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ACADEMIA

THE MAGAZINE OF THE POLISH ACADEMY OF SCIENCES

Poles at the Poles

100 years of Polish polar research, described by:
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TOMASZ WAWRZYŃIAK

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PIOTR ANDRYSZCZAK

The polar regions are extraordinary, magical places. They are cold, windy, inaccessible, ice-clad for most of the year, and yet still teeming with life.

What is it about them that attracts so many enthusiasts, scientists, and people willing to spend months there? Is it a thirst for adventure? Or the opportunity to discover the secrets of nature, practically untouched by humans? Why do Pole scientists so eagerly choose these regions as the target of their research? And why is it that, although we are physically so far away, we Poles do feel so much a part of the polar family?

It was sixty years ago that the Polish Polar Station, Hornsund, was established near the Polar Bear Bay at Hornsund Fjord on Spitsbergen, the largest island of the Svalbard Archipelago. It was founded by an expedition led by Stanisław Siedlecki, and to this day, managed by the PAS Institute of Geophysics, it serves both Polish and international polar researchers. A second Polish research station was established forty years ago on Admiralty Bay on King George Island in the South Shetland Archipelago, now managed by the PAS Institute of Biochemistry and Biophysics. If we include all the work conducted at sea from the research vessel *S/Y Oceania* maintained by the PAS Institute of Oceanology, it is undeniable that the Polish Academy of Sciences has become a truly global player in the field of polar research.

This rich infrastructure and the enthusiasm of many extraordinary people have contributed to the advancement of many scientific fields in Poland. Our polar explorers are renowned throughout the world and are the pioneers behind many discoveries you will read about in the following pages. This is fostered by the collaboration of scientists from more than twenty academic centers and research institutes. Thanks to this enormous potential, Polish scholars participate in many international programs, often coordinating them, and indeed it is at the Polish stations where numerous young scholars from all over the world are taking their first professional steps. We offer excellent opportunities for junior scientists. It was in Poland that a unique interdisciplinary doctoral program was created, enabling students to study the natural environment of the Arctic and Antarctic. The Centre for Polar Studies, which currently holds the title of a Leading National Research Centre, was established for this purpose.

This anniversary date, 60 years after Poland began its polar station tradition, offers a great opportunity to talk about amazing places and incredible people. Here's hoping the articles in this special issue will help spread the word about fascinating polar research and the enthusiastic people doing it.

PAWEŁ ROWIŃSKI, VICE-PRESIDENT OF THE POLISH ACADEMY OF SCIENCES



JAKUB OSTAŁOWSKI

THE VIEW FROM THE NORTH

ACADEMIA: The station on Spitsbergen accounts for what share of the complete century of polar research facilities we are now celebrating?

PIOTR GŁOWACKI: Quite a large share, in fact. It was sixty years ago, in July 1957, that two ships sailed away from Poland carrying an expedition and materials to build a Polish outpost there in the far north.


What was the motivation behind this? Especially in the 1950s, which do not seem to have been particularly conducive for research.

Already in 1956 there had been talk of holding an International Geophysical Year. Poland had gotten involved, for instance, in launching a magnetic station in Vietnam, and so it was concluded that we could

take part in another undertaking. Poland was then likely seen by the Russians as an element of their support on the international arena in the far north, as a country acceptable to the Western countries. Sometimes political factors coincide with research initiatives in a good way. If one can take advantage of that, it can lead to success.

So why particularly there, in the Hornsund fjord?

The site had been selected by a reconnaissance expedition led by Prof. Stanisław Siedlecki in 1956. The southern part of Spitsbergen shows a cross-section of all the Earth's geological epochs, all within an area of just 40 kilometers. Moreover, the Hornsund fjord has eight glaciers reaching the sea, with varying dynamics, including some highly responsive to climate



We learn about the Polish Polar Station in Hornsund on Spitsbergen from **Prof. Piotr Głowacki**, who headed the PAS Institute of Geophysics' Department of Polar Research for 15 years.

change. When the polar circle was being studied in 1898–1901, the precise range of the glaciers in this region was recorded. Later photogrammetric, aerial, and satellite images were taken. So today we can see the pace of change – for instance the Horn glacier has withdrawn by nearly 17 km over these 115 years.

That does not bode well.

No, it does not. Because this fjord has *sund* in the name, which means 'straights.' Our research indicates that there really is a passageway between the Greenland Sea and Barents Sea, which are characterized by different temperatures and different currents. If the 'cork' plugging up the passageway disappears, and simulations indicate this could happen around 2035, it will be possible for water to circulate

around the southern part of Spitsbergen. This will probably give rise to conditions for cyclonal circulations. Such vortexes are found around Iceland, where most of our atmospheric lows are formed. Most of these lows move along Norway towards Spitsbergen. If a stable low is formed there, the movement of the Icelandic ones will be constrained and will be pushed over Scandinavia and partly the Baltic, in other words they will start to affect Poland as well. That means we can expect a larger number of extreme weather phenomena and changes in precipitation, for instance. And so our station may be viewed in the coming years as an element of an early warning system for our country.

Nearly everything is better visible on Spitsbergen, even literally so. The air is cleaner, nearly devoid of

■ Name ■
**THE "STANISŁAW
SIEDLECKI" POLISH
POLAR STATION
IN HORNSUND**

■ Location ■
**WHITE BEAR BAY
ON THE HORNSUND
FJORD, SPITSBERGEN
ISLAND**

■ Date of founding ■
1957

■ Owner ■
**PAS INSTITUTE
OF GEOPHYSICS**

pollutants, the thermal variations are not so great, and often the humidity is lower. We can keep an eye on what is happening even 10 km away without binoculars.

The kind of place that offered a different type of perspective from the very outset?

Yes, in communist times it was in every respect an open window to the big world of science. Firstly, after WWII, Eastern bloc citizens had to have visas to visit the West. But because Poland had signed the Svalbard Treaty back in 1931, we had free access to the archipelago guaranteed. Secondly, the countries under Soviet influence were under high-tech embargo, but that did not apply to Spitsbergen. I once saw, for instance, specialists from our Space Research Centre come to visit the station. I wondered why, until their colleagues from the United States also flew in, bringing hardware that is still being used to send out readings to NASA every 20 minutes. When travelling off to spend the winter for the first time in the 1980s, I received a Commodore computer from the Polish Academy of Sciences. Two months later the Norwegians and Americans brought us an IBM PC. But the equipment we brought from Poland was truly good, because any mediocrity, repairs, or returns were out of the question. Everything there had to be the best: from the food to the clothes. We had a sense of comfort and satisfaction at working on such a high level. Thirdly and finally, quite a number of scientists from other countries passed through there. Some of the polar researchers working with us came with invitations in their pockets, to come on fellowship to their home institutions. That is why we now have polar research personnel excellently educated abroad.

We now study everything – from deep-earth structures 10 km down, to the ionosphere 600 km above the surface of the globe.

They didn't experience trouble, such as not being given foreign currency to travel abroad with?

No, because we used a barter system. If a foreign guest was at the station for a week, our scientist would have a week at their institution. That's the way we still work today. In general we try to be economical. For instance, we take food from Poland so as not to spend horrendous amounts buy-

ing it in Norway. The prevailing principle at the station is this: the money is in a single wallet and while there are no rigid rules of accounting for it, but obviously it has to be spent so that it will serve our mission well.

Like in a well-functioning family.

The first founder, Prof. Stanisław Siedlecki, called the station a Polish home near the North Pole. No one dreams of taking advantage of anyone else or of displaying any typical "rat-race" attitudes, because it's impossible. One is forced to maintain good interpersonal relations for months. For instance, because the weather conditions change very quickly, and also because of the bears. Nowadays they pay somewhat fewer visits, but during my first winter we recorded more than 140, during the second 240. It really is a zoo up there, just in reverse: the bears are the ones peering in the windows and observing us.

When any researcher goes out into the field to take measurements, they have to be accompanied. One cannot have one's gaze fixed on the readings on a device or monitor while at the same time looking around to see what kind of danger might be approaching. And so we always go out with a fellow researcher, carrying a weapon, who can react quickly in an emergency – for instance if we should fall into a crevasse. We all have to be certain that if we work together we can rely on one another. If someone does not know how to do something, it's better to admit it straightaway, rather than pretending to be macho. That also means that the researchers represent all the generations, including both experienced and quite young scientists. We really do have competent successors: there are now 26 individuals working on their doctorates at the Centre for Polar Studies. Even 90-year-old Prof. Krzysztof Birkenmajer, a guru of Polish research in both polar regions, can find a common language with them quite easily.

