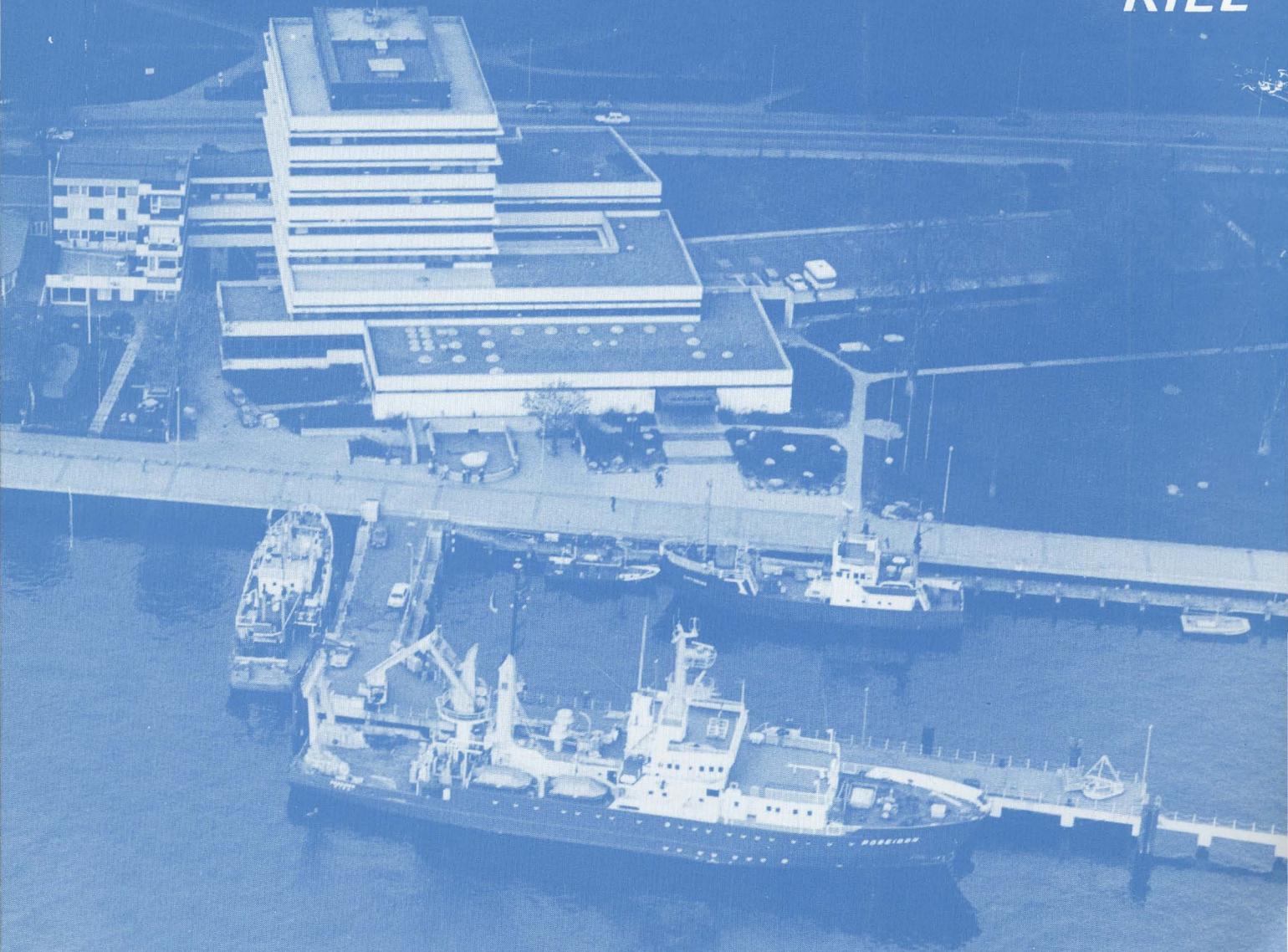


# *INSTITUT FÜR MEERESKUNDE*

## *KIEL*



English Edition

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*MARINE BOTANY*

*MARINE ZOOLOGY*

*FISHERIES BIOLOGY*

*MARINE  
PLANKTOLOGY*

*MARINE  
MICROBIOLOGY*

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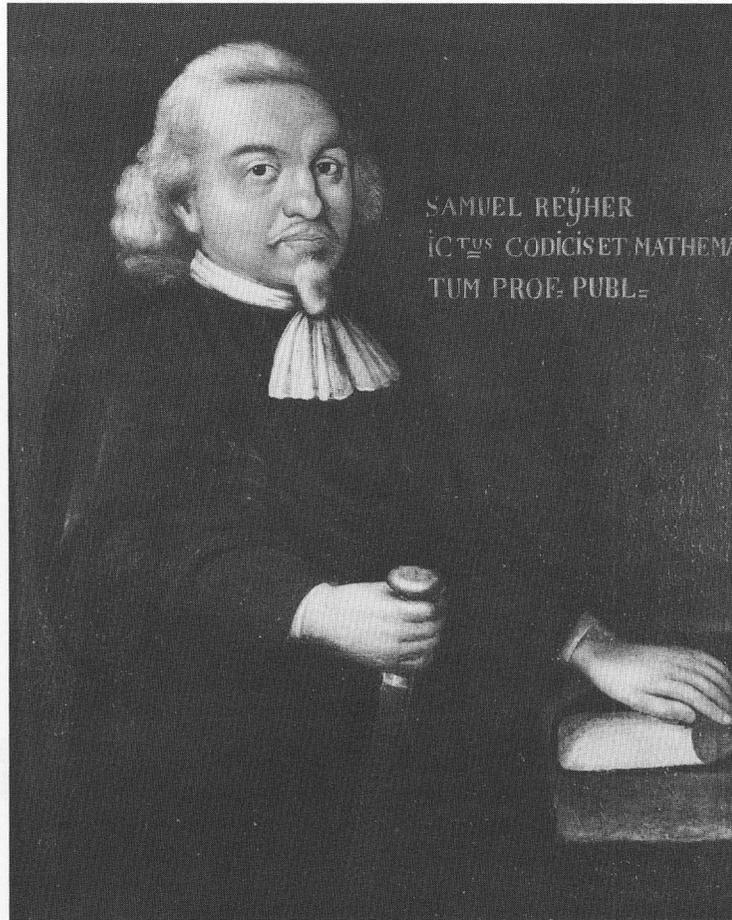
**Telemail:** Packet switching

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## **Contents**

1. Brief history of the Institute
2. Organization of the Institute
3. Research in the departments
  - Regional Oceanography
  - Theoretical Oceanography
  - Marine Physics
  - Maritime Meteorology
  - Marine Chemistry
  - Marine Botany
  - Marine Zoology
  - Fisheries Biology
  - Marine Planktology
  - Marine Microbiology
4. Special interdisciplinary research projects
5. Teaching
6. Central scientific and technical facilities
  - Research vessels
  - Library
  - Electron microscopy
  - Isotope laboratory
  - Computer center
  - Aquarium
  - Central workshop
7. Publication series



Samuel Reyher (1635 – 1714)

As early as 1697, Samuel Reyher, professor for mathematics at Kiel University, described an experiment for the determination of the salinity of sea-water below ice-cover, collecting and using oceanographic and meteorological data.

