

## IV Antarctic Expedition to the Arctowski Station (King George Island, November 1979 — May 1980)

### 1. Introduction

The Cabinet passed the bill (No 173/77 on November 29, 1977) for the realization of the Interdepartmental Problem MR-II-16 "Complex research of the Antarctic and Arctic as a basis for protection and knowledge of their natural habitat" coordinated by the Institute of Ecology, Polish Academy of Sciences. Thus scientists from many institutes of Polish Academy of Sciences, from the Ministry of Education and Schools of Academic Rank, Ministry of National Defence, Ministry of Health and other departments, carry out research on the Arctowski and Dobrowolski Antarctic Stations.

The IV Expedition (1979/1980) was the fourth expedition to the Arctowski Station organized by the Institute of Ecology, Polish Academy of Sciences; it had a scientific programme, organization and technical outline, expedition instructions, instructions for the management, rules and regulations for the Arctowski Station and participants issued by the Scientific Secretary of the Polish Academy of Sciences and also the dispositions of the Head of the Institute of Ecology, Polish Academy of Sciences.

The aim of the expedition was to continue the studies in the region of the Admiralty Bay within the Interdepartmental Problem MR-II-16. Biological, medical and studies of earth were conducted.

The technical aims of the expedition concerned the maintenance, repairs and exchange of equipment, buildings, electric wiring, plumbing, help in fulfilling the scientific programme, refuelling the tank up to 890 tons and close cooperation with the I Geophysical Expedition of Polish Academy of Sciences to the West Antarctic (Polish Navy Ship "Kopernik"), especially as regards refuelling.

The management of the expedition:

Ass. Prof. Andrzej Myrcha — head

Jacek Zalewski, M. Sc., — assistant to technical matters

Com. Ryszard Ułamek, M. Sc., — assistant to maritime affairs

Eugeniusz Moczydłowski, M. Sc., — head of wintering group

Col. Kazimierz Potrzebowski — assistant of the head of wintering group to technical matters

## 2. Expedition members

### Scientific team:

1. Barbara Cygan, M. Sc., — Institute of Meteorology and Water Management
2. technician Krzysztof Czuba — Botanical Garden, Polish Academy of Sciences
3. Dr. Gerard Drewa — Medical Academy, Gdańsk
4. Jacek Goździewicz, M. Sc., — Institute of Ecology, Polish Academy of Sciences
5. Ryszard Gutkowski, M. Sc., — Department of Biology at the Białystok Branch of Warsaw University
6. Dr. Ryszard Halba — Institute of Zoology, Warsaw University
7. Dr. Bolesław Jabłoński — Institute of Zoology, Polish Academy of Sciences
8. Hanna Jackowska, M. Sc., — Institute of Ecology, Polish Academy of Sciences
9. technician Antoni Janasek — Botanical Garden, Polish Academy of Sciences
10. technician Jerzy Komorowski — Institute of Geophysics, Polish Academy of Sciences
11. Andrzej Kozik, eng. M. Sc., — Institute of Geography, University of Warsaw
12. Andrzej Kutner, M. Sc., — Institute of Pharmaceutical Industry
13. Tomasz Linkowski, eng. M. Sc., — Sea Fisheries Institute
14. Andrzej Maciążek, eng. M. Sc., — Institute of Meteorology and Water Management
15. Grzegorz Marczak, eng. M. Sc., — Department of Meteorology of the Military Technical Academy
16. Eugeniusz Moczydłowski, eng. M. Sc., — Institute of Ecology, Polish Academy of Sciences
17. Ass. Prof. Andrzej Myrcha — Institute of Ecology, Polish Academy of Sciences
18. Dr. Ryszard Ochyra — Institute of Botany, Polish Academy of Sciences
19. Dr. Andrzej Paulo — Academy of Mining and Metalurgy
20. Dr. Stanisław Pietr — Department of Agricultural Microbiology, Academy of Agriculture in Wrocław
21. Dr. Joanna Pilarska-Obojska — Institute of Ecology, Polish Academy of Sciences
22. Piotr Presler, M. Sc., — Department of General Zoology, *Á*ódź University
23. Dr. Zygmunt Rawa — Institute of Meteorology and Water Management
24. Dr. med. Jacek Różyński — Military Institute of Air Medicine
25. Ass. Prof. Zbigniew Rubinowski — Institute of Geology *Á*więtokrzyski Department
26. Jacek Siciński, M. Sc., — Department of General Zoology, *Á*ódź University
27. Anna Szewielow, M. Sc., — Institute of Ecology, Polish Academy of Sciences
28. Jan Taylor, M. Sc., — Institute of Ecology, Polish Academy of Sciences

29. Dr. Andrzej Tatur — Institute of Ecology, Polish Academy of Sciences
30. Anna Tokarska, M. Sc., — Department of Geological Sciences, Polish Academy of Sciences
31. Dr. Antoni Tokarski — Department of Geological Sciences, Polish Academy of Sciences
32. Magdalena Tulli, M. Sc., — Institute of Ecology, Polish Academy of Sciences
33. Dr. Aleksander Wasilewski — Institute of Ecology, Polish Academy of Sciences
34. Józef Weiss, eng. M. Sc., — Institute of Geophysics, Polish Academy of Sciences
35. Tadeusz Wojciechowski, eng. M. Sc., — Institute of Meteorology and Water Management

Also the technical team counted 27 persons. Alana Puchalska, M. Sc., and a journalist Hanna Krzyżaniak joined the expedition.

During the winter of 1980 on the Station stayed: Ryszard Gutkowski, M. Sc., Dr. Ryszard Halba, Dr. Bolesław Jabłoński, technician Jerzy Komorowski, Andrzej Maciążek, M. Sc., Grzegorz Marczak, M. Sc., Eugeniusz Moczydłowski, eng. M. Sc., Dr. Zygmunt Rawa, Dr. med. Jacek Różyński, Dr. Aleksander Wasilewski, Józef Weiss, eng. M. Sc. and 9 people from the technical group.

Altogether 62 people took part in the IV Antarctic Expedition of Polish Academy of Sciences to the Arctowski Station. The scientific team consisted of 35 scientific workers from 6 institutes and 1 department of the Polish Academy of Sciences, and 8 High Schools (universities, Medical Academy, Academy of Agriculture, Academy of Mining and Metalurgy, Military Technical Academy) and 5 departmental institutes. The expedition used ships m/s "Antoni Garnuszewski" and m/s "Kapitan Ledóchowski" chartered by the Institute of Ecology, Polish Academy of Sciences.

### 3. Diary of the expedition

- 10.11.79 — The IV Antarctic Expedition on m/s "Antoni Garnuszewski" sailed out at 3.20 p.m. from Gdynia.
- 23.11.79 — At 0.12 a.m. m/s "Antoni Garnuszewski" crossed the equator.
- 30.11.79 — Entering Montevideo.
- 1.12.79 — Stop at Montevideo.
- 7.12.79 — At 7 a.m. m/s "Antoni Garnuszewski" sailed into the Admiralty Bay. Greeted by the group staying there for winter 1979. M/s "World Discoverer" visiting.
- 8.12.79 — 8.30 a.m. landing and loading the equipment and scientific material of the wintering group of the III expedition. 4 p.m. a visit of Chile troopship m/s "Aguiles" supplying its Antarctic stations.
- 15.12.79 — Visit of a passenger ship m/s "Lindblad Explorer".

- Robert Hernandez, responsible for expedition organization, is applied first-aid (broken shoulder blade).
- 17.12.79 — Unveiling of a tombstone placed over the grave of Włodzimirz Puchalski who had died during the previous expedition.
- 18.12.79 — End of landing and loading m/s “Antoni Garnusze-wski”.
- 19.12.79 — Farewell of the wintering group and ship crew. New wintering group of the IV Antarctic Expedition is now responsible for the Arctowski Station. 4 p.m. m/s “An-toni Garnuszewski” set out on its way back to Poland.
- 31.12.79 — 9 a.m. Polish Navy Ship “Kopernik” with the I Geo-physical Expedition to the West Antarctic on board entered the Admiralty Bay.  
11.00 a.m. — Visit of passenger ship m/s “World Disco-verer”.
- 2.01.80 — Polish Navy Ship “Kopernik” supplied with 180 tons of fuel.
- 3.01.80 — 10.30 a.m. — 4 ships anchored in the region of the Station, in the Ezcurra Inlet. The Russian salvage ship “Hurricane” together with Chile tow vessel “Ultramar III” and Argentine salvage vessel “Gen. Irigoyen” warped m/s “Lindblad Explorer”. Polish Navy Ship “Kopernik” gave the Russian ship a batimetric map of the bay. Technical and medical help was given to crew members of m/s “Lindblad Explorer”.
- 4.01.80— 6.01.80 — Commanding staff and the crew of Argentine ship “Gen. Irigoyen” visited the Station.
- 15.01.80 — South-African towing boat entered the Station region.
- 16.01.80 — m/s “Lindblad Explorere” left its mechanic for medical cure at the Station.
- 19.01.80 — 8.30 a.m. — visit of Argentine warship “Francisco Gur-ruchaga”.  
5 p.m. — French yacht “Momo” anchored near the Station.  
6 p.m. — Polish Navy Ship “Kopernik” entered.
- 20.01.80 — Refuelling of Polish Navy Ship “Kopernik” and filling its water reservoirs.
- 21.01.80 — 8.30 a.m. the base of “Gryf Pomorski” anchored in Ezcurra Inlet.  
10.30 — refuelling the station reservoir with the help of barges (890 tons of fuel) during 4 days.
- 22.01.80 — Visit of m/s “World Discoverer”. The sick mechanic from m/s “Lindblad Explorer” was taken on board.
- 24.01.80 — Visit of an English hydrographical ship H. M. S. “En-durance”.
- 26.01.80 — Visit of r/v “Hero” — research vessel of American Station “Palmer” with a group of geologists from the

- Ohio State University and biologists from Dr. McWhinnie's laboratory.
- 31.01.80 — The Arctowski Station inspected by American State Inspection Group of Antarctic Observers: R. C. Scully — president, O. W. Silkwood, R. H. Schaus, M. Kazanowska, C. R. Oleszycki. In the bay of U.S. Coast Guard Cutter "Polar Sea".  
 Nine members of the IV Expedition visited the Russian Station "Bellingshausen" and the Chile one "Frei".
- 3.02.80 — Visit of m/s "World Discoverer".  
 Visit of delegation from Russian Station "Bellingshausen" and Chile Station "Frei".
- 4.02.80 — Visit of r/v "Hero".
- 5.02.80 — m/t "Włócznik" brought for medical cure its crew member suffering from acute joint inflammation.
- 6.02.80 — Polish Navy Ship "Kopernik" entered for fuel and water supply.
- 7.02.80 — Visit of Russian delegation from Station "Bellingshausen".
- 12.02.80 — French yacht "Momo" sailed in again.
- 15.02.80 — 5.30 — r/v "Hero" brought Dr. Francis S. L. Williamson — head of American polar research — with a finger broken in two places. Doctors at the Station applied medical aid.  
 8 a.m. — fishing boat m/t "Tucana" entered and was supplied with 60 tons of water.
- 18.02.80 — Polish Navy Ship "Kopernik" entered.
- 26.02.80 — Celebrations of the third anniversary of the Station foundation.
- 28.02.80 — Visit of W. A. Spiczkin — head of the Russian Station "Bellingshausen".
- 1.03.80 — Visit of the head of IV Expedition and the management of the group wintering on the Russian Station "Bellingshausen" and the Chile Station "Frei".
- 7.03.80 — "Hero" brought the mail from Ushuya. Another arrival expected together with the summer group from American Station "Palmer".
- 9.03.80 — 5 p.m. — m/s "Kapitan Ledóchowski" entered the Admiralty Bay and lied at anchor in the Ezcurra Inlet. The ship was chartered: landing and loading of equipment and scientific material of the IV Expedition. Argentine ship "Francisco Gurruchaga" sailed in the neighbourhood of the Station.
- 18.03.80 — 5.30 p.m. — m/s "Kapitan Ledóchowski" with the summer group and part of the wintering group sailed out in the direction of Argentine station "Esperanza".
- 19.03.80 — Because of bad navigation conditions the ship put about in the direction of Deception Island.

- 21.03.80 — Farewell of the wintering group. 4 p.m. — handing over the ship's charter.
- 22.03.80 — 8.00 — m/s "Kapitan Ledóchowski" with summer group of the IV Expedition on board put back to Poland.
- 27.03.80—31.03.80 — The ship stopped near Port Stanley on Falkland Islands. Fish flour was loaded on ship from the fishing base "Gryf Pomorski".
- 4.04.80— 5.04.80 — The ship stopped at Montevideo.
- 24.04.80 — The ship stopped at Santa Cruz de Tenerife.
- 4.05.80 — m/s "Kapitan Ledóchowski" sailed into port in Szczecin.

#### 4. Main trends and results of research

##### Biological studies

The IV Expedition continued the complex ecological studies initiated by the III Antarctic Expedition of Polish Academy of Sciences. Investigations aimed at construction of a model of the functioning of Antarctic ecosystem of the near-shore zone and a monography of the Admiralty Bay and the surrounding land. The III Expedition concentrated mainly on studying the physical and biological processes in marine environment. The IV Expedition, apart from a continuation of ocean-biological studies, concentrated more on processes occurring on land.

It has been observed that large breeding groups of birds, especially of penguins, are the main factors of great significance in matter cycling and energy flow in the ecosystem of near-shore zone and in the formation of biotic land environment (Institute of Ecology, Polish Academy of Sciences, Department of Agricultural Microbiology Wrocław, Institute of Geography, Silesian University).

In 1979/1980 there were almost 90 000 penguins of the *Pygoscelis* genus in a number of rookeries in 4 places of the Admiralty Bay. During the time the penguins stay on land (mid-November to mid-March) they bring out from sea where they feed a tremendous amount of organic matter, i.e., faeces, which they leave mainly on the areas of colonies and ways leading to them. In the region of the Admiralty Bay this is 19—34 tons per 24 hours. The main part of this organic matter is intensely mineralized on land and the nutrients are released gradually and their majority return in the form of simple chemical compounds to sea together with water flow or are released to the atmosphere. The rate of decomposition and return of matter from breeding places to sea depends on the site of rookery and on climatic conditions, mainly the intensity of snow and ice melting and precipitation. It should be also pointed out that feeding places of penguins eating krill are first of all in the Bransfield Strait, sometimes several tens of kilometres from the rookery, and the nutrients flow directly to the near-shore zone of the bay fertilizing it to a great extent.

In the case of some rookeries of *Pygoscelis antarctica* (less than 10% of the total number of penguins), in the direct neighbourhood of sea, on cliffs the flow is fast and the decomposition is low. But as regards colonies of *P. papua* and *P. adeliae* on flat sea shore terraces or on top of the hills the faeces accumulate for a longer time and are washed out much slower. All cases in the Admiralty Bay have been investigated.

All the summer the trends and decomposition rate of organic compounds and the return rate of nutrients to sea have been investigated on the example of determined microdrainage basins with many nesting birds and without penguin rookeries. Most important in decomposition are microorganisms.

The first process of great significance in mineralization is proteolysis, whereas ammonification process is the second stage of nitrogen compounds.  $N-NH_3$  part after mineralization is adsorbed by organic compounds or remains in the form of simple ions in the solution and is slowly released to the atmosphere. Simultaneously the mineralization of organic phosphorus takes place. On the soil surface of the colony intense microbiological chitin decomposition occurs. But chitin is mineralized after being washed and after partial mineralization of other organic compounds. Further change of nitrogen compounds, nitrification, occurs after a longer period of time and in deeper layers of soil profiles or in some distance from the rookery. The occurrence of layers of weathered material of considerable thickness delays the transport of not decomposed organic compounds and products of their decomposition:  $P_{ortho}$ ,  $N-NH_3$ ,  $N-NO_3$  reach mainly the bay.

But not all the phosphorus returns to the sea. Phosphates being the main component of binding agent of gross cumulate in soils, thousands of tons in the Admiralty Bay.

Results obtained will be analyzed as regards the possibility of balancing this link of carbon, nitrogen and phosphorus cycling.

The effect of large colonies of birds on soil-forming processes, on plant succession and formation of phytosociological associations, on numbers and species composition of soil fauna has been also investigated (Institute of Ecology, Polish Academy of Sciences, Institute of Botany, Polish Academy of Sciences).

Types and kinds of ornithogenic soils in this region are described. Ninety per cent of all soil animals occur in the surface soil layer (0—3 cm). They are represented by *Protozoa*, *Rotatoria*, *Nematoda*, *Tardigrada*, *Apterygota* and *Acarina*. There have not been many phytophagous animals, only those represented by *Tardigrada* connected with soils abundant in unicellular algae. Predatory forms are also not numerous — only some *Acarina* being hardly 0.5% of the population. In Antarctic soils examined saprophages and bacteria-saprophages dominate. Therefore the soil fauna is more numerous in environments more abundant in organic matter with the exception of soil of large active breeding colonies with too high ammonia concentration.

Intense botanical studies have resulted in finding in the Admiralty Bay 44 moss species, 7 species of liverworts, 67 species of lichens and 2 species of vascular plants. Among them 6 species were new for South Shetlands and 3 were new for the Antarctic zone. Twenty phytosociological associations were distinguished, the majority new ones from 3 classes and 7 orders.

Phytosociological maps were made for two big regions (Rescuers Hills and oasis where is the Station), the development and succession of plant communities were observed.

In order to grasp quantitatively and qualitatively the ways of energy flow in the terrestrial zone bioenergetic and population studies of dominant groups of animals were continued (Institute of Ecology, Polish Academy of Sciences, Institute of Zoology, Polish Academy of Sciences).

Respirometric and calorimetric methods were used to investigate the energy balance of the growth period of penguins of the genus *Pygoscelis*, whereas the food method was used for studying the balance elements of adult individuals of some of the most numerous species of birds. Intense studies on population and reproduction biology of penguins, Wilson petrels, giant petrels, were carried out. Numbers and biomass of the remaining 8 species of nesting birds and of pinniped mammals, were estimated. Also a microclimatic reconnaissance was made of places used by animals during reproduction and moulting and which were colonized by different plant communities.

As regards the oceanobiological research (Institute of Ecology, Polish Academy of Sciences; Department of General Zoology, Łódź University, Sea Fisheries Institute) species composition was still elaborated and biomass of benthic animals was estimated with regard to ecological and environmental factors, population studies of zooplankton were conducted and the food of fish in the bay was analyzed. Fluctuations in the numbers of protozoans and their role in the Antarctic marine environment were studied.

Another group of biological problems studied by the IV Expedition was the search of new sources for food and chemical industry. Some of the already mentioned research problems on seals, fish and crustaceans are connected with the problem.

Very interesting are the results of biochemical studies on steroid compounds in the bile of different species of Antarctic animals (Institute of Pharmaceutical Industry) and the content of lipides fluorine in crustaceans of the genus *Euphausia* (Institute of Ecology, Polish Academy of Sciences).

The main component of bile in Antarctic fishes is the taurocholic acid without free cholanic acids and with a slight admixture of dihydroxycholanic acids conjugated with taurine. Thus the isolation of main components in a very pure form is possible. White-blooded Antarctic fish, containing plenty of bile in easily separated gall bladders, may become a source of this valuable raw material or pharmaceutical industry. For several days the fishing boat m/t "Merkury" has taken bile from 1.5 tons of fish, mainly white-blooded, for further research in laboratory on the technology of production of cholic acid.

Fluorine content in krill when analyzed has shown that this negative fluor component is mostly in the chitin carapace and in the head part of crustaceans, whereas the least is found in muscles and in the pancreas-liver. Also great amount of samples from four species of Antarctic algae were collected, i.e., *Himantothallus* (*Phyllogigas grandifolius*), *Leptosomia simplex*, *Monostroma hariotti* and *Adenocystic utricularis* for detailed biochemical investigations (Department of Biology, the Białystok Branch of Warsaw University). Protein and carbohydrates content in these plants were analysed



in situ, determining their production, photosynthetic activity, dark and photo-respiration. Also content and activity of arylsulphatase (E.C. 3.1.6.1) in livers of different species of animals were determined (Medical Academy, Gdańsk).

Under this group of problems come also the botanical breeding experiments in the glasshouse on the Arctowski Station (Botanical Garden, Polish Academy of Sciences).

The third group of problems concerns the research on monitoring the contamination and the protection of Antarctic environment (Institute of Zoology, Warsaw University; Medical Academy, Gdańsk; Department of Agriculture Microbiology, Academy of Agriculture, Wrocław).

DDT and PCB (polychlorinated biphenyls) and their derivatives in the Antarctic trophic chain have been determined thus allowing to grasp the cycling of these compounds in the ecosystem examined. Another subject were studies on the influence of oil and its derivatives and of detergent ABS on life processes of crustaceans in the Admiralty Bay. Drinking water was analysed microbiologically (almost sterile on the Arctowski Station) and also the sewage. In the settling tank of the station pathogenic bacteria are reduced considerably, but they occur also in sewage discharge. The sewage thus is being enriched in the first chamber of the settling tank.

### Medical studies

This concerned studies on the effect of climatic factors on human organism, the functioning of the thermoregulation, characteristics of daily and seasonal rhythms in people living under changed environmental conditions and psychological observations of small isolated human groups (Military Institute of Air Medicine).

### Studies on earth

The meteorological station functioning all year round carries out observations of all meteorological elements, i.e., temperature of air, ground and water, atmospheric pressure, high and low winds, air humidity, cloudiness, meteorological phenomena, visibility, insolation and radiation, cooling, state of ground and ice cover and water levels. The majority of these elements are recorded automatically thus making possible observations during a period of time. Furthermore weather maps are obtained from centres in Buenos Aires and Pretoria and the Antarctic Station Molodiznaja. This is a great help for making weather forecasts for the West Antarctic. Data recorded on the Arctowski Station are regularly transferred to other Antarctic stations and to the WHO centre.

Vertical distribution of chosen meteorological parameters in the lowest several metre-layer of atmosphere was investigated in relation to thermal conditions and dynamics of this layer and the climatic seasonal and general circulation (Institute of Meteorology and Water Management).

All sky photographs were made few times a day. Meteorological satellite photographs from three day orbits in the visible and infra-red channels

and from three night orbits in the infra-red band were obtained by means of Russian satellites Meteor 23, Meteor 24 and Meteor 25 and from two American satellites Tiros N and NOAA 6 (Department of Meteorology, Military Technical Academy).

On the Arctowski Station there are also seismic and magnetic observatories functioning all year round (Institute of Geophysics, Polish Academy of Sciences). The magnetic observatory records elements of the magnetic field (components H, Z, D), measurements of total intensity of magnetic field, measurements of declination and horizontal component in order to determine absolute values and base values for components H, Z, D and also the indices of magnetic activity and to describe special phenomena.

Constant seismic registration is conducted on the basis of recordings of three short period seismographs of SV-67 type (two horizontal, one vertical) with parallel time control of an accuracy to 0.1 sec.

Recorded magnetic and seismic data are regularly sent to the Institute of Geophysics, Polish Academy of Sciences.

Glaciological studies concerned the following problems: reconnaissance and characteristics of glaciers in the region of Ezcurra Inlet-Bransfield Strait, dynamics of slope processes on areas with advancing deglaciation and finding the intensity of thermokarst processes in moraine formations (Institute of Geography, Silesian University).

A group of geologists (Department of Geological Sciences, Polish Academy of Sciences; Academy of Mining and Metallurgy, Institute of Geology — Świętokrzyski Department) worked intensely during the IV Expedition and finished the second stage of geological charting of the King George Island after closing the survey of the region of King George Bay. On the whole, including the area charted during seasons of 1977/78 and 1978/79, the survey covers about 450 km<sup>2</sup>.

A great success has been the discovery and study of the Arctowski Mountains. The central part of mountains is a granitoid intrusion up to the west to the Dobrowolski Peak, from where its contact with rock of the shield is visible. To the east the glacier bassets disappear under the glacier Academic Teacher, which covers its contact with the shield. The eastern part of the Arctowski Mountains is constructed of formations of the Group Mt Hopeful consisting of three volcano and volcano — sedimentary formations and the intrusions in the form of dikes and sills. Two bottom formations of a thickness over 110 m consist mainly of lava. The highest formation Ice Breccia Gl. consists mainly of agglomerates and conglomerates of volcano, sedimentary material and of plutonic rocks. The series contains inserts of sandstone, mudstone and tuff. The thickness of formations assuming no tectonic repetitions is at least 950 m. Formations of Group Mt Hopeful are epidoted and chlorited regionally, which is characteristic of the "mezozoic" series on the island. Thus it is extremely important to find in the Ice Breccia Gl. formation tuffs with plant traces. This is the first site of flora in "mezozoic" formations and may provide material for age determinations. Group Mt Hopeful seems to be without an equivalent in other parts of the island.

The formation of Dobrowolski Peak probably consists of thermically

much changed vulcanities with inserts of clastic rocks. According to structural investigations this formation may be an equivalent of a fragment of the sequence of Group Mt Hopeful.

Eastern part of the Arctowski Mountains is the first example of Alpine tectonics found on the island. The two bottom formations of the Group Mt Hopeful are not much deformed and possibly are brittle. Above, separated by the surface of the overlap, there are steep detritic Ice Breccia Gl. formations encompassed by regional cleavage.

The occurrence of Alpine tectonics and the differentiation of tectonic style depending on the lithology of deformed series seem to be a significant contribution to the geotectonic position of Antarctands.

In the Arctowski Mountains symptoms of copper mineralization are quite common. In formations of Group Mt Hopeful this is a vein and stockwork with chalcopirite and piryte. The veins are 4 cm thick. In the Dobrowolski Peak massif in granitoids of intrusion and in shield rocks occurs sputters of chalcopirite, piryte and magnetite of a diameter up to 1 cm.

This type of mineralization has been discovered for the first time in South Shetlands and then in West Antarctic. This discovery confirms the opinion about the passing of Andes ore-bearing province to Antarctands.

Lithostratigraphic sequence has been elaborated and a correlation was made of its bottom part with Mazurek Pt. Formation for the region of Three Sisters Pt. — Turret Pt. Volcanó centres were situated. A characteristic feature of the region is the long-lasting existence of volcanic centre, from the deposited Mazurek Pt. Formation to the contemporary volcano of the Penguin Island. A new site of fossile flora, possibly the youngest one on the island, has been discovered. Its elaboration will provide more information about the climatic conditions in the period preceding directly the glaciation Polonaise.

Conglomerations with the exotics observed on nunataks Magda and Conglomerate, on Three Sisters and on the Harnasie slope are sea tillits of Polonaise Formation, i.e., sediments of the oldest known glaciation on South Shetlands. The recently discovered sites broadened considerably the occurrence range of the Polonaise Formation, which is at present known for the whole shore between the Vaureal Peak and Three Sisters Pt. The occurrence of these sediments on Conglomerate nunatak at least at the height of 265 m provides more information as regards the range and character of young tectonic movements.

Two levels of piryte mineralization have been observed on the Keller Peninsula. In one of them there is a piryte layer on Ore Pt, elaborated in detail. There are lenticular bodies with impregnatory mineralization with iron sesquisulphide. The thickness of ore-bearing complex is estimated as 12—60 m. The mineralization processes occurred probably before the sedimentation of the upper part of Visca Anchorage Formation.

Also the occurrence of zeolite mineralization on the King George Island has been investigated. The material obtained will allow to describe changes in character of this mineralization in time and space, which considering the common occurrence of zeolites on the island may be useful in lithostratigraphical correlations.

## 5. Organization-technical work and transport

1. Participants took part in a course "Safety and Hygiene of Work" at Mikołajki.
2. M/s "Antoni Garnuszewski" was chartered and the participants took ship.
3. M/s "Antoni Garnuszewski" landed — mean landing rate 94 tons per day.
4. The Station tank was filled with 890 tons of fuel from msg "Gryf Pomorski" — 225 tons per day.
5. Polish Navy Ship "Kopernik" was refuelled 5 times with the total of 400 tons of fuel and 180 tons of water. M/t "Tucana" was also provided with 70 tons of water.
6. 1000 empty fuel barrels were prepared for shipment.
7. A new gangway for floating vessels with a hoisting gear was made.
8. The buildings of meteorology and geophysics were protected from cold.
9. An aviary was built for experimental ornithological investigations.
10. The roof of the metal house was repaired and riveted.
11. After putting in order the wooden house shelves were constructed up to the top thus becoming the central store-room of the Station.
12. The old hydrophore room was changed into a food store.
13. The washroom, day room and kitchen were repaired.
14. Shutters of the dwelling-house and of meteorological and biological laboratories were changed for new ones; the buildings and cooling containers were painted.
15. The scrap and old boxes were removed and a waste incinerator was built.
16. Fuel tank was repainted.
17. In the metal house a workshop for repairing sets was built and also a store for installation material, and upstairs above the duty-room — a locked storeroom for clothes.
18. A warmed section of water supply system (with circulation) was constructed for meteorological and biological laboratories.
19. The sanitary and water supply system in the dwelling-house was rebuilt — new showers, and additional WC, washing-machines.
20. Putrid settling tank was cleaned.
21. Inspection and maintenance works on helicopters were carried out as agreed upon with Air Force Command.
22. Routine repairs were made of trucks UAZ, STAR and ZIS, excavator, fork-lift truck, crane ZSK, crane POLAN and a major repair of the bulldozer.
23. The truck STAR — BESAM was disassembled and reconstructed as a lorry.
24. The engine and propeller of the fishing boat "Dziunia" were changed, the davit and hoisting winch were repaired, the hull was painted and the old engine was repaired.
25. Amphibians PTST No 2 and No 3, cutters KH were repaired and pontoons with accessories were maintained.

26. Fuel barges were painted with anti-corrosive paint.
27. Electric units were surveyed and repaired and two units for technical purposes were prepared for the summer.
28. All cooling containers were washed and disinfected, installations were inspected and the evaporator was repaired.
29. All technical work required for scientific teams was done (assembling, connections, repairs and maintenance of scientific equipment).
30. Everything was prepared as regards scientific research on water and the water transport of scientific teams in the region of Admiralty Bay. For this purpose the fishing boat "Dziunia" was running for 450 hours, the speed-boat for 50 hours and the amphibians were 26 times on water.
31. As regards medical service the participants asked for medical advice 106 times and 10 sick people from beyond the Station were looked after.
32. An inventory of the Station's property was made.
33. M/s "Kapitan Ledóchowski" was chartered and the participants of the expedition took ship.
34. 1000 barrels for drowning were loaded on m/s "Kapitan Ledóchowski" and 40 tons of cargo.

## 6. Popularizing, scientific and technical aspects of the expedition

During the voyage on ships m/s "Antoni Garnuszewski" and m/s "Kapitan Ledóchowski" there were 16 scientific seminars for participants of the IV Expedition, to which invited were crews of ships and students of Naval Colleges from Gdynia and Szczecin. The scientific plans of research groups and the achievements were discussed. The seminars were preceded by two introductory lectures as regards the subject of Antarctic studies.

In the summer of 1979/1980 the Arctowski Station was visited by 6 Polish ships: cargo and training, fishing and research; altogether by 500 crew members of these ships. Excursions were organized in groups of 20—30 people under the guidance of biologists to show the Station surroundings. This was also done for people coming on passenger ships m/s "World Discoverer" and m/s "Lindblad Explorer" (5 times altogether).

Five Russian and East German scientists visited the Station for 4 days. They were given the possibility to collect material around the Station and to use the laboratories.

Abundant didactic material was provided for Polish universities (Łódź, Warsaw, Białystok, Academy of Mining and Metallurgy, Geological Institute), i.e., preserved specimens of marine fauna, contemporary flora and fossile flora, osteological material — mainly antarctic seals (whole skeletons or skulls of dead specimens found) and rock samples.

Participants of the IV Expedition also collected plenty of scientific material for other research institutes and scientific groups not participating in the expedition (Institute of Genetics and Animal Breeding, Polish Academy of Sciences, Institute of Experimental Biology, Polish Academy of Sciences,

Institute of Parasitology, Polish Academy of Sciences, Institute of Ecology, Polish Academy of Sciences, Institute of Geography, University of Warsaw etc.). These were frozen or preserved specimens of fauna and flora and ready preparations.

The IV Expedition co-operated successfully with the I Geophysical Expedition of Polish Academy of Sciences to the West Antarctic on the Polish Navy Ship "Kopernik" (cargo, refuelling, water supply). Thus it will be possible for future expeditions to cooperate on the basis of the station facilities.

The IV Antarctic Expedition of Polish Academy of Sciences provided frequently technical help to other floating units stopping in the Admiralty Bay: (m/s "Lindblad Explorer", m/s "Kapitan Ledóchowski", French yacht "Momo"), supplied fishing boats with water (m/t "Tucana", msg "Gryf Pomorski"). Technical cooperation and mutual help as regards the Russian Station Bellingshausen should also be mentioned.

Medical service was given to participants of the expedition, to passengers of ships and crew members (m/s "Lindblad Explorer", r/v "Hero", Polish Navy Ship "Kopernik", m/t "Włócznik", m/t "Tucana").

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Andrzej Myrcha