Let's get back to history. Building a station in such a location was no simple task?

No, certainly not. There's no port there, so the ship remained at sea and everything had to be delivered by boats or military pontoons. And anything can be done only during the polar summer, which essentially means two months a year. Building anything that quickly would not be possible, so the station was prepared back in Poland in the form of prefabricated wooden elements. All of them were taken by boat and pontoon, then on shore along a "human chain," passed from one person to the next, until the whole station rose up like a ship, made of ribs.

Renovation was another important moment.

Yes, when the geophysical year was over, there was not enough funding to stay there permanently. The

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station was used intermittently, only in the summer seasons, and not every year. From 1970, when science gained a bit more momentum, there were more frequent expeditions, organized above all by a group of glaciologists led by Prof. Stanisław Baranowski from the University of Wrocław. Finally, in 1978, a decision was made not only to restore the station, but to make it continually habitable. It is even hard to even imagine what fortitude the members of the first expedition led by Prof. Jan Szupryczyński in 1978 must have had. They brought 840 tons of cargo with them. During the last renovation in 2001–2005, when we dismantled everything that could be dismantled, I had a chance to admire the solid handiwork and the quality of the material used – the floorboards laid together by the highlander craftsmen without using nails still had the smell of resin.

But in the late 1970s Poland was in economic crisis.

Yes, but firstly, the idea of opening up to the West was then being pursued, and secondly, there was an economic motive. Only countries holding territory or contributing to research in Svalbard had access to the rich fishing grounds of the Barents Sea. The fact that our fleet subsequently became decrepit and we never fully utilized our fishing quotas is another matter.

What does it mean that our station is the only one functioning within a national park in the Arctic?

First came the station, later the Norwegians created the national park, in view of the unique natural conditions there. The station rests on permafrost, which on Spitsbergen is an average of 100 m thick, and in certain places goes down 300 m. Every impression made on the frozen ground causes the ice to melt. That is why the station stands on poles – if pressure in one location causes the ice to melt, other poles take over the burden, and so on. When the building was raised, one could crawl under it. Sixty years

later, it is now only some 20 cm above ground. The polar researcher Kazimierz Zając, who has already wintered at the station seven times, always brings a big bearing-ball with him. He puts it on the floor in his room and watches which way it rolls. It never rolls the same way; each time the station is inclined differently.

So the permafrost is a bit problematic. But it also has its advantages. We can't bury anything, no trash, we also can't pour out waste because nothing seeps into the soil, it will just stay there as an icefall or icicle and attest badly to us. We also have a purification facility that outputs a dry granulate, which can even be used to fertilize soil. Like other segregated and pressed wastes, we turn it over to the Norwegians.

Why?

So that we are not suspected of throwing it into the sea on the way to Poland. But the quantities of such waste are not great, we have only three types: the ashy granulate from the incinerator, glass and metal. We have a lot of glass containers, cans, used tools, equipment, and snow scooters. Everything else gets incinerated ecologically.

We are the only ones on Svalbard to have a high-temperature trash incinerator, and so we do not emit pollutants into the atmosphere. As far as the fuel depot is concerned, we are equipped with monitored, double-walled tanks, and the pipes are even triple-walled to make sure there are no spills. We have power from diesel generators, which also give us exhaust heat for warming the facility.

And so we are as maximally ecological as we can be. Over the last 15 years, the governor of Svalbard has frequently brought in guests, including ministers, ambassadors, and members of parliament from other countries, to show them how a facility can function in a national park without posing a threat to or degrading the environment.

It is important for the Norwegians that our station is situated at a location where two sea currents meet: the warm Western Spitsbergen Current (as a branch of the Gulfstream) and the cold current from the Barents Sea. And so, any castaways or ecological pollutants appear first of all in the region of our station. When a nuclear powered submarine was lost between Bear Island and Spitsbergen in 1986, for three weeks the Norwegians flew around the vicinity of the station, collecting samples of water to test for radioactive contamination. In the days when the only communications were by radio, the station acted as a relay point for rescue operations. Since 1988, we have had a rescue container in which accident victims can survive. A few years ago, a tourist excursion ship sailing deep in the fjord had an accident when a big chunk of ice fell onto it from a glacier. The more than 20 people injured were all

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is a physicist and chemist, and earned his DSc in the field of Earth sciences. A member of the PAS Committee on Polar Research and the Committee on Geophysics. Since 2014 he has been Poland's representative to the Svalbard Science Forum (Research Council of Norway), a research advisory body. In 2015 he was decorated with the "Bene Merito" medal by the Polish minister of foreign affairs for his contribution to strengthening Poland's position in the international arena. He has wintered on Spitsbergen twice and has worked there for shorter stints more than 50 times.

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The Svalbard Treaty (also known as the Spitsbergen Treaty)

An accord signed on 9 February 1920 in Paris by the United States, United Kingdom, Denmark, France, Italy, Japan, the Netherlands, and Sweden. Today there are 42 signatory countries. It stipulates that the Svalbard archipelago belongs to the Kingdom of Norway, but the signatories have equal rights to access its natural resources and conduct research there. Poland signed the treaty on 2 September 1931.

International Geophysical Year (IGY)

A research project embracing various studies in geophysics undertaken between 1 July 1957 and 31 December 1958, with a total of 67 countries taking part, from both sides of the Iron Curtain. It was an extension of the concept of the International Polar Year, which had been organized twice: 75 and 25 years previously (and so IGY is sometimes described as the "Third International Polar Year").

brought to us, where they were given first aid, then evacuated to a hospital by helicopter over the course of two days.

The excellent location of course has its limitations: we cannot expand the station, because negative environmental impact would drastically increase. That is why the number of people who can stay is limited. We have an 11-member wintering team, plus only 20 spots for researchers from Poland and abroad. But because there is a lot of competition for access to the station, those who do come are the very best, which translates into good research results.

Of what sort?

Initially the station primarily had a geophysical profile. With time, however, specialists from other fields started doing projects there and we noticed that its potential and capabilities were much greater, so the research and monitoring work was extended to include further fields.

Our weather station, which is the most northward synoptic station in the European sector of the Arctic, performs several kinds of monitoring and wise data online every minute to the worldwide observations. In the 1970s and 80s our seismic station was very important, because it registered not only all kinds of natural earthquakes, but also nuclear explosions. Today it still remains one of the "police officers" keeping tabs on what's happening on our globe. On average we have 38 grants underway, one-third of them involving foreign money, the remainder being national projects, plus the costs of technical maintenance of the station.

All told, Poland spends not quite 8 million zlotys on research in the Arctic. What do we get in return for this? Aside from propaganda, political or economic aspects, it above all gives us great prestige in the scientific world. If we look at just last year,

Polish polar scientists published 114 papers in top-ranked, ISI-listed journals plus 50 others in monographs and post-conference collections, and gave 160 conference presentations (three-quarters at international conferences). Every year sees about two DSc (*habilitation*) degrees, three to five doctorates, and 20-55 master's degrees earned in polar fields. We supply unique data to many world centers and databases, which through mutual access are therefore available not only to our polar researchers, but also to scientists in other fields. Even though it seems to many that polar research is expensive, in fact we spend money in the most economical way, in terms of the research effects achieved.

Why do measurements have to be made by people? Technology has moved so far forward, couldn't this just be automated?

No. A machine cannot replace a person everywhere. When it breaks down or is damaged by bears, it will not replace itself. Often one has to go outside every three hours to make meteorological observations. To look at the cloud cover, identify the type of clouds, ascertain how high they are. One has to record the visibility and measure the precipitation twice a day. Snow needs to be brought to the station and melted, though not on the stove, where it would evaporate. There are two meteorologists working on alternating 24-hour shifts, because no one can be on their feet every three hours for a year. The glaciologists go up onto the glacier to measure how much snow fell in the winter, and how much melted in the summer. They used to have to use a theodolite for positioning, now things are easier: there are fixed GPS sensors and data is read from them, which is then analyzed in the station. The chemist collects all sorts of atmospheric precipitation, since something falls there nearly every day. This is analyzed



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in terms of pollution, and then backward trajectory analysis is used to deduce where it may have come from and whether it contains telltale components, such as from Russia or Canada. The oceanographer studies the sea currents. The geophysicist works on earthquakes, the hard terrestrial crust, and magnetism. The ionospherist looks at all the aurora effects, calibrating data for satellites, and given that every circumpolar satellite flies over the region nearly 15 times a day, there's a lot to do. There is also an atmospheric physicist, who studies all types of aerosols, UV radiation, ozone levels. There's also the mechanic of the expedition, plus a so-called handyman, because with so much equipment at the station the mechanic is unable to take care of everything. And there's also the leader of the expedition, who also cannot be replaced by an answering machine.