## 1. Brief history of the institute

Marine research has continually been carried out in Kiel since about 1870. In those days the physiologist VICTOR HENSEN and the zoologist KARL MÖBIUS were teaching here at the university. They undertook marine – essentially ecological – studies in Kiel Bight, together with plankton research. This led to the first great expedition of German marine biologists, the tropical Atlantic cruise on board the research ship „National“. At the turn of the century the „Preußische Kommission zur Wissenschaftlichen Erforschung der Deutschen Meere“ (Prussian Commission in Kiel for the scientific exploration of the seas around Germany) created a „laboratory for international marine research“ at which physical, chemical and biological investigations were undertaken. At that time the Kiel geographer OTTO KRÜMMEL wrote the first oceanographic textbook.

After the First World War Berlin became the center for marine research in Germany. The planning and direction of the famous „German Atlantic Expedition“ 1925–1927 was carried out at the Berlin university „Institut für Meereskunde“ (Institute for marine sciences). Two of the expedition members on the first research ship „Meteor“, the marine chemist HERMANN WATTENBERG and the physical oceanographer GEORG WÜST, later became directors of the Kiel „Institut für Meereskunde“ (IfM). Both scientists took an active part in preparing the thirty volume „Meteor report“.

From 1936 on marine research in Kiel regained importance. In 1937, the university affiliated „Institut für Meereskunde“ was founded, adding a third, biological department to the two existing provisional departments of hydrochemical and marine geological research. This

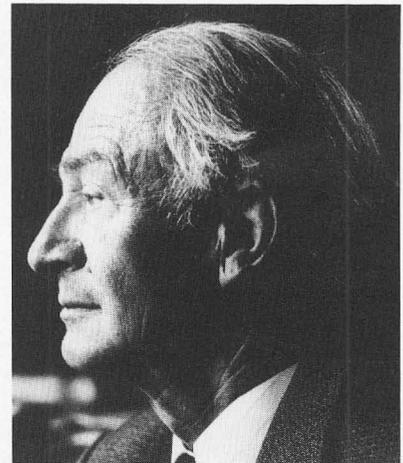
Victor Hensen (1835 – 1924)



Otto Krümmel (1854 – 1912)



Adolf Remane (1898 – 1976)



guaranteed the future of research and teaching in the marine sciences. The institute was established at Kitzberg on the East bank of the fjord with the Kiel zoologist ADOLF REMANE as the first temporary director. The extensive oceanographic library of the former „Prussian Commission” provided the nucleus for an independent institute library for the three departments. Even during the Second World War it proved possible to complete a considerable number of scientific papers, until July 1944, when the institute building was totally destroyed by bombing, with the director, HERMANN WATTENBERG, and nine staff members losing their lives.

Soon after the end of the war, GEORG WÜST (previously mentioned as a member of the „Meteor” expedition) was appointed director of the Institute which found new quarters in a virtually undamaged villa in Hohenbergstraße 2 near the West bank of the fjord. This offered a number of advantages compared with the

rather isolated location at Kitzberg – it became possible to give lectures in our own institute building, and the proximity of the institutes for zoology and botany facilitated work for the students of marine biology. Generous support by the administration of the ministry of science and education and through grants for research projects, principally from the „Deutsche Forschungsgemeinschaft” (DFG) (German Science Foundation) made reestablishment rapid. Thus, it was also possible to restock the specialist library and to restart the institute journal „Kieler Meeresforschungen” which led in due course to the essential exchange of publications with many institutes at home and abroad. The many contacts with friends and scientists in other countries were particularly valuable at that time.

For example, in 1946, Dr. J.N. CARRUTHERS, then oceanographer to the British Admiralty, arranged for the former surveying boat „Südfall” to be allocated to the

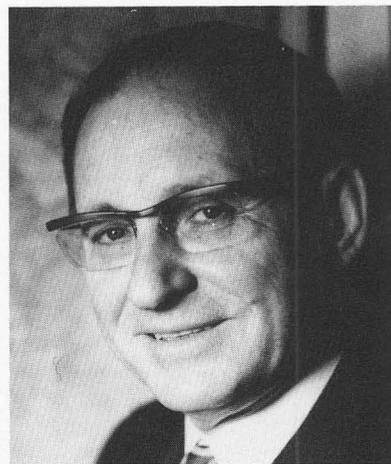
Hermann Wattenberg (1901 – 1944)



Georg Wüst (1890 – 1977)



Günter Dietrich (1911 – 1972)



First building of the Institut für Meereskunde at Kitzberg on the East bank of Kiel Fjord (1937–1944)



institute as a research cutter. From 1954 until the end of its commission in 1976 this ship bore the name „HERMANN WATTENBERG“.

The vigorous research and teaching activity in the years from 1948 until 1955 led to an increase in the number of diploma and doctorate students. There was soon a shortage of suitable laboratories. But at that time it was impossible to plan a costly new institute building. Thus, the only extension was an annex which helped to satisfy the increased need for space in the three biological departments. At that time 1955/56 there were four departments altogether: Oceanography (G. WÜST), Marine Botany (C. HOFFMANN), Marine Zoology (C. SCHLIEPER) and Fisheries Biology (R. KÄNDLER). Furthermore, the chemical and planktological laboratory was enlarged.

In 1959 the physical oceanographer GÜNTER DIETRICH – a member of the North Atlantic „Meteor“ expedition 1937/38 – took over as director of the Institute. At that

time marine science got priority support in the Federal Republic of Germany as well as in other countries.

Since 1960 the Deutsche Forschungsgemeinschaft has promoted „focal point“ programs for marine research making it possible for a large number of scientists to participate in great international research ventures.

The government side also looked for new ways to respond directly to the increasing needs of marine research. In view of the national importance of the IfM-Kiel, an administrative agreement was concluded between the Federal Minister for Education and Science and the Minister of Education and Cultural Affairs of the Land (State of) Schleswig-Holstein, which established the financing of the institute budget by equal shares from Federal and State funds.

Meanwhile there had been a further increase in staff and the number of departments had doubled to ten.

Thus, acute lack of space became the main problem of the institute which by 1970 was accommodated at ten different sites in the city of Kiel. After nine years of planning and construction and despite manyfold problems, the move into the new building on Kiel Fjord finally became possible during the second half of 1972.

The Institut für Meereskunde at the University of Kiel today includes within its ten departments all aspects of

research and teaching in physical oceanography, marine biology, maritime meteorology and marine chemistry. Marine geology and geophysics are taught at the corresponding Kiel University institutes with which we have numerous contacts in both teaching and research. These institutes as well as the University institutes for Zoology and Botany participate in cruises of the IfM research vessels.

## 2. Organization of the Institute

In accordance with the IfM statutes from December 1981 the institute is run by the Board of Directors and the Managing Director. The Administrative Committee (according to § 5 (2) of the Ausführungsvereinbarung zur Rahmenvereinbarung Forschungsförderung über die gemeinsame Förderung von Einrichtungen der wissenschaftlichen Forschung) has to discuss and issue recommendations of general affairs and matters of importance. The Board (Kollegium) consists of the heads of the ten departments and two members of the scientific staff of the departments and regulates the allocation of research and teaching funds.

The Managing Director is one of the heads of departments appointed by the Minister for Education and Cultural Affairs of the Land Schleswig-Holstein at the recommendation of the Board for a two years term. He is

chairman of the Board and head of the institute and represents the institute in external affairs.

A Scientific Advisory Board advises the organs of the institute in scientific matters of basic importance.

Staff members total about 240, 100 of them being scientists. In addition about 150 graduate students work at the institute.

Up to 1977 half of the institute's budget was met by Federal funds and half by the Land of Schleswig-Holstein. Since 1977 the IfM belongs to the „institutes of the blue list” and is funded according to a general agreement between the Federal Republic of Germany and the states (Rahmenvereinbarung Forschungsförderung nach Artikel 91 b Grundgesetz). In addition to this block funding, special grants are obtained from other bodies to support particular research projects.

## 3. Research in the departments

All ten departments are actively engaged in teaching and instruction and in fundamental research development of measurement methods covering between them nearly all aspects of oceanography, maritime meteorology, marine chemistry and biology. By these efforts they lay the foundations for embarking on the applied studies that are becoming increasingly important these

days and which are, to a limited extent, being undertaken at the Institut für Meereskunde, too. Included in this category is work related to environmental protection, investigations into the use of food stocks of the ocean and research aimed at understanding the energy budget of ocean and atmosphere.

## Regional Oceanography

The research activities in Regional Oceanography comprise two subjects: investigations on climatological aspects of the upper oceanic layer and the observation and interpretation of low frequency changes in water movement and stratification of the North Atlantic current. The first topic includes development of measuring techniques as well as experimental and analytical investigations on aspects of time and space of the structure of the upper oceanic layer. This concerns the oceanic fronts which participate in the energy transfer processes between movements of different size scales as well as the seasonal development of the upper layer with corresponding problems in climatology and production biology.

The investigations on low frequency changes in water movement and stratification in the central North Atlantic aim at improving the knowledge on processes involved in oceanic heat transport. In this context, questions concerning the interrelationships between large-scale and meso-scale currents in the Mid Atlantic Ridge area, which are of importance for this heat transport, are of special concern.

Additionally, special regional problems in local hydrography, important especially for fisheries, are attacked.

## Theoretical Oceanography

The basis objective of Theoretical Oceanography is to obtain solutions for the system of hydrodynamic equations for oceanographic problems. Most investigations deal with the general circulation of the North Atlantic Ocean. Large-scale and local models are applied to investigate currents, waves and eddy fields. The influence of bottom topography is investigated on various scales. In order to deduce the current field from hydrographical data sets, inverse modelling is used. Calculations are complemented by measuring programs in the Atlantic in co-operation with other departments.

In order to gain insight into the large-scale current fields, satellite tracked drifting buoys are deployed and the drift field is analyzed. Emphasis is also laid on satellite oceanography. By means of infrared images from NOAA-satellites single phenomena like frontal displacements and eddy generation are investigated. By taking into consideration data gained from satellite tracked drifting buoys, it is attempted to throw light upon the dominant scales and dynamics of eddy fields.

## Marine Physics

The activities of the department cover two fields: The study of physical processes in the ocean through observational programs, and the development of methods and instrumentation for such observations.

The investigation of physical processes deals with the formation, mixing and transport of water masses, with meso-scale eddies and oceanic fronts, with internal



Development of oceanographic measuring devices  
(photo: E. Mempel)

waves and with the fine structure of temperature and salinity. Also included are air-sea interaction processes relevant for climate studies. Major emphasis is laid upon the joint research program „Warm Water Sphere of the Atlantic Ocean“. In this program, the circulation of the large-scale subtropical gyre is of particular interest, with special studies performed in the Canary Basin region. These programs are coordinated with international investigations in the North Atlantic.

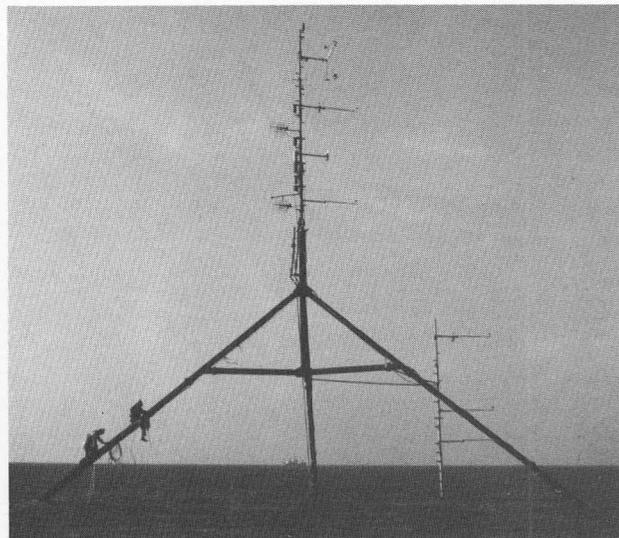
The work on observational methods and techniques includes the development of deep-sea moorings for long-term deployment and of vertically profiling instruments. The activities include electronic/mechanical design, component laboratory testing, and modelling of measurement system response. The department is also developing hardware/software for data processing on board research vessels, ships of opportunity and in shore-based laboratories.

### Maritime Meteorology

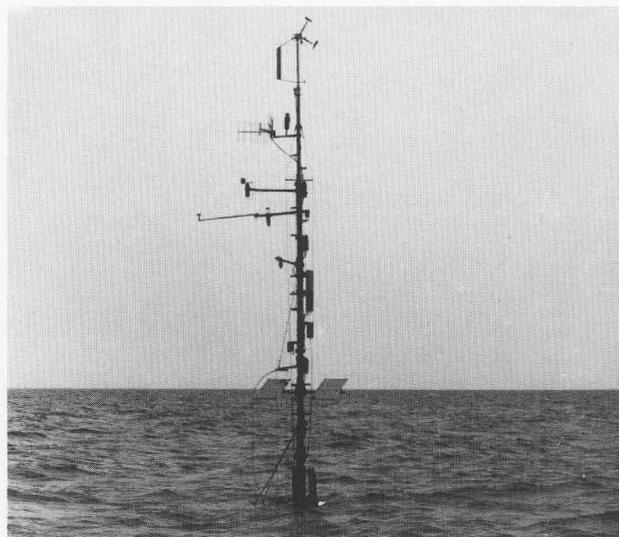
As indicated by the name of the department, main activities are centered around interactions between oceans and atmosphere. For measurements of vertical transport of heat, momentum and water vapour at the sea-surface, a floatable tripod is available (Fig.). It can be deployed in depths of up to 14 m and permits undisturbed installation of probes at coastal seas.

These measurements are aimed at improving basic knowledge of vapour-, heat-, radiation- and momentum fluxes at the air-sea-interface. This leads to improved methods for determining these fluxes as reliably as possible from simply measurable parameters like humidity, temperature, cloudiness and wind.

Besides of small scale studies, large-scale fields are analyzed. This work is focussed on the North Atlantic, the research area of the joint research program 133 „Warm water sphere“. An atlas of the heat and momentum budget of the North Atlantic is produced, providing



Tripod, deployed in coastal waters with instruments for the undisturbed measurements of meteorological parameters (photo: P. Timm)



a useful tool for better understanding of climatological problems. The co-operation with the physical oceanographic departments of the joint research program 133 stimulates the improvement of measuring and analytical techniques in marine meteorology, e.g. by combining conventional and satellite measurements.

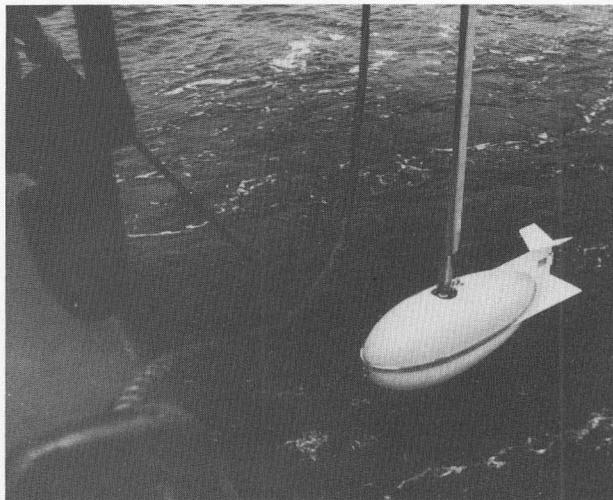
Additional research effort is devoted to development of remote sensing techniques via satellite, airplane and research vessel. These procedures are also termed „satellite meteorology“. Satellite images often show surprising details of oceanic structures. Unfortunately, the oceanic portions of the signals received by satellites are masked considerably by the atmosphere, even in cloudless situations. By means of mathematical modeling of satellite data an attempt is made to identify the atmospheric interference. Here, the limits of remote sensing technique become apparent. Simultaneously procedures are tested to deduce energy budget components, e.g. net flux of long wave radiation at the sea-surface, from spectral satellite measurements.

## Marine Chemistry

The research efforts of this department concentrate on three major fields: nutrient chemistry, trace metal chemistry and organic marine chemistry.

The working group „nutrient chemistry“ primarily deals with the chemistry of certain inorganic nutrients (e.g. nitrate, phosphate, silicate) in the Baltic Sea. Their short-time and small-scale variability in the water column are investigated as well as exchange and transformation processes at the interface between oxygen-rich and oxygen-free water masses. Generation and spreading of hydrogen sulfide in near-bottom waters are additional subjects of investigation. Inorganic chemical parameters are measured and data recorded by automatic equipment. An underwater pump towed by ship is used for continuous sampling at different water depths (Fig.).

The working group „trace metal chemistry“ deals with occurrence, chemistry and fate of selected trace metals



Deployment of the „chemical profiler“ for continuous sampling in different water depths (photo: E. Mempel)

(e.g. zinc, cadmium, lead, copper, tin, iron and cobalt) in various marine regions. Main objective of these investigations is to gain understanding of the horizontal and vertical distribution of these elements, quantitative recording of transport processes (input from the atmosphere and sedimentation of metals adsorbed to particulate matter in the water column) and the identification of their chemical speciation, the latter being specially important for the assessment of biological availability and toxicity of these metals.

The „organic marine chemistry“ group concentrates research efforts on the occurrence, distribution and abiotic alteration of natural and anthropogenic lipophile substances in sea-water (hydrocarbons, aldehydes, ketones, organic acids etc.) present in solution and/or adsorbed to particulate matter. Additionally, occurrence in and input from the atmosphere are investigated for these compounds. Research on sensitized photo-oxidation is an expanding activity. Of special interest are lipophilic compounds in the anoxic deep water of the Baltic proper which appears to be a reservoir for these sub-

stances. Furthermore, certain biogenic compounds constitute research targets as they possess structures similar to those of known pheromones. They are considered to mediate communication among planktonic organisms. The main research area of the department is the Baltic Sea. However, individual groups also participate in large multidisciplinary oceanographic research projects.

### **Marine Botany**

Besides dealing with aspects of marine botany, research effort is devoted to marine benthology in general. This field not only comprises benthic algae and seaweeds but also bottom dwelling animals of different sizes and their relations to microorganisms. Currently, Kiel Bight forms the center of interest. There hardly exists another marine area that has been more thoroughly investigated by biologists during the past decades, thus a systematic résumé of single phenomena can be tackled. These investigations are designed to lead to a comprehensive picture of the ecosystem of Kiel Bight, using both existing data and supplementary studies in order to assess the importance of plant and animal life in this area.

Special attention has to be paid to seasonal patterns of Kiel Bight ecology. Among the questions to be answered are e.g. to which extent plant material decaying in winter influences nutrient and oxygen budgets in the area and why in summer hypoxia occurs in water depths below 20 m in the Western Kiel Bight.

The working group „marine phytobenthos“ studies vegetation structure, seasonal appearance and productivity of the phytobenthic communities. The working group „marine zoobenthos“ deals with the composition of benthic macrofauna, their reaction to environmental stress and the significance of macrobenthic production as food for demersal fish. The working group „physiological ecology“ devotes their main interest to the performance of organisms in the ecosystem with varying environmental conditions, especially concerning the budget of inorganic and organic matter in near coastal ecosystems of

different climatic zones. In this context, studies are performed dealing with the question to which extent pollutants in the ocean impair performance of organisms. The working group “sediment biology” studies parameters of biomass, metabolism and microbial activity in sediments, including the physical effects of benthic animals upon the sediment.

### **Marine Zoology**

Physiological and ecological investigations on marine animals, especially invertebrates are the focal point of research. Three teams attack them with different methods. In the group working on physiological and biochemical questions, growth and physiology of metabolism of marine crustacea and antarctic animals are most important. As growth is linked to molting in crustaceans, molting processes and the ensuing physiochemical transport processes are analyzed. They influence to a great extent life and behaviour of the crustacea.

Since only optimal feeding results in maximum growth, food requirements of the crustacea and other marine animals are determined as well. In the marine environment food search depends to a great extent on the reception of chemical messenger substances. To identify them and to determine their efficiency limits is another aim.

Boreal and antarctic krill species are preferably used for the investigation on fluor accumulation and its purpose. Subsequently, fate and effect of fluor are analyzed in the higher levels of the food chain (e.g. in penguins and seals).

Primarily, this project serves purposes of basic research. However, it also possesses applied aspects, since crustacea occupy an important position in the marine ecosystem and in many cases are commercially important themselves.

The working group „ecophysiology and ecotoxicology“ studies performances of marine invertebrates and analyses their metabolic adaptations to varying environmental

conditions. At present, special attention is paid to the following topics: Protecting mechanisms against injuring effects of freezing. Uptake of dissolved organic nutrients by selected marine species and developmental stages. Accumulation and release of metabolic compounds by bottom invertebrates during longtime anaerobiosis and their value for indication of anoxic conditions. Improvement of monitoring and the fate of heavy metals in marine invertebrates. Physiological and biochemical indication of environmental stress induced by abiotic factors of the Baltic Sea in connection with waste water compounds.

The working group „Marine ultrastructure research” investigates metabolic processes and mechanisms of adaptation of marine invertebrates. Presently, studies on the histology, biology and ecology of the gutless Pogonophora form the focal point of the research. Pogonophora are of great phylogenetic and ecological importance. The worm-like animals satisfy their energy demand partly by absorbing dissolved organic matter from the seawater. In addition, recently discovered bacteria seem to contribute to their host's nutrition by supplying their own metabolic products. Hopefully, it will be possible to answer questions pertinent to the evolutionary processes by investigations on these fascinating deep-sea animals.

## Fisheries Biology

The research of this department is directed to the biology of exploitable aquatic organisms. Especially important in this context is the question of the productivity of fish, bivalves and crustacea in their natural habitat and in experiments. The studies are primarily designed to enlarge basic knowledge in the two following fields:

1. Ecological position of fish in their natural environment.  
Interactions between fish and the biological and non-biological factors of their biotope have to be recognized and scaled. In this context, studies on growth



Fisheries biological investigations on exploitable fish during a research cruise (photo: U. Piatkowski)

and feeding, on abundance, temporal and spatial distribution of fish, fluctuations in fish stock and effects of pollutants present in the water are to be carried out. Applying different methods, this ecological research is conducted on early life history stages of fish, belonging to the plankton community, as well as on adult stocks (photograph). Regionally, work is focussed on Baltic and North Sea and on inland waters of Schleswig-Holstein. Furthermore scientists and students of this department are engaged in research in tropical and subtropical areas, either within the framework of expeditions or projects conducted in co-operation with other countries.

2. Metabolic physiology, productivity and reproductive biology of individual aquatic species under controlled conditions.

Investigations in this field are performed by means of experiments in the laboratory and in open-air tanks. Here, short- and long-term measurements on individuals and groups of animals are conducted. Thus, foundations for further development of aquaculture can be laid. Results from these studies are also helpful in interpreting data collected in natural biotopes.

The department of fisheries biology co-operates in manifold ways with other departments of the institute as well as with the Federal Research Laboratory for Fisheries, the German Scientific Commission for Marine Research, different university and state institutes in the Federal Republic of Germany; foreign research is contributed by scientists and graduate students financed exclusively with project money.

### Marine Planktology

Investigations of this department deal with the exploration of the pelagic ecosystem. The main interest lies in understanding the flow of energy and matter in this system. Therefore, long-term and intensive short-term measurements in relation to space and time and various environmental factors influencing production and stock are carried out.

These measurements are designed to throw light upon the formation of organic matter, its transfer via the food chain, its transport to the bottom (sedimentation) and its remineralization. Additionally, investigations on the nature and composition of detritus (the non-living part of suspended particulate matter) are carried out.

Routine investigations extending back over many years make it possible to estimate fluctuations in the stocks of plankton in relation to important environmental conditions which are brought about by climatic changes and possibly through the influence of pollutants.

The main study areas for these problems are the Baltic Sea, the North Sea and various regions of the Atlantic.

The short-term measurements are designed to contribute to our knowledge of the dynamics of fundamental processes in the ecosystem. For the clarification of selected aspects, laboratory experiments and tests in enclosed water bodies (plastic containers) are performed in conjunction with open-ocean studies. Together with scientists of other departments, studies are carried out



Sampling with the multiple opening and closing net on board FK „Alkor“ (photo: E. Mempel)

in the framework of the biological monitoring program of the Baltic Sea.

In collaboration with other disciplines in marine science, the department is working on a mathematical model of a virtually closed ecosystem by combining existing theory and available data. This model should aid in clarifying structures and biological processes in the sea and should be capable of allowing predictions.

## **Marine Microbiology**

The department is concerned with bacteria, fungi and viruses of the marine biotope and with the role of these microorganisms in the life cycle of the sea. The emphasis is on ecological studies, but taxonomic, physiological and methodological studies are also carried out.

A research program supported jointly by all scientists of the department deals with the relationship between bacterial development and microbiological turnover of substances in the Baltic. The degradation rates associated with bacterial production and seasonal changes of the microflora in both water and sediments are studied in particular. For this, fluorescence and scanning electron microscopy are employed together with micro-radiography.

Extensive studies are also made on the influence of waste water and solid waste on bacteria and fungi in Kiel Bight and adjacent fjords, and on the role of these microorganisms in the natural purification processes. Here, particular attention is paid to the survival time of waste water bacteria in the brackish water of the Baltic and the Elbe estuary under different conditions. Additional research is concerned with the toxicity of various

components of marine and brackish water microbes, with questions of so-called thermopollution and with wood-destroying fungi in the Baltic fjords.

In co-operation with the department of fisheries biology, a research program on prophylaxis and therapy of fish diseases in marine intensive cultures is under way. It mainly deals with bacterial pathogens of exploitable fish and possibilities of controlling them.

Benefitting from the institute's position on the Baltic with its brackish water, work has already been carried out for several years on the salt requirements of bacteria and fungi from this area, also their capability for adaptation to higher and lower salinities. Isolated stocks are investigated as to their taxonomy and autecology.

Further research is devoted to the role that heterotrophic microorganisms play in the energy transfer from primary producers to consumers in the food chain.

Furthermore, microbiological and ecological studies are conducted in the deeper parts of the Eastern Atlantic, the Skagerrak and the Baltic proper.

A culture collection of sea-water- and brackish water bacteria is regularly being extended.

## **4. Special interdisciplinary research projects**

### **Applied marine research**

In addition to the various investigations with applied aspects carried out as part of the fundamental research programs in the departments, three topics of applied marine research are covered in separate programs supported by the Federal Ministry of Research and Technology, the Federal Ministry of Food and Agriculture and the Ministry of Food, Agriculture and Forestry of the Land Schleswig-Holstein. They form an essential part of

the general program „Marine Research and Technology” of the Federal Government.

In the „marine pollution” program questions concerning the introduction of noxious substances, the transport, dilution through mixing processes, accumulation in organisms, transfer through the food chain and breakdown of noxious substances are studied. In this context, special attention is paid to studies on models of Kiel Bight. This is a field of close interdisciplinary co-

operation in the center of which is the analytical work of the participating chemists. The usually very low concentrations and the similarity between anthropogenic and natural substances in sea-water demand new, extraordinarily exact analytical techniques. Several topics of pollution research are interlocked: Impact of nutrient and organically rich waste water input on the microbial activity and on the plant and animal communities; occurrence of pollutants in fish, crustacea and bivalves due to accumulation in the food chain and direct uptake from water and sediment; impact of pollutants on the organisms and their offspring; fate of pollutants in the sea as a consequence of physical transport-, mixing- and sedimentation-processes.

Several IfM scientists participate actively in governmental and nongovernmental organizations in planning international projects and drawing up guide-lines for the prevention of marine pollution.

In the „food from the sea” program, emphasis is placed on two themes: Mariculture experiments primarily serve the artificial propagation of species of marine fish, development of methods enhancing growth and cultivation and the support of field populations by supplying fry to near-coastal biotopes. Besides their strongly applied aspects, these studies contribute to a better knowledge of the physiological and autecological characteristics of the species under study. Furthermore, the institute pro-

vides scientific support for and/or conducts pilot studies in the field of aquaculture.

In the „interaction ocean/atmosphere” program, problems of energy transfer between atmosphere and the ocean are investigated within the scope of large international projects about marine climate and weather forecast.

### **Joint research program (JRP) 133**

About 30 staff members of the physical departments of the IfM participate in the JRP 133 „Warm water sphere of the Atlantic Ocean”. The focal points of this JRP are:

- general circulation in the North Atlantic
- seasonal fluctuations in the North Atlantic
- circulation in the East Atlantic and meso-scale processes.

The Atlantic Ocean warm water sphere is decisive in the European climate. By means of measurements and numerical modelling, the JRP aims at gaining better insight into the general circulation and the heat transport associated with it in the North Atlantic. Investigations are focussed on the current system near the Midatlantic Ridge north of the Azores (North Atlantic Current), the recirculation in the area between the Azores and the Canaries, the eddy fields in this area and the heat storage in the upper 400 m.

## **5. Teaching**

17 full and associate professors work at the institute. They are complemented by 10 assistant professors as well as scientific staff members who contribute to teaching whenever necessary. The scope of the courses offered by the institute is unsurpassed by any other European oceanographic institution.

Diploma and doctorate theses completed in Oceanography, Maritime Meteorology, Biological Oceanography

and Fisheries Biology are of special significance to the progress in the institute's research. Furthermore, there are theses dealing with marine aspects of zoology, botany and microbiology as well as dissertations in marine chemistry. Topics of these theses pertain to the current research of the institute. In 1982, about 150 diploma and doctorate candidates, including students and young scientists from developing countries, were doing their research in the institute.

The coordinated course and lecture program and classes jointly conducted by several departments highlight the interdisciplinary nature of oceanography.

In order to give an example of the versatile course program, some classes from different disciplines of the institute are listed below. They are repeated in an updated version in a biennial cycle.

a) *Lectures*

Introduction to physical oceanography I + II  
Physical Oceanography I – IV  
Turbulence of the ocean  
Estuaries and coastal waters  
Circulation and water masses of the subtropical areas  
Methods for measurements of physical oceanography  
Introduction to theoretical oceanography I – IV  
Theory of surface waves I + II  
Theory of internal waves  
Theory of ocean currents  
Theory of the geostrophical motions I + II  
Introduction to meteorology I + II  
Theoretical meteorology I – IV  
Cloud physics  
Statistical and spectral analysis of observation series  
Terrestrial and astronomical positioning at sea  
General marine chemistry I + II  
Selected topics of organic marine chemistry  
Chemistry of side and marginal oceans  
Introduction to marine botany I – III  
Introduction to marine phytobenthology  
Introduction to marine zoology  
Introductory lecture to the marine zoological laboratory course  
Biology of marine invertebrates  
Current problems of marine pollution  
Biology of the tropical ocean  
Introduction to biological oceanography I + II  
General fisheries biology  
Methods of biological oceanography  
Anatomy, biology, systematics and exploitation of fish  
Development of aquaculture  
Primary production of the plankton  
Ecology of the phytoplankton

Ecology of the zooplankton  
Microbiology of the ocean I + II

b) *Seminars, exercises, practical studies, field trips and colloquia*

Practical studies in physical oceanography I + II  
Introduction to practical studies in physical oceanography I + II  
Exercises in physical oceanography I – IV  
Exercises to introduce to theoretical oceanography I – IV  
Oceanographic seminar for advanced students  
Seminar for graduate students in physical oceanography  
Oceanographic-meteorological seminar  
Exercises to introduce to meteorology I + II  
Exercises in theoretical meteorology I – IV  
Exercises in time series analysis  
Exercises on thermo-dynamics of the atmosphere  
Seminar for graduate students in meteorology  
Seminar in weather analysis and forecast  
Practical studies of meteorological instruments  
Marine chemistry laboratory course I + II  
Introduction to the marine chemistry laboratory course I + II  
Marine chemistry colloquium  
Marine radiochemical course  
Seminar in marine botany and marine zoology  
Seminar in biological oceanography and Fisheries biology  
Exercises on identification of marine animals with field trips  
Marine zoological laboratory course  
Marine algae laboratory course  
Laboratory course in aquaculture  
Methods in electron microscopy  
Marine planktological-oceanographical laboratory course at sea  
Seminar for graduate students in planktology  
Marine microbiological seminar  
Major laboratory course in biological oceanography I + II  
Biochemical methods (laboratory course)  
Seminar on biology of polar oceans  
Oceanographic colloquium  
Advice to graduate students in scientific research

## 6. Central scientific and technical facilities

### Research vessels

The operational planning for „Poseidon“, „Alkor“ and „Sagitta“ is carried out by the IfM, for „Littorina“ by the IfM in conjunction with the University of Kiel. The ships „Alkor“, „Littorina“ and „Sagitta“ are run by the IfM, „Poseidon“ is run by a Bremen shipping-company (Reederei-gemeinschaft Forschungsschiffahrt GmbH).

The smaller ships are used for research cruises lasting from one day up to a few weeks and also for student training cruises. „Poseidon“ is mainly used for longer cruises and for participation in international expeditions. Additionally, research groups of the institute frequently participate in cruises with the research vessels „Meteor“, „Polarstern“, „Anton Dohrn“, „Walter Herwig“ as well as occasionally „Valdivia“.

Name	Type	Year of Construction	Length (m)	Beam (m)	Draught (m)	Displacement (t)	Tonnage (GRT)	Speed	Range (nm)	Crew	Scientists
Poseidon	FS	1976	60.80	11.40	3.85	1318	1049.0	12.5	4000	18	12
Alkor	FK	1966	30.77	7.60	2.40	280	236.0	10.0	2400	8	12
Littorina	FK	1975	29.82	7.42	2.80	200	168.0	10.0	2400	5	6
Sagitta	FB	1966	11.00	3.00	1.15	14	11.5	7.8	400	2	8*

FS: Research vessel

FK: Research cutter

FB: Research launch

\* 1-day cruises

### Library

At present, the library holds some 43.000 bibliographical units. It is directly connected to the external scientific book exchange and co-operates closely with the university central library.

### Electron microscopy

A small electron microscope group has been in existence since 1965, initially in Hohenbergstraße 2. This modest start led to the development of the present electron microscope laboratory designed to provide the biological departments with the facilities for elec-

tron microscopic investigations and to familiarize diploma and doctorate students with this type of research. Two electron microscopes are available in the laboratory. One of them permits histological investigations to resolutions finer than 10 A.

Since recently, the Marine Microbiology department is equipped with a modern scanning electron microscope which is open to the other departments as well. The two Reichert microtomes (OM U2 and OM U3) have proven successful.

A well-equipped darkroom completes the laboratory; electron microscope photographs can thus be developed and enlarged immediately.

## Central isotope laboratory

The institute has a small well-equipped isotope laboratory for studies employing isotopes. Usually, radioactive nuclides are used as tracers. In these experiments, fate and distribution of the nuclide as such or as part of chemical substances is traced, be it in chemical analytics, in physiological or in food chain investigations. Concentrations of the elements in question can also be determined by neutron activation or X-ray fluorescence analysis. This methodology represents an attractive research tool for a number of projects in various departments. However, difficulties in keeping live material limit the application to a certain extent.

The equipment is robust and designed for operation using automatic samplers for both routine and special investigations. Thus, for measurements of alpha-, beta- and gamma-rays a liquid scintillation spectrometer is available as well as a gamma counting system (each for 200 samples) and a Planchet changer adaptable for measuring all three types of radiation with a 60 sample capacity for non-destructive investigations of filter papers and other flat samples. Complex gamma-ray spectra of the type derived from neutron-activation can be interpreted on a multi-channel analyzer equipped with high resolution coaxial-Ge(Li) detectors. The data are computer processed. Locked into the same computer is a total reflexion X-ray activator combined with a Silicon-(Li)-detector and a multi-channel analyzer. Both devices are equipped with sample changers. For data processing with personal computers and on line a variety of software programs is available.

## Computer center

The computer center provides computer hardware and software for analysis of oceanographic-meteorological, chemical and biological data. It comprises a small computer with associated peripherals (digitizer, line printer, magnetic tape drives, disks, plotter etc.). The functions of the computer can be broadly divided into three parts.

1. Processing and storing expedition data (calibration, correction, analysis, plotting).
2. As a link to the Kiel University Computer Center on a data line for developing and testing programs to be used in the scientific analysis of data and running theoretical models.
3. Linked by data line to the large computers at the Regional Computer Center Hannover (Cyber 76) and the Computer Center Berlin (CRAY 1) for running programs requiring above average memory and computation time (e.g. numerical simulation of circulation processes in the sea).

## Aquarium

The public display aquarium of the Institut für Meereskunde was opened on the 10th May 1972 on the occasion of the Olympic exhibition „Man and the Sea“. The 33 tanks with capacities ranging from 200 to 1.100 litres show – in ecological order – about 200 species of fish and invertebrate animals from the local lakes and rivers and the North Sea and Baltic, the North Atlantic and the Mediterranean. By way of contrast, fish and invertebrates from the coral seas are presented in a number of tanks.



Guided tour through the display aquarium (photo: E.Mempel)

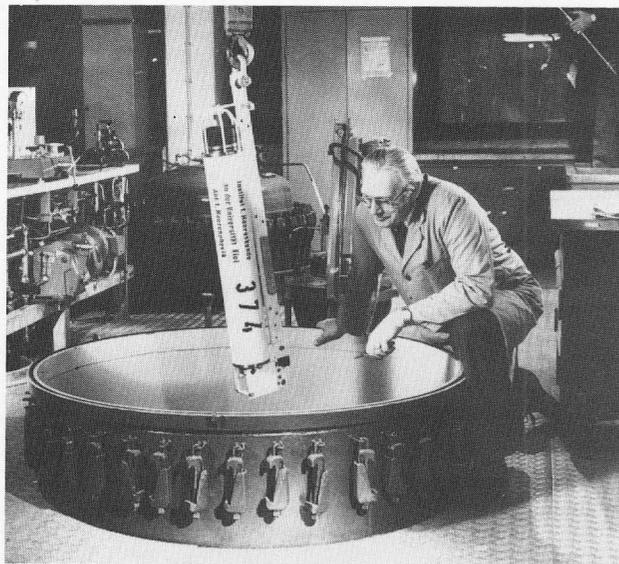
For the first time in a display aquarium of this size the main circulation (North and Baltic Sea water) comprising 50 and 30 m<sup>3</sup> respectively is cleaned almost exclusively by albumen skimming with adjustable addition of ozone and a built-in algae tank used as a regeneration basin.

The systems running at 10° C (North Sea) and 13° C (Baltic Sea) are processed once an hour and are topped up once a week with about 2 – 10 % of new water. Since 1982, the water processing is improved by the additional use of trickling filters consisting of polypropylene balls. Due to their three-dimensional grid-like structure, these balls have a very large surface on which bacteria grow; they clean the water by absorbing dissolved substances. The water is recharged from a depth of 9 m in the Kiel Fjord via a separate container with a capacity of 182 m<sup>3</sup>, equipped with a gravel filter. Attached to the aquarium is a seal basin which at present holds 5 common seals.

### Central workshop

This central service of the institute comprises a precision mechanic's workshop, a locksmith's workshop, a carpenter's workshop, an electro-technical workshop, storage facilities for large gear and a pressure tank. This facility serves for the development and construction of scientific gear if it is neither commercially available nor developed by the departments themselves, the adjustment of commercially available instruments to the special needs of oceanography and testing, maintenance and repair of instruments.

Additionally, technicians working here participate in scientific cruises on research vessels. The central workshop also serves as a training facility for precision mechanics.



Testing of an instrument in the pressure tank prior to the deployment at sea (photo: E. Mempel)

## 7. Publication series

Collected Reprints (started in 1974)

„Kieler Meeresforschungen“ (journal, started in 1937 continued as occasional special issues since 1976)

„Berichte aus dem Institut für Meereskunde“ (report series, started in 1937)

„Jahresberichte“ (annual reports, started in 1968).

# Wissenschaftler des Instituts für Meereskunde an der Universität Kiel und Leiter bzw. Betreuer der zentralen Einrichtungen

Physikalisch-chemische Abteilungen

## Regionale Ozeanographie

**Direktor:** Prof. Dr. F. Schott

### Wissenschaftlicher Stab:

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Dr. J. Fischer	Dr. V. Strass
Dr. M. Rhein	Dipl.-Oz. M. Visbeck
Dr. U. Send	Dr. S. Wacongne

## Theoretische Ozeanographie

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Dr. K.P. Koltermann	
Dr. T.J. Müller	
Dr. R. Onken	<b>Gastforscher:</b>
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Dipl.-Met. K. Bumke	Dipl.-Met. A. Neugum
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Dr. H.-J. Isemer	Dr. K. Uhlig
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April 1990

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Kustos:

Prof. Dr. G. Kortum

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Amtsrat J. Wittmaack

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Dr. J. Kielmann

## Zentrallabor für Isotopentechnik

U. Rabsch

## Zentrallabor für Chemische Analytik

Prof. Dr. J.C. Duinker

## Zentrallabor für Meßtechnik

Dr. T.J. Müller

## Zentrallabor für Kultivierung von Meeresorganismen

Dr. U. Waller

## Werkstatt

U. Lentz / Dr. W. Zenk

## Forschungsschiffe

Prof. Dr. G. Kortum

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Techn. Leiter: W. Marwedel

Biologische Abteilungen

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(beurlaubt)	Dr. U. Waller
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Dr. U. Piatkowski	

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Dipl.-Biol. W. Koeve	Dipl.-Biol.
Prof. Dr. J. Lenz	Dr. Thiele-Gliesche
Dipl.-Biol. M. Meyerhöfer	Dipl.-Biol. M. Voss

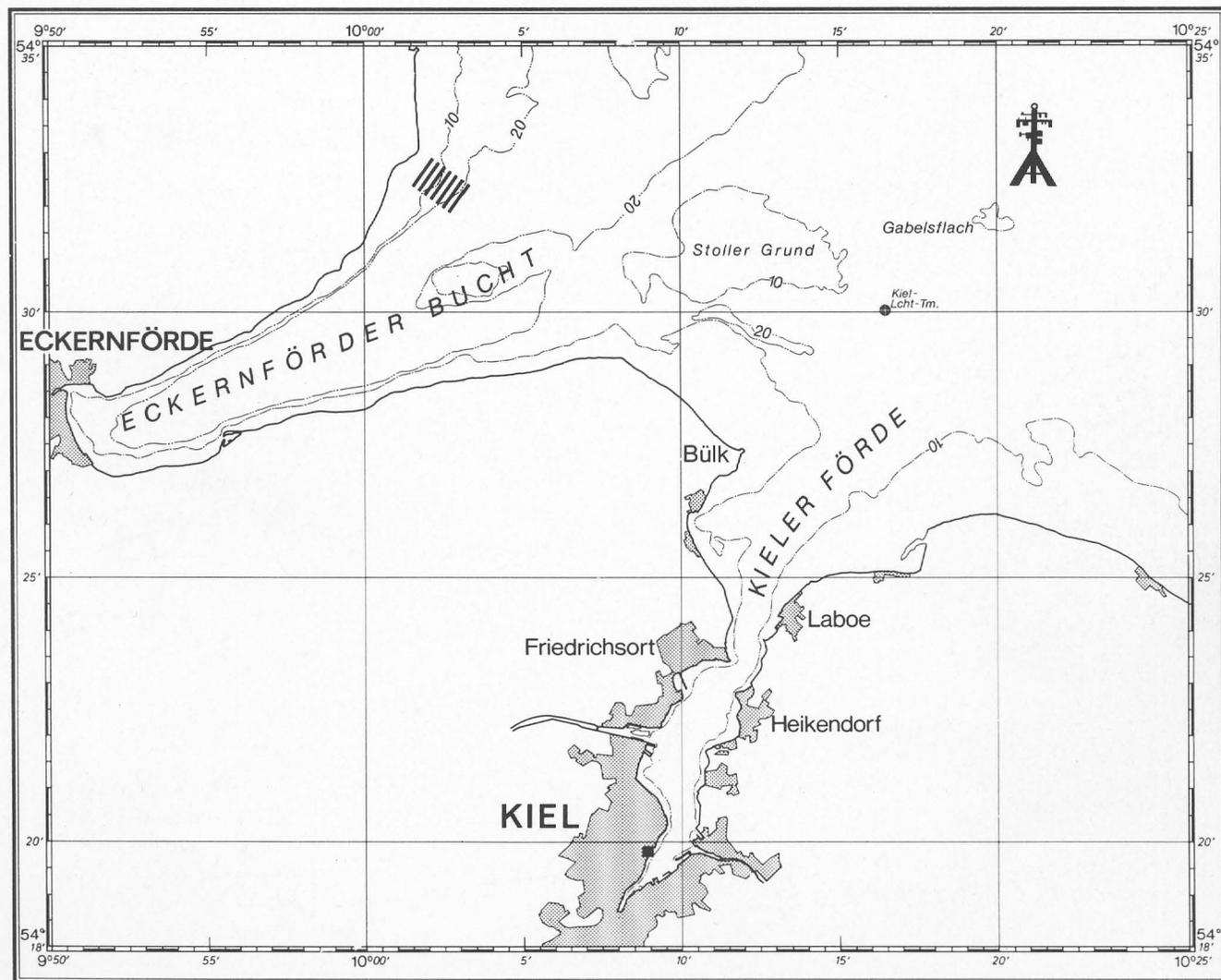
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Dipl.-Biol. H. Giesenhagen	Dr. L.-A. Meyer-Reil
Dr. K. Gocke	Dr. R. Schmaljohann
Prof. Dr. H.-G. Hoppe	Dr. J. Schneider
Dr. K.-O. Kirstein	Dr. H. Sich
Dipl.-Biol. M. Köster	Dipl.-Biol. J. Wesnigk
Dr. K. Lochte	

# KIELER BUCHT SOUTHWESTERN PART



Meteorological station



Area restricted to research

Southwestern part of Kiel Bight with the area restricted to research and with the site of continuous in situ registration of maritime meteorological data.

## RESEARCH VESSELS



F.S. "POSEIDON"

(Built 1976) GRT 1049 Length 60,80 m Beam 11,40 m  
18 men crew and 12 scientists



F.K. "ALKOR"

(Built 1966) GRT 236 Length 30,77 m Beam 7,60 m  
8 men crew and 12 scientists



F.K. "LITTORINA"

(Built 1975) GRT 168 Length 29,82 m Beam 7,42 m  
5 men crew and 6 scientists



F.B. "SAGITTA"

(Built 1966) GRT 11,5 Length 11 m Beam 3 m  
2 men crew and 8 scientists

Construction  
financed by:

F.S. "POSEIDON"  
F.B. "SAGITTA"  
F.K. "ALKOR"  
F.K. "LITTORINA"

} Bundesminister für Forschung und Technologie und  
Kultusminister des Landes Schleswig-Holstein  
Volkswagenstiftung  
Deutsche Forschungsgemeinschaft