

CONTEMPORARY CHANGE OF SUBPOLAR AREAS – DIRECTION AND METHODS OF INVESTIGATIONS

(Discussion panel)

The discussion was chaired by **prof. J. Jania** from the University of Silesia – the Chairman of the Polish Committee on Polar Research, PAS. Many researchers studying the circumpolar regions nature took the floor.

Professor S. Rakusa-Suszczewski – for many years the Manager of the Polish Antarctic Station of PAS – emphasized that the reports raised the issues of relations between a description of climatological, glaciological or hydrological phenomena and biological processes which are especially important in polar regions. The condition and changes of polar ecosystems are determined mainly by geophysical processes. Such opinion has been so far expressed by many researchers, among others – a famous polar explorer **K. Sherman**. The scale of changes of these phenomena can be, macro, meso, micro or even molecular. The speaker gave some cause-and-effect examples of such: changes in the convergence and divergence around the Antarctic influence the occurrence of large krill swarms; shrinking of the ice cover diminished the under-ice primary ‘production’, decreased in a significant way the feeding surface area for krill and thus its biomass; as a consequence the number of organisms for which krill is the main source of food – penguins and other sea bird, seals, eared seals and whales – have been reduced. A phenomenon such as El Niño also has an influence on krill transport and biomass. The lack of krill in the region, as Polish research has shown, causes a migration of eared seals to the south. They, in turn, influence land ecosystems, fertilizing them, but also trampling down and destroying the flora which is sparse already, causing changes several times greater than the results of human activity.

In the mesoscale, phenomena in the polar land environment are the most often observed; they are accompanied by visible effects of biological changes in ecosystems, their distribution, colonisation, succession of plants and animals. Here are some more examples: retreat of sea-reaching glaciers as a result of the climate warming, changes in precipitation, elevation of snow accumulation line etc cause creating coastal lagoons with a specific, estuary environment, inhabited by certain species and complexes of high ecological tolerance of salinity fluctuations and the content of suspension and oxygen. Ice retreat increases areas of bird nestling and of plant occurrence. This is accompanied by the processes of land irrigation and then its drying, which cause changes in plant complexes. The

meltwater flowing down washes out the characteristic for the maritime Antarctic biogenic salts from oritogenic deposits, impoverishing polar land environments.

In micro scale climate changes influence many physical factors, such as freezing, thawing, unfrozen water availability or temperature, which have an impact on the pace of adaptation of organisms, both native and alien to the Antarctic. Exploring these complex processes requires employing modern genetic, metagenomic or physiological techniques, which do not only describe, but also explain the processes happening. And so, for example the research of *Deschampsia antarctica* has shown its large epigenetic variety, which is a response to the changeable environmental conditions. A comparison of *Deschampsia antarctica* and *Deschampsia cespitosa* (a species occurring in Poland) by Bystrzejewska has shown that the optimum temperature for the photosynthesis of the Antarctic species is 13°C. Together with air temperature rise, a decrease in the intensity of this process has been observed in the case of the Antarctic species. With the climate warming in the Antarctic Peninsula region and the increase of the human impact on the environment in this area, alien species started appearing there. The genetic analysis of the first newcomer, *Poa annua*, on King George Island allowed to define the origin of this species. The influence of certain physical phenomena and the response to them of both maritime and land organisms vary in time in polar regions. Changes in polar environments may be of different characters, happen irregularly or cyclically; therefore long-term observations should be conducted to find out the trends of these phenomena. Changes caused by direct human activity are also not without importance.

To summarise, **prof. S. Rakusa-Suszczewski** emphasized that only a close cooperation of specialists in various disciplines allows to explain the causes of particular phenomena in polar regions and the mechanisms mechanisms of processes started by these causes.