Things have grown to such an extent that we now study everything – from deep-earth structures 10 km down, to the ionosphere 600 km above the surface of the globe. And we also look carefully much further – at the Sun.

For what purpose?

To try to avoid the end of the world.

Are you trying to scare us?

No, everything depends on how one understands the end of the world. For many people, especially young people, not having any phone coverage, Internet or GPS would already qualify. And that's probably going to happen, we just don't know precisely when, and more importantly, we have no way of preventing it. The solar wind and the plasma flowing towards Earth slips around the planet's magnetic field, but it comes in much closer in the polar regions, where the field is different. That is why we observe auroras mostly here, rather than elsewhere on the globe. At

the same time non-geostationary satellites fly several times a day through zones where the density of that plasma is the greatest. If there is a lot of plasma, it is easier for the apparatus to be damaged or even burnt out. Two years ago, after just two sunspots appeared, a Chilean military satellite flew into such plasma and got fried, and the remainder damaged several other satellites. This included one taking measurements for us, for mathematical models related to changes in ice cover and their influence on rising sea and ocean levels. That was a catastrophe. Until the Japanese put up a new satellite, for several months specialists were devoid of their basic tool supplying data. The largest power-supply blackouts came at the same time, because the transformer stations were short-circuited. But this was just two sunspots.

All the satellite technology that has been developed since the 1990s works because the Sun is asleep, as far as plasma eruptions are concerned. Once it returns to the kind of activity seen in the 1970s or 80s – as happens cyclically – there will be trouble.

Plasma reaches the Earth from the Sun in two or three days, but the flash is visible just about eight minutes later. Observations can be used for three-dimensional modeling of where the greatest density will be. We can attempt to help satellites that are in danger by turning them off temporarily and changing the arrangement of their antennas, which improves their chances of making it through safely.

And so the Sun is also best visible from the north?

Yes, but only during the polar day. From 1 November to 11 February it is below the horizon.

INTERVIEW BY ANNA ZAWADZKA
AND KATARZYNA CZARNECKA
PHOTO BY TOMASZ WAWRZYŃIAK

Images, from left:
Measuring water flow in the river Lorschelv.
Reindeer grazing on the tundra.
Checking the density of snow to evaluate its accumulation on a glacier.
Tundra cover comprises dwarf shrubs, mosses, lichens, and also mushrooms.
A polar bear by the lighthouse.



PRESTIGE FROM POLE TO POLE



**Prof.
Jacek A. Jania**

is a researcher of glaciers and polar regions, a renowned geomorphologist, and a specialist in remote sensing, internationally known for studying tidewater glaciers.

A member of the European Polar Board (EPB), Chairman of the PAS Committee on Polar Research, and Head of the Centre for Polar Studies (a Leading National Research Centre) and member of the Board of the Polish Polar Consortium, comprising 18 scientific institutions. He lectures at the University of Silesia in Katowice.
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Why do we study the polar regions of the Earth? For the same reason a mountaineer climbs mountains: "Because they are there!" And in addition, they are of great importance to the entire planet and to our country.

Prof. Jacek A. Jania

Chairman of the PAS Committee
on Polar Research

Polish scientists began polar research at the end of the 19th century, but it was not until 1932 that the first expedition took place, setting off from independent Poland to the Norwegian Arctic island of Bjornøya. That was the time of the Second International Polar Year (2nd IPY). The scientific objectives of the expedition were primarily of an explorative nature, but they also had some very important practical aspects. For twelve months the expedition team conducted meteorological and other geophysical observations, also studying changes in the Earth's magnetic field and propagation of radio waves. The results of the 2nd IPY were significant for the development of radio communication, as well as maritime navigation and aviation (then just developing), not only in the Arctic.

The nature of the research has essentially not changed much since those days. Polish polar scientific stations are still focused on pure research, but their findings are useful in practice, both in the polar regions and at home. In the ten years since the largest coordinated research program in the world, the fourth International Polar Year (2007–2009), Arctic and Antarctic research has been being conducted on an unprecedented scale, also involving many Polish scholars.

But what does Poland gain from researching such distant, polar regions?

✓ **We are among an elite group of countries that conduct long-term multidisciplinary research of both polar regions.** This we owe to the 60 years of work conducted by the scientific station at Svalbard in the Arctic, and the 40-year operation of the H. Arctowski station on King George Island in the Antarctic Archipelago of South Shetland Islands. The Polish flag flying over modern research facilities is an important sight. Polish polar stations play the role of scientific embassies at the ends of the Earth. It is mainly thanks to this that Poland is an active participant in key intergovernmental organizations, such as the Antarctic Treaty System, and as an Observer State in the Arctic Council. Poland's Ministry of Foreign Affairs has become the initiator and organizer of discussions between the Observer States and the subsequent presidency of the Arctic Council, the so-called "Warsaw Format Meetings." This kind of scientific diplomacy helps build Poland's image on the international stage.

✓ **Discoveries and innovative findings bring prestige to Polish researchers.** This due to our intensive pursuit of pure research, furthering our understanding of the Earth's polar regions, including their geological structure and the potential location of mineral and biological resources. The latter is important also for the fishing industry. Polar research is also a playing field for a noble kind of international scientific rivalry in discovering new phenomena and species, as well as understanding the changing patterns of the polar environment.

✓ **Knowledge of modern processes of glacier recession can help better understand the phenomena that have previously occurred in Poland.** Only quite recently (from a geological perspective of



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course) over 80% of Poland was several times covered over by the Scandinavian ice sheet. Its development and disappearance significantly influenced the shape of the terrain and type of surface geological deposits in our country. The deglaciation processes determined the location of mineral resources used in construction (such as gravel, sand, clay and silt for making bricks), affected the geotechnical conditions that are now crucial for building foundations and communication routes, and influenced the formation of soils.

✓ **We are gaining knowledge about the trends and pace of climate change on the global scale.**

Both polar regions are crucial to this issue. While Antarctica is still a climate stabilizer due to the presence of its large continental ice sheet, the Arctic region is warming up 3-4 times faster than Europe, for example. This phenomenon is called Arctic amplification. This is what is setting the trends of climate change at mid-latitudes, due to the interaction of the atmosphere with the ocean and sea ice. The rapidly shrinking ice cover on the Arctic Ocean increases the atmosphere warming process due to its contact with a warmer sea. Engaging in systematic observations allows us to obtain direct access to our own data, to arrive at our own findings and to contribute to those gained through international collaboration. This not only the basis for understanding what is happening with the climate, including in our own country, but it also makes it possible to forecast certain scenarios of climate change in the future. And this certainly has practical implications for economic planning.

✓ **Long-term research in the Earth's most severe regions also involves many other applied aspects,**

such as testing the performance of various materials (e.g. clothes), the resilience of technical equipment, and the appropriateness of new technological and logistical solutions (including polar station waste water treatment, as an example). It also gives specialists not only training in a wide range of scientific disciplines, but also great opportunities to gain practical experience. It allows us to test how people deal in extreme conditions. The state-of-the-art knowledge and first-hand personal experience of the polar researchers teaching at the Polish universities belonging to the Polish Polar Consortium help disseminate and harness the latest scientific findings.

Finally, I would like share the reasons why I personally am involved in studying Arctic tidewater glaciers that produce icebergs, in what is called ice-calving. Yes, they are beautiful and are highly challenging to study, so we still don't know much about them. But what is most important is the greatest unknown: what their actual contribution is to raising the level of the world's oceans. Apart from melting, calving apparently also contributes to this phenomenon. A slow rise in sea level of about 3.5 mm/year is already a fact, but accelerated melting, flow and calving of large outlet Greenlandic glaciers, and especially the great West Antarctic glaciers, may in the long run lead to an increased ocean level by meters rather than centimeters. It is crucial to investigate the driving factors behind iceberg formation in order to identify and assess this threat. My colleagues from the Centre for Polar Studies and I, through broad international cooperation, are helping to seek answers. Is it important for the future of Poland's own coastline and ports? I think that goes without saying. ■

THE VIEW FROM THE SOUTH

ACADEMIA: The United States, Norway, the United Kingdom, and Australia – these countries are scientifically active in the Antarctic, just like Poland. What did we do to deserve a place in this group? Is Poland a polar power?

