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Early Attempts for an European Antarctic Science Programme 1970 – 1974

by Bernhard Stauffer[1]

Abstract: During the first half of the nineteen seventies leading European scientists in polar glaciology planned a common European research programme in Antarctica. The project could finally not be realised, mainly due to financial reasons. However, the discussions and especially the suggested programme are interesting, because not only classical glaciological projects have been suggested but also attempts have been made to obtain answers concerning global climatic and environmental change. This report summarises the discussions and conclusions based on the minutes of the various meetings and the suggested science plan. The planning meetings were held with the support and under the umbrella of the Council of Europe. The Committee of Ministers had finally to decide about a realisation of the project. Therefore, also discussions and reactions of the meetings of ministers' deputies are reported.

Zusammenfassung: Zwischen 1970 und 1974 planten führende Wissenschaftler auf dem Gebiet der polaren Glaziologie ein gemeinsames europäisches Forschungsprojekt in der Antarktis. Das Projekt konnte schließlich – hauptsächlich wegen finanzieller Probleme – nicht realisiert werden. Die Diskussionen und das vorgeschlagene Forschungsprogramm sind aber dennoch interessant, da neben klassischen, glaziologischen Projekten, erstmals auch Antworten auf Fragen globaler Veränderungen des Klimas und der Umwelt gesucht werden sollten. Der Bericht fasst Diskussionen und Beschlüsse gemäß von Sitzungsprotokollen zusammen und gibt im Anhang einen gekürzten Forschungsplan wieder. Die Planungstreffen fanden mit finanzieller Unterstützung und unter der Schirmherrschaft des Europarates statt. Das Ministerkomitee entschied sich schließlich gegen eine Realisation des Forschungsprojektes. Aus diesem Grunde sind auch einige Überlegungen und Diskussionen dieses Komitees aufgeführt.

THE IDEA AND FIRST INFORMAL MEETINGS

The idea for a European collaboration in Antarctic research was born during a SCAR (Scientific Committee on Antarctic Research) meeting 1970 in Oslo. Especially scientists from Belgium, France, Norway and the United Kingdom thought that the "Committee on Science and Technology" (TSC) of the Consultative Assembly (Called the Parliamentary Assembly after 1994) of the Council of Europe could help to launch a broad European Antarctic Programme. A first informal meeting was held in November 1970 in Brussels. A collaborator of the TSC, Dr. J.-P. Massué was attending this meeting. Common scientific interests and possible collaborations were discussed and it was suggested investigating the feasibility of a broad glaciological expedition in Dronning Maud Land or the region around Vostok (both in East Antarctica) or in Greenland.

For a first meeting of a study group, held 19/20 April 1971 in Paris, scientists from twelve Nations have been invited. Finally 20 scientists from seven Nations (Austria, Belgium, France, Germany, Norway, Switzerland, United Kingdom) attended the meeting (see Tab. 1). A majority suggested planning a comprehensive glaciological programme in Dronning Maud Land. The TSC was asked to establish and to finance a "Working Party on European Polar Research (Antarctic Programme)". The relatively complicated name of the suggested Working Party reflected already some conflicts of interest among the participants. Delegates from nations, which have not been adhered to the Antarctic Treaty at that time, especially from Germany, would have preferred, due to simpler and cheaper logistics, an expedition in Greenland. However, there was finally agreement to plan an expedition to Dronning Maud Land, but with the addendum that, if this expedition could not be realised, a similar expedition in Greenland should be foreseen. It was also discussed what a "broad glaciological programme" should be. While many scientists focussed on investigating the behaviour and characteristics of the ice sheet, especially scientists from France and Switzerland advocated not only to apply modern glaciological methods but also to tackle new important questions, like changes of the global environment and climate. A corresponding memorandum submitted at the meeting by C. Lorius (F) and H. Oeschger (CH) is added in Appendix 1.

FIRST MEETINGS OF THE WORKING PARTY ON EUROPEAN POLAR RESEARCH (ANTARCTIC PROGRAMME)

The first meeting of the Working party was held 22-23 October in Oslo. Chairman of the Working Party was Baron Gaston de Gerlache de Gomery, president of the "Comité Antarctique Belge". Vice chairmen were Charles Swithinbank (UK) and Walther Hofmann (D). C. Lorius (F) and H. Oeschger (CH), the principal supporters for ice core drillings and a programme concerned with Global Change, were not attending this meeting. Uwe Radok, who at that time spent a sabbatical year (from his professorship at University of Melbourne) at the University of Munich, attended the meeting as German representative. He questioned the ambitious programme and recommended to be more modest and to focus the programme only to the flow characteristics of the ice sheet, a very classical attempt. Most of the participants of the meeting followed at least partly his recommendations and it was finally decided:

- That the programme, outlined already in Paris, should be accomplished in three phases, each representing a different level of logistic support.
- That each participant representing a country (official representatives, however, have never been nominated or elected) should find out during the next five months on the fields of glaciology in which his country can contribute modern methods and contribute scientists competent to develop them in the context of a European polar project.

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	Delegate from country	Brussels 1970	Paris 19/20 April 1970	Oslo 22/23 October 1971	Karlsruhe 16/17 1972	Study Group Brussels 24 July 1972	Paris 3/4 Non.1972	Utrecht 15/17 June 1973	Rome 19/20 Oct. 1973	Paris 20/21 Dec. 1973
Baron G. de Gerlache de Gomery	B	X	X	X	X		X	X	X	X
W. Hofmann	D		X	X	X	X	X		X	X
C. Swithinbank	UK	X	X	X	X	X	X		X	X
T. van Autenboer	B	X	X	X	X	X	X	X	X	X
J.P. Bloch	F			X	X					
M. Bossolasco	I			X	X		X	X		X
R. Bost	F	X	X	X	X		X	X		X
H. Decleir	B	X		X	X	X	X	X	X	X
T. Gjelsvik	N	X		X				X	X	
M. Kuhn	A		X				X		X	
L. Lliboutry	F		X				X	X	X	
C. Lorius	F		X		X	X	X	X	X	
J.P. Massué	CoE	X	X	X	X		X	X	X	
K. Nottarp	D	X	X		X	X	X			
H. Oeschger	CH		X		X	X	X	X		X
O. Orheim	N				X	X	X		X	
G. Ratti	I						X		X	
J. Vaugelage	F	X	X	X	X	X	X	X	X	
Sir Vivian Fuchs	UK		X							
Gordon Robin	UK		X							
V. Schytt	S			X						
B. Stauffer	CH			X				X	X	
T. Wisnes	N		X	X						X
P. Gudmandsen	DK							X	X	X
K.W. Rutten	NL							X		
Paul Emil Victor	F		X						X	X

Tab. 1: Participants at Study Group and Working Group meetings (Delegates or guests attending only one meeting are generally not listed).

Tab. 1: Teilnehmer an den Treffen der Studiengruppe und der Arbeitsgruppe; Delegierte oder Gäste, die an nur einem Treffen teilgenommen haben, sind nicht aufgeführt.

The three phases summarised:
• Phase 1 should focus on the coastal sector of Dronning Maud Land north of 75° S. Ice thickness and sub glacial relief should be determined by radar echo soundings. Mass balance should be determined by surface velocity measurements and by the determination of accumulation rates at various sites. The glacial history, especially changes in the ice cover, should be investigated by glacial-geological studies and by temperature measurements also in the interior of the ice sheet. The duration of Phase 1 was estimated to need about five years and to cost about 12 Million US$.
• During Phase 2 the investigations should be extended to selected areas south of 75° S.
• For Phase 3 several core drillings to 500 m and one deep drilling to bedrock were planned.

For phases 2 and 3 no estimates of costs and duration have been made. The next meeting of the Working Party was held 16/17 June 1972 in Karlsruhe. The most important item of the agenda was the discussion of the answers by the different national delegates. Italy, the Netherlands, Norway and the United Kingdom were only interested in the programme if it takes place in Antarctica. For Switzerland there is no clear preference for Antarctica or Greenland. More specific have been the answers by the German and French delegates. Germany stated again to prefer a programme in Greenland because it would be less expensive for comparable results. France signalised that it could only participate if the programme formulated in Oslo would be substantially modified. Especially core drillings should be planned already in Phase 1 and generally the programme should focus on regions on the Antarctic Plateau and not on coastal regions. These requests were roughly the contrary of what was decided in Oslo. To find a solution in this difficult situation, a Study Group was nominated to elaborate a modified scientific programme. Members of the Study Group have been M. Bossolasco (I), H. Decleir (B), C. Lorius (F), K. Nottarp (D), H. Oeschger (CH), O. Orheim (N), C. Swithinbank (UK), J. Vaugelade (F) and T. Van Autenboer (B). The first six members mainly for the scientific programme, the other three mainly to elaborate a tentative operation plan. The chairmen G. de Gerlache de Gomery mentioned at the meeting also the situation concerning the Antarctic Treaty organisation. The Council of Europe could not accede to the treaty and it would be difficult for non-treaty nations, willing to participate in the programme, to accede before its implementation. Indications were that Antarctic Treaty nations would consider it very satisfactory if all members of a European expedition were to agree to respect the

clauses of the Treaty. The representative of the Council of Europe mentioned also that the Committee on Science and Technology had to inform the Committee of Ministers on the work carried out by the Working Party latest in January 1973.

THE SCIENCE PLAN AND COST ESTIMATES

At the Working Party meeting 3/4 November 1972 in Paris, the science plan elaborated by the study group was discussed in detail. A small group (H. Decleir (B), W. Hofmann (D), C. Lorius (F), H. Oeschger (CH), O. Orheim (N) and C. Swithinbank (UK)) modified the science plan taking into account the decisions resulting from the discussions. The Working Party adopted the final document as the official, whenever tentative, science plan (added in Appendix 2). L. Lliboutry announced that his institute (Laboratoire de Glaciologie et Géophysique de l'Environnement, Grenoble) would be ready to take over the responsibility for the deep drilling. The research activities were planned for a period of five years. A first cost estimate resulted in costs of 22 million US$. After a controversial discussion, it was decided to ask the Committee on Science and Technology to submit the science plan and the cost estimates by the channel of the assembly to the Committee of Ministers. However, the cost estimates should be adjusted before. Submitted was finally a cost estimate of 17 million US$. The Committee on Science and Technology accepted the science plan and the cost estimate and trans-ferred it with 18 to 1 vote with a positive recommendation to the Committee of Ministers.

A summary of these recommendations:
a) Ask member governments to respond favourably to the proposed European Antarctic Programme.
b) Ask the member governments concerned to intimate by 31 December 1973 whether they are prepared in principle to participate in this European Antarctic research project, in the light of the preliminary financial estimate.
c) To enable further financial support for the Working Party on Polar Research.

FIRST REACTIONS OF THE COMMITTEE OF MINISTERS (MINISTERS' DEPUTIES)

The representative of the Council of Europe, J.P. Massué, informed the Working Party about the outcome of the discussions and decisions of the Committee of Ministers. However, the following summary of the reactions of the Committee of Ministers is based on the written "Conclusions of the meetings of the ministers' deputies", because the statements by J.P. Massué are not recorded in detail in the Working Party minutes. At the 220th meeting of the ministers' deputies from 9-13 April 1973 the recommendations mentioned above have been discussed for the first-time. The representatives of Denmark, France, Norway and Switzerland responded positively, endorsed recommendation c) (financial support of the Working Party) but could not give any promise concerning a final participation. The representative of the United Kingdom stated that the polar research authorities decided with regret that his country could not participate in the programme because all resources in this field were already fully committed. Nevertheless the British Antarctic Survey would be willing to provide practical help and cooperate in the planning of the programme. The representatives of Ireland, Austria and Italy said that they had not yet received any instructions. Finally the representatives agreed to decide at their 222th meeting in May whether the Working Party could be supported by 50,000 FRF (at that time about 10,000 US$) to continue its work.

At the 222th meeting of the minister's deputies 22-30 May 1973 it was decided (11 to 0 votes and 3 abstentions) to support the Working Party further financially. Notable was a remark by the representative of the Netherlands doubting very much if his country could participate in the programme due to the very high operation costs. He requested also an estimate how much each country had to contribute financially.

ANSWERS OF THE WORKING PARTY AND START OF A DETAILED PLANNING

On its meeting of 15-17 June 1973 in Utrecht the delegate of the European Council, J.P. Massué, informed the Working Party about the reactions of the ministers' deputies. He mentioned explicitly that the deputies expected to examine, if the costs for the programme could be reduced substantially. However, the Working Party agreed that the European Antarctic Project constitutes a coherent whole and cannot be cut down without its scientific value being reduced to the extent of rendering it pointless. Consequently it seemed to be impossible to reduce the estimated costs, except that some logistic costs could be reduced by collaboration with the US and/or the UdSSR. J. Vaugelade and T. Gielsvik were asked to get in contact with representatives of the polar programmes of the two countries and to check possibilities of collaboration. It was also decided to spread the programme over seven years (instead of five as in the submitted science plan) to reduce the annual costs. The main logistic problem for the European countries turned out to be the transport of heavy equipment within Antarctica with ski-equipped airplanes. A general discussion on the distribution of the financial burden between participating countries was held. It was thought that some general logistic expenses should be shared equally between participating countries, while scientific and logistic expenses for specific projects should be covered by the nations responsible for its execution. A study group (W. Hofmann, O. Orheim, H. Oeschger, C. Lorius, T. Van Autenboer, J. Vaugelade) was asked to examine this problem and to propose a key of repartition. The group suggested to share equally 6.77 million US$ between participating countries and 7.28 million US$ project costs should be covered proportional to participating scientists in the specific projects. The 3 million US$ for the modification and operation of a ski-equipped C130 airplane was not included in this calculation, because it was hoped that these costs could be reduced substantially by collaboration with US.

The Working party met again 19/20 October 1973 in Rome. It was considered to be the last meeting before the minister's deputies would decide about the realisation of the programme. It was a very turbulent meeting. The contacts with the head of the US Antarctic Research Program (J. Fletcher) showed that the US was very interested in the European programme but was not in the position to provide the air trans-

port of heavy equipment in Dronning Maud Land. There was a long discussion how the US could be convinced to take over at least part of the transports on the basis of reimbursement in form of cash or an exchange of other logistic services. Also the separation of the programme in two or three phases was discussed again. Several delegates stated that they felt the distribution of the financial burden between participating countries unfair. The Austrian delegate found especially the fix equal costs for each country too high. It was decided to share also the logistic costs according to participating scientist-seasons of each country. The logistic costs of a scientist-season were set at 60,000 US$, the additional costs for science between 18,000 US$ (snow sampling) and 34,000 US$ (deep drilling). The estimated costs for each participating country have been:

Austria	580,000 US$
Belgium	2,350,000
Denmark	690,000
Federal Rep. of Germany	3,020,000
France	3,300,000
Italy	1,720,000
Norway	1,620,000
Netherlands	350,000
Switzerland	1,600,000
total	15,230,000

No financial contribution of the United Kingdom was foreseen, based on the statement by the UK representative in the committee of ministers. Finally it was decided to submit to the council and to the minister's deputies the original science plan together with a slightly reduced budget of 15.23 Million US$.

THE END OF THE AMBITIOUS PROGRAMME

At their 226th meeting in November 1973 the committee of minister's deputies discussed only shortly the European Antarctic Research Project. The representatives of Switzerland, Belgium, Sweden and Norway mentioned the interest aroused in their countries by the project. The representative of the Federal Republic of Germany found that the project had some interesting scientific aspects, but questioned whether the Council of Europe was the appropriate body to undertake this programme because of the high operational costs and announced that her government would not agree to contribute the 3 million US$ foreseen for her country. The ministers' deputies asked the secretariat to prepare a new budget and a new apportionment key. Several members of the Working Party met 20/21 December 1973 in Paris and elaborated a new budget of 13 million US$ and a new key of distribution of costs to the participating countries, without a contribution from Germany. The reduced budget implied that one had to cancel, or at least to postpone, the deep drilling on the plateau of Dronning Maud Land. Also this reduced programme found no acceptance among the ministers' deputies. On their 229th meeting 19-27 February 1974 the representatives from Italy, France, Austria, Denmark and The Netherlands announced that they would not be able to participate in the suggested project for financial reasons, France also for technical reasons due to its engagement in IAGP. There were some more helpless attempts to rescue the programme. At a meeting of a small study group in March 1974 in Bern (T. van Autenboer (B), W. Dansgaard (DK), H. Decleir (B), H. Oeschger (CH), O. Orheim (N), B. Stauffer (CH), C. Swithinbank (UK)) a re-duced programme for 6.4 million US$ was suggested. The programme concentrated on a, much smaller area of Dronning Maud Land but has foreseen still three core drillings to 500 m depth. The new programme was accepted by a Working Party meeting on 23 March 1974 in Paris. However, the primary enthusiasm had faded away.

At the 233th meeting of the ministers' deputies 25 June - 3 July 1974 the representative of the office of the clerk made a statement including the following remarks: "This first plan, probably to ambitious a one, was thought by several delegations to place too great a burden on the budget, since its cost was estimated at 17 million dollars. In January and again in April 1974 the same Working Party presented an amended plan based on the idea of a joint European expedition, which would still be sent to Antarctica, though at a cost reduced first to 13, and then to 7 million dollars. However, the government authorities of several countries let it be known that the cost of taking part, although less than before, was still too high." He added that, as a result of the discussions within the Working Party, two or three nations plan to collaborate in a modest research project in Spitsbergen. However, for the ambitious European Antarctic Research Project it was the end.

SOME PERSONAL REMARKS

After the abortive attempt to implement an ambitious European research project in Antarctica, most of the laboratories contributing to this field of research were looking again for partners outside Europe. France intensified their projects in the area of Vostok in the frame of the IAGP mentioned already. They realised 1977/78 a core drilling with a French drill at Dome C down to 980 m. After 1989 they collaborated with the UdSSR and the US in the deep drilling project at Vostok, which was started already 1980 by the UdSSR and which reached a depth of 3623 m in 1998. Denmark and Switzerland collaborated with the US in the "Greenland Ice Sheet Project" (GISP). In the frame of this project, starting in 1973, several medium depth core drillings down to 400 m depth were performed. In August 1981 a common deep drillling at the US radar station Dye 3 reached bedrock in a depth of 2037 m. This drilling was performed by an ice drill called ISTUK, which was developed and constructed at the University of Copenhagen.

Was the attempt for a European Antarctic Programme 1970-1974 not realistic or was it a missed chance? – Probably something between. The submitted programme was not only ambitious but also very modern. Many of the ideas were used in later proposals for polar programmes. The composition of the members of the "Working Party on European Polar Research (Antarctic Programme)" was heterogeneous. Beside younger scientists there were very experienced well-known scientists, which were legends already at that time. They supported the submitted programme, which went beyond classical glaciology and focussed on the question of global climatic changes. The Council of Europe with its Consultative Assembly and the Committee of Science and Technology was certainly not the ideal body to form the umbrella for such a costly and complex programme.