Professor W. Walczowski from the Institute of Oceanology, PAS, stated that we are nowadays discovering evidence and giving a new meaning to the well-known truth of the influence of the ocean on the climate. However, not all meteorologists or climatologists are ready to accept interactions discovered these days. Professor recognized that one should fully agree with the opinion that only a close cooperation between different fields of science can ensure progress in explaining certain phenomena in the polar regions. Unfortunately, not many reports were interdisciplinary, based on results of cooperation between different scientific disciplines. One of the first such projects is ELEIK programme, in which studies of three spheres meet: in the hydrosphere, the cryosphere and the biosphere. It is by design a full-scale and scientifically innovative project. Another important issue are the measurements which are the basis of research. More and more often one may observe the so called 'case studies', i.e. research of special cases. In climatological research descriptions of one-time measurements, but in fact only tediously gathered continuous measurements are of real value. The third problem concerns advection connected with local processes. The first to speak about it was a representative of biologists, **prof. J.M. Węslawski** from the IO, PAS, referring to local biological processes. Studying changes which we would like to ascribe to climate changes, we must distinguish what is caused by advection, or the influx of external air masses, from what is caused by internal, local processes. It is extremely important. These causes cannot be completely divided, as they are closely linked, but it should be remembered that not all observed changes are caused by climate changes.

Professor M. Zajęzkowski from the IO, PAS, emphasized that two issues, to which not much attention is paid, should be included into a broader scientific discussion. The first

of them is the need of studying contemporary local changes in the context of global changes. It is worth saying here that some phenomena which take place for example in the area of Spitsbergen do not necessarily have to proceed in the same way in all the Arctic. He quoted the conclusions of his own article from 2010, in which attention was drawn to the fact that phenomena connected with warming, and thus the lack of winter ice cover, cause larger differentiation between fjords and the open Arctic sea, e.g. Barents Sea. Comparing the results of the research with **P. Bosman's** results in Barents Sea has shown that Spitsbergen reacted differently than the remaining part of the Arctic.

The second topic refers to the lines of enquiries connected with climate changes. Paleo-oceanographic research results clearly show that during all Holocene the climate of Svalbard depended very much on the influx of Atlantic waters or the lack of them, which was confirmed by isotope research and the analysis of bottom foraminiferous sediment. The influx of Atlantic waters is now understood as a result of the surface, dependent on the strength and direction of wind West Spitsbergen Stream, which is an ending of the Gulf Stream. The influx of Atlantic waters is now shown as wind-powered surface West Spitsbergen Stream, which is an ending of Gulf Stream. It is superimposed by termohaline circulation of completely different origin. There is no certainty about the oceanic water masses superimposing on one another in the region of Spitsbergen and it is not sure if they 'cooperate' with one another. Have they always superimposed on one another and strengthened one another in the past, and could they therefore be the cause of differentiation of the Atlantic waters influx? In the past it was found out that the influences of these two factors had taken different patterns. Here the discussant referred to the problem mentioned by **prof. M. Węslawski** from IO PAS in his report, namely to the occurrence of dependent on the presence thermophyting kind- *Mytilus edulis* (blue mussel), which avoid ice. Conclusions resulting from many paleoceanologists' research indicate that this mussel used to be common on the east coast of Spitsbergen. The discussant, however, is inclined to agree with the opinion that there could not be sea ice in the Arctic in many periods of Holocene (8–9 thousand years ago was a very warm without ice) so there were no proper conditions for the occurrence of this organisms dependent on the West Spitsbergen Stream and the termohaline circulation (after period of the prosperity disappeared and next to appear in 2004 on West Spitsbergen).

Professor K. Migala from Wrocław University referred to **prof. S. Rakusa-Suszczewski's** statement about the difficulties in explaining processes and not just describing phenomena themselves. However, when **J. Śniadecki** put Stevenson screens in the Botanical Garden of the Jagiellonian University at the beginning of the 19th century, he did not anticipate global warming. The most difficult issue, apart from making hypotheses and drawing conclusions, is understanding one another within interdisciplinary subjects. The presentation by Jagiellonian University team lead by **prof. M. Olech** proved that the current division of the Arctic into climate-botanic zones is too generalized. Drawing attention to local differences may explain a lot, not only to botanists, but also to geophysicists. According to the discussant the works of physical oceanologists are the most impressive, because their research gives a chance to explain what is the source of climatic processes in the global scale. In the panel discussion too small number of interdisciplinary studies referring to sequences of events in polar regions was emphasised. He agrees with the conclusion of the Jagiellonian University botanist team that as long as the morphology and the lie of the land change in a given area, there are no chances for species colonisation.

Studying sequences of events is very important and interdisciplinary research of these problems should be aimed at.

Doctor M. Korczak-Abshire from Antarctic Biology Department, PAS, and APECS¹ POLSKA referred to cooperation in studying polar regions. She stressed the necessity of including young scientists into all stages of research work, that is also into presenting research results at national and international symposia and conferences. She appealed for larger participation of young researchers in meetings similar to the present one, so that they would have more occasions to participate in scientific discussions in the future. She emphasised the importance of interdisciplinary cooperation, giving as an example interesting results of research conducted by the Unit of Antarctic Biology, PAS, in cooperation with scientific centres in Cracow, Olsztyn and Wrocław. At this point the first round of the discussion was finished.

In the discussion panel the oceanologists from the IO, PAS, were the most active, stressing the importance of the relation to sea currents and the role of the global ocean in estimating the global warming. Many problems and causes are yet unknown, we only know that the ocean and circulation are of large importance in the shaping of climate. For instance: if we want to find out about the processes taking place around Spitsbergen, we must go upstream, that is to the Norwegian-Atlantic Stream, then to the North Atlantic one, because heat transport starts in the region of the equator and depends on trade-winds. And so sea currents depend on wind, but not always – e.g. it is so in the case of the West Spitsbergen Stream. The bottom lie and the shape of shores may also be important in shaping sea currents. The so called ‘switch’ phenomenon in the area of a giant subarctic whirl on the Atlantic can be an example. A part of the water from the whirl on the north side is carried to the east and north by the North Atlantic Stream and another part goes back to the east and south as the Canary Stream. It is not known how much water will flow in which direction and why. A similar phenomenon occurs when the Norwegian-Atlantic Stream approaches Nordkapp – a part of the Atlantic water is carried by the Nordkapp Stream to Barents Sea and another part to the north by the West Spitsbergen Stream. It is supposed that local conditions influence the proportions.

Professor R. Przybylak of Nicolaus Copernicus University stated that it is difficult to give a quantity answer on what rules global climate changes. In what percent is this the influence of natural factors and in what percent – of the human? If we want to define the human share in global changes, then we must first define the so called range of natural climate changeability. If the atmosphere, for example air temperature, goes beyond this range, there is big likelihood that this is human impact, but we may also stretch it to other derivative elements, for example sea currents. Climatologists try to define the natural changeability of various meteorological elements, attempting to reconstruct the climate in the past thousand or even two thousand years, using indirect data. For some time research concerning using the results of ‘early instrument’ measurements and texts about weather conditions has been conducted. In Europe historical sources have been used to a large extent for a long time already. Doing this, it is aimed at gathering information on various elements of the Arctic natural environment. If we are appealing for interdisciplinary research, then climatologists call on sea and continental glaciologists or oceanographers to cooperate with them in search of information and creating data bases.

¹ Association of Polar Early Career Scientist

The answer referring to the oceanologists' statement was given by: **prof. T. Zieliński** from the IO, PAS, who explained that natural changeability caused by the warming of the West Spitsbergen Stream was studied in 2006 by IO, PAS. Later research conducted by Russians confirmed recording the highest water temperature during instrumental observations. This year 'Science' published an article which, on the basis of paleoclimatic research, states that at the beginning of the 21st century, in the period between 2000 and 2006 precisely, the warmest summers were caused by waters of high temperature observed in the Arctic. We are living in the times of unusual anomalies, since in 2010 the air and water temperature around the Arctic was, for a change, the coolest. Moreover, Professor drew attention to the importance of Arctic aerosol. For instance strong intrusions of polluted air masses over the Arctic area during the phase of so called Arctic Haze are especially interesting from the point of view of defining human influence on the radiation balance, as well as on cloud creation processes. Physical and chemical processes connected with the period of moving from Arctic Haze phase to the periods of year when arctic areas are not influenced by the transport of polluted air masses from lower altitudes have not been studied yet. It is connected with the changes in the kind of transport and may impact the changeability of trace gases streams and particles (aerosols) to Arctic regions.