ROBERT BIALIK: From the perspective of investments in science, we obviously can't compare ourselves to such giants as the United States and Norway, not to mention Australia, New Zealand, and the UK, which has the British Antarctic Survey, the largest organization that conducts research in the Antarctic, and the Scott Polar Research Institute in Cambridge. Those are powerful countries that have a huge infrastructure and employ thousands of people. However, we also have polar stations, both in the north and in the south, which gives us a major advantage, because we can conduct comparative research. What did we do to deserve that? The Arctowski Station was established in 1977. We all know what system of government we had in Poland back then, we know that the Soviet Union was a powerful country that treated us as a satellite state. In an attempt to expand their sphere of influence, the Rus-

sians handed over the Dobrowolski Station to Poland. It was not used actively on a yearly basis, but it was needed for access to the marine food resources.

“Krill to feed Poland?”

That essentially was the idea. But it works best as a source of protein for farmed salmon. In addition to conducting scientific research, the Arctowski Station was supposed to provide logistic support for krill fishing vessels. Personally, I believe that what happened back then was phenomenal. Building an entire village with its own infrastructure – a power station, fuel storage facilities, cooling chambers, and warehouses – took just two months. Two hangars were built that are still used as storage facilities. These days, whoever works with helicopters in the region of the South Shetland Islands are the winners, because they have the logistics. Poland was one of those countries during the 3rd and 4th Antarctic Expedition, which means in the late 1970s and early 1980s. For the first years, we had pilots, mechanics, and maintenance. Back then, Poland was a powerful player in terms of logistic support for scientific research.

PIOTR ANDRYSZCZAK

Asst. Prof. Robert Bialik, head of the Department of Antarctic Biology at the PAS Institute of Biochemistry and Biophysics, talks about the Henryk Arctowski Polish Antarctic Station on King George Island



So what happened?

The system of government changed and the economy collapsed. The world started to wonder if the Antarctic marine resources were not being over-exploited. Consequently, the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) was established in 1982, and it started to regulate the catches of the Antarctic krill and the Antarctic toothfish, a type of fish living in the waters surrounding the Antarctic. At the same time, the Polish fleet, adjusted to the requirements set for the vessels in that region, became outdated, and there was no money for new vessels.

The krill dream came to an end, but the station remained in place.

Exactly. Its location was scientifically the best choice that could be made. When you go into the jungle, you can hear animals. Here, when you leave, you can see 10,000 animals. Three penguin species nesting close to the station (the Adélie penguin, the gentoo penguin, and the chinstrap penguin), elephant seals, Weddell seals, leopard seals, and Antarctic fur

seals. We should also remember about two penguin species that visit the station area from time to time, namely the king penguin and the macaroni penguin. They can be found in the Antarctic Specially Protected Areas (ASPA). You can't just start your research there, bring your equipment, say a drilling rig, and make noise. You can't conduct any invasive activities. Expeditions to the region are monitored. Poland manages two such areas, namely ASPA 128 and ASPA 151. Close to the station, there is an area called the Jasnorzewski Gardens, one of the largest marine wetlands in the whole of the Antarctic region. Some sources say it dates back around 5,000 years. You can't even walk there, because every impression your step makes stays there for years. Others envy us for this.

What scientific opportunities does that offer?

Our strength lies in ecology. Things have looked so from the very beginning. Back in the 1980s, those who worked there, aside from the staff from the Department of Antarctic Biology, included a team from the University of Łódź whose members included

■ Name ■
**THE "HENRYK
ARCTOWSKI" POLISH
ANTARCTIC STATION**

■ Location ■
**ADMIRALTY BAY ON KING
GEORGE ISLAND IN THE
SOUTH SHETLAND
ARCHIPELAGO**

■ Date of founding ■
1977

■ Owner ■
**PAS INSTITUTE
OF BIOCHEMISTRY
AND BIOPHYSICS**

Prof. Krzysztof Jażdżewski and Prof. Jacek Siciński. The materials collected back then are still used as a basis for PhD and DSc (*habilitacja*) dissertations. Today, there is not enough tax, whereas we have discovered many new species. There are the studies of Prof. Wojciech Majewski from the PAS Institute of Paleobiology, who collected core samples and determined the age of new organisms. There is the work of Prof. Maria Olech's team, appreciated by the SCAR this year. There've been plenty of studies, especially in the field of biology, because that was the scientific profile that the station adopted as a result of the presence of numerous organisms, and – despite the fact that the Antarctic climate is that of barren deserts – a wide variety of mosses and lichens.

From the outset, the station has observed indicator species such as penguins. Dr. Małgorzata Korczak-Abshire was entrusted with the task of developing these observations by the previous head. As a result of her work, the database that was created as a result of the counting of species and the population of the animals that are found there (pinnipeds, penguins, and birds such as the south polar skua and the southern giant petrel) became so extensive that it attracted the interest of the international community. We started to conduct observations of krill-dependent indicator species, including the Adélie penguin. After the economic crisis in the United States, when the Americans decided to limit the observations in the region of the Copacabana Station, located in the vicinity of the Arctowski Station, we began to continue those studies. Over the past 10 years, we have also monitored indicator species at Lions Rump, King George Bay. In 2014, the CCAMLR decided it was one of its main observation points. Three years ago, a Polish-Norwegian consortium led by the PAS Institute of Biochemistry and Biophysics in collaboration with the Warsaw University of Technology, the Northern Research Institute in Tromsø, and other institutions, was given the Project MONICA (“A novel approach to monitoring the impact of climate change on Antarctic ecosystems”), whose purpose was to use new technologies such as unmanned aerial vehicles (UAVs) to conduct monitoring. Photographs taken by the aircraft allowed us to estimate the size of the population of penguins and pinnipeds as well as to map plant communities. Of course, such actions improve research to a great degree, but they are not sufficient. People must be present there, because you can't establish the weight and number of the eggs or the weight of the chicks from an aircraft. Aside from that, an aircraft does not work without interruptions. That's what we can boast about: the Project MONICA and ecological monitoring.

Is that enough to ensure the station's maintenance?

No. When I was appointed head of the Department of Antarctic Biology two years ago, I decided it was necessary to conduct projects also from other disciplines. For example, we launched projects in glaciology and climate science. The glaciers in the Antarctic are the same as those on Spitsbergen, or even larger, and the climate is very similar, so it's natural that we conduct comparative research. This year, we also have prominent ornithologists: Prof. Dariusz Jakubas's team from the University of Gdańsk, which studies two species of small birds from the family Oceanitidae. We've started collaboration with Prof. Żaneta Polkowska from the Gdańsk University of Technology in the hydrochemical study of watercourses. We've started monitoring glacial meltwater to see how it shapes the moraines. Also, there are analyses of the impact of the station on the environment, and the results are favorable for us. Over these 40 years, however, we have also made some blunders. A type of grass called *Poa annua*, a highly invasive species, was accidentally brought to the station – either from Poland or from South America, we don't know. For now, we are trying to remove it and burn it, but we have a botanical project aimed at eradication. Analyses of the speed of coastline changes conducted by scientists from the University of Wrocław are also directly useful to us. The most important problem we face is caused by the fact that when the main building of the station was erected, it was more than 10 meters away from the coastline. Today, the distance is only 1.5 meter.

Is it all possible to move the buildings?

Only the British have such modern buildings that could be moved, if need be. For example, that's what happened to the research station Halley VI this year. But we will probably never have the money to afford this solution. Aside from that, this method can only be used on ice. The Arctowski Station is situated on normal soil. The only way is to build a new station elsewhere.

Should we do that immediately?

Yes, because every storm is dangerous. Five years ago, there was such a strong storm that the winter-over expeditioners reinforced the coastline with concrete slabs. We realize this was done against the landscape conservation rules, but that was the only thing that allowed them to survive. Fortunately, things have been very peaceful since then. This year, however, we can expect unfavorable winds. The waves are already crashing against the windows of the room of the chief of the winter-over expedition. So the station is directly under threat, and action is needed immediately.

ASST. PROF. ROBERT BIALIK



JAKUB OSTALOWSKI

Who should take such action?

The Arctowski Station is supervised by the PAS Institute of Biochemistry and Biophysics, whose statutory activity is financed from the funds of the Polish Ministry of Science and Higher Education. For that reason, we file relevant applications. Last year's application was rejected. As for this year, there is no decision yet. However, we fear we will not get the money. The costs are enormous.

What does this mean?

Around 100 million zlotys, which is a lot for a single ministry. Various ministries are involved in the Antarctic affairs, including the Ministry of the Maritime Economy and Inland Navigation, which represents Poland in the CCAMLR, and the Ministry of Foreign Affairs, which is responsible for the Antarctic Treaty meetings. If they could participate in the costs, things would be much easier. However, the only ministry that can finance scientific infrastructure is the Ministry of Science and Higher Education. The only hope is that decisions will be made at the level of the government.

So if that sum of 100 million were found, then...

Then we have a design ready for a new Arctowski station, as a single, three-story building. Of the kind that houses other modern stations.

At this point the station is fragmented?

There is a main research building, which also has a dining room, kitchen, and rooms for the 14-member over-winter group. There is a "Meteo" building where weather observations were previously done, and now is where the head of the Department of Antarctic Biology customarily lives when at the station. Scientists make use of three houses with two-, three-, and four-person rooms without any conveniences, only beds and electricity, situated about 200 m from the station, but allowing for normal life and work. Everyone comes to the main building for meals. That arrangement is problematic, at the very least because

of the wind. Such weather is only possible in Antarctica: sunshine, a blue sky, and wind of 100 km an hour for a week. One can barely open the door, walking 100 m takes some 15 minutes, and large-sized pebbles are flying around at the level of your knees.

Despite everything, I myself, and probably also my colleagues, will miss the main building of the station. Perhaps it can be preserved at least in part, as a museum. The part that is a unique mess hall can be separated, because it is composed of containers.

That means it is light. Erecting a large building in difficult terrain is an additional challenge?

Yes, that's why last year the PAS Institute of Biochemistry and Biophysics also invested in the work of a team partially consisting of scientists from the Faculty of Geology at the University of Warsaw, which studied the soil some 200 m from the coastline. In subsequent steps we have to evaluate the environmental impact and secure permission for the construction. We should receive it, because the main justification is that there is a risk of catastrophe, and our people have to be safe.

How much does the station cost to maintain per year?

Our annual subsidies amount to 6 million zlotys. And that suffices to maintain ongoing operations. However, logistics are really expensive. Just hiring a ship entails huge expenses, and travelling from Gdynia to our island takes around 42 days each way. Fortunately, every year the call for bids is answered by a ship that is going to Antarctica anyway, so it takes our people and cargo with it essentially on the way. Increased subsidies would secure the functioning of the station, but it would also enable it to be adapted to facilitate top-notch research.

What does the station give back to Poland, to make spending such sums of money worth it?

Firstly, maintaining our presence on the continent, and the ability to have a hand in decisions there, should be part of Poland's state interests and the Arctowski station allow us to do so. Aside from that, we truly are a kind of Polish embassy in the Antarctic. We are visited by guests from various countries and we try to greet them with the highest honors, we have the national flags of all the countries working in the Antarctic, to hang on the mast outside the entranceway to the main building. This is scientific diplomacy. Secondly, polar research raises Poland's prestige in the international arena. Especially the ones that attract a lot of publicity.

For instance?

With the ability to conduct direct observations, we can report that over the past 5 years there has been

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KURYLWICZ & ASSOCIATES



LESZEK KRZEMIEŃ

Images, from top:
Design for a new Arctowski
Station.
Dr. Michał Pętlicki doing
glacier-scanning work.
Dr. Mateusz Strzelecki
hard at work at the
Arctowski Station.



PROF. GRZEGORZ RACHLEWICZ

a local climate cooling and a noticeable slowing in the process of deglaciation, at least during the Antarctic summer. Many scientists conclude that things are nevertheless warming and that we have to curb CO₂ emissions, which is of course hard to debate. But a discussion is starting in which we can say: we have additional information and our voice is starting to be important. About how what is happening at the poles is not a question of climate, but of certain other factors. And about the consequences of the phenomenon. A second example: this year we noted that seals were starting to die – over the course of a week, we were finding one body after another, 8 of them all told. If we had not been there, we would know nothing about it. Now our National Veterinary Research Institute. This happens year after year, all thanks to the fact that we can observe anomalies there. Our monitoring is valuable in and of itself, because it has been underway for 40 years now. Few countries possess such long-term data.

What interests you personally the most in the Antarctic?

Hydrology, of course.

But there are no big rivers there.

No, but the small streams that flow out of the glaciers are even more amazing. If one sees that a stream has appeared in a place where there was not one a year ago, I can work out how things once must have happened in Poland and predict changes in the future. For example, the transport of river debris. In Poland we have the Vistula River, which transports so much material that it is immeasurable. There is so much of it that we cannot evaluate the quantity. Models are fashioned, but it is only in the Antarctic, on this small scale, that it turns out we can verify them. Of course someone might say: why don't you verify them in the Tatra Mountains in Poland? Because there we have already formed postglacial streams and washed-out moraines. We also have floods in Poland. When the water recedes, a lot of rubble remains. But again we don't know how much. There, we can evaluate it. In other words, without intervening in nature, we can observe things that be naturally adapted to the environmental landscape back here in Poland. There are many such topics.

In other words, Antarctica is the world in miniature?

Yes, a natural laboratory. A wealth of potential topics to study, and a major brand of its own.

INTERVIEW BY ANNA ZAWADZKA
AND KATARZYNA CZARNECKA

AGNIESZKA KRUSZEWSKA, MS

STRATEGIC THINKING

The successful integration of the polar research community in Poland – through collaboration between the PAS Committee on Polar Research, the Polish Polar Consortium and the Polar Studies Centre – has led to the development of a Polish Polar Research Strategy, setting forth a set of directions for the future.

Agnieszka Kruszevska, MS

PAS Institute of Biochemistry and Biophysics

This Strategy, edited by Dr. J. M. Węśławski (PAS Institute of Oceanology) and Dr. W. Ziąja (Jagiellonian University), identifies a set of top priorities in for the further development of polar research in Poland, taking into account their cognitive, educational, social and economic significance. Its overall aim is to strengthen Poland's international position as a country with great scientific potential in protecting the natural resources of our planet. The document proposes four main directions of research to be undertaken in the polar regions, considering their complementarity and interdisciplinary nature. They include:

- ✓ studying the abiotic components of the polar region environment, including their functional properties,
- ✓ advanced investigation into the state and modifications of the biotic components of the polar environment, and the properties that govern them,
- ✓ better understanding of the conditions, course, and consequences of the processes related to human activity in polar conditions,
- ✓ researching the social aspect of polar regions, and including it in the further development of Polish social sciences and the humanities.

The Strategy also underlines the need to initiate more extensive research into the application of advanced technologies in extreme polar conditions (including as space-analogue environments). It notes that the development of Polish polar research should focus on the following important aspects: strengthening the active and significant

presence of Polish researchers in polar areas, providing expert consultations on behalf of industry and political bodies, building synergy between polar research and innovation, educating new generations of polar researchers, active participation in initiatives aimed at protecting polar regions, bolstering social involvement (educational campaigns, dissemination), and, equally importantly, improving logistics.

Whilst recognizing that funding for science must always be awarded on a competitive basis with merit-based criteria, the authors of the Strategy are calling for special resources to be allocated for its implementation, so as to bring about four major outcomes: modernization of Polish infrastructure in the polar regions, greater global recognition for Polish researchers through major publications, creating an open database of polar research, and strengthening and developing Polish polar research personnel. The authors stressed that the attainment of these goals is possible by utilizing and strengthening the various scientific centers already collaborating under the framework of the Polish Polar Consortium and the Polar Studies Centre, while remaining open to broad collaboration with other national and international teams, as well as with state administration bodies, commercial companies, and education authorities.

Polar research has been a part of our Polish national culture for more than eight decades, helping to reinforce Poland's brand and prestige in the world and enabling us to honor the kind of international treaties and commitments that are taken on by countries responsible for studying the state of the Earth's natural environment. We have much indeed to be proud of: great traditions and academic achievements, extensive experience, excellent staff and our own research platforms in the Arctic and Antarctica. ■



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ALONE AMIDST THE SNOW

Asst. Prof. Agnieszka Skorupa from the University of Silesia discusses the psychological consequences of a prolonged stay at a polar station.



Agnieszka Skorupa, PhD,

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ACADEMIA: As a psychologist, you went to Spitsbergen to study more closely how polar expeditioners work. What made you take an interest in this subject?

AGNIESZKA SKORUPA: They live in extreme conditions, so they are physically and mentally overburdened. In science, polar conditions are referred to as “isolated, confined, and extreme,” or ICE. Such an extreme environment is isolated, both socially and physically. Social isolation means you can’t contact whoever you want and whenever you want. Physical isolation, in turn, means that you live in restricted spaces and you may be prevented from leaving the premises of the polar station by weather conditions, temperature changes, round-the-clock polar nights, or, in such regions as Spitsbergen, the threat posed by polar bears.

How do those conditions affect the mental health of explorers?

First and foremost, we are affected by the amount of light. In our daily routine, we are accustomed to the circadian rhythm typical of the temperate zone, where Poland lies. Polar days and polar nights disturb the secretion of hormones produced by the pituitary gland and the thyroid, which may disrupt the sleep-wake cycle. Consequently, the body’s capacity to regenerate gets worse, there may be feelings of anxiety and low mood. However, we can’t say that every polar expeditioner on Spitsbergen will suffer

from depression or sleep disorders during the polar winter. Various scientific studies demonstrate that the rate of mental disorders among those working at polar stations ranges from 0.3% to 5%, which is close to, or maybe even somewhat below the average for the general population. Also, we should remember that there are three groups of polar expeditioners: “over-winterers,” or those who stay for a whole year, summer expeditioners, who go to polar stations for the period from June to September, and participants of temporary research expeditions that may last 1 or 2 weeks or a month. Each of these groups will be affected by a different set of factors.

Let’s focus on those who spend the winter.

They have especially numerous stereotypes surrounding them, related to how polar stations work. Many people are convinced that the stations are freezing cold, dangers lurk around every corner, and the explorers live in extreme isolation or dash through the snow in a sled pulled by sled dogs. The reality helps dispel these old and somewhat romantic images. These days, explorers prepare carefully for expeditions, and they are recruited and trained by experts. Although they leave for a year, the consequences of the physical or physiological discomfort experienced by the expeditioners are kept to a minimum, because the station is well-prepared. What we can’t minimize is the impact of the natural environment – the polar night and day, polar bears,



NOEL_BAUZA/WWW.PIXABAY.COM

crevasses, and harsh weather conditions make work and life more difficult. Likewise, we can't eliminate issues resulting from natural group dynamics. All groups, not only those working in polar conditions, go through certain stages of development. At the beginning, there is usually the "forming" stage, where the group members establish relations, get to know one another. They want to put their best foot forward, because they aren't sure what the rules are. This is followed by the "storming" stage, where the group members decide they can't be polite all the time, they have their own distinctive opinions and views they want to highlight, and this leads to conflicts. Once they go through this stage and accept the fact that everyone is different, they lay down new rules in a process referred to as the "norming" stage and start working together effectively, which means entering the "performing" stage. As I said, this is typical of every group. However, group dynamics are especially important at a polar station, because they are coupled with isolation.

What mental characteristics does one need to have to decide to stay at a polar station for so long?

We would very much like to have a clear answer to this question, because we could say: these are the traits one needs, because such people will prove themselves well out there. But that's impossible, because there's no single personality or temperament, so it is hard to distinguish the traits that guarantee

the same level of effectiveness throughout the year. Moreover, a healthy team is a diverse team, which means that sending people all with very similar traits that impact on individual adaptation does not necessarily translate into the effectiveness of the entire group.

So whom will you discourage from going on a polar expedition?

In recruitment, there is the "select in" approach and the "select out" approach. In polar research, we know less about who we want to recruit (that's "select in"), but we can say more about who we don't want ("select out"). We look for stable and level-headed individuals who are mentally and physically in good health. Individuals who are very neurotic, extremely disagreeable or susceptible to low moods are unlikely to be recruited for a job at a polar station. If someone is an extrovert or an introvert is of secondary importance, because people can satisfy the need for contact with other people in different ways. It would seem that those open to new experiences prove themselves better. However, very high openness is not necessarily recommended. It is related to cognitive curiosity, the need to be active, whereas a job at a polar station, fascinating though it is, involves a repertoire of jobs and tasks that is rather limited.

How do polar explorers cope with being away from their families and friends?

The Internet has changed this greatly. Aside from incidents of extreme weather conditions and sporadic system failures, access to the Internet is available all day. Those who live at the station feel that although they have left their loved ones at home, they can still keep in touch with them, for example using Skype. This lessens the sense of isolation. At the same time, the Internet brings them close to the problems their families face at home, but these problems are beyond their control. That may result in a feeling of helplessness.

Those who work at the stations are both men and women. Do they differ in terms of their mental characteristics?

For a long time, there was a prevailing belief that male teams and female teams differed in terms of how they worked. The first teams that went to live in extreme conditions were composed only of men, and it was believed such teams worked best. Today, we have male teams, female teams, and mixed teams. Studies show that the presence of women can calm down the atmosphere and facilitate communication, not only in terms of tasks but also ordinary, everyday issues. However, there is sexual tension. Studies carried out at major stations such, for example the

US McMurdo station, show an increase in comments regarding women and sexuality that may be considered offensive or upsetting. Most members of the staff go to polar stations without their partners or as singles, and they stay with members of the same sex for the whole year. Arrival of a member of the opposite sex changes the group dynamics. Of course, this is a problem not only for polar expeditioners but also for soldiers on military missions or any long-term expeditions characterized by isolation.

You conducted your study among expeditioners spending the winter, over a period of one year.

Yes, but I myself did not stay at the station for the whole year. I didn't want the explorers to feel uncomfortable, because I was part of their team yet was watching their behavior carefully. I met with the participants of the expedition before they left. Those who agreed to participate in the study filled out questionnaires once a month and submitted them via the Internet. I went to Spitsbergen at the end of their expedition and conducted in-depth interviews with the group members.

What did you want to find out?

I tried to capture to what extent various problems, stress, and potential discomfort resulted from the extreme environment, and to what degree from what happens between people everywhere. After all, a group doesn't need to be staying in an extreme environment to go through a stage of conflict. I created a complex model, because we studied the behavior of people who had specific characteristics yet also were going through various mental states, which were influenced by external conditions, such as the occurrence of polar night, and intergroup factors. I tried to take account of all these components and I wanted to find out if any of them would prove more important for the adaptation of humans to the polar conditions.

Did you find such a factor?

The study showed that the Big Five personality traits had no significant impact on whether someone successfully adapts to isolated, confined, and extreme environments. That is fascinating, because the best adapted individuals turned out to range from an extreme introvert to an extrovert, from a neurotic to a very calm person, from a disagreeable individual to a very agreeable person. In other words, we can't hope to use psychological tests to determine a specific personality type and say that such people should definitely go to a polar station.

Also, there was moderate evidence to support the existence of the "polar syndrome," or the hypothesized emergence of conflicts and low moods during polar night, caused by the fact that it is cold and dark,

but the explorers can't leave the station. It turned out there was more evidence in support of a "third-quarter syndrome," whereby the participants of a mission, regardless of how long it takes, tend to mentally divide it in half. On the one hand, they feel that lasting through the first half is a success. On the other one, their mind tells them, "There is still the second half left to go, and that's a long time." For that reason, conflicts occur more frequently in the third quarter, and the moods may be low as well. The final stage of the mission is also interesting, because it also leads to tensions. The participants are happy that the mission is over, but they feel anxious about returning home. In addition, they have to answer for the tasks they undertook to perform.

We're talking about threats, conflicts, and problems. Are there any moments of happiness?

Those who listen to my lectures usually feel horrified, because I talk about all these negative things. But I do so to make sure people are aware of what may happen. Of course, there are also positive results of polar expeditions, and they even outnumber greatly the negative ones! If you ask the polar explorers from the PAS Institute of Geophysics, they will tell you that their self-confidence and self-efficacy goes up after an expedition. They've experienced quite an adventure, and this gives them social approval. They've done something extraordinary, so they feel special. Most polar explorers adapt to the conditions at a polar station very well, they come back without traumas or injuries. They feel stronger, because they've done something extraordinary or they've faced their fears and overcome difficulties. Moreover, the environment that we stereotypically perceive as a potential source of extreme experiences is in fact very rewarding. The participants of my study named contact with the nature and the beauty of the environment as their most important experiences from the stay on Spitsbergen.

Did you experience anything that ran counter to your stereotypical beliefs?

I was especially surprised by the fact that I could drink coffee from a coffee machine! I'm glad I went there. Before I went to the polar station, I read plenty of scientific publications and polar books. I watched films from expeditions, but what I discovered there was not what I'd expected. Such an experience is extremely valuable to a researcher: to see things as they truly are. I saw the beauty of that place, a very good station. Above all, I met great people. The station is not a psychology lab. It's a place of work with completely normal people who were brave enough to take this great challenge.

INTERVIEW BY ANNA ZAWADZKA

ASST. PROF. MICHAŁ ŁUSZCZUK

“ON” AND “FOR” FOUR MILLION

For many people, the Arctic is not just a place to visit for various reasons, but actually their home. As such, polar research can study not only the importance of the Arctic and Antarctic for the world at large, but also what the world can do to help those who live and work there.

Asst. Prof. Michał Łuszczuk

The scientific secretary
of the PAS Committee on Polar Research

For centuries, polar regions were treated as located somewhere beyond the edge of the world, both figuratively and literally. Discovering and exploring those areas took several hundred years and cost many people their lives

and fortunes. Even today, polar research remains highly challenging, both logistically and mentally. It is worth bearing in mind, though, that this popular, heroic and romantic vision of the polar regions represents just one possible point of view, especially with respect to the Arctic.

In Poland, polar research was popularized by two prominent researchers with broad scientific interests in the earth sciences, namely Henryk Arctowski and Antoni Bolesław Dobrowolski, and subsequently developed by natural scientists, chiefly in Svalbard. For that reason, we often forget about “the human face” of the Arctic. We fail to see that the re-



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GEORGE R. KING/WIKIMEDIA COMMONS

An Inuit family, 1917.

The Arctic Council, established in 1996 by virtue of the Ottawa Declaration, is an international institution that currently wields the largest amount of influence over decisions concerning Arctic problems. Its members are eight Arctic countries: Canada, Denmark, Finland, Iceland, Norway, Russia, Sweden, and the United States. Poland is in the group of the first four states (alongside Germany, the Netherlands, and the UK) to receive the status of permanent observers in 1998 (it was subsequently granted to France and Spain, whereas China, Italy, Japan, Singapore, South Korea, and the European Commission have the status of applicants).

The Arctic Council focuses on sustainable development in the Arctic, which means conservation of the natural environment, comprehensive scientific research, monitoring of the consequences of climate change, and assistance for indigenous peoples. Its interests also include the launch of new shipping routes in the Arctic and the management of the region's natural resources.

Source: Polish Ministry of Foreign Affairs

gion is actually inhabited by around 4 million people, including more than 400,000 indigenous inhabitants. In the modern era, not only have these people been affected by many of the same processes as those who live in other regions of the world (modernization and globalization), they have also been forced to confront many different, usually negative consequences of climate change around the North Pole. When seen from their perspective, which still relies on so-called indigenous knowledge, the changing Arctic cannot be thought of as just a topic of scientific study (despite what some researchers believe), just in terms of polar bears and wonderful auroras (despite what tourists tend to think) or just potential natural resources (important for governments and corporations) – it is above all the place where these people have chosen to make their home.

Four important questions

Polar research has a relatively long history: it emerged at the juncture of various fields of science as a result of the unique characteristics of the natural environment in the regions located around the Earth's geographic poles. As a result of differences between the northern and southern polar regions, researchers quickly began to distinguish between Arctic and Antarctic research. A closer look at the topics of scientific publications in the field of polar research from the past several decades, whether for the Arctic or the Antarctic (or both simultaneously), reveal the clear dominance of earth and biological sciences in the broad sense. Does this mean that the researchers in the social sciences and humanities have no business studying polar regions?

Surely not: the phrase “polar social sciences and humanities” is coming into increasing use in scientific discourse (although it may come across as contrived or unnecessary to some). There is, as yet, no universally accepted definition of this term, but the most recent international strategies for the development of Arctic research (IASC's “Integrating Arctic Research – a Roadmap for the Future,” ICARP III) and Antarctic research (SCAR's “Strategic Plan 2017–2020: Con-

necting and Building Antarctic Research”) do call for efforts to strengthen the role and importance of social sciences and humanities. Why?

First of all, the ongoing changes in the Arctic and Antarctic have prompted greater recognition, not only from most scientists but also from the whole of the international community, of the substantial interdependencies that exist between natural and social sciences, both regionally and globally. The two polar regions have imminently demonstrated, in many ways, that it is nowadays impossible to fully explore and explain any important process or phenomenon through research limited to only one scientific discipline. For that reason, the future of polar research largely lies in interdisciplinary research in close symbiosis with natural sciences, social sciences and humanities, and others field of science, such as medicine and technology.

Secondly, the results of much earth-science research done by polar scientists in the late 19th and early 20th century had both purely scientific value and practical applications. Similarly, research in polar social sciences and humanities is increasingly likely to yield theoretical knowledge as well as to contribute to solving many non-scientific problems faced by the inhabitants of the Arctic and the countries and international institutions that are jointly engaged in the governance of the Antarctic region.

Thirdly, current trends in polar social sciences and humanities research are generally consistent with the general trends in these disciplines. What distinguishes this field is the broadly-understood “polar focus” of the topics it addresses. However, the crucial factor is not that the objects of study are situated within the boundaries of the polar regions (as is typical of most of empirical polar research in the fields of natural sciences), but rather there exist certain clearly distinguishable links to these regions. This means that the general scope of polar social sciences and humanities can be described as encompassing humans and their relationship with the world, including creativity, society as well as its products, both within and outside the boundaries of the polar regions, just as long as these are clearly linked in some way to the Arctic and/or Antarctic.

Fourthly, the trajectory of development evident in polar social sciences and humanities research to date strongly suggests that the field will only continue to develop. Instead of being oriented towards narrow specializations, this development will instead largely rely on interdisciplinary research conducted both within the broad field of polar social sciences and humanities and in collaboration with natural sciences. This will result in the emergence of new epistemological challenges and necessitate the development of skills needed to effectively communicate research findings and transpose them

The two polar regions have imminently shown that it is nowadays impossible to fully explain any important process or phenomenon through research in just one scientific discipline.

to different branches of science. Also, further development of polar social sciences and humanities will result in the emergence of new interdisciplinary topics, strands, and disciplines in both Arctic and Antarctic research. Anthropological studies will be limited to the Arctic, whereas studies in the field of new approaches to international law or the psychological aspects of human activity in extreme conditions will be more likely to pertain to the Antarctic. The distinction between the two regions will be largely linked to the changes currently taking place in human activity there and the resultant new scientific and social needs.

Three Polish tasks

Reports written under the auspices and for the needs of the Arctic Council and other international organizations as well as the aforementioned strategic documents drafted by international scientific institutions draw attention to several major directions of research within Arctic social sciences and humanities, including sustainable development in the region, the impact of globalization, climate change, and innovation. The complex processes and phenomena underpinning those topics may attract the attention of researchers interested in humanities as well as cultural, social, economic, legal, political, and environmental issues. As for the Antarctic, the main areas of study may include: the international governance of the region, pressure urging greater exploitation of natural resources, and climate change. Since the only inhabitants of the Antarctic are exclusively scientific personnel (despite the fact that more and more tourists have been deciding to visit the region), Antarctic research will most probably pertain mostly to law and politics, economics, environment, and to a much smaller extent humanities.

As for Poland's priorities in polar social sciences and humanities, a formulation of them was recently put forward by the Panel on Social Sciences and Polish Polar Research History under the PAS Committee on Polar Research (based on the experience amassed by Polish polar researchers to date, the potential for future work in this direction, and the potential expansion of international collaboration), naming three specific interdisciplinary areas of research:

✓ **Maintaining a Polish presence in the polar regions**

This area may involve studies pertaining to the history of Polish polar research, Poland's foreign policy towards the polar regions, polar literature in Poland, the Polish community in the Arctic countries, and the development of Poland's research potential in the polar regions.

Out of the around 4 million inhabitants of the Arctic, around 50% live in Russia, 31% in the Nordic countries, 16% in Alaska, and 3% in Canada. The problems they face are typical of the inhabitants of peripheral, poorly populated regions. In addition, they face challenges related to the austere natural conditions of the Far North and climate change (for example, the thawing of permafrost, leading to the devastation of infrastructure). Socially, the Arctic is highly diversified: demographics, standards of living, and the scope of law vary both between the Arctic countries and within each such country. One special feature of the Arctic social landscape is the substantial role of indigenous peoples (a total of 400,000 people) in the governance of specific regions, especially in terms of natural resources.

Major present-day challenges facing the Arctic peoples

include: ecological and environmental issues, the protection of culture, language, and traditions, access to education and health care, and relations with researchers. Earlier work in these areas was largely research done "on" the traditions, languages, and beliefs of indigenous peoples. For that reason, they chiefly comprised ethnography and anthropology and were conducted from Eurocentric perspectives. Today, Arctic research is also done "for" the indigenous peoples and issues important to them: the possibility of increasing their political presence at local, national, and international level (political and legal sciences), sustainable development in the region (economic sciences), and health-related problems (medical sciences). Aspects important from the perspective of the study of international relations include international collaboration in the region, for example the role of international organizations and security challenges.

✓ **The Arctic and the Antarctic as areas of threats to multidimensional international security**

In this area, researchers may conduct research in international relations, security studies, and risk management in collaboration with natural sciences, in particular those that focus on environmental protection.

✓ **The Arctic and its inhabitants in the era of globalization as well as climate and environmental change**

This area covers studies in anthropology, ethnography, health sciences, sociology, political sciences, economics, and law conducted in collaboration with natural sciences.