The idea of a European Antarctic Research Programme had to

be given up in 1974. In the same year, the "European Science Foundation" (ESF) was established by the Council of Europe. This organisation gave twelve years later an ideal umbrella for important European programmes. Within the framework of the joint European Greenland Ice Core Project (GRIP) a 3029 m long ice core was drilled in Central Greenland from 1989 to 1992 at 72°35' N, 37°38' W. The European Project for Ice Coring in Antarctica (EPICA) realised a deep drilling at Dome C (75°06.10' S, 123°23.71' E) down to 3233 m and one at Kohnen Station in Dronning Maud Land (75°0.10' S, 0°4.07' E) down to 2882 m. The results of the analyses of these ice cores provided a wealth of information about past global changes and their mechanisms.

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Appendix 1: Programme memorandum submitted by C. Lorius and H. Oeschger at the meeting of the study group April 1971 in Paris.

Study of the World Climatic Environment
Claude Lorius and Hans Oeschger

A subject, which it would be particularly desirable to develop is a study of the world climatic environment. Natural climatic variations observed during previous epochs may now be affected by human activity.

For the study of these problems the polar ice caps, apart from the important role they play in regulating world climate, are extremely favourably placed and of unique interest:
• excluding local phenomena, they are representative of the general terrestrial environment;
• they have preserved information concerning environmental changes throughout the ages. The layers of snow and the tracer elements they contain constitute a particularly reliable and detailed record of atmospheric conditions.

Recent studies have permitted temperature variations over the last 100,000 years to be established; a wealth of other data on the history of the polar ice caps, the Earth and even the planetary system are to be found in the ice. Their utilisation would call for the development of sampling and analysis techniques. The European countries have a scientific potential, which can make an important and original contribution to these studies. To institute this research and make its results reliable it would be necessary for tests and comparative studies to be carried out in Greenland. Such a programme would enable Europe to make its contribution towards solving problems that have a critical effect on man's living conditions.

Appendix 2: Draft of the Science plan prepared by the Committee on Science and Technology.

Draft outline programme (October 1972)

INTRODUCTION

It is in the interest of man to develop a study of the world climatic environment. Although climatic fluctuations have been in the past a normal and natural feature of the environment, there are indications that now for the first time our climate may be affected by human activities. Partly for this reason many countries have established environmental monitoring stations to determine the extent of current changes. However, there are two major difficulties. Firstly, significant changes were taking place before precise measurements began; and secondly, there are insufficient criteria for deciding whether the observed contemporary climatic changes are really due to the impact of man or would have occurred anyway from natural causes. These difficulties may to a large extent be overcome by extending such studies to the polar regions. The polar ice sheets play an important part in regulating world climate and are of unique interest in that they preserve a long period record of past and current environmental changes. The layers of snow and the trace elements that they contain constitute a particularly reliable and detailed record of atmospheric conditions. This record is more representative of the general terrestrial environment because the polar ice sheets are far from the major sources of industrial pollution and because the original deposits have not been disturbed by mixing. Recent studies in Greenland and Antarctica have allowed temperature variations over the past 100,000 years to be established. The first tentative steps in climate prediction based on modern mathematical analysis have come from this work. A wealth of other data on the history of the earth and even of the planetary system are to be found in the ice. There is no better record anywhere of man's progressive contamination of the atmosphere since the industrial revolution. European countries have a scientific potential that can make important and original contribution to these studies. A European polar research programme would enable Europe to make its own contribution, toward solving problems that have a critical effect on man's living conditions.

General considerations

Apart from the biological aspect, the prime aims of studying the environment are to determine the characteristic parameters of this environment and to measure and if possible to forecast their variations. The polar regions offer particularly interesting and undoubtedly unique possibilities particularly in two fields:
• remoteness from any major source of pollution makes it possible to set up base stations unaffected by local factors, thus enabling atmospheric phenomena of universal significance to be studied;
• the archive contained in these layers of snow, which are authentic records of atmospheric conditions, enable one to study the history of the variations in this environment and to determine natural levels which it is necessary to know in order to define standards of emission.

The following scientific programme is applicable in both polar regions. Indeed it would be an advantage to pursue similar programmes in Antarctica and in the Arctic, since comparative studies would allow the results obtained to be generalised. But we believe that the significance of the work would be greater in Antarctica because new techniques could be developed and applied in an area where no comparable studies are underway, whereas related studies are being planned for Greenland. Moreover the Antarctic ice sheet controls the world climate to a much greater degree than does the Greenland ice sheet. For these reasons we have selected for study an area of Dron-

ning Maud Land, which includes the Dronning Maud Land ice dome. The unique advantages of this area are:
(a) that a well-defined section of the main Antarctic ice devide lies within 1,000 km of the coast;
(b) that the coast is known to be accessible from the sea;
(c) that no major studies of the ice sheet are planned or under way within 2,000 km;
(d) that seven member States of the Council of Europe have at some time sponsored expeditions to the area; and
(e) nearly all member States of the Council of Europe have specialists with relevant experience in polar research. The following measurements should be made. Most of the work can take place during summer seasons, but full atmospheric observations and the study of precipitation will necessitate a winter station, which should also support the drilling programme.

I. PRESENT ENVIRONMENTAL CONDITIONS

A. Parameters connected with recent changes of climate
1. Selected meteorological and micrometeorological data, possibly using automatic stations.
2. Solar radiation and atmospheric turbidity.
3. Chemical composition of the atmosphere and precipitation; condensation nuclei.

B. Parameters connected with pollution of the earth, concentrations and cycles of different elements
1. Mercury, lead, cadmium, selenium,
2. Compounds of sulphur, nitrogen, phosphorus and carbon (in the form of gases or aerosols). Various chlorinated organic compounds, hydrocarbons.
3. Radioisotopes (^{90}strontium, ^{137}caesium)

C. Comparative variations of natural elements
1. Elements of marine, terrestrial or extraterrestrial origin; (magnesium, sodium, potassium, calcium, silicon, aluminium, nickel).
2. Isotopic composition of precipitation (deuterium and ^{18}oxygen) in relation to atmospheric conditions.

II. CLIMATE AND ENVIRONMENT: THE HISTORICAL RECORD

The aim of this part of the programme is to study the history of the earth's climatic environment. It is believed to be possible to find a record of this history covering a period of more than 100,000 years. As coring sites must be located where this old ice is to be found they will have to be chosen with particular regard to local climate, accumulation rates and the various parameters affecting the ice flow.

A. General survey of the area
1. Topography of the surface and of the rock base; determination of flow lines (radio echo soundings on a grid with 100 km spacing of flight lines).
2. Geophysical studies by remote sensing.
3. Determining accumulation rate by locating artificial radioactive horizons.
4. Selection and survey on a 10 km grid of sites for detailed studies.

B. Detailed studies at four to eight special sites on the ice divide and on a flow line
1. Medium depth coring (to about 500 m) to study historical variations in the content of pollutants and natural elements.
2. *In situ* bore hole measurements and sampling.
(a) Deformation, density, temperature and associated geophysical measurements.
(b) Dating: (^{14}carbon, ^{32}silicon, ^{39}argon); terrestrial and cosmic dust studies.
3. Physical and chemical properties of ice cores.
(a) Stratigraphy, crystallography, mechanical, electrical and thermal properties.
(b) Geochemistry: stable isotopes, ^{210}lead, gases, trace elements.
4. Surface studies:
(a) Correlation between studies at coring stations and at the wintering station.
(b) Areal variability of accumulation to ensure that the chosen sites are representative.
(c) Horizontal and vertical surface deformation.
(d) Detailed topography of the surface and the rock base (1 km spacing).

C. Deep drilling
The above studies will be used to select one or more sites for drilling to bedrock. All studies listed under B will be undertaken at these sites.

D. Past and present behaviour of the ice sheet studied at selected sites
1. Studies of the glacial history of ice-free marginal regions.
2. Mass balance studies.
3. Variations with time in the surface level of the ice sheet.

III. CONCLUSION

The Working Party requests that the European nations support this scientific project as a European programme in polar research to be carried out in the selected area of Dronning Maud Land.