The Arctic is a very sensitive environment and radiative properties of aerosols connected with their physical and chemical properties, as well as interactions between aerosols and clouds in relation to natural and human-caused sources of aerosols have not yet been thoroughly studied.

Referring to the appeal for scientific integration **dr M. Korczak-Abshire** from APECS POLAND asked if there was a possibility of cooperation with climatologists of Nicolaus Copernicus University in Toruń, solicited for by young researchers, within Torun station, not only PAS station in Hornsund.

Professor A. Marsz's (Marine University) statement referred to many formal issues, namely the definitions of the terms used, such as global, the Arctic etc. Of course the Arctic environment is influenced by other parts of the Earth, but great notional 'entanglements' observed for many years are caused by not very precise use of the term 'global climate change'. Global climate change are the most often identified with the changes of global air temperature. Other climate changes are not taken into account.

Another problem is calculating global air temperature as an arithmetic weighted mean. The changes of climate in the Arctic determine forty odd percent of changeability, of mean value. The big amplitude of air temperature changes in the Arctic forces a big amplitude of global temperature changes. Air temperature changes happen on the whole globe but with different intensity, which is confirmed by instrumental measurements conducted for over 130 years on the northern hemisphere.

The third issue is the range of natural changes. A pivotal question arises: what does a natural change mean? In the case of the Arctic natural meteorological changes are referred to a few elements in about a dozen of points. It is not true that temperature changes of the water carried by the West Spitsbergen Stream are not known. In the last thirty years more than ten serious works presenting coinciding conclusions have been published. On the other hand in one of the latest 'Science' issues all works that contradict the proposed thesis of global warming are carefully eliminated. Also there are water temperature changes in the West Spitsbergen Stream recorded in at least a few points since deglaciation of this region.

The fourth problem is connected with the period of instrumental observation. The region of Spitsbergen and Franz Josef Land, lying at the border of areas of ice and pycnocline reach, in Barents–Greenland region of the Arctic, is characterised with the biggest amplitude of temperature, which is confirmed by instrumental observations. The biggest temperature rise was observed in the so called great Arctic warming in the nineteen thirties; the biggest decrease of 7–8°C beneath the average in the time of cooling in the sixties and seventies; nowadays the biggest rise of temperature is visible. It is the amount of solar energy flowing in during the annual cycle that determines these changes. There are no proofs that changes reaching more than ten percent really occur. The changeable amount of energy is caused by the motion of water brought in by circulation with the West Spitsbergen Stream and the Nordkapp Stream. The discussant has tried several times in vain to publish an article on the close links between the change of surface water temperature and air temperature in the Arctic. The negative reviews resulted from rejecting the increase of carbon dioxide concentration in the atmosphere as a reason of global warming in the results. The speaker stressed the high values of the results of research conducted by oceanologists from the IO, PAS. They obtained ones of the best in the world long-term data collections, which contribute very much to the understanding of processes and mechanisms shaping the climate that take place in the Arctic.

Professor J. Jania remarked that one of the effects of this multidisciplinary session under the auspices of the National Committee for Global Changes of Biosphere and Geosphere, PAS, is the fact of noticing anew the role and importance of the ocean in the process of global warming. He pointed out that **dr M. Łuszczuk** of Maria Curie Skłodowska University was the only one to remind everybody that geopoliticians are only reached by the most condensed information. If it is constantly stressed that it is the human who has caused the global warming, then this is the notion which is consolidated among the general public. The speaker had a chance to be a guest on ‘Oceania’ ship recently, where a discussion with oceanologists started on the relation in which the amount of carbon dioxide produced by the oceans is to the production of carbon dioxide caused by business activity in connection with ocean warming. This is one of the key problems to be explained on large scale. He also drew attention to using proxy data referred to by **prof. R. Przybylak** in his report, that is to looking for indirect indicators bringing us closer to finding out about the real state of the atmosphere and climate of the Arctic.

He also mentioned the importance of cryosphere and its interaction with land and sea environment as a certain indicator of phenomena happening in the polar area. It takes a long time for glaciers to disappear or for new species to appear in the Arctic. The rise of temperature in the Arctic in the twenties and thirties is not quite explained, nor is the cooling in the sixties. These phenomena cannot be explained by solar radiation changeability. The reason must be different, e.g. atmospheric circulation or hydrological cycle. To sum up, the analysis of the integrated changes in land and sea ecosystems and in the range of cryosphere indicates far-fetched consequences of air temperature changes in the region.

Professor R. Przybylak stressed that climate global changes are identified not only with global air temperature changes at the surface of the Earth, but also concern the temperature of the water surface level, which was expressed in IPCC report. The global increase of air temperature changes at the surface of the Earth is an undisputable fact. If the Earth is limited to a one-dimension model, in which the energy reaching the atmosphere causes a rise in temperature at the surface of the Earth, then this rise can be only explained by a change of the

composition of the atmosphere. Therefore the Arctic climate should be analysed in relation to the climate of the whole Earth. Changes in the amount of solar energy reaching the Earth have to be noted, and the World Ocean has a large potential of accumulating and releasing heat. Therefore it causes local fluctuations, just like the changes in the Arctic. Only the World Ocean has heat capacity large enough to shape long term changes.

Professors T. Zieliński and T. Petelski from the IO, PAS, raised the problem of modelling geophysical processes. The used mathematical model of climate assumes energetic balance in a 'budget' year, so the same amount of energy that comes in must come out. If the outflow is smaller than the inflow, the air temperature must rise. This model does not consider the inert element, taken into account by meteorologist **Rossy**, who pointed out the fact that ocean water circulation causes many-decade or many-century-long periods of heat accumulation and then of its release. If a period of releasing the heat accumulated before in the waters comes, a temperature rise must occur. If a temperature rise which is not compensated for by a decrease somewhere else occurs, statistically there will be a global rise of temperature!

Doctor M. Pańczyk from the Polish Institute of Geology stated that as a geologist she sees, among different factors causing climate changes, volcanic activity as well. So is there any research concerning the influence of volcanic activity, which is observed for instance in Iceland, conducted on Spitsbergen? In the last hundred years the character and frequency of volcanic eruptions have changed there. In the past these were in majority effusive eruptions, nowadays they are powerful phreatomagmatic eruptions, throwing into the air large quantities of carbon dioxide. Therefore, is it not high time to study volcanic ashes in the ice cover? For example during the latest eruption of Grimsvotn crack, a large cloud of sulphur compounds was observed. Is the emission of CO₂, sulphur compounds and volcanic ash fall studied? The Polish Institute of Geology has recently started monitoring dust coming from Icelandic volcanoes to Poland. It should be also remembered that volcanoes have the opposite influence, at least in the short term, that is they make the climate cooler, not warmer. Research on dust is conducted by UNIS University centre in Spitsbergen. Eruptions in Iceland do not have a direct influence on global CO₂ production so they are local phenomena which are quite quickly eliminated by atmospheric processes. Atmospheric circulation rather indicates that dust moves from the direction of Europe.

Professor A. Marsz made a correction of the wrong information that volcanoes are currently the main CO₂ producer. There are completely different sources of this gas, mostly of anthropogenic origin. The ocean releases CO₂ into the atmosphere, which is a kind of feedback, but the source of it are not volcanoes. In fact there is a theory of leaving the 'snowball' period in which tectonic phenomena in the Earth's crust and emission of carbon dioxide connected with it caused leaving such state of complete frozenness, because in Neoproterozoic, in Cryogen to be precise, the Earth froze completely together with all its oceans. This is the only relatively complete thesis explaining the mechanism of leaving the 'snowball' stage, so it indicates that volcanoes, especially the submarine ones, put such amount of carbon dioxide into the ocean that the process of warming in connection with greenhouse effect caused a temperature rise on the surface of the Earth.

Because of the limited time of the discussion, **prof. A. Kostrzewski** from the National Science Council affiliated with the Ministry of Science and Higher Education took the floor. In his opinion, the greatest value of the present meeting was drawing attention to a correction in some of the research and analyses concerning particular problems taking into

account the impact of the ocean factor on the changes in circumpolar regions. One common feature of opinions and methodology of the research concerning slope and fluvial processes or deglaciation in the polar regions was distinctive. Embracing the presence of **ambassador J.T. Wolski**, he pointed out the following issue: for more than ten years we have been battling in the system of sciences to convince other scientific disciplines of the importance of polar research. This concerns both sanctioning and financing our polar station, as well as 'Oceania' vessel. We have put forward a proposal to define the stations mentioned above and 'Oceania' as priority governmental units. Unfortunately their financing is still insufficient and their functioning is threatened. Moreover, there is a lack of political will of solving these problems. The basic issue is, as **prof. J. Jania** mentioned, that in its future work the Committee on Polar Research, PAS takes into account also the key research priorities. The essential matter is also creating theme data bases and polar monitoring. Without these elements modern research is impossible.

Doctor M. Korczak-Abshire from APECS POLAND remarked that Polish biologists, from the beginning of Arctowski Station have been conducting the monitoring of environmental changes in the Antarctic. The results of these studies are a precious source of information for non-governmental institutions dealing with the problem of exploiting commercial species of the South Ocean.

Professor J. Jania expressed his fear that the discussion would be directed only to the subject of the global warming, a problem which we are not able to solve. It is worth discussing the possible ways of improving the quality of research. The simplest way to put it is to say that the whole history of climate changes can be found in bottom sediments of the ocean, since paleoceanography has given answers to many questions, but not all of them, many questions remain open. Many of them concern shores, e.g. the ones of Spitsbergen. He expressed hope that a cooperation of different centres, among others those of Poznań, Cracow and Wrocław, would allow to start a programme which would be interdisciplinary by definition; it would join oceanography, paleoceanography, geology, geography and climatology. The programme concerns bringing suspension to the area of shelves and fjords on Spitsbergen. Surely this project will be successful, also in terms of publications. We should aim to concentrate on studying large problems and not the small and local ones. The National Centre of Science has been created in Cracow, it is a pity that polar research section has not been established. Research projects proposed to various theme sections are brushed off. Creating a clear lobbying group for creating a section of polar sciences would be an important and effective solution.

Professor J. Piechura from the Institute of Oceanology PAS informed that in mid-April this year in Saint Petersburg a working meeting on the preparation for the International Polar Decade had taken place. Preparation started two years ago already. World scientists came to a conclusion that it would be a pity to waste the infrastructure created on the occasion of the International Polar Year and the research started should be continued. On account of this it was decided to organize the International Polar Decade basing on somewhat different conditions. The International Polar Year had been organized on the basis of freedom of choice – anyone could propose a subject, obtain their own financing and start the research. There was also an attempt to coordinate them by The International Polar Committee. The Polar Decade is to be different. A team of international specialists will work out appropriate key subjects. The Polar Year subjects were superficial, shallow, while the International Polar Decade proposes to concentrate on narrow but in-depth subjects. The Arctic Council did not

discuss this problem at its meeting, but clearly supported the concept. The International Oceanographic Committee will soon start an open competition for research projects. At the moment a secretariat already works, and that is in two organizations, namely in the World Meteorological Organization and the International Arctic Science Committee, which will coordinate the preparation and precisely define the programme. In October (2011) a conference was organized in Helsinki on preparing the issues of The International Polar Decade. The guidelines are to prepare the programme draft at the next Arctic Science Summit Week meeting in Montreal.

Ambassador J.T. Wolski from the Ministry of Foreign Affairs shared a few of his impressions on the conference. He highly evaluated the scientific session which had very interesting presentations and a fascinating discussion. The conference was illuminating, helping to understand the polar milieu and its problems. A very interdisciplinary discussion took place. **Doctor M. Łuszczuk**'s (from Maria Curie- Skłodowska University) presentation gave the polar research a political interpretation. The most important issue is a broad exchange of information. The problems mentioned ideally coincide with the activity in working groups of the Arctic Council. He appealed again the polar explorers' milieu: we vitally need the activity of Polish scientists in working groups of the Arctic Council, in which the presence of Poland must be noticeable. Another conclusion is organizing the 'Polar Task Force'. It is a completely fresh place where discussions and communication about polar regions research can really take place. It is important to lobby in the international open forum, where science meets bureaucracy and politics. He said that the scientists gathered at the conference were in a happy situation to deal with the antipodes, that is problems of abroad, so the Ministry of Foreign Affairs has the right prerogatives to deal with them.

As a conclusion, **prof. J. Jania** thanked **Ambassador J.T. Wolski**, all the authors of reports, panel discussion moderators and participants. He expressed his joy with the fact that **prof. J. Piechura** had been invited to Saint Petersburg to a decision-making meeting. The Polar Decade has started its activity taking its own course and information about it is so far scarce. Next year another Polar Symposium is planned in Sosnowiec. (Silesia) **prof. J. Jania** made a promise in Łódź to prepare this meeting as cheaply as possible so that a maximum number of young scientists could participate in it. A scientific committee of the Arctic Science Summit Week in Cracow in 2013 has already been called. For the **Polar Research Committee** affiliated with the Presidium of the PAS for the term in office of 2011–2014, which has been recently called (and not chosen, according to the new rules) it will be the first major task. Our role will be finding about 100–150 thousand dollars, as such are the costs the host must cover. In connection with the meeting in Montreal it is worth thinking things over, so that a maximum number of young scientists could participate in the approaching congress. The speaker congratulated **dr M. Łuszczuk** on being given the task of chairing one of the sessions in Montreal at a conference which would take place just after the Arctic Science Summit Week and would be immanently connected with the Polar Decade. As it was concluded from the discussion, priorities in polar research should be determined and a place for them should be found in the Polar Decade programmes.

Finishing his speech he invited **prof. M. Gutry-Korycka**, the chairlady of the **Polish National IGBP Global Change Committee PAS** – the main organizer of the conference – to close it.

Professor Gutry-Korycka thanked the organizers – the chairpersons of the three Committees the common activities of which lead to preparing a national conference on polar subjects **presenting the present state of research and opinions of researchers in Poland.**

It seems that the assumed goal has been reached, but to make it long-lasting, post-conference materials – articles and the discussion summary – should be prepared to be published in the ‘Papers of Global Change’ Vol.18 – a periodical published by the **National Committee IGBP Global Change PAS**. This will be a chance to provide a broad audience with the range of polar research and lines of enquiry connected with the international platform. At the end she thanked all organizers, especially **dr K. Chwedorzewska** from the Antarctic Biology Department, PAS, the secretary of the National IGBP Committee PAS for her large contribution and help in organizing the conference. She expresses the hope that Polish **National Committee IGBP Global Change PAS** had made its small contribution to the great polar research. The Professor assessed that the participants of the meeting had familiarized themselves with new results, often preliminary, of research which would be continued to learn about the mechanisms and biotic and abiotic processes that rule polar regions. The research is often very difficult, multilevel and interdisciplinary. It seems that the intended goal of the conference has been reached. Polish researchers constantly bear testimony of their value and possibilities. They are also strongly engaged in the trend of modern research, which is a great achievement of Polish science in the international arena, for polar research have for many years been a strong point of the modern knowledge of the world and its changes.

(Compiled on the basis of a sound recording by A. Marchwińska-Sławińska)