): A heterogeneous complexation model of the adsorption of trace metals on natural particulate matter.
- J.W. Murray & L.S. Balistrieri (School of Oceanography, University of Washington, Seattle, U.S.A.): Metal-solid interactions in the marine environment: surface chemistry of sediment from the sediment water interface.
- D.K. Nordstrom & J.W. Ball (U.S. Geological Survey, California, U.S.A.): Chemical models, computer programs and metal complexation in natural waters.
- E.A. Creselius, N.S. Bloom (Battelle, Marine Research Laboratory, Sequim, Washington, U.S.A.), E.A. Jenne & C.E. Cowan (Pacific Northwest Laboratories, Richland, Washington, U.S.A.): Silver speciation and adsorption in coastal water.
- I. Ružic (Center for Marine Research Zagreb, Croatia, Yugoslavia): Kinetics of complexation and determination of complexation parameters in natural waters.
- J.R. Tuschall (Illinois State Water Survey, Champaign, U.S.A.) & P.L. Brezonik (Department of Civil and Mineral Engineering, University of Minnesota, Minneapolis, U.S.A.): Heavy metal binding by dissolved aquatic organic matter and polymeric model compounds: effects of electrostatic interactions on stability constants.
- W.J. Langston & G.W. Bryan (Marine Biological Association, Plymouth, England): Relations between metal species distribution and organisms.
- T.M. Florence, B.G. Lumsden & J.J. Fardy (CSIRO Division of Energy Chemistry, Sutherland, Australia): Algae as indicators of copper speciation.
- B. Imber, F. Pollehne (Royal Roads Military College, Victoria, Canada) & M.G. Robinson (Institut für Meereskunde, Kiel, Western-Germany): Complexation by diatom exudates in culture and in the field.
- W. Sunda (Atlantic Est. Fish Center, Beaufort, U.S.A.): Determination of complexation capacity using biological systems.
- M.S. Shuman, B.J. Collings & S.E. Cabaniss (University of North Carolina, Chapel Hill, U.S.A.): An affinity spectrum model for metal binding.

- F.J. Millero (Rosenstiel School of Marine and Atmospheric Science, University of Miami, Florida, U.S.A.): The activity of metal ions at high ionic strengths.
- R.F.C. Mantoura, M. Varney, D. Turner & M. Whitfield (Institute for Marine Environmental Research, Plymouth, England): Copper and lead binding by aquatic fulvic acid: a comparative electrochemical investigation.
- F.H. Frimmel, A. Immerz & H. Niedermann (Institut für Wasserchemie und Chemische Balneologie der Technischen Universität München, Western-Germany): Complexation capacities (CC) of isolated aquatic humics (HUS).

Posters:

- Yu Guo-Hui (2nd Institute of Oceanography, Hangzhou, Peoples Republic of China), C.J.M. Kramer & J.C. Duinker (NIOZ, Texel): Possibilities for misinterpretation of the complexation capacity determination by ASV analysis.
- C.M.G. van den Berg, P.J.M. Buckley & S. Dharmvanij (Department of Oceanography, University of Liverpool, England): Experimental comparison of the MnO_2 and DPASV techniques for the study of metal complexation in estuarine and open ocean waters.
- R.F.M.J. Cleven & H.P. van Leeuwen (Laboratory for Physical and Colloid Chemistry, Agricultural University, Wageningen): "Counterion condensation" in the binding of heavy metals to polymeric ligands; an electrochemical study.
- F. Elbaz-Poulichet, W.W. Huang, J.-M. Martin (Laboratoire de Géologie, École Normale Supérieure, Paris, France) & G. Cauwet (Laboratoire de Géochemie et Sédimentologie Marines, Université de Perpignan, Perpignan, France): Total and "organic" dissolved Cd, Hg and Pb in major french estuaries (Gironde, Loire, Rhône) and Tagus estuary (Portugal).
- R.-D. Wilken (Chemical Department GKSS Research Center, Geesthacht, Western-Germany): The influence of antibiotics on the adsorption kinetics of ^{54}Mn and ^{59}Fe on suspended particles in river Elbe water.
- M.L.S. Simoes Gonçalves & M.M. Correia dos Santos (Centro de Quimica Estrutural, Lisboa, Portugal): Kinetics of the dissociation of amino acid cadmium complexes.
- G. Gillain* & C. Brihay** (Laboratoire d'Océanologie* et de Chimie analytique**, Université de Liege au Sart-Tilman, Liege, Belgium): Application of anodic stripping voltammetry to a speciation routine method for polluted coastal sea water.
- C.A. Johnson & A.R. Burkin (Royal School of Mines, Imperial College, London, England): Use of the ligand expression in the study of inorganic complex formation using differential pulse polarographic analysis.
- M. Laegreid, J. Alstad, D. Klaveness* & H.M. Seip (Department of Chemistry and Department of Limnology*, University of Oslo, Norway): The response of the algae *Selenastrum capricornutum* Printz towards metal additions to natural waters in comparison with evaluated metal complexation.
- M. van der Werff (Biologisch Laboratorium, VU Amsterdam): The effect of natural complexing agents on heavy metal toxicity in aquatic plants.
- P. del Castilho, R.G. Gerritse (Institute for Soil Fertility, Haren), J.M. Marquenie (MTTNO, Den Helder) & W. Salomons (Delfts Hydrolics Laboratory, Haren Branch): Metal speciation and the *in situ* accumulation by the mussel *Dreissena polymorpha*.
- M. Gnassia-Barrelli, M. Härdstedt-Romeo & E. Nicolas (Laboratoire de Physique et Chimie Marines, Villefranche-sur-Mer, France): Copper and cadmium uptake in different phytoplankton culture media.
- R.W. Zuehlke (University of Rhode Island, U.S.A.) & R.H. Byrne (University of South Florida, U.S.A.): Free metal concentration predictions as a guide to limitations of trace metal speciation calculations.
- D. Dyrssen *et al.* (Department of Analytical and Marine Chemistry, CTH/GU, Göteborg, Sweden): Chemical reactions in the anoxic bottom water of Framvaren.
- W. Lund (Department of Chemistry, University of Oslo, Norway): Bound copper in the Orkla river.

- K. Kremling, A. Wenck & C. Osterroht (Institut für Meereskunde, Kiel, Western-Germany): Dissolved organic copper in Baltic waters.
- L. Brüggemann (Institut für Meereskunde, Rostock-Warnemünde, D.D.R.): Relationship between "dissolved" and particulate trace metal fractions in Baltic sea water.
- A.K. Hanson & D.R. Kester (Graduate School of Oceanography, University of Rhode Island, Narragansett, Rhode Island, U.S.A.): The speciation of dissolved copper in the northwestern Atlantic Ocean.
- R.W.P.M. Laane (BOEDE, Texel) & C.J.M. Kramer (NIOZ, Texel): Complexation of copper (II) with humic substances in relation to different extraction procedures of marine sediment.
- D.S. Gamble (CBRI Agriculture Canada, Ottawa, Canada) & C.H. Langford (Chemistry Department, Concordia University, Montreal, Canada): The titration function of a mixed ligand, fulvic acid.

The role of organic matter in the Wadden Sea

A symposium entitled "The role of organic matter in the Wadden Sea" was organized within the frame work of Dutch-German-Danish Wadden Sea conservation management. The symposium, organized by RIN (Research Institute for Nature Management), was opened by Ir. G.J.M. Braks, Minister of Agriculture, and made use of the NIOZ lecture room and other facilities. There were 60 participants. The Proceedings of the symposium will be published in the Neth. Inst. Sea Res. Publ. Ser.

Lectures:

- H. Postma (NIOZ, Texel): Organic matter in coastal seas and the Wadden Sea.
- R.W.P.M. Laane (BOEDE, Texel): Characteristics of the organic matter in the Wadden Sea.
- W. Jäppelt: Outline of the North Sea measurement programme.
- E.T. Degens & V. Ittekott: Tracking of marine DOC and POC.
- F. Colijn (BOEDE, Groningen): Characteristics of primary production in the Wadden Sea.
- G.C. Cadée (NIOZ, Texel): Has input of organic matter to the western Wadden Sea ecosystem increased during the last decades?
- P.A.W.J. de Wilde & J.J. Beukema (NIOZ, Texel): The role of the benthos in the consumption of organic matter.
- S. Wellershaus: The behaviour of solid matter in estuaries - a microscopical introduction.
- J. Dronkers: Import of fine marine sediment in tidal basins.
- S.A. Gerlach: A discussion of eutrophication phenomena in the Federal Republic of Germany.
- A. Hansen: A model system for studying decomposition of plant tissue in fine-grained estuarine sediment and its release as dissolved organic compounds and mineralized CO₂.
- J.C. Duinker (NIOZ, Texel): Organochlorines in the Wadden Sea.
- W.J. Wolff (RIN, Texel): Concluding remarks.

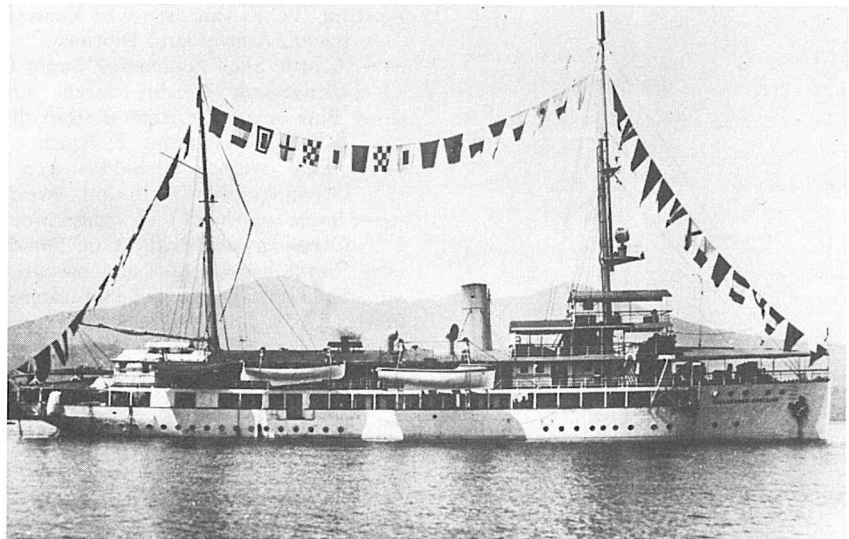
2.2.2. Lectures of NIOZ scientists given elsewhere

- Baars, M.A.: (Zooplankton and secondary production). Rijksuniversiteit Groningen, Vakgroep Mariene Biologie, 31 January.
- Bennekom, A.J. van: (Dating of pelagic sediments with Beryllium-10 and Aluminium-26. Literature research and possible applications). Miniconference massspectrometry with accelerators. R.J. van de Graaff Laboratorium, RU Utrecht, 13 January.
- : (Interaction of marine cycles of aluminium and silica). Landbouwhogeschool Wageningen, Gespreksgroep Kleimineralen, 3 March.
- : (Deep sea basin ventilation programme (SNELLIUS II)). Trippenhuis, Amsterdam, Oceanografenclub, NRZ, 10 November.
- : (The cycle of silica in the Weddell Sea). Trippenhuis, Amsterdam, Oceanografenclub, NRZ, 10 November.
- Berger, G.W.: (Uraan/thorium analyses in deep sea sediments). Sectie Radio- en Stralingschemie Koninklijke Nederlandse Vereniging voor Natuurkunde. Natuurkundig Laboratorium, Groningen, 28 October.
- Beukema, J.J.: Parallel fluctuations of numerical densities in zoobenthic populations living in different parts of the Dutch Wadden Sea. Workshop COST-47, University of Galway, Eire, 13-16 June.
- : Immediate and long-term effects of severe winter stress on a macrobenthic tidal flat community in the Dutch Wadden Sea in the years 1969-1983. 18th European Marine Biology Symposium, Oslo, Norway, 14-20 August.
- : (On the relation of growth velocity of bivalves and food availability on Balgzand tidal flats). BION werkgemeenschap Aquarische Oecologie, Amsterdam, 26 October.
- Boon, J.P.: Uptake, distribution and elimination of selected PCB components of Clophen A40 in juvenile sole (*Solea solea*) and effects on growth. 18th European Marine Biology Symposium, Oslo, Norway, 18 August.
- : Uptake, distribution and elimination of selected PCB components of Clophen A40 in juvenile sole (*Solea solea*) and effects on growth. Fiskeridirektorates Havforskningsinstitutt, Marine Pollution Department, Bergen, Norway, 6 September.
- G.C. Cadée: (Changes in production and import of organic matter in the western Wadden Sea since 1950). Meeting BION werkgemeenschap Aquatische Oecologie, Amsterdam, 26 October.
- : Has input of organic matter to the western Wadden Sea increased during the last decades? International Wadden Sea Symposium, Texel, 1-3 November.
- : Behaviour of POC, DOC and fluorescence in the fresh water tidal compartment of the river Ems (also on behalf of R.W.P.M. Laane, BOEDE). Workshop on carbon transport in major world rivers. SCOPE/UNEP, Assiut, Egypt, 26 February-2 March.
- Dral, A.D.G.: Amphibious vision in dolphins. International Symposium on Vertebrate Morphology, Giessen, Western-Germany, 22-26 August.
- : Study on the mechanism of amphibious vision in seals. Yearly meeting European Seal Group, RIN, Texel, 14 December.
- Duinker, J.C.: New developments in the analyses of organochlorines in sea water. Skidaway Institute of Oceanography, Savannah, U.S.A., 28 January.
- Eisma, D.: Macro-aggregates, particle size of suspended matter and particulate organic matter in the Ems estuary (also on behalf of J. Boon, V. Ittekkott, W.G. Mook). Workshop on carbon transport in major world rivers. SCOPE/UNEP, Assiut, Egypt, 1 March.
- : (Sources and effects of pollution). Symposium Stichting Toekomstbeeld der Techniek, Nederland en de rijkdommen van de zee, Rotterdam, 14 April.
- : (Geology and sediment transport in the North Sea). Biologisch Centrum, Groningen, 17 January.
- : (Organic matter and grain size distribution of suspended matter in the Gironde estuary (also on behalf of J. Boon, V. Ittekkott, W.G. Mook)). Symposium Interaction Continent-Océan (GRECO-ICO), Parijs, 6 October.

- : Flocculation and aggregation in estuaries and the sea. Commissao do Ambiente, Lisboa, Portugal, 7 December.
- Everaarts, J.M.: (Heavy metal research). Kursus "Maatschappelijke Biologie", Sub-faculteit Biologie, University of Utrecht, 3 and 23 March, 7 and 14 December.
- : Uptake and distribution of copper and its effect on some oxygen binding properties of the haemoglobin of the polychaete *Arenicola marina*. 18th European Marine Biology Symposium, Oslo, Norway, 14-20 August.
- : SNELLIUS II, theme 5. Nederlandse Oceanografen Club, Amsterdam, 10 November.
- : Pollution of the North Sea. Rijksuniversiteit Groningen, Vakgroep Mariene Biologie, 21 February.
- Fransz, H.G.: Horizontal drift and local development of *Calanus finmarchicus* during spring in the Fladen Ground area of the northern North Sea. ICES Statutory meeting, Göteborg, Sweden, 10 October.
- Gaast, S.J. van der: Effects of different cations and relative humidity on hydration-dehydration mechanism of Wyoming Montmorillonite. Fifth meeting of the European Clay Groups, Praha, Czechoslovakia, 31 August-3 September.
- Gieskes, W.W.C.: (Phytoplankton and primary production in the North Sea. Rijksuniversiteit Groningen, Vakgroep Mariene Biologie, 24 January.
- : Chemotaxonomical applications of HPLC: determination algal pigment concentrations in the North Sea and the Atlantic Ocean. HPLC-milieuseminar, themadag HPLC-analyses in de milieuwetenschappen, Etten-Leur, 18 May.
- Jansen, J.H.F.: Evolution of the Zaire-Congo deep sea fan and shelf in relation to African geology. 12e Colloque de Géologie africaine. Musée Royal de l'Afrique centrale, Tervuren, Brussel, Belgium, 6-8 April.
- : Middle and Late Quaternary paleo-oceanography and -climatology of the Zaire (Congo) deep sea fan and the adjacent eastern Angola Basin. First International Conference on Paleooceanography. ETH, Zürich, Switzerland, 19 July.
- : (Angola Basin and Zaire fan during the Quaternary). Nederlandse Oceanografenclub, Amsterdam, 21 April.
- : (Series of lectures Marine Geology). Hogere Zeevaartschool, Amsterdam, March.
- Klein Breteler, W.C.M.: (Growing behaviour of pelagic copepods). Oecologische Kring, NDV, Landbouwhogeschool Wageningen, 28 April.
- Kramer, C.J.M., Yu Guo-Hui & J.C. Duinker: Possibilities for misinterpretation in ASV-speciation studies of natural waters. Symposium über Anorganische Analytik in Umweltforschung und Umweltschutz. Kernforschungs Anlage Jülich, Jülich, Western-Germany, 13-16 June.
- Kramer, C.J.M. & L.M. van der Vlies: Heavy metals in sediments of the Dutch Wadden Sea. Conference on Heavy metals in the environment, Heidelberg, Western-Germany, 6-9 September.
- Kuipers, B.R.: Role of the benthic fauna in the southern North Sea. Rijksuniversiteit Groningen, Vakgroep Mariene Biologie, 7 February.
- Lavaleye, M.S.S.: Biological results of the DORA-expedition of 1982 to the NE Atlantic site for the disposal of low-level radioactive waste. Workshop on the role of microflora and microfauna on the long-term availability of the radionuclides in marine ecosystems. E.N.E.A. Centro Studi Ambiente Marino. Santa Teresa, Italy, 27-29 April.
- : Abyssal meio- and macrofauna of the NE Atlantic dumpingsite for radioactive waste (46°N, 17°W). Fifth International Meiofauna Congress. State University of Ghent, Ghent, Belgium, 16-20 August.
- Postma, H.: (Oceanography of the North Sea). Rijksuniversiteit Groningen, Vakgroep Mariene Biologie, 17 January.
- Rutgers van der Loeff, M.M.: (The cycle of nutrients in the North Sea). Rijksuniversiteit Groningen, Vakgroep Mariene Biologie, Haren, 24 January.
- Spaargaren, D.H.: Effects of environmental osmotic conditions on some physiological functions of shrimps and crabs. University of Southampton, Department of Oceanography, Southampton, England, 8 June.

- Spitzer, D.: An interpretation of spectral reflectance in terms of water quality parameters, XVIII IUGG Congres, General Assembly, Hamburg, Western-Germany, 15-27 August.
- Spitzer, D. & R.W.J. Dirks: Absorption and fluorescence effects in the red part of the reflectance spectra of coastal waters. XVIII IUGG Congres, General Assembly, Hamburg, Western-Germany, 15-27 August.
- Swennen, C.: The effect of time limitation on cockle feeding in the oystercatcher. 6th International Workshop on ecology of shorebirds. Cardiff, England, 12-16 September.
- : (Birds of the Wadden Sea). "De oecologie van het Waddenzegebied". Rijkswaterstaat, directie Friesland, Leeuwarden, 23 February.
- : Oiled bird observations. Presentation and discussions of oil pollution related research projects NIOZ/RIN, Texel, 9 September.
- : (International importance of Texel salt marshes with respect to birds). Districtsvergadering Nederlandse Vereniging tot Behoud van Natuurmonumenten, Texel, 2 February.
- Veth, C.: (Vertical structure and turbulence in the water column). Overleggroep Transportverschijnselen van de Raad van Overleg voor het Fysisch Oceanografisch onderzoek van de Noordzee. Rijkswaterstaat, directie Waterhuishouding en Waterbeweging, fysische afdeling, Den Haag, 3 June.
- : (Turbulence measurements in the North Sea with a laser-doppler velocity meter). Subgroep Turbulentie van de contactgroep warmtetransport. NIOZ, Texel, 6 October.
- Vosjan, J.H.: (Measurement of respiratory electron transport activity). BION werkgroep Aquatische ecologie, Amsterdam, 14 september.
- Weering, T.C.E. van: Series of lectures General Sedimentology. Hogere Zeevaartschool, Amsterdam, February.
- : Clastic Shelf Sediments. Caput College, Instituut voor Aardwetenschappen, Universiteit Utrecht, March.
- : Fine grained turbidites from the Zaire deep sea fan. Oceanografen Club, KNAW, Amsterdam, 21 April.
- : Fine grained turbidites from the Zaire deep sea fan. Woods Hole Oceanographic Institution, Woods Hole, U.S.A., 18 November.
- : Some aspects of sedimentation in the Faroer-Shetland Channel. Woods Hole Oceanographic Institution, Woods Hole, U.S.A., 2 December.
- : Some aspects of sedimentation in the Faroer-Shetland Channel. Lamont-Doherty Geological Laboratory, New York, U.S.A.
- Wilde, P.A.W.J. de: The use of ETS measurements in estimating the activity of the benthic system of the North Sea. ICES, benthos group, Hamburg, 6 April.
- : *In situ* measuring methods of benthic community metabolism. SHELL, international meeting on applied research. NIOZ, Texel, 9 September.
- : OPEX experiments and research on the functioning of benthic ecosystems. BION, presentatie werkgroepen, Amsterdam, 23 March.
- Wilde, P.A.W.J. de & J.J. Beukema: The role of benthos in the consumption of organic matter. International Wadden Sea Symposium, NIOZ, Texel, 3 April.
- Zijlstra, J.J.: Impact of coelenterate predation on larval fish stocks in the coastal zone of the southern North Sea. ICES, Göteborg, Sweden, 14 October.
- : (Research of Theme 3 "Pelagic systems" in the SNELLIUS II-expeditie). Nederlandse Oceanografenclub, Amsterdam, 10 November.
- : (Series of lectures in Marine Biology). Rijksuniversiteit Groningen, Texel, 16-17 June.
- Zimmerman, J.T.F.: (Lecture series Internal waves). Utrecht University, January-May.
- : (Lecture series Long waves and tides). Utrecht University, September-December.
- : (Physical oceanography). Series of lectures at the International Institute of Hydraulics and Environmental Engineering, Delft, May.
- : Symmetry and asymmetry in theories concerning ocean circulation. Natuurk. Colloq. Rijksuniversiteit Groningen, 10 March.

- : Tidal vorticity dynamics and tidal sand ridges. Symposium Sedimentation on the continental shelf, Hangzhou, China, 16 April.
- : Dynamics of tidal rectification at a shelf break. Second Institute of Oceanography, Hangzhou, China, 16 April.
- : Dynamics and kinematics of tidal residual eddies. Department Oceanography, Dalhousie University, Halifax, Canada, 9 June.
- : Dispersion by frozen 2d turbulence. Bedford Institute of Oceanography, Dartmouth, Canada, 12 August.
- : Theoretical aspects of combined current meters, drogue and dye patch experiments in tidal areas. Marine Sciences Research Center, Stony Brook, U.S.A., 2 August.



HMs "Snellius" in Indonesian waters during the first SNELLIUS expedition.

Posters presented

- A.J. van Bennekom, S.J. van der Gaast, J. van Iperen, J.H.F. Jansen & J. Pieters. Opal B: Missing sink in the oceanic silica budget. Lecture series comparative sedimentology division, Institute of Earth Sciences, Utrecht, 10-11 January.
- Boon, J.P., G. Eijkel, P.G. Kistemaker, D. Eisma & J. de Leeuw. Pyrolysis mass spectrometry combined with multivariant data analysis. Study of particulate matter in the Ems estuary. Poster 11th Conference Organic Geochemistry, Den Haag, 5-9 September.

- J. Kuiper, P.A.W.J. de Wilde & W.J. Wolff. Oil Pollution Experiment (OPEX). I. Fate and effects of an oil mass in a model ecosystem presenting a Wadden Sea tidal mud flat. International symposium Ecotox. Testing for the Mar. Environment, Ghent, Belgium (abstract of poster).
- R.S.C. de Ruiter, J.H.F. Jansen & T.C.E. van Weering. Two new silicoflagellate datum levels for the Late Quaternary in the tropical Atlantic. First International Conference on Paleoceanography. ETH, Zürich, Switzerland, 19 July.
- Spitzer, D. An interpretation of spectral reflectance in terms of the water quality parameters. IUGG XVII General Assembly, Hamburg, 15-27 August, IAPSO programme and abstracts: 145-146.
- Veth, C. Turbulence measurements in the central North Sea. IUGG XVIII General Assembly, Hamburg, 15-27 August, IAPSO programme and abstracts: 287-288.

2.2.3. Advice offered

- On behalf of the Wadden Working Group the series "Ecology of the Wadden Sea" was presented to the President of the Wadden Advies Raad (Wadden Sea Advisory Board) in Leeuwarden, 15 November.
- At the request of Mr Jonson-Thendenberg, legal advisor of the Swedish Embassy, an exchange of views took place on Antarctic research, in The Hague, 21 November.
- Advice in a research programme on amphibious vision in dolphins, to be carried out by J. van der Toorn in Ouwehand's Zoo, Rhenen, The Netherlands.
- Advice to C. van Beek and J. van Beek (Texel) in an experimental project for rearing rainbow trout in net-cages in the NIOZ harbour, Texel.
- Advice to the Stichting Ontwikkeling Aquacultures Nederland, The Hague, for a pilot programme for fish culture in heated sea water from a power plant at the river Maas estuary.
- Advising Natural Environmental Research Council, England, over onderzoeksproject "Nitrogen excretion in intertidal fish".

2.2.4. Visitors from abroad

Dr H. Bernard, Departement Scheikunde, University of Antwerpen, Belgium.
 G. Borstad, Institute of Ocean Sciences, Sidney, B.C. Canada.
 Dr K.R. Bjørklund, Geologisk Institutt, Universitet i Bergen, Norway.
 Dr Burkill, Institute for Marine Environmental Research, Plymouth, England.
 Mr P.R. Chandra, Director Geological Survey of India.
 Dr G. Craig, Ontario Ministry of Environment, Aquatic Toxicology, Rexdale, Ontario, Canada.
 Prof. Dr E. Degens, Geologisch-Paleontologisch Institut, Hamburg, Western-Germany.
 Mr A. Dhar, Joint Secretary Department of Mines, Delhi, India.
 Prof. Dr W. Ebenhoe, University of Oldenburg, Western-Germany.
 Dr H. Farke, Institut für Meeresforschung, Bremerhaven, Western-Germany.
 Prof. Dr C.J.R. Garrett, Department of Oceanography, Dalhousie University, Halifax, Canada.
 J.F.R. Gower, Institute of Ocean Sciences, Sidney, B.C. Canada.
 Dr V. Ittekkot, Geologisch-Paleontologisch Institut, Hamburg, Western-Germany.
 Dr K. Kranck, Bedford Institute of Oceanography, Dalhousie University, Halifax, Canada.
 Prof. Dr G. Krause, Institut für Meeresforschung, Bremerhaven, Western-Germany.

W.C. Mahaney, Department of Geography, Atkinson College, York University, Downsview, Ontario, Canada.
 Dr C. Mizota, Kyushu University, Fukuoka, Japan.
 Dr V.E. Noshkin, Lawrence Livermore National Laboratory, Livermore, California, U.S.A.
 Prof. Polk, Free University, Brussels, Belgium.
 Dr C.A. Sancetta, Lamont-Doherty Geological Observatory, New York, U.S.A.
 Dr M. Salzwedel, Institut für Meeresforschung, Bremerhaven, Western-Germany.
 Dr H. Soegiarto, LON, Jakarta, Indonesia.
 Dr H. Sonlin, Normal University, Shanghai, China.
 Dr K.R. Sperling, Biologische Anstalt Helgoland, Hamburg, Western Germany.
 Mr B. Srikantan, Deputy Director General Geological Survey of India.
 Prof. Dr B. Sundby, University of Quebec, Canada.
 Dr R.E. Turner, Louisiana State University, Baton Rouge, Louisiana, U.S.A.
 K. Voss, A & M University, Station College, Texas, U.S.A.
 Prof. Dr K. Wada, Kyushu University, Fukuoka, Japan.
 Prof. Dr A. Willig, University of Oldenburg, Western-Germany.

A group of Belgian scientists of the Free University of Brussels visited NIOZ on 14-15 March, to discuss combined North Sea research.
 A group of German scientists from the Institut für Meeresforschung, Bremerhaven visited NIOZ to continue discussions on combined North Sea research.



Isaacs-Kidd net for macrozooplankton sampling.

3. Vervolg wetenschappelijk gedeelte

3.1. INLEIDING

3.1.1. Waddenzee en andere estuaria

Van oudsher is de Waddenzee, met een sterke variatie in chemisch-fysische condities en biologisch gezien, relatief arm aan soorten, een belangrijk onderzoeksterrein voor het NIOZ.

Optische metingen aan het wateroppervlak in het spectrale gebied tussen 400-720 nm werden vergeleken met gelijktijdig waargenomen concentraties van gesuspendeerd materiaal, chlorofyl en "yellow substance" in het water, in verband met toepassingsmogelijkheden voor Remote Sensing. In een studie over de stikstofcyclus in het Eems-Dollard estuarium werd gebruik gemaakt van een ééndimensionaal fysisch model van het estuarium, waaruit onder meer kon worden afgeleid dat de verspreiding van nitrificerende bacteriën in het water vermoedelijk samenhangt met het transport van gesuspendeerd materiaal. Er werd een begin gemaakt met experimenteel werk over de stikstofcyclus in het sediment, waarbij onder meer gebruik wordt gemaakt van een stikstofsotoop (^{15}N).

Onderzoek in de estuariën van de Rijn, Gironde, Elbe, Weser en Eems gaf aan dat op de overgang van zoet naar zout water nauwelijks flocculatie van zwevend materiaal optreedt. Wel werden zowel in zoet als in zeewater grote aggregaten van organisch materiaal en minerale deeltjes waargenomen. De afmeting van deze aggregaten hing af van de heersende turbulentie, waarbij de aggregaten zeer fragiel bleken.

In verband met mogelijke eutrofiëring van de Waddenzee werd een poging gedaan de tot nu toe verrichte waarnemingen over de primaire produktie te evalueren. Hierbij werden aanwijzingen verkregen dat de produktie van microscopische bodemalgen (microfytobenthos) en van het fytoplankton in de westelijke Waddenzee sinds 1970 is toegenomen.

Onderzoek aan zware metalen (Cu, Zn, Ni, Mn) werd verricht in het Schelde- en Eems-estuarium, waarbij onder meer de capaciteit van het water tot complexering van koper werd bestudeerd. In de Nederlandse Waddenzee en in de aangrenzende Noordzee werden de concentraties van zware metalen en organochloorverbindingen in sediment en in bentische organismen bepaald. Vergeleken met oudere sedimenten (> 1500 jaar) bleken lood en zink met een faktor 3, cadmium met een faktor 5 en koper met een faktor 2 te zijn verhoogd. In het onderzochte gebied waren duidelijke geografische trends aanwezig, die echter verschilden voor de diverse metalen. Het veldonderzoek werd aangevuld met experimentele studies, onder meer over het effect van enkele zware metalen (Cu, Zn, Cd) op mariene organismen. Hierbij werd het effect van de metalen op de zuurstofbinding van het haemoglobine van *Arenicola marina* onderzocht, terwijl ook de verdeling van de opgenomen metalen over de lichaamscompartimenten van het dier werd bestudeerd. Uit een veldstudie over de concentratie van PCB-

componenten in het water en in enkele bodemorganismen (*Macoma balthica*, *Nereis diversicolor*) bleek, dat in het water de laag-, maar in de dieren de hooggechloreerde componenten overheersten. In een langdurig experiment werd het effect van PCB's op de tong (*Solea solea*) onderzocht, waarbij in overeenstemming met de veldwaarneming werd gevonden dat laaggechloreerde componenten relatief snel uit het dier verdwenen. Voorts bleken met PCB's behandelde tongen slechter te groeien dan een controle-groep.

Een veldstudie werd verricht naar de verdeling van sulfide-oxyderende bacteriën (Thiobacilli) in het Schelde-estuarium, in relatie tot saliniteit en O_2 -concentratie. In een serie experimenten werden de groeicondities onderzocht van enkele soorten nitrificerende bacteriën (*Nitrobacter*, *Nitrosomonas*), in afhankelijkheid van substraat-concentratie, saliniteit en zuurstofconcentratie. De bacterie-stammen werden geïsoleerd uit het Eems-Dollard estuarium.

Uit een nadere analyse van een lange waarnemingsserie (15 jaar) aan het macrobenthos van het getijdengebied op het Balgzand kon het effect van een strenge winter worden vastgesteld. De sterfte in het macrobenthos (alle soorten tezamen), veroorzaakt door de meer extreme wintercondities, bleef voornamelijk beperkt tot de lager gelegen en minst geëxponeerde delen van het getijdengebied en betrof vooral gevoeliger soorten, die zich gedurende perioden met zachte winters in dit gebied kunnen handhaven. Het negatieve effect van extreme wintercondities op soortensamenstelling en biomassa was daardoor beperkt en werd ver overtroffen door een sterke broedval van vele soorten in de zomer, volgend op de koude winter, mogelijk door het tijdelijk ontbreken van belangrijke predatoren. Als gevolg hiervan lijkt op iets langere termijn (2-4 jaar) een extreme winter tot een verhoging van de biomassa van het macrobenthos te leiden.

Meiofauna speelt in getijdengebieden van de westelijke Waddenzee in metabolisch opzicht vermoedelijk slechts een beperkte rol in vergelijking met het macrobenthos, in tegenstelling tot de situatie gemeld voor andere getijdengebieden in NW-Europa. Dit verschil wordt vooral verklaard door de relatief hoge dichtheid van het macrobenthos in de Waddenzee ten opzichte van de meiofaunadichtheid.

In de laatste jaren werd aandacht besteed aan het optreden van hoge dichtheden van enkele coelenteraten-soorten (*Pleurobrachia pileus*, *Aurelia aurita*, *Sarsia tubulosa*) in de westelijke Waddenzee in de eerste helft van mei en het effect op binnenkomende vislarven. De sterke afname van de vislarven (onder meer schol, bot) in die periode werd in verband gebracht met predatie door de kwallen, die daartoe blijken in de literatuur vermelde experimenten in staat zijn.

Uit groei-experimenten met tong bij verschillende soorten voedsel (mossel vlees, droogvoer) en verschillende voedingsregimes bleek onder meer dat optimale groei werd bereikt bij twee keer voeren per dag met een dagelijks rantsoen (droogvoer) van ongeveer 5% van $W^{0.8}$ (W = natgewicht vis). Voorts bleek tong beter te groeien op mossel vlees dan op het gebruikte droogvoer, hetgeen vermoedelijk samenhangt met het hogere proteïnegehalte van mossel vlees.

Experimenten over de betekenis en het ontstaan van verschillende snelvormen in de scholekster wezen op individuele adaptaties in het voedsel-

zoeken en de voedselbehandeling. Door wijziging van het voedselvoorkomen konden snel morfologische en gedragsveranderingen worden geïnduceerd.

De in de laatste decade sterk toegenomen kennis van het Waddengebied, onder andere ten aanzien van de interacties van fysisch-chemische factoren met het biologisch systeem en de relaties binnen dit systeem, zal naar verwachting in de komende jaren leiden tot een poging tot modellering.

3.1.2. Noordzee

Het fysisch onderzoek was toegespitst op grootschalige transportprocessen in de Zuidelijke Bocht. De metingen aan drijververplaatsingen, die verricht zijn in het kader van het "Breeveertien" experiment, zijn geanalyseerd in samenhang met simultane metingen aan een zich verplaatsende kleurstofvlek en metingen met verankerde series stroommeters. De resultaten van al deze metingen geven informatie over de ruimtelijke structuur van grootschalige turbulente wervels en reststromen in delen van de Zuidelijke Bocht.

Theoretisch werk op het gebied van grootschalige transportprocessen is verricht waarbij bestaande theorieën over dispersie door restwervels zijn vergeleken en getoetst op hun praktische bruikbaarheid. Dit werk is verricht samen met het Oceanography Department van Dalhousie University, Halifax. In samenwerking met het Bedford Institute of Oceanography is begonnen met een theoretische analyse van de verticale structuur van getijstromen die door topografie-effekten gelijk gericht zijn. Dit werk wordt nu ook gedaan voor gelaagde media waar barokliene effecten een rol spelen. Het ziet er naar uit dat de opwekking, de voortplanting en de dissipatie van gedwongen inwendige getijden, aspecten zijn van essentieel hetzelfde probleem als reststromen in een ondiepe shelfzee. Dit werk wordt verricht samen met het Instituut voor Meteorologie en Oceanografie van de Universiteit van Utrecht. Verder worden de methoden die ontwikkeld zijn bij de studie van grootschalige transportprocessen in de Noordzee toegepast bij de studie van de circulatie in oceaانبekkens.

Kleinschalige transportprocessen, turbulentie en menglagen werden bestudeerd aan de hand van de waarnemingsresultaten van het gezamenlijke onderzoeksproject "Stratified North Sea 81/82". De voorlopige resultaten, onder andere verkregen met het laser-doppler meetsysteem, geven een verband tussen turbulentie in de door de wind gemengde bovenlaag van de zee en de windsnelheid, dat op eenvoudige wijze kan worden afgeleid uit de bekende theorie van Ekman over door de wind aangedreven stromen in zee. In de gelaagde delen van de waterkolom zijn turbulentiespektra gemeten, die waarschijnlijk te interpreteren zijn met behulp van theorieën van Monin-Bolgiano of Lumley-Shur. Kleinschalige turbulentiemetingen gedurende het project "Breeveertien" hebben een model opgeleverd, dat de turbulentie goed kan beschrijven in een ondiepe ongelaagde shelfzee. Met dit model is het ook mogelijk een redelijke beschrijving te geven van de turbulentie vlak na de kentering.

Onderzoek aan het sedimenttransport in de Noordzee gaf aan dat de hoogste concentraties aan gesuspendeerd materiaal voorkomen in de Zuide-

lijke Bocht en in het Skagerrak-Kattegat. Dit hangt samen met in die gebieden optredende concentratieprocessen.

In het kader van het projekt "Stratified North Sea 81/82" werden *in situ* metingen verricht over de dagelijkse variaties in de zuurstofconcentraties in de waterkolom. Uit het in mei, juli en september 1981 verzamelde materiaal werd op grond van deze gegevens een schatting van $\sim 600 \text{ mg C} \cdot \text{m}^{-2} \cdot \text{d}^{-1}$ voor de primaire produktie verkregen, aanzienlijk lager dan de gelijktijdig bepaalde ^{14}C -schatting ($\sim 1000 \text{ mg C} \cdot \text{m}^{-2} \cdot \text{d}^{-1}$). De sterke "patchiness" van het fytoplankton in het gebied kan de via de zuurstof-methode verkregen schatting nadelig hebben beïnvloed. Voor het gebied werd op grond van de ^{14}C -methode de primaire produktie op $\sim 250 \text{ g C} \cdot \text{m}^{-2} \cdot \text{j}^{-1}$ werd geschat, terwijl de produktie van voornamelijk herbivore copepoden op $\sim 10 \text{ g C} \cdot \text{m}^{-2} \cdot \text{j}^{-1}$ werd geschat. Het in de zomer optredende meroplankton (voornamelijk echinopluteuslarven) voegde hieraan nog $\sim 3 \text{ g C} \cdot \text{m}^{-2} \cdot \text{j}^{-1}$ toe. De groei van copepoden werd vooral in de zomer beperkt door voedselschaarste.

Het in 1983 uitgevoerde REFLEX-programma (28 april-23 mei) was vooral gericht op de populatiedynamica van *Calanus finmarchicus* (de voornaamste herbivore copepode) in relatie tot de fytoplanktonontwikkeling. Het sedimentarend materiaal werd onderzocht met sedimentvallen geplaatst onder de thermocline. Het materiaal bleek vooral te bestaan uit uitwerpselen ("faecal pellets") van euphausiden, die weinig talrijk in de menglaag waren, terwijl "faecal pellets" van de talrijke copepoden nagenoeg ontbraken. De eerste resultaten gaven aan, dat de algen niet door sedimentatie uit de eufotische zone verdwenen, maar door begrazing, zoals bleek uit een verhoogd phaeophorbideniveau in de menglaag. Een merkwaardige waarneming betrof het voorkomen van benthische diatomeeën (met chlorofyl) in de bodem op 120 m diepte!

Zowel uit veldwaarnemingen als uit experimenten aan boord bleek dat *Calanus* een sterke dag-nacht variatie in graasactiviteit vertoonde met een minimum overdag. De experimenten toonden bovendien een sterke coprofaagie in *Calanus*, hetgeen de afwezigheid van "faecal pellets" in de sedimentvallen verklaart.

De biomassa van bacteriën en de mineralisatie activiteit vertoonden een sterke samenhang met het optreden van de fytoplanktonbloei. Een dagelijkse variatie in deze parameters kon echter niet worden aangetoond.

In de zuidelijke Noordzee werd het optreden van coelenteraten (voornamelijk hydromedusen) bestudeerd in verband met hun mogelijke rol als predatoren op de copepoden in dit gebied. Er werd een fraaie successie van diverse soorten aangetoond, die soms in hoge dichtheden voorkwamen (*Phialidium* tot 3000 m^{-3}). Uit een maandelijks bemonstering van het gebied benoorden Texel met een Isaacs-Kidd net bleek dat Scyphozoa geen belangrijke predatoren van copepoden waren. Die moeten eerder gezocht worden onder de hydromedusen, mysiden, euphausiden en vislarven.

Onderzoek aan de benthische fauna van de zuidelijke Noordzee richtte zich vooral op een overgangszone van de zandige Zuidelijke Bocht naar de meer slikkige centrale Noordzee in het gebied van de Oestergronden. In dit overgangsgebied ligt een relatief smalle zone met een hoog slibgehalte en een rijke benthische fauna. Aan die fauna, zowel uit de rijke zone als uit

zuidelijker gelegen zandige en noordelijker gelegen slikkige gebieden, werden studies verricht naar vestiging, dichtheid en groei. Daarnaast werden enkele typische vertegenwoordigers in experimenten in het aquarium bestudeerd.

De vraag is gesteld of de aanwezigheid van dit rijke gebied samenhangt met een nabij gelegen getijdenfront met een daaraan geassocieerde verhoogde primaire produktie of tot stand komt door sedimentatie van organisch materiaal afkomstig uit de Zuidelijke Bocht. De aanwezigheid van een permanent chlorofylmaximum boven de rijke zone, onafhankelijk van de plaats van het getijdenfront, wijst op de tweede mogelijkheid. Hierbij zou het fytoplanktonmaximum ontstaan door mineralisatie van elders aangevoerd organisch materiaal in en boven de rijke benthische zone.

De meiofauna van het overgangsgebied blijkt arm in het zandige deel en het rijkst, zowel naar soorten als naar biomassa, in het slikkige noordelijke gebied. In de rijke overgangszone werden de hoogste aantallen nematoden waargenomen. Evenals in de Waddenzee lijkt in de overgangszone de verhouding in biomassa van macrofauna en meiofauna relatief hoog (> 20).

Ook zeevogels (voornamelijk zeekoeten) vertonen buiten het broedseizoen hogere aantallen in de nabijheid van het getijdenfront en langs de kust.

In het overgangsgebied, zowel in de rijke zone als in het zandige deel bezuiden en in het slikkige gebied benoorden die zone, werd de zuurstofopname van het benthos gemeten met op de zeebodem neergelaten "zuurstofklokken". Dit geschiedde met behulp van elektronische registratieapparatuur. De in deze klokken gemeten zuurstofopname bleek 2-4 maal hoger dan die gemeten in bodemkernen die aan boord werden geïncubeerd. Aan de ontwikkeling van deze klokken werd financieel bijgedragen door Shell International Research Company. De *in situ* meetmethode werd ook toegepast tijdens het REFLEX-projekt, in de noordelijke Noordzee, waar op 120 meter diepte een goed ontwikkelde bodemfauna aanwezig bleek te zijn ($\sim 11 \text{ g AVD} \cdot \text{m}^{-2}$).

In voorgaande jaren is een schatting gemaakt van verspreiding en dichtheid van benthische carnivoren (vooral vissen, crustaceën en echinodermen). Om de rol van deze groep in het benthische ecosysteem kwantitatief vast te stellen werden experimenten aan enkele soorten uitgevoerd ter bepaling van hun metabolische activiteiten in termen van groei, voedselopname en respiratie. De experimenten, uitgevoerd bij twee temperaturen, werden voorlopig beperkt tot de Gadidae *Merlangius merlangus*, *Trisopterus luscus*, *Gadus morhua*. Voor deze drie talrijke soorten werden zowel voedselopname als respiratie als afhankelijk van het gewicht van de vis en de temperatuur in een formule vastgelegd.

In de eerstkomende jaren zal het Noordzee-onderzoek zich naar verwachting vooral richten op de overgangszone tussen gemengd en in de zomer gestratificeerd water benoorden onze kust. Hierbij zal zowel onderzoek aan de bodem als in de waterkolom plaatsvinden.

3.1.3. Oceaan

De laatste jaren is een goed inzicht verkregen in de aard en betekenis van sedimentatie- en paleoceanografische processen van de diepzee-delta aan de voet van de Zaire canyon. De sedimenten uit het Kwartair zijn opgebouwd uit diverse combinaties van terrigene, shelf en oceanische componenten, waarbij dit terrigene en shelfmateriaal kan worden onderscheiden aan de hand van de kleimineralen waaruit ze voornamelijk zijn opgebouwd. De sedimentaanvoer door de Zaire-rivier was groot in interglacialen, terwijl gedurende glaciële perioden de toevoer van shelfmateriaal maximaal was. Thorium- en uraniumisotopen worden met succes gebruikt voor datering van sedimenten. Onderzoek aan de diatomeeën in sedimenten uit het Kwartair laten een afwisseling zien van tropische en subtropische soorten, die de opeenvolging van glaciële en interglaciële perioden weerspiegelen. Enig onderzoek werd verricht aan slecht gekristalliseerd smectiet in laterietbodems, hetgeen de eigenschappen van de bodem sterk beïnvloedt. Laag kristallijn smectiet kan moeilijk worden ontdekt met conventionele technieken en wordt daarom dikwijls als afwezig verondersteld, maar speelt in de mineralogie van de sedimenten van het Angola Bekken een overheersende rol.

Uit de profielen van interstitieel water uit diepzee-bodems in het Angola en Guinea Bekken en uit de Noorse Zee werd de "diffusie" van opgelost silikaat uit de bodem berekend. Deze berekening is nodig om opgelost silikaat te gebruiken als "tracer" van watermassa's in de Atlantische Oceaan. Uit dit werk bleek dat het silikaatgehalte van het dieptewater uit het Angola Bekken niet verklaard kan worden uit de samenstelling van het tegenwoordig aangevoerde dieptewater en de toevoer van silikaat uit de bodem, zodat aangenomen moet worden dat het bronwater in het verleden een andere samenstelling bezat. In de Noorse Zee echter kan het silikaatgehalte wel worden verklaard uit het gehalte van het bronwater en de toevoer vanuit de bodem, zodat de vorming van diep water daar kennelijk een stationair proces was gedurende de laatste eeuw.

In een onderzoek over transport- en sedimentatieprocessen in het gebied van de Schotland-Groenland Rug, werd het huidige systeem vergeleken met systemen gedurende verschillende laat kwartaire perioden; zoals afgeleid uit bodemkernen. De eerste resultaten vertonen een grote variabiliteit in het gesuspendeerde materiaal, in het bijzonder in de diepe geul tussen de Faeröer en Shetland eilanden. Op de rug zelf bleek de troebelheid hoger nabij de bodem, hetgeen vermoedelijk samenhangt met de heersende getijstroom in het gebied. Uit bodemkernen, genomen in de Faeröer-Shetland geul werden transportprocessen van materiaal over de continentale helling van de Noordzee bestudeerd. In deze kernen werden significante hoeveelheden van het instabiele kleimineraal vermiculiet aangetroffen. Dit mineraal kan geen droog milieu overleven. De bron van deze vermiculieten ligt in Skandinavië, zodat het zich vanaf de vorming aldaar tot aan de afzetting in de diepzee onder water moet hebben bevonden. Bij de gebruikelijke methoden van bewaren gaat het dus verloren door uitdroging van de kernen.

Experimenteel onderzoek over magnetische processen van sedimenten liet onder meer zien dat bioturbatie in sterke mate magnetisatie tegenwerkt.

De in maart 1982 verzamelde gegevens uit het pelagiaal van de noord-equatoriale stroom (NECTAR III) laten zien dat in vergelijking met eerdere expedities in de herfst van 1977 en 1978, de menglaag dieper, het zoutgehalte hoger en de temperatuur $\sim 3^{\circ}\text{C}$ lager waren. De stroming varieerde sterker en was niet konsekwent westwaarts gericht. Dit kan erop wijzen dat ten opzichte van de herfst in maart de positie van de Noordatlantische wervel iets naar het zuiden was verschoven.

Met uitzondering van de silikaatgehaltes waren de nutriëntenconcentraties laag in het oppervlaktewater. Dat was echter niet het geval in het opstromingsgebied nabij de kust. Op de oligotrofe stations werd op vrijwel dezelfde diepte als tijdens de vorige expedities een chlorofylmaximum aangetroffen. In het opstromingsgebied overheersten grotere algen ($> 8 \mu\text{m}$), op de oligotrofe stations kleine tot zeer kleine algencellen ($< 3 \mu\text{m}$), waarbij in de menglaag coccoïde cyanobacteria en in het diep gelegen chlorofylmaximum groenalgen en fycoxanthine bevattende groepen domineerden. Drie onafhankelijke methoden ter bepaling van de primaire produktie (^{14}C , O_2 , POC) gaven in 1982, in tegenstelling tot in 1978, redelijk vergelijkbare resultaten. Relatief hoge waarden werden gemeten ($\sim 800 \text{ mg C} \cdot \text{m}^{-2} \cdot \text{d}^{-1}$) in het oligotrofe gebied.

Nauplii en copepoditen van copepoden bleken ongeveer even talrijk, waarbij de nauplii dieper voorkwamen en geassocieerd leken met het diepe chlorofylmaximum. In het opstromingsgebied vertoonde de voedselopname van de copepoden een dag-nachtritme dat op de oligotrofe stations ontbrak. Merkwaardig genoeg waren de chlorofylconcentraties in copepodenmagen op de oligotrofe stations veelal hoger dan in het opstromingsgebied, omgekeerd dus aan de situatie in het water.

De Deep Scattering Layer vertoonde in het oligotrofe gebied twee maxima op 150 m en 500 m diepte. Mesopelagische vissen waren duidelijk talrijker dan in de herfst van 1977 en 1978, hetgeen mogelijk verband houdt met de zuidwaartse verplaatsing van de Noordatlantische wervel. Een deel van de visfauna, in het bijzonder de Myctophidae (lantaarnvisjes) vertoonde een sterke verticale migratie gedurende het etmaal.

Een gezamenlijke NIOZ-ECN expeditie naar de noordelijke Atlantisch Oceaan in de zomer van 1983 was gericht op het bepalen van de concentratie van diverse spore-elementen en van organochloorverbindingen. De eerste resultaten geven aan dat de Cd-concentraties van de oppervlakte toenemen tot een konstante concentratie in dieper water, zoals ook elders werd gevonden. In de westelijke Atlantische Oceaan blijkt het niveau in het diepe water echter hoger te zijn dan in de Noorse Zee. Veel tijd werd besteed aan het uittesten van nieuw op het NIOZ ontwikkelde watermonsterapparatuur, die contaminatie van de monsters in zee en aan boord uitsluit. De bepaling van organochloorverbindingen werd bemoeilijkt door zowel de extreem lage concentraties ($\text{pg} \cdot \text{l}^{-1}$) als door de aanwezigheid van storende organische verbindingen.

Om satellietbeelden te kunnen vertalen in termen van concentratieverdeling in open zee werd de doorlaatbaarheid van het water voor zonlicht, de stralingsoverdracht in eutroof en oligotroof oceaanwater bestudeerd. Bijzondere

aandacht werd besteed aan de fluorescentie-effekten van chlorofylsoorten, en van kunstmatige optische tracers, bij verschillende hoeveelheden en vertikale verdelingen van gesuspendeerd materiaal. Door de grootte en plaats van het emissiemaximum in het rode deel van het spectrum te bepalen kan remote-sensing worden toegepast bij chlorofylconcentraties groter dan $1 \text{ mg} \cdot \text{m}^{-3}$. Helaas bleek deelname aan de internationale MOBIX 83 expeditie onmogelijk door een staking van het personeel van het Franse onderzoeksschip.

Deelname aan de Duitse Antarctis II-expeditie met het onderzoeksschip "Polarstern" in oktober-november 1983 leverde bevredigende waarnemingen op van de verdeling van chlorofyl en algen in het Antarctische onderzoeksgebied. Er werden sterke chlorofylvariëaties waargenomen, met hoge concentraties vlak tegen de ijsrand. Algen en chlorofyl bleken gelijkmatig verdeeld in de bovenste 100 meter, waarbij meestal diatomeeën sterk dominant waren. Zowel de sterke horizontale gradiënten als de gelijkmatige verticale verdeling van chlorofyl en algen maken het gebied zeer geschikt voor het gebruik van remote-sensing technieken voor synoptische karteringen van algenbiomassa.

Een oriënterende studie naar het effect van diverse fixatievloeistoffen op de preservatie van microzooplankton gaf weinig bemoedigende resultaten. In alle experimenten met naakte protozoën bleken slechts enkele procenten van de organismen perfect gefixeerd, terwijl een groot deel verdween zonder een spoor na te laten.

Een vergelijking van de chemische samenstelling van mariene organismen en hun omgeving leidde tot een aantal belangrijke conclusies, onder meer dat er geen aanleiding is om essentiële, neutrale en toxische elementen te onderscheiden. Voorts lijkt het biologisch gebruik van diverse elementen eerder bepaald door hun functionele eigenschappen dan door hun voorkomen in de omgeving. Tenslotte lijkt de elementaire samenstelling van mariene organismen meer op de primitieve Suess-Urey verdeling van de elementen, zoals gevonden in stollingsgesteenten, dan op de samenstelling van zeewater, die daar sterk van afwijkt. Verondersteld wordt dat fysisch-chemische processen, tezamen met het ontstaan van het leven op aarde, de samenstelling van het zeewater in de geologische historie door selectieve fractionering hebben gewijzigd.

In de komende jaren (1984-1985) zal het oceaanonderzoek van het Instituut in hoge mate bepaald worden door de Nederlands-Indonesische Snelius II-expeditie, die volgens het plan van mei 1984 tot juli 1985 zal worden uitgevoerd in Oostindonesische wateren. Voor deze expeditie, waaraan diverse instituten en instellingen in Nederland en Indonesië zullen deelnemen en die in Nederland door de NRZ (Nederlandse Raad voor Zeeonderzoek) wordt gecoördineerd, werd in 1983 reeds veel voorbereidend werk verricht zowel in wetenschappelijk als technisch opzicht.

3.1.4. Speciale projecten

In het kader van het DORA-project (Diepzee Onderzoek Radioactief Afval) werden de gegevens, in de zomer van 1982 verzameld over de stortplaats voor laag-radioactief afval in de Golf van Biscaye, verder geanalyseerd. De resultaten gaven aan dat in het stortgebied regelmatig verstoringen van de bodem plaatsvonden door afglijdingen. In bodemkernen neemt naar de diepte toe het zuurstofgehalte af, waarbij Mn wordt geconcentreerd op de grens van zuurstofuitputting. Dieper in het sediment nam ook het carbonaat af door verlaging van de pH, waarbij de meeste onderzochte elementen werden gemobiliseerd. Zowel de meio- als de macrofauna bleken numeriek nog redelijk talrijk, de diepte van de stortplaats (3-5 km) in aanmerking genomen. De meiofauna werd gedomineerd door nematoden, de macrofauna door sipunculiden. Vermoedelijk door bioturbatie, vooral van sipunculiden, werd een maximum van ^{210}Pb en $^{239+240}\text{Pu}$ gevonden op 4-6 cm diepte in het sediment.

Het OPEX-experiment (Oil Pollution Experiment) van 1982 werd afgesloten met een rapportage. Dit experiment, gefinancierd door de EEG, het Ministerie van Verkeer en Waterstaat en Shell International, wordt uitgevoerd in samenwerking met TNO-Den Helder, RIN-Texel en NIOZ en beoogt het effect na te gaan van olieverontreiniging op wadplaten. Het onderzoek wordt uitgevoerd in kunstmatige wadsystemen (MOTIF's), ingericht in de voormalige mosselverwaterplaats van het RIN. In 1983 werd aan een nieuw experiment begonnen met 8 identieke systemen met het doel de natuurlijke fluctuaties tijdens de ontwikkeling te registreren. De experimenten verliepen voorspoedig, maar de vestiging van jonge dieren in het systeem alsook de reproductie liet te wensen over. Voorstellen werden gedaan voor voortgezet onderzoek met de MOTIF's, waarbij onder meer het effect van het gebruik van detergentia zal worden getest.

Ten behoeve van de Deltadienst Milieu Inrichting (DDMI) werd een literatuurstudie verricht over de kokkel ten aanzien van filtratie en voedselopname, in verband met het beheer van de toekomstige Oosterschelde.

Het BOEDE-project (Biologisch Onderzoek Eems-Dollard Estuarium), uitgevoerd op het Biologisch Centrum van de R.U. Groningen en op het NIOZ, werd op 1 juli 1983 beëindigd. Dit project werd in 1972 gestart in verband met de toenmalige voornemens het afvalwater van de aardappelmeel- en strokartonindustrie, geschat op 22 miljoen inwonerequivalenten in het Eems-Dollard gebied te lozen en het estuarium te gebruiken als "waterzuiveringsinstallatie". Het onderzoek heeft onder meer geleid tot het opstellen van een mathematisch model. In Canada, waar men de bouw van een getijcentrale overweegt in de Bay of Fundy, bestaat een grote interesse voor het Eems-Dollard model, hetgeen geresulteerd heeft in het houden van een gemeenschappelijke workshop op het NIOZ.

Op verzoek van de Nederlandse Raad voor Zeeonderzoek (NRZ) werd medewerking verleend aan het opstellen van een rapport over Antarctisch onderzoek en een mogelijke Nederlandse deelname, waarvoor verschillende scenario's werden opgesteld.

3.2. BEZOCHTE CONGRESSEN

(zie ook 2.2.2)

- Bespreking Deepsea Research on Radioactive Waste (DORA), EEG, Brussel, België, 11 januari: H. Postma.
- 3e Symposium over de stofwisseling van metalen. Interuniversitair reactor instituut, TH Delft, 27-28 januari: D.H. Spaargaren.
- Gordon Research Conference, California, U.S.A., 27 januari-4 februari: J.C. Duinker.
- Workshop carbon transport in major world rivers. Assiut, Egypte, 26 februari-2 maart: G.C. Cadée, D. Eisma.
- 11th Symposium of the European Association for Aquatic Mammals, Ouwehand's Dierenpark, Rhenen, 15 maart: A.D.G. Dral.
- Colloquium Atomic Adsorption Spectrometry (AAS), Konstanz, Zwitserland, 14-17 maart: R.F. Nolting.
- Joint meeting of the task groups of the NEA co-ordinated research and environmental surveillance program. Santa Teresa, La Spezia, Italië, 22-24 maart: M.M.S. Lavaleye, M.M. Rutgers van der Loeff.
- Meeting of the Benthos Methodics Working Group (ICES), Hamburg, West-Duitsland, 5-8 april: F. Creutzberg, P.A.W.J. de Wilde.
- 12e Colloque de Géologie africaine. Musée royal de l'Afrique centrale, Tervuren, Brussel, België, 6-8 april: J.H.F. Jansen.
- Vergadering planningscommissie Snellius II over thema 2, Djakarta, Indonesië, 7-10 april: H. Postma.
- International symposium on sedimentation on the continental shelf, with special reference to the east China Sea, Hangzhou, China, 12-16 april: H. Postma, J.T.F. Zimmerman.
- Nederland en de Rijkdommen van de Zee. Rotterdam, 14 april: J.M. Everaarts.
- Vergadering begeleidingscommissie Biologische Anstalt Helgoland, Helgoland, West-Duitsland, 18-21 mei: H. Postma.
- Workshop COST-47, Galway, Ierland, 13-16 juni: J.J. Beukema.
- Vergadering begeleidingscommissie Institut Océanographique, Parijs, 16-18 juni: H. Postma.
- Vergadering over associatie van oceanografische instituten, Raad van Europa, Strassbourg, Frankrijk, 19-23 juni: H.G. Fransz, H. Postma.
- Kursus "Chromatografie Steroiden", TH Eindhoven, 21 juni: J.M. Everaarts, M.T.J. Hillebrand.
- Council of Europe research group Cosmic chemistry, chemical evolution and exobiology. Summerschool on chemical evolution and the origin of life. Stevensbeek, 4-10 juli: D.H. Spaargaren.
- 6e Symposium International Bryozoology Association, Wenen, Oostenrijk, 12-23 juli: G.C. Cadée.
- First International conference on paleoceanography, ETH, Zürich, Zwitserland, 19-21 juli: J.H.F. Jansen, T.C.E. van Weering.
- 18th European Marine Biology Symposium, Oslo, Noorwegen, 14-20 augustus: J.J. Beukema, J.P. Boon, J.M. Everaarts, J.J. Zijlstra.
- IAPSO Symposium Coastal and near shore zone processes, IUGG XVIII, General Assembly, Hamburg, West-Duitsland, 15-27 augustus: M.M. Rutgers van der Loeff, D. Spitzer, C. Veth.

Fifth International Meiofauna Congress, Gent, België, 16-18 augustus: G. Duineveld, A. Groenewold.

18e General Assembly International Union of Geodesy and Geophysics, Hamburg, 22-27 augustus: A.J. van Bennekom.

Eighth International Malacological Congress, Budapest, Hongarije, 28 augustus-4 september: M.M.S. Lavaleye.

Vergadering Scientific Committee on Oceanic Research, Parijs, Frankrijk, 31 augustus-2 september: H. Postma

Fifth meeting of the European Clay Groups. Praa, Tsjecho-Slowakije, 31 augustus-3 september: S.J. van der Gaast.

SCOR/UNESCO/IABO Working Group 65, Texel, 12-15 september: J.J. Zijlstra.

Chemical processes in lakes, organized by EAWAQ-Dübendorf, Stans, Zwitserland, 14-17 september: C.J.M. Kramer.

Symposium on ecophysiology, Groningen, 16 september: J.H. Vosjan.

PCB-seminar, Scheveningen, 28-30 september: J.P. Boon.

Internationaal Watertribunaal, Rotterdam, 3-8 oktober: J.M. Everaarts, M.T.J. Hillebrand (getuige deskundige, 5 oktober).

ICES 71e statutaire vergadering, Göteborg, Zweden, 10-16 oktober: H.G. Fransz, C. Veth, J.J. Zijlstra.

International Wadden Sea Symposium, The role of organic matter in the Wadden Sea, Texel, 1-3 november: G.C. Cadée, W. Helder, H. Postma, J.H. Vosjan, P.A.W.J. de Wilde, J.J. Zijlstra.

Meeting Wader Study group, Haamstede, 19-20 november: C. Swennen.

Vergadering over associatie van oceanografische instituten, Raad van Europa, Parijs, Frankrijk, 29 november-2 december: H. Postma.

3.3. BESTUURSFUNKTIES

- J.J. Beukema
 - coördinator van de sectie “Intertidal soft bottoms” van het EG-project COST-47 (Coastal marine benthos)
 - lid technische werkgroep “Voorwaarden boringen Waddenzee”
- J.P. Boon
 - lid begeleidingscommissie Accumulatie van organochloorverbindingen in steltlopers in de Waddenzee, Instituut voor milieuvraagstukken van de VU (RIZA)
- G.C. Cadée
 - lid commissie voor buitenlandse marien-biologische stations KNAW
 - lid DORA commissie (diepzee opberging radioactief afval)
 - bestuurslid BION werkgemeenschap aquatische oecologie
- A.D.G. Dral
 - bestuurslid Nederlandse stichting voor onderzoek van Cetacea
- J.C. Duinker
 - voorzitter group of experts for methods, standards and intercalibration (GEMSI, IOC)
 - lid marine chemistry working group (ICES)
 - lid begeleidingscommissie Ministerie van Volksgezondheid en Milieuhygiëne, PCB in afvalstromen
 - Nederlands vertegenwoordiger in marine environmental quality committee (ICES)
- D. Eisma
 - lid ICES working group on marine sediments in relation to pollution
 - lid toetsingspanel milieu-effekt rapporten (VOMIL)
 - lid adviesgroep marien aardwetenschappelijk onderzoek van de Koninklijke Nederlandse Akademie (NRZ)
 - lid SCOR working group 46, river input into the ocean systems
 - lid projectgroep slibeigenschappen en coördinatiecommissie slib van de Raad van Overleg fysisch oceanografisch onderzoek Noordzee
 - voorzitter AWON werkgroep mariene geologie
 - lid commissie geologische wetenschappen van de KNAW
- J.M. Everaarts
 - lid commissie biologische problemen koelwater
 - lid kontaktgroep water van de commissie TNO/CNB voor onderzoek inzake nevenwerkingen van bestrijdingsmiddelen
 - lid begeleidingscommissie VROM project Contaminantenonderzoek Waddenzee
- H.G. Fransz
 - bestuurslid werkgemeenschap populatiebiologie (BION)
 - lid commissie mariene biologie van de Nederlandse Raad voor Zeeonderzoek
- W.W.C. Gieskes
 - lid werkgroep remote sensing van de Nederlandse Raad voor Zeeonderzoek
- M.T.J. Hillebrand
 - lid begeleidingscommissie RIZA project Accumulatie van PCB's in steltlopers
- C.J.M. Kramer
 - voorzitter stichting werkgroep Noordzee van de samenwerkende milieuorganisaties

- H. Postma
- lid Nederlandse Raad voor Zeeonderzoek
 - lid scientific committee on oceanic research (ICSU)
 - lid Raad van Overleg fysisch oceanografisch onderzoek van de Noordzee
 - lid Nederlandse UNESCO-commissie
 - lid Koninklijke Akademie van Wetenschappen
 - lid beheerscommissie ZWO Laboratorium Isotopengeologie
 - lid deskundigencommissie BOEDE
 - lid "Comité de perfectionnement" van het Institute Océanographique, Parijs en Monaco
 - voorzitter bestuur Beyerinck-Popping fonds
 - lid Waddenzee-adviesraad
 - lid CO₂-commissie van de gezondheidsraad
 - voorzitter wetenschappelijke commissie Biologische Anstalt Helgoland, Hamburg
- J.W. Rommets
- secretaris van de technische commissie van het Nederlands Centrum van Oceanografische gegevens
- D.H. Spaargaren
- secretaris van de commissie voor buitenlandse marien-biologische stations van de Koninklijke Akademie van Wetenschappen
- D. Spitzer
- lid werkgroep remote sensing van de Nederlandse Raad voor Zeeonderzoek
 - lid werkgroep zichtbaar licht in open water van Rijkswaterstaat
 - lid gebruikerswerkgroep CAESAR-project van het Nationaal Lucht- en Ruimtevaart Laboratorium
 - lid SCOR working group 70 remote sensing of the oceans from satellites van de scientific committee for oceanic research
 - lid ocean colour working group van de European Space Agency
 - lid taakgroep ERS-1 programma voor Nederland, Ministerie V. en W.
- C. Swennen
- lid werkgroep bijlage V EG-vogelrichtlijn
 - lid Nederlandse sectie International Council of Birds Preservation (ICBP)
 - nationaal kontaktpersoon sea duck branch van het International Waterfowl Research Bureau (IWRB)
- S.B. Tijssen
- lid hydrography committee van de ICES
- C. Veth
- lid coördinatiegroep WST van de Raad van Overleg voor het fysisch oceanografisch onderzoek van de Noordzee
 - corresponding member of SCOR working group 69 (small scale oceanic turbulence)
 - lid programmaraad van de werkgemeenschap meteorologie en fysische oceanografie van ZWO
- T.C.E. van Weering
- lid werkgroep Noordzee van de samenwerkende milieu-organisaties
 - Nederlands correspondent voor de International Association of Sedimentologists
 - lid technische commissie Snellius II
 - assistent coördinator mariene geologie, Snellius II
 - lid werkgroep Bodem van de Raad van Overleg voor het Fysisch en Oceanografisch Onderzoek van de Noordzee
- P.A.W.J. de Wilde
- lid commissie van beheer Delta Instituut
 - adviseur wetenschappelijke studiering Nederlandse Antillen
 - lid Nederlandse commissie voor internationale natuurbescherming
 - lid stuurgroep OPEX
 - lid projectgroep OPEX
 - lid natuurbeschermingsraad, Ministerie voor Landbouw en Visserij
 - lid coördinatorenoverleg internationaal Waddenonderzoek
 - lid ICES North Sea benthos group
 - lid begeleidingsgroep macrobenthos, Oosterschelde

J.T.F. Zimmerman

- lid commissie fysische oceanografie van de Nederlandse Raad voor Zeeonderzoek
- lid programmaraad werkgemeenschap MFO-ZWO
- lid redaktieraad Continental shelf research
- IAPSO vertegenwoordiger nationaal WGGI comité

J.J. Zijlstra

- lid bestuur Nederlandse Raad voor Zeeonderzoek
- voorzitter commissie mariene biologie van de Nederlandse Raad voor Zeeonderzoek
- lid planningscommissie Snellius II
- lid Koninklijke Nederlandse Akademie van Wetenschappen
- vice-voorzitter van de Biologische Raad
- voorzitter stuurgroep commissie van beheer en onderzoek Waddengebied (COBW)
- lid commissie van beheer van het Limnologisch Instituut
- lid wetenschappelijke commissie van het Rijksinstituut voor Natuurbeheer (RIN)
- voorzitter Nederlandse Oceanografen Club
- lid redactiecommissie boek Inleiding tot de oecologie
- president European Marine Biology Symposium
- lid biological oceanography committee ICES
- voorzitter SCOR-UNESCO werkgroep 65: coastal-offshore interactions

3.4. STUDENTENONDERZOEK

Als onderdeel van hun doctoraalstudie of als stagiaire namen de volgende personen deel aan het onderzoek (nummers verwijzen naar project (zie sectie 1.7))

M. Aarts	R.U. Utrecht	H3-04
J.E.E. van Beusekom	R.U. Groningen	H4-02
H. Bos	R.U. Leiden	H4-01d
P. Blotkamp	R.U. Leiden	B2-01c
M. de Bruin	R.U. Leiden	B2-02e
A. Cramer	G.U. Amsterdam	B2-02e
S. Cramer	R.U. Amsterdam	H4-06
		B1-05
P.M.J. Cornelis	R.U. Utrecht	B1-05
S. Diel	T.U. Braunschweig	B4-02
R.W.J. Dirks	R.U. Utrecht	H2-02
J. van Elk	T.U. Delft	H2-06
L. Enselink	R.U. Utrecht	B2-03
L. Enserink	R.U. Utrecht	B4-01
A. Groenewold	R.U. Groningen	B2-02e
G.R. Helling	T.U. Braunschweig	B4-02
B.T.W. Holtkamp	R.U. Utrecht	H3-03
D. ten Hulscher	G.U. Amsterdam	H3-02
E. Jacobs	R.U. Utrecht	H4-01
B. Klein	R.U. Groningen	B4-01/04
F. van Lent	G.U. Amsterdam	B2-03
M.F. Leopold	R.U. Utrecht	B3-04
R. Mors	L.H. Wageningen	B3-06
P.H. Nelissen	G.U. Amsterdam	H3-04
G. de Niet	T.U. Enschede	H3-03
M. Reichert	G.U. Amsterdam	H3-04
R.S.C. de Ruiter	V.U. Amsterdam	H4-03
M.B.A.M. Scheffers	R.U. Utrecht	H2-07
Y. van Scheppingen	R.U. Utrecht	B1-01
		H3-04
I. Sprong	V.U. Amsterdam	H4-06
J. Stefels	G.U. Amsterdam	H3-04
A. Stolk	R.U. Utrecht	H4-01
L. Stolwijk	G.U. Amsterdam	H3-04
H. de Swart	R.U. Utrecht	H2-06
W. Wiersingen	R.U. Groningen	B1-01
H. v.d. Wijst	L.H. Wageningen	B2-02d
H.C. Zelleler	G.U. Amsterdam	B3-04
C. Garben	S.O.L. Utrecht	B3-04
M.J.M.A. Govaert	S.O.L. Utrecht	H3-08
A.M.C. de Groot	S.O.L. Utrecht	B3-04
J.J.L. de Rooy	S.O.L. Utrecht	H3-08
K. Hollenberg	S.O.L. Utrecht	B3-04
T.M.J. Schraven	S.O.L. Utrecht	B3-04

3.5. KURSUSSEN, VERGADERINGEN EN EXCURSIES

3.5.1. NIOZ kursussen

3.5.2. Andere kursussen gehouden op het NIOZ

11-15 mei	kursus Groninger biologen duikvereniging
1-4 juni	kursus Biologen Leistung, Dr B. Erdelen, Köln, F.R.G.
6-10 juni	kursus Aquatische Biologie, Univ. Amsterdam
5-10 september	kursus Van den Broek Instituut, Amsterdam
12-24 september	kursus Biologie, Technischen Hochschule, Aachen, F.R.G.
12-14 oktober	kursus Dr Ir W.L. Ghysen Instituut, analistenschool Utrecht

3.5.3. Ontvangen gezelschappen van verwante instituten, overheidsdiensten, e.d.

25 februari	excursie biologiestudenten
9 maart	excursie MZW-project Texel
14-18 maart	workshop BOEDE (Texel)-Bedford Institute (Canada)
17 maart	excursie School voor Laboratoriumpersoneel, Leeuwarden
23 maart	excursie Stichting Opleiding Leraren, Utrecht
23-25 maart	BION-vergadering werkgroep Algemene Microbiologie
30 maart	excursie Hogere Landbouwschool, Leeuwarden
31 maart	excursie Hoger Rijks Instituut voor Tuinbouw, Vilvoorde, België
15 april	excursie Utrechtse Biologen Vereniging
22 april	bezoek van 2 SPD Bundestag leden aan BOEDE en RIN
27 april	excursie 4 HAVO-leerlingen van het Newton College, Breda
28 april	excursie Fysisch Mathematische Faculteitsvereniging Groningen
9 mei	bezoek 4 leerlingen van het Calvinlyceum, Kampen
12-15 mei	bezoek afdeling educatie van Instituut voor Natuurbescherming, Amsterdam aan NIOZ-haven
16 mei	excursie Katholiek Gelders Lyceum, Arnhem in het kader van het "Scholenprogram"
17 mei	excursie Hogere Landbouwschool, Groningen
17-18 mei	2 excursies van VWO-5 klassen
2 juni	excursie MAVO, Hillegom in het kader van het "Scholenprogram"
10 juni	bezoek van 5 directeuren en secretaressen van de hoofdgroep Maatschappelijke Technologie, TNO Delft
14 september	excursie Laboratorium voor Elektronen Microscopie, Rijksuniversiteit Leiden
15 september	bezoek Delta Marine Consultants
19 september	bezoek Instituut voor Vrije Leergangen (films)

20 september	excursie afdeling geologie en geochemie van het Institut für Geologie und Paläontologie, Tech. Univ. Braunschweig
23 september	Vrije Universiteit Amsterdam
30 september	excursie Rijkswaterstaat Planologische Dienst Haarlem
3 oktober	bezoek Hoogheemraadschap Uitwaterende Sluizen Edam, waaronder 12 Duitse biologie- en waterdeskundigen uit het Roergebied
5 oktober	excursie Bodemkundig Laboratorium van het Instituut voor de Tropen, Amsterdam
7 oktober	excursie Schulenzentrum Süd Wuppertal
25-26 november	BION-vergadering werkgroep Populatie Biologie
1-2 december	BION-vergadering werkgroep Aquatische Oecologie
15-16 december	BION-vergadering werkgroep Ethologie

4. HULPAFDELINGEN

4.1. Bibliotheek

Ondanks de stijgende prijzen werden er 52 boeken en 2 atlassen aangeschaft. 11 lopende series van handboeken bleven gehandhaafd. De bibliotheek ontvangt via abonnementen 106 tijdschriften.

Uitbreiding door ruil met Neth. J. Sea Res. 1983:

- Centre Earth Science Studies Trivandrum, Technical Report (no. 17, 1982), Annual Report (1980)
- District Kust en Zee (no. 1, 1982)
- Publicados de Asturias (no. 8, 1981)
- Publicaties Afdeling Bodemkunde & Geologie, LH Wageningen (no. 751, 1981)
- Report Fisheries Research Laboratory, Mie University (no. 3, 1982)
- Journal of Shering Island (vol. 1 (1), 1981)
- Publicaties Raad Milieu en Natuuronderzoek (no. 1, 1983)
- Fisheries Research Paper Adelaide (no. 4, 1983)
- Tropic Oceanology (vol. 2 (2), 1983)

Gratis uitbreiding:

- Rapporten en Resultaten Rijncommissie Waterleidingbedrijven: samenstelling Rijnwater en Maaswater (1974)
- Internationale Arbeitsgemeinschaft der Wasserwerken im Rheineinzugsgebiet Arbeitstagung und Jahresbericht (1973)
- Newsletter Radionuclides migration in the Geosphere OECD Nuclear Energy Agency (no. 2, 1980)

4.2. Rekencentrum

In 1983 werd de NORD-100, evenals in 1982, voornamelijk gebruikt voor gegevensverwerking, ontwikkeling van modellen (BOEDE), statistische bewerkingen en tekstopslag. In de loop van 1983 nam het aantal gebruikers van het computercentrum zeer sterk toe. De snelheid van werken werd hierdoor zeer sterk beïnvloed; tevens werd de opslagcapaciteit van de geheugenschijf een beperkende faktor. Het aantal CP-uren varieerde van 60 uren per maand in het begin van 1983 tot circa 200 à 300 uren per maand aan het einde van het jaar.

Het rekencentrum verleende assistentie bij een tweetal workshops georganiseerd door het BOEDE.

Sinds het eind van 1983 kunnen teksten die aangemaakt zijn op de NORD-100 doorgestuurd worden naar de nieuwe fotozetter.

Gezien bovenstaande ontwikkelingen en de te verwachten grote toevloed van gegevens (Snellius II) zal er in 1984 meer geheugenruimte worden aangeschaft (150 MB) en zullen er meer terminals beschikbaar komen voor de vele gebruikers.

4.3. Reprografische afdeling

Buiten het gangbare routinewerk voor publikaties, lezingen, etc. zijn door de afdeling een tweetal exposities verzorgd. In de maand februari presenteerde het NIOZ een overzicht van haar werk op de expositie "Milieu en energie" te Enschede. Vervolgens werd in samenwerking met de Nederlandse Raad voor Zeeonderzoek in december ter gelegenheid van het 175-jarig bestaan van de Koninklijke Nederlandse Akademie van Wetenschappen een algemene overzichtstentoonstelling betreffende zeeonderzoek samengesteld en gerealiseerd.

De huisdrukkerij heeft een uitbreiding ondergaan door de aanschaf van een A3 offsetpers en een fotozetmachine. Hierdoor is onder andere de productie van de jaarverslagen nieuwe stijl (1982 en 1983) mogelijk geworden.

Ook stond de reprografische afdeling open voor een tweetal vrijwilligers, die assistentie verleenden in de donkere kamer, tekenkamer en drukkerij.

4.4. Biologisch studiemateriaal

De afdeling, gevestigd aan de Buitenhaven in Den Helder, leverde evenals voorgaande jaren levend en gefixeerd biologisch studiemateriaal aan universitaire laboratoria, scholen, buitenlandse instituten en educatieve instellingen. Circa 80 000 levende en 20 000 gefixeerde dieren werden verkocht. Educatieve instellingen zoals Artis waren de grootste afnemers van levende organismen, terwijl scholen en universitaire laboratoria in binnen- en buitenland de voornaamste klanten voor het prijziger gefixeerd materiaal waren. Bij het verkrijgen van het biologisch materiaal werd steun verkregen van de visserij-afdeling van het NIOZ op Texel. Tevens werd aan diverse instellingen in totaal een 65 000 liter zeewater geleverd.

De heer M. Buhre, sinds vele jaren het hoofd van de afdeling studiemateriaal, verliet het instituut wegens ziekte. Hij werd opgevolgd door de heer J.M. Nieuwenhuizen, die hem reeds geruime tijd verving.

4.5. Werkplaatsen

Dit jaar stond in het teken van het oceaanprogramma en de komende SNELLIUS-expeditie naar Indonesië. Na de vaartochten met het onderzoekschip "Tyro" werd een begin gemaakt met een grote revisie van alle drie de oceaanlieren, waarbij nu tevens de Power Packs in containers worden gemonteerd. Dit kan nu geschieden in de nieuwe werkplaatshal die dit jaar in gebruik is genomen en in alle opzichten goed voldoet. Ook dit jaar zijn veel adviezen gegeven voor de aanpassing van de "Tyro". Voor de NRZ zijn 1 werktuigkundige, 1 elektrotechnicus en 1 elektronicus aangenomen voor

twee jaar ten behoeve van de SNELLIUS-expeditie. Evenals in 1982 werd in 1983 een technicus ingeschakeld om ervaring op te doen bij een Duitse expeditie naar de Zwarte Zee.

De afdeling elektronica ontwikkelde een zoöplanktonteller, een netsonde met monitor en een sedimentgeleidbaarheidsmeter. De instrumentmakerij ontwikkelde een vloeistof-vloeistof extractor, een benthosklok, een lichtmeter voor remote-sensing onderzoek en een spectraalirradiatiemeter. De werktuigkundige afdeling bouwde twee grote kastengrijpers. De apparatuur van deze afdeling werd uitgebreid met een grote kolomboor en een freesbank.

Veel adviseringswerkzaamheden en training van technici uit Indië zijn verricht ten behoeve van het project Motor Launches India van het Ministerie van Buitenlandse Zaken.

4.6. Haven en vaartuigen

Op de haven werd door de technische dienst een hydraulische kraan geplaatst ten behoeve van het laden en lossen van de schepen. Het ponton werd eind 1983 gedokt en kreeg een grote onderhoudsbeurt. Ten behoeve van het onderzoek werden de volgende aantallen vaardagen gemaakt: Aurelia: 171, Navicula: 160, Griend: 121.

4.7. Logeergebouw

De bezettingsgraad van de woningen bedroeg 86,6%. De bezettingsgraad van de 10 éénpersoonskamers bedroeg 100%, terwijl die van de 14 slaapzalen voor studentenbewoning 93,2% was.

Het aantal studenten/stagiaires bedroeg 59 met 8369 overnachtingen. Het aantal kursisten bedroeg 625 met 1526 overnachtingen. Het aantal gasten bedroeg 126 met 254 overnachtingen. Op kosten van het instituut verbleven 8 gasten met totaal 13 overnachtingen. Het totaal aantal overnachtingen exclusief de woningen bedroeg 10 162 door 847 personen.

5. SOCIAAL JAARVERSLAG 1983

5.1. Algemeen

Het NIOZ is ruim 100 jaar geleden onder de naam Zoölogisch Station gesticht door de Nederlandse Dierkundige Vereniging (NDV). Sinds 1930 ontvangt de vereniging voor de exploitatie gelden van het Rijk; voordien hadden directeur en enkele medewerkers een dubbelfunctie en waren tevens in dienst van het Rijksinstituut voor Visserijonderzoek (RIVO) dat ressorteert onder de Minister van Landbouw en Visserij.

De naamsverandering dateert uit 1961, toen de Minister van Onderwijs en Wetenschappen in verband met de toenemende maatschappelijke betekenis van de zee en de groeiende behoefte aan onderzoek besloot het instituut te laten groeien tot een compleet oceanografisch instituut. Hierbij werd uitgegaan van de situatie in andere landen met een goed ontwikkeld zeeonderzoek.

Uitgaande van het standpunt dat het instituut tot een volwaardige instelling voor zeeonderzoek diende uit te groeien verstrekte de Minister gelden voor een nieuw complex op Texel dat in de periode 1969-1977 werd gebouwd. Het bestaat uit een hoofdgebouw, laboratoria, een zogenaamd experimenteeraquarium, een havencomplex en een gastverblijf voor studenten en gastonderzoekers. Voorts kreeg het instituut in 1972 de beschikking over een onderzoekingsschip voor de Noordzee.

Bij het vaststellen van de afmetingen van de gebouwen werd uitgegaan van een uiteindelijke personeelsbezetting van ongeveer 160 personen, waaronder 34 academici, inclusief de directie; verder van de aanwezigheid van 16 promotieassistenten en enkele tientallen studenten. Deze bezetting is niet volledig gerealiseerd: op 31 december 1983 waren 116 personen in vaste dienst en waren er twee promotieassistenten.

5.2. Beheer

De NDV, als ontvanger van het subsidie, is verantwoordelijk voor het beheer van het NIOZ. Wel werd de invloed van de Minister van Onderwijs en Wetenschappen versterkt bij de transformatie van Zoölogisch Station naar NIOZ. Zo wordt de directie door de Minister benoemd, op voordracht van het bestuur van de NDV. Voorts heeft de Minister een ambtelijke vertegenwoordiger in de Financiële Commissie, en benoemt hij, eveneens op voordracht van het bestuur, de leden van de Wetenschappelijke Commissie. De laatste Commissie kan de Minister direct adviseren over de wetenschappelijke zaken betreffende het instituut en het Nederlands zeeonderzoek in het

algemeen. Zij maakte in 1983 hiervan gebruik door de Minister op de hoogte te stellen van haar, positieve, standpunt betreffende voorgenomen onderzoek in Indonesië (SNELLIUS II). In de Wetenschappelijke Commissie hebben zitting vertegenwoordigers van de Nederlandse universitaire instellingen en van enkele zusterinstituten werkzaam op het gebied van zeeonderzoek.

De Financiële Commissie bestaat uit de genoemde vertegenwoordiger van het ministerie, de voorzitter van de Wetenschappelijke Commissie, de penningmeester van de NDV en een speciaal aangewezen lid van het bestuur (de "commissaris van de NDV") die doorlopend belast is met het toezicht op de directie. Bij belangrijk overleg van de directie met OZB is de commissaris aanwezig.

Als gesubsidieerd instituut beschikt het NIOZ over een rechtspositiereglement in overeenstemming met artikel 136j van het Burgelijk Wetboek. Dit betekent dat het personeel ambtenaar is in de zin van de pensioenwet.

Bestuur (per 1-12-1983)

Nederlandse Dierkundige Vereniging

Commissaris:	Prof. Dr. W. Scharloo
Commissie van toezicht:	Prof. Dr. W. Scharloo Dr. J.L. Dubbeldam (penningmeester NDV) Prof. Dr. A.D.F. Addink
Financiële commissie:	Prof. Dr. W. Scharloo Dr. J.L. Dubbeldam Prof. Dr. A.D.F. Addink Drs J. Bezemer (Ministerie van O en W)

Wetenschappelijke commissie

	vertegenwoordigt:	vakgebied:
Prof. Dr. A.D.F. Addink (voorzitter) Gorlaeus Laboratorium	Rijksuniversiteit Leiden	fysiologie
Prof. Dr. C. den Hartog (ondervoorz) Laboratorium voor Aquatische ecologie	Katholieke Universiteit Nijmegen	aquatische ecologie
Dr. A.F. Vlasblom (secretaris) Delta Instituut voor Hydrobiologisch Onderzoek	Delta Instituut voor Hydrobiologisch onderzoek	mariene biologie
Prof. Dr. N. Daan Rijksinstituut voor Visserijonderzoek IJmuiden	Rijksinstituut voor Visserijonderzoek	visserij biologie
Prof. Dr. C. van den Hoek Laboratorium voor Plantensystematiek, Haren (Gr.)	Rijksinstituut Groningen	plantensystematiek
Dr. J. van der Land Rijksmuseum van Natuurlijke Historie Leiden	Rijksmuseum van Natuurlijke Historie	mariene biologie

Prof. Dr. J. Lever Biologisch Laboratorium van de Vrije Universiteit	Vrije Universiteit Amsterdam	biologie
Prof. Dr. W.G. Mook Laboratorium voor Isotopenfysica Rijksuniversiteit	Rijksuniversiteit Groningen	isotopen- fysica en -chemie
Dr. Ir. L. Otto Afd. Oceanografie, KNMI, De Bilt	KNMI, De Bilt	fysische oceanografie
Dr. R.C. Peters Laboratorium voor Vergelijkende fysiologie	Rijksuniversiteit Utrecht	aquatische fysiologie
Dr. P.J. Roos Vakgroep Aquatische Oecologie	Universiteit van Amsterdam	aquatische ecologie
Dr. E.A.Th. Verdurmen ZWO Laboratorium voor Isotopen- geologie, Amsterdam	ZWO Laboratorium Isotopengeologie	geologie chemie
Prof. Dr. W. Scharloo Lab. voor Populatie- en Evolutie- biologie, Utrecht	Nederlandse Dierkundige Vereniging	biologie
Prof. Dr. A.J. Wiggers Rijksinstituut voor Natuurbeheer Leersum	Rijksinstituut voor Natuur- beheer	geologie natuurbe- heer

5.3. Werkoverleg

Het jaarverslag van de ondernemingsraad is in dit boekje opgenomen (zie onder 6).

Werkoverleg tussen directie en de hoofden van dienst (stafvergadering) vond 18 keer plaats. Tijdens dit overleg werd gesproken over onder meer begrotingszaken, investeringen, uitvoering van grote projecten, verslagen van externe vergaderingen en hun consequenties voor het instituut, algemene personeelszaken e.d. Daarnaast vond in werkgroep-verband overleg over het werk in kleinere kring plaats.

5.4. Personeelsbeleid

Bevorderingen

In 1982 werden onderstaande personen bevorderd:

R.M. Daalder	D. Spitzer
C. Mozes	J.C. Tuntelder
H.H. de Porto	B. Verschuur

Mutaties

Onderstaande mutaties vonden plaats in 1983:

Ontslag	J.C. Duinker	01-05	
	B. v.d. Werf	01-08	
	Th. Agema-Lebbe	01-08	VUT
	M. Buhre	01-11	VUT

	S. Dogger	01-11	Pensioen
	J. de Vries	01-12	VUT
	D.E. Jourdan-Thomas	31-12	Pensioen
In dienst	E. Sebens	01-04	i.p.v. R.J.R. Anthonijsz
	W.J.M. Koomen	01-07	i.p.v. G.H. Steenhuizen
	E. Adriaans	01-09	i.p.v. S. Dogger
	J. Leijtens	01-12	elektronica
Overplaatsing	R.J.R. Anthonijsz	01-04	naar Navicula
	G.H. Steenhuizen	01-07	naar kantine
	J.M. Nieuwenhuizen	01-11	naar Studiemateriaal

5.6. Personeelslijst (per 31-12-1983)

<i>Direktie:</i>	<i>Secretaresse:</i>	<i>Assistentie:</i>
Prof. Dr. H. Postma	J. Hart-Stam	J.W. Rommets
Dr. J.J. Zijlstra	L. Everhardus	J.I.J. Witte
<i>Beheerder:</i>		
Ing. E. van Abs		

Onderzoekafdelingen	<i>Onderzoeker:</i>	<i>Assistentie:</i>
afd. chemische oceanografie en onderzoek zeeverontreiniging	Dr. J.M. Everaarts Drs J.F. Bakker Drs J.P. Boon Dr. W. Helder Drs S.B. Tijssen	M.T.J. Hillebrand R.F. Nolting R.T.P. de Vries F.J. Wetsteyn
afd. fysische oceanografie	Drs C. Veth Prof. Dr. J.T.F. Zimmerman Dr. D. Spitzer	M.R. Wernand M.W. Manuels
afd. mariene geologie en geochemie	Dr. D. Eisma Dr. J.H.F. Jansen Dr. T.C.E. van Weering Drs A.J. van Bennekom	G.W. Berger S.J. van der Gaast J. van Iperen J. Kalf J. Schilling
afd. experimentele systemen	Dr. P.A.W.J. de Wilde Dr. J.H. Vosjan Dr. R.P.M. Bak	E.M. Berghuis A. Kok G. Nieuwland E. Paupit
afd. autecologie	Dr. F. Creutzberg A.D.G. Dral Dr. M. Fonds Dr. B.R. Kuipers Drs G. Duineveld	G. van Noort P. van der Puyl H.J. Witte
afd. pelagische systemen	Dr. H.G. Fransz Dr. W.W.C. Gieskes Dr. M.A. Baars Dr. W.C.M. Klein Breteler	S.R. Gonzalez G.W. Kraay S.S. Oosterhuis

afd. benthische systemen	Dr. J.J. Beukema Dr. G.C. Cadée C. Swennen Dr. D.H. Spaargaren	W. de Bruin J. Hegeman P. Duiven J. Zuidewind
Hulpafdelingen		
publikatie en bibliotheek	Drs J.W. de Blok (redactie) J. v.d. Wal-Doornekamp (bibliotheek)	G.E. de Schipper M. Bruining-du Porto
administratie	G. Goslinga	D.J. Bruin E.C. Lanser I. Wernand-Godée G. Swaan-Zonnenberg
reprografie	H. Hobbelink	B. Verschuur R.P.D. Aggenbach
rekencentrum		F. Eijgenraam R. Dapper
onderhoudsafdeling	T. Verveer T. Buisman L. Heerschap F.J. Schilling H.J. Boekel	S.D. Groot F.J. Parlevliet H.H. de Porto R.M. Daalder A. Ran J. Visser S. Gieles
instrumentmakerij	M. Manshanden	A. Vaars J. van Heerwaarden
elektronica	Ing. J.J.A. van Weereld	G.M. Manshanden Ing. R.L. Groenewegen Ing. J. Leijtens
biologisch studiemateriaal (Den Helder)	J.M. Nieuwenhuizen	
huishoudelijke dienst	G.H. Steenhuizen	G.C. Weijdt-Eelman
logeergebouw "de Potvis"	S.W. de Porto	
haven en vaartuigen	H.A. Beumkes C. Wisse C. van Zwieten	W.P. Jongejan J.C. Tuntelder C. Gerssen J.C. Groot E. Adriaans R.J.R. Anthonijsz A. Boon G.L. de Vries A.J. Souwer E. Sebens C. Mozes W.J.M. Koomen

5.6. Tijdelijke personele ondersteuning

J. Asma	01-06 tot 01-09	elektronica
J. Beukema	01-01 tot 01-04	benthische systemen
P. Drijver	tot 01-04	vervanger C. Wissen "Navicula"
A. Meyboom	01-02 tot 01-05	benthische systemen
N. Schogt	01-01 tot 01-04 en 01-09 tot 31-12	planktontelster pelagische systemen

ZWO beurzen

Onderzoekers met een ZWO-beurs:

M.J. van Vreumingen	mariene geologie
M. Veldhuis	pelagische systemen
Drs R. Daan	pelagische systemen

Stimuleringsfonds Ministerie van O en W, afd. DGWB

Bij de afdeling fysische oceanografie is W.M.L. Lambrechts (analist) in dienst.

Werken met behoud van uitkering.

In 1983 hebben een aantal personen op het instituut gewerkt met behoud van een uitkering. In sommige gevallen is een kontrakt gesloten met het leerlingensysteem hetgeen inhoudt dat diegenen één dag per week onderwijs volgen op een streekschool en de andere dagen ervaring opdoen. Tevens is van de mogelijkheid gebruik gemaakt om personen, die een uitkering genieten, na goedkeuring door of de gemeente, de bedrijfsvereniging of het Ministerie van Binnenlandse Zaken, vrijwilligerswerk te laten verrichten.

H. van Beveren	zeeverontreiniging
J. Broekstra	instrumentmakerij
Drs C. Fisher	experimentele biologie
I. Ginus	chemische oceanografie
Drs E. van Ierland	
M.W. Kannegieter	benthische systemen
A.J.M. Koelemeijer	elektronica
T. Kuip	technische dienst
R. Lakeman	technische dienst
R. Sablerolle	technische dienst
M. Tijssen	reprografische afdeling
J. Veenbaas	reprografische afdeling
G. Vlaming	technische dienst

Speciale projecten

Het NIOZ verleent haar medewerking aan de uitvoering van speciale projecten, bv. ter onderbouwing of uitvoering van het beleid van andere ministeries dan het Ministerie van Onderwijs en Wetenschappen en van het bedrijfsleven. Zij stelt hiervoor ruimte en wetenschappelijke kennis ter beschikking, op basis van werkelijk gemaakte kosten. Personeel voor deze projecten wordt speciaal ingehuurd voor de duur van het project. Het eigen personeel, dat de eigenlijke taak van het instituut uitvoert (fundamenteel onderzoek), is hierbij slechts in een adviserende rol betrokken.

Het beleid van de directie in het aannemen van deze speciale projecten is terughoudend, waarbij in principe slechts projecten worden aangenomen die in het verlengde liggen van en samenhangen met de eigenlijke taak van het instituut. De looptijd van de projecten kan sterk variëren, van enkele maanden tot vele jaren. Er waren de volgende speciale projecten (zie ook onder 1.5 en 1.7.3):

Projekt:

Contaminantenonderzoek Waddenzee
Deltadienst
DORA

OPEX
RIZA
Vaarplan

Medewerkers:

Drs C.J.M. Kramer
Drs C.G.N. de Vooy
Dr. M.M. Rutgers van der Loeff
Drs M. Lavaleye
G.J. Zigterman
D. Waaijers
Drs R. Dekker
Drs C.G.N. de Vooy
P.R. Alkema
A.J. Asjes
A. Balk
Ing. H. Franken
A. Goes
H. van Veen
J. Wagenaar
R.J.C. Witte

Stagiaires

Aan een groot aantal studenten uit HBO en MBO werd gelegenheid gegeven een stage te volgen. In principe staat deze mogelijkheid open voor studenten aan Laboratoriumscholen uit het gehele land en voor studenten aan de Middelbaar en Hogere Technische scholen in Noord-Holland. Gestreefd wordt naar stages van 6 maanden of langer.

Lijst van stagiaires in 1982:

J.M. Zijp	01-01-83/01-02-83	Van den Broek Instituut, Amsterdam
J. Asma	01-01-83/01-06-83	HTS Alkmaar, elektronica
K. Minnes	01-01-83/01-07-83	MTS Alkmaar, werktuigkunde
R.J. Smit	01-01-83/01-07-83	MTS Alkmaar, elektrotechniek
G. Vlaming	01-01-83/01-06-83	MTS Wenckenbach, werktuigbouwkunde
E. Visser	01-01-83/01-03-83	MTS Alkmaar, werktuigbouwkunde
B.C. van Meegen	01-01-83/01-03-83	Stova, Wageningen
N. Gelder	01-01-83/01-03-83	MTS Alkmaar, elektrotechniek
P. Reinders	01-01-83/01-03-83	HTS Haarlem, elektronica
J.S. Bos	01-01-83/01-04-83	MTS IJmond, elektronica
C. Lampers	01-03-83/01-07-83	MTS Alkmaar, werktuigkunde
E. Okkels	01-04-83/01-07-83	Swennen
A. Beekhuizen	01-03-83/01-06-83	MTS IJmond, elektronica
R.J. Wiersma	01-01-83/01-05-83	Bakhuis Roozeboom Instituut, Hegeman
H.T. Kloosterhuis	01-01-83/01-06-83	HBO Chemie, Rotterdam
R. van Kempen	01-01-83/01-06-83	Bakhuis Roozeboom Instituut
W. Bocxe	01-05-83/01-08-83	Vrije Leergangen VU, Pauptit
T. Popma	01-08-83/01-12-83	MTS Alkmaar, elektrotechniek
R. Boogaard	01-08-83/01-01-84	MTS Hoorn, elektrotechniek
H. Windt	01-08-83/01-01-84	HTS Alkmaar, elektronica
E. de Jonge	01-08-83/01-01-84	
J.H. Boogaard	01-09-83/01-01-84	Bakhuis Roozeboom Instituut
J.D. Jacobs	01-09-83/01-01-84	Bakhuis Roozeboom Instituut
P.J.A. Tolsma	01-09-83/01-01-84	HTS Eindhoven, milieutechniek
H.R.M. Koops	01-09-83/01-01-84	HTS Eindhoven, milieutechniek
J.J. Waning	01-09-83/01-01-84	Bakhuis Roozeboom Instituut
R. Botter	01-12-83/01-01-84	MTS Alkmaar, werktuigbouwkunde
M. Portanger	01-12-83/01-01-84	MTS IJmond, elektronica
M. Bakker	01-12-83/01-01-84	MTS Hoorn, elektrotechniek
R. Verschoor	01-12-83/01-01-84	MTS Alkmaar, werktuigbouwkunde

5.7. Verdere personeelszaken

Totaal zijn er in de NIOZ formatie 116 personen werkzaam geweest, waarvan er 86 op Texel woonden. Aan de overigen en aan tijdelijk personeel en stagiaires werd aan pontkosten f 35.000,- uitbetaald.

Deeltijd

Elk verzoek om deeltijdarbeid wordt door de directie van geval tot geval bekeken, waarbij enige criteria kunnen zijn dat:

- 1e) de organisatie beheersbaar moet blijven,
- 2e) de kwaliteit en kwantiteit van de dienstverlening gegarandeerd moet blijven,
- 3e) de afspraken over deeltijd bindend zijn.

J. van der Wal	35 uur	bibliothecaresse
G.C. Weijdt	11,5 uur	kantine-assistente
L. Everhardus	36 uur	secretaresse
I. Wernand	24 uur	administratie-assistente
W.C.M. Klein Breteler	32 uur	bioloog
E.C. Lanser	24 uur	administratie-assistente
M. Bruining	35 uur	bibliotheek-assistente
M. Zonnenberg	37 uur	telefoniste
J.T.F. Zimmerman	24 uur	fysicus

Ziekte

Vervanging van langdurig zieken is en zal ook in de toekomst zoveel mogelijk worden opgevangen door eigen personeel. Slechts bij hoge uitzondering wordt door het Ministerie extra steun verleend.

J.M. Nieuwenhuizen nam de afdeling studiemateriaal over van M. Buhre. G.H. Steenhuizen volgde Mevrouw Agema-Lebbe op in de kantine.

Het ziektepercentage over 1983 bedroeg 5,18% (1982: 4,9%).

Overwerk

Voor overwerk gemaakt door de bemanningen van de schepen wordt de Rijksregeling toegepast. Dit heeft er mede toe geleid dat de post overwerk niet meer te begroten en te financieren is. Eind 1982 zijn besprekingen geopend met de bemanningen en de OR over een vaste overwerkvergoedingsregeling. Begin 1983 is deze regeling met een proeftijd van een jaar aangenomen. Overwerk wordt alleen betaald aan de bemanningen van de schepen en aan de chauffeurs.

Gratificaties

Onderstaande personen ontvingen een gratificatie:

J.W. de Blok	25 jaar dienstjubileum
J.J. Beukema	idem
H.A. Beumkes	idem
J.W. Rommets	idem

5.8. Veiligheid, gezondheid en welzijn

Dit jaar is de eerste aanzet gegeven om van de voorbereidingskommissie een vaste commissie voor veiligheid, gezondheid en welzijn te maken. Leden zijn: H.J. Boekel, J. Hegeman, W.P. Jongejan, J.W. Rommets en J.I.J. Witte.

De registratie van bedrijfsongevallen laat zien dat er zeven ongevallen waren, gelukkig zonder ernstige gevolgen met slechts gering werkverzuim. Besloten werd geen buskruit meer te gebruiken voor het openen en sluiten van bijvoorbeeld plankontorpedo's.

A. Vaars behaalde het diploma brandwacht 1e klas van de stichting brandweeropleidingen.

5.9. Verslag van de personeelsvereniging

De personeelsvereniging heeft in 1983 de volgende activiteiten georganiseerd voor de medewerkers van het instituut.

Nog steeds staat een groot gedeelte van de festiviteiten in verband met de toneelgroep "Comedia de la NIOZ", welke inmiddels ook steeds meer buiten het instituut bekend raakt door voorstellingen elders. Op 26 maart was in verband met de voorstelling "Vingers van de macht" (van Kees Holiërenhoek) een feestavond georganiseerd met muziek, cocktailbar, voordrachten van middeleeuwse gedichten (van François Villon) met de daarbij behorende taferelen, en geheel vooraf een optreden van de Texelse volksdansgroep.

Later in het jaar (21 oktober) presenteerde de PV het engelse kabaret "Foreign Bodies". Het aantal bezoekers was redelijk. Het idee is gerezen de toneelzaal vaker te gebruiken voor dergelijke gelegenheden, mits het financieel haalbaar is.

Een groot succes werd het pannekoekenfeest op een late vrijdagmiddag in november, special voor de NIOZ-kinderen met hun ouders. Er is kennelijk behoefte elk jaar iets dergelijks te organiseren. Met een clownsvoorstelling en tekenfilms was de avond compleet.

Sport wordt beoefend binnen het PV-kader in de vorm van zaalvoetbal (in competitieverband) door NIOZ I en NIOZ II en volleybal (eilandcompetitie) door een herenteam (DGM) en een damesteam (Retsina). Het damesteam Retsina is nieuw opgericht en speelt in de 3e klasse dames. Naast de competitie is ook deelgenomen aan verscheidene toernooien.

Het enthousiasme voor de activiteiten is in het algemeen naar tevredenheid. De feestavonden worden veelal goed bezocht door de gebruikelijke groep mensen, waarvan een deel ook elke keer goed meewerkt aan de voor- en nabereidingen.

5.10. Toekomstvisie

Zoals reeds aangekondigd in het jaarverslag over 1982 zal in 1984 en 1985 de expeditie in Indonesië (Snellius II) een belangrijk deel in beslag nemen van het wetenschappelijk potentieel van het instituut.

Het personeelsbeleid van de direktie blijft gericht op handhaving van het huidige personeelsbestand, dat als een noodzakelijk minimum wordt gezien voor de uitvoering van de diverse taken van het instituut, zowel voor het fundamentele als het beleidsgerichte onderzoek. Waar mogelijk zullen projecten met extra personeel worden aangetrokken.

Er wordt, in overleg met de ondernemingsraad, gewerkt aan een wat veranderde opzet van het instituut, waarbij het aantal werkgroepen zal worden beperkt en de hulpafdelingen geconcentreerd. In dit kader kwam in 1983 een samenvoeging van chemische oceanografie en onderzoek zeeverontreiniging tot één afdeling tot stand.

De direktie besteedde voorts in dat jaar zeer veel aandacht aan diverse reorganisatieplannen voor het wetenschappelijk onderzoek en onderwijs, die hun invloed zouden kunnen uitoefenen op de positie van het instituut. Het ziet er naar uit dat deze aktiviteit in 1984 niet zal verminderen.

6. JAARVERSLAG ONDERNEMINGSRAAD 1983

6.1. Algemeen

In het begin van het jaar werd tijdens een vervolgcursus voor ondernemingsraadsleden gediscussieerd over de functie van de OR bij het NIOZ. De ondernemingsraad lijkt zich een plaats verworven te hebben als onafhankelijk funktionerende en opererende instantie, naast de direktie en het instituut van werkgroepelersvergadering. Zij heeft zich ontwikkeld tot een inspraakorgaan waar de direktie rekening mee bleek te houden, en tot een bron van informatie die het grootste gedeelte van het personeelsbestand bestreek, dankzij vergaderingen die OR-leden regelmatig belegden voor hun achterban en tevens dankzij het prompt publiceren van al datgene wat besproken werd tijdens OR-vergaderingen en vergaderingen met de direktie. In deze OR-publikaties werden ook konfrontaties met de direktie gemeld, maar geprobeerd werd steeds om de teneur van de artikelen die de OR openbaar maakte te laten stroken met het voornemen van de raad om te allen tijde in de kontakten met de direktie te streven naar soepel overleg volgens het harmonisch overlegmodel. Aangezien de informatiestroom die van de direktie naar de OR gesluisd werd soms van geringe afmetingen was viel het de OR soms niet gemakkelijk binnen de kaders van zo'n model te blijven opereren.

Gezegd moet overigens worden dat de dialoog met de direktie op geen enkel punt ooit verzand is in ernstige konflikten: alle voorkomende problemen zijn steeds in goede verstandhouding doorgesproken. De direktie heeft wel gesuggereerd dat bij bepaalde gelegenheden de OR wellicht meer informeel overleg had kunnen voeren met direktieleden om eventuele geschilpunten vroegtijdig door te praten. De OR is echter van mening dat ze niet voor zichzelf kan spreken maar er is voor de achterban, met wie over alles ruggespraak gevoerd dient te worden. De direktie vond daarentegen dat OR-leden gekozen zijn en dientengevolge een mandaat hebben, en daarmee de vrijheid om standpunten in te nemen zonder raadplegen van degenen die hen gekozen hebben. Nog op een ander punt dat tot moeilijkheden in het overleg direktie-OR kan leiden werd de aandacht gevestigd door de direktie: het probleem dat een OR volgens haar moeilijk kan beoordelen hoe het direktiebeleid is, omdat een afgewogen oordeel daarover slechts geveld kan worden na grondige studie: direktiebeleid is immers een dagtaak dus hoe kan een OR daarover meedenken? De OR stelde hiertegenover dat zij weliswaar niet op alle punten ter zake kundig is, maar dat doet niet af aan de functie van een OR binnen het NIOZ bedrijf: inzicht te krijgen in de motieven die achter het beleid schuilgaan, dit beleid te beoordelen op de gevolgen voor de personeelsleden, en de meningen en gevoelens van deze duidelijk kenbaar te maken bij de direktie.

6.2. Punten van aandacht

Slechts een klein deel van het personeel bleek geporteerd voor invoeren van een nieuw beoordelingssysteem, en de OR sprak zich dan ook uit tegen dit systeem, hoewel beoordelen op zich een goede zaak werd gevonden: het houden van funktioneringsgesprekken is ooit bevochten door de vakbonden. Weinigen onder het personeel waren principieel tegen beoordelen, maar de bereidheid om aan het voorgestelde systeem mee te werken was gering. Algemeen werd de mening aangehangen dat beoordelen zou moeten gebeuren aan de hand van regelmatig werkoverleg. Er was veel kritiek te beluisteren op de kwaliteit van zo'n overleg op het NIOZ. De nadelen die kleven aan het voorgestelde beoordelingssysteem werden overigens niet als zodanig gezien door de direktie. Deze merkte ook op dat het systeem in elkaar was gezet in Den Haag en goedgekeurd was door de vakbonden. Het zou derhalve besproken dienen te worden met vertegenwoordigers van het personeel in het Centraal Overleg. Op dit punt was aan het eind van het jaar nog geen verdere actie ondernomen, en van dwangmatig invoeren van het systeem was nog geen sprake.

Kombinatie van de werkgroepen Zeeverontreiniging en Chemische oceanografie tot een zogenaamde afdeling, te leiden door een hoofd dat in de plaats zou komen van de vertrekkende werkgroep leider bij Zeeverontreiniging, werd door de direktie niet gezien als reorganisatie binnen het instituut. De samenvoeging van de werkgroepen stuitte aanvankelijk op verzet van de meeste leden van beide groepen maar na overleg tussen direktie en werkgroepen dat gedeeltelijk via de OR en gedeeltelijk rechtstreeks werd gevoerd werden alle geschilpunten gladgestreken. Er werd tijdens overlegvergaderingen wel gesproken over plannen om in de komende jaren over te gaan op veel ingrijpender reorganisaties, bijvoorbeeld door het aantal werkgroepen te reduceren. Plannen voor een nieuwe organisatiestructuur werden door de direktie ontwikkeld en de OR ter kennisname aangeboden. Zelfs de beheersvorm onder welke het hele instituut nu ressorteert (de Nederlandse Dierkundige Vereniging) zou in de toekomst anders kunnen gaan worden. Voor de OR zullen vooral de personele konsekventies van toekomstige konstrukties van belang zijn.

In het kader van de door het Ministerie van Onderwijs en Wetenschappen gewenste doelmatigheidsbevordering van wetenschappelijk onderzoek werd door het organisatie-adviesbureau Bakkenist, Spits & Co. de financiële en organisatorische aspecten van het NIOZ en de personeelsopbouw geïnventariseerd. De schaalvergroting waarvan sprake is in een van de uitgebrachte rapporten houdt combinatie en associatie in met andere, veel kleinere instellingen. De komende jaren zal de problematiek die gepaard gaat met plaatsing van het NIOZ in een groter geheel vaak te vinden zijn op de overlegvergaderingen. In dit verband dient nog gemeld te worden dat de Nederlandse Dierkundige Vereniging aan het eind van het jaar goedkeuring uitsprak over een kontrakt van het NIOZ met Rijkswaterstaat waarbij overname van de BOEDE-groep geregeld wordt.

6.3. Verkiezingen en samenstelling OR

Op 25 mei werden verkiezingen gehouden. De verkiezingskommissie bestond uit Hans Witte en Gusti de Schipper. Voor de groep niet-biologisch laboratoriumpersoneel hadden zich vier kandidaten aangemeld, terwijl het technisch personeel uit twee kandidaten kon kiezen. Bij de groep biologisch wetenschappelijk personeel hoefde niet gestemd te worden: er waren geen andere kandidaten. De OR had na 25 mei de volgende samenstelling:

Gusti de Schipper	(voorzitter), voor het administratief personeel en personeel algemene dienst
Winfried Gieskes	(secretaris), voor het biologisch wetenschappelijk personeel
Gjalt Steenhuizen	(ABVA), voor het varend en havenpersoneel
Doeke Eisma	(ABVA), voor het niet-biologisch personeel (geologen, chemici, fysici)
Rob de Vries	voor het niet-biologisch laboratoriumpersoneel (geologen, chemici, fysici)
Hans Witte	voor het biologisch laboratoriumpersoneel
Herman Boekel	voor het technisch personeel

Aan het eind van het jaar werd Steenhuizen's plaats ingenomen door Wim Jongejan vanwege het feit dat Gjalt vanaf september in de kantine is gaan werken en voortaan bij de groep personeel algemene dienst hoort.

6.4. Kommissies

De veiligheidskommissie (een voorbereidingskommissie, ingesteld ter voorbereiding van de Arbowet) bestond uit Herman Boekel, Gjalt Steenhuizen, Joop Rommets en Jan Hegeman (de laatste twee als toegevoegde, niet-OR-leden).

Hans Witte en Herman Boekel hielden zich (hoewel niet in commissieverband) bezig met het financiële NIOZ-beleid, terwijl Rob de Vries en Gusti de Schipper het personeelsbeleid volgden (ook niet in commissieverband).

6.5. Vergaderingen

Er werden 11 vergaderingen van de OR belegd, en er werd 6 maal in overleg getreden met de directie en de heer van Abs, de beheerder.

6.6. Scholing

In februari werd een vervolgcursus voor ondernemingsraadsleden gevolgd van het Scholings- en Vormingsinstituut van de Arbeidersgemeenschap der Woodbrookers in Kortehemmen bij Beetsterzwaag. Hierover werd verslag uitgebracht in het personeelsblad "Tussen de Skeape".

6.7. Financiën

Het door de OR uit te geven bedrag stond voor 1983 begroot op *f* 4000,-. De voornaamste uitgavepost bestond uit de kosten die gemoeid waren met de cursus (zie punt 6.6). Het abonnement op het OR-blad werd gecontinueerd. Aan het eind van het jaar was *f* 3300,- besteed voorzover kon worden nagegaan dd. 24-1-84.