By studying what is happening in the Arctic or in connection with the Arctic, researchers can not only develop scientific knowledge but also show respect, care, and a sense of responsibility. And that is exactly how polar research is always to some extent linked to social sciences and humanities, no matter which particular field of science is involved.

MICHAŁ ŁUSZCZUK



COLD BUT FASCINATING YEARS

We had not always dreamed of becoming polar explorers. It was through pure chance, and a bit of courage, that we became the first married couple to spend winters at both of Poland's polar stations.

**Dagmara Bożek-Andryszczak
Piotr Andryszczak**

PAS Institute of Geophysics

Jhen it's cold you can dress warmly, but when it's hot, there is nothing you can do. This is probably why we had no fear of staying in a place where temperatures are low for most of the year. And why we responded immediately when we saw an online advertisement recruiting for a polar expedition. Three weeks later it turned out that we were going to the North Pole. In July 2012, after undergoing tests at the Polish Military Institute of Aviation Medicine, a series of training sessions and eight days on the research ship *Horyzont II*, we found ourselves in the Arctic taking part in the 35th Polar Expedition organized by the PAS Institute of Geophysics. The Polish Polar Station, Hornsund,

on the Norwegian island of Spitsbergen became our new home for the next year.

Among the bears

When we told our family and friends about our plans, some of them thought it was a great idea, but others said we wouldn't last a single polar day, or night. And that the bears would eat us.

We did not think much of it while being trained at a shooting range. It was not until we arrived in the Arctic that we realized that polar bears were no joke. In Hornsund we noted every one of their visits. We wrote down who had shooed off the bear, when, where, and with what. It was not so bad when they came near the station buildings. The dogs barking got us to our feet and we would run out to the entrance, sometimes in our pajamas, with loaded weapons (you always have to carry a weapon in the Arctic). It was much worse to run into a bear out in the field, where there was no place to hide. At that



PIOTR ANDRYSZCZAK

point the only choice was to run away, or, unfortunately, as a final resort, to use heavy ammunition. Fortunately, no one had to use this option during our stay that winter.

And what about those very long days and nights? First we had to get used to the fact that for several months the sun does not set. Later, for the next few months we would not be able to see it at all. The latter was a much more interesting experience for us, because there was a lot to admire in the sky, such as the aurora borealis, which we witnessed quite often. We did not actually experience the predicted months of depression. The only thing we felt occasionally was more sleepiness.

So without any great shocks we spent that time carrying out our duties, that of a geophysicist (Peter) and that of an administrator and teacher conducting online classes as part of the Eduscience project (Dagmara). When we returned, we knew that if given another chance, we would repeat this adventure. We immediately missed the tranquility of the North, the clean air, and unique nature. Two years later, we fulfilled our plan.

Among the penguins

And so in November 2015 we found ourselves on King George Island in the Antarctic as participants of the 40th Polish Antarctic Expedition. At “the Arctowski,” as the station is commonly called, our roles were electrician and computer scientist (Piotr), and administrative worker (Dagmara). Of course we continued promoting Eduscience in the form of online lessons from the Antarctic, thanks to the help and kindness of PAS Institute of Geophysics staff. The living conditions were similar, but there were noticeable differences.

The “Arctowski” is located outside the Antarctic Circle, so there are no polar nights or days there. What surprised us most were the animals, which

are everywhere, close enough to touch. They have no natural enemies on land and so are not afraid of people. You can almost trip over seals, or be frightened by a sea lion, when you mistake it for a boulder lying on the beach.

Despite what some people may imagine, there are online lessons from the Antarctic. On the other hand, there are penguins instead. We first saw them on the way from the ship to the base. While we were unloading, three Gentoo penguins stood calmly at the seashore. We quickly learned that these animals don’t stay at the penguin colony all day, but wander right up to the station as well.

Before we saw those first penguins, we had spent 36 days on the ship *Polar Pioneer*, sailing from the Polish port of Gdynia. First we counted the days, then weeks. We had a lot of time to get to know each other, watch movies or read books that we never had time for before. Sometimes there were attractions like dolphins jumping in front of the bow or flying fish. In the vicinity of the equator the temperature rose to about 35°C and most of the passengers and crew spent time sunbathing.

A last stop in Argentina was our final contact with civilization for a year. Later, when the summer season ended, we were left only with our eight-member company and occasional explorers from other expeditions visiting us from time to time, such as from Brazil’s nearby Comandante Ferraz station. In the summer, both stations were visited by tourist cruise ships and private yachts. Sometimes helicopters flew over. In the north, every few months we had been visited by the residents of the Norwegian town of Longyearbyen, who brought us our mail. It was a very nice break from the monotony of dark winter months on Spitsbergen.

Holiday time

Holidays were, of course, the nicest time. For two polar years, despite thousands of miles separating us from our home and family (over 3,000 km on Spitsbergen, and over 14,000 km on King George Island), we still celebrated our private events, such as wedding anniversaries, the Midwinter Feast, or the one hundred days to go before the end of our wintering on King George Island. But the most important holidays were Easter and Christmas.

In the Arctic, as Christmas and Easter approached, preparation duties were divided between expedition members. Through such cooperation, on Christmas Eve we were able to have our traditional Polish dishes of borsch, mushroom soup, carp, salmon in lemon sauce, fried potato and cheese pierogi, and three types of cabbage dishes, including with peas and with mushrooms. There was also the traditional dried fruit compote, and for dessert we had cheesecake, gingerbread,

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They both took part in the 35th Polar Expedition to the Hornsund Polar Station on the island of Spitsbergen, and the 40th Antarctic Expedition to the H. Arctowski Polish Antarctic Station on King George Island.

The PAS Institute of Geophysics was the originator and leader of EDUSCIENCE, an innovative educational project (running 2011–2015). More than 3,500 schools and 15,000 teachers benefited from the project. The aim was to raise the interest of children and young adults in mathematical and natural sciences through innovative teaching methods and communication with scientists, including employees of the Polish Hornsund Polar Station on the island of Spitsbergen. Students were encouraged to take part in the research and to use the research methods at the school. The Institute staff supported these activities by providing over 6,000 educational materials. An eLearning platform was created for the purposes of the project, as well as a natural science website (www.eduscience.pl with over 200,000 visits per year), methodological materials, 9 educational tours, and a nature monitoring program. The project was tested in 250 schools in Poland. Approximately 56,000 class hours, 254 field trips, 89 EDUSCIENCE picnics and 12 Science Festivals were held. No other academic institution in Poland has offered access to such a large number of educational materials to so many audiences. The project proved such a success that the Institute of Geophysics decided to continue it throughout Europe. Since 2016, it has coordinated the **EDU-ARCTIC** project funded by Horizon 2020 and implemented by 6 institutions from 5 countries (www.edu-arctic.eu). Learning about the fascinating Arctic world and polar research is available to high school students across Europe. Researchers are able to bring the subject closer to students, thus encouraging them to take an interest in science and to pursue a career in a scientific field. Students from 30 European countries will have the opportunity to learn more about the work of scientists and the nature of polar regions thanks to online classes conducted from the Arctic, and even trips to polar expeditions. The project offers webinars with polar explorers, an environmental monitoring program, Polarpedias, Arctic competitions and workshops for teachers. All classes are free for teachers.

Dr. Agata Goździk, EDUSCIENCE and EDU-ARCTIC Project Manager

kutia and Silesian poppy seed cakes. At the South Pole, most of the Christmas Eve dishes had been prepared by the cook who worked at the Arctowski station during the summer. Thanks to her, we had fancy Christmas dishes like stuffed trout and jellied carp. There were also great poppy seed cakes, the culinary debut of our colleague, as well as kutia, but we also had the traditional poppy seed noodles, borsch with dumplings, and cabbage pierogi. Almost like home, if not for the distance – which still seemed just as great during these special celebrations, even with satellite communication available.

In addition to tasty dishes, there were also presents, Christmas carols, a Christmas tree, and in the Antarctic we even had a Kraków Nativity scene and the traditional Christmas wafer, which made it to us undamaged, shipped in a box together with a board game. At midnight, we organized a Midnight Mass outside a chapel at the lighthouse, and thanks to the satellite link and VOIP telephony, we could share Christmas wishes with our families back home.

We celebrated New Year's Eve as well. In Hornsund we had saluted the new year with our weapons. In

the Antarctic, luckily no one had the idea to launch the signaling flares, which could have scared off the penguins or sea lions. Part of the group preferred to spend New Year's Eve at the nearby Brazilian station, but we, along with a few members of the summer group, decided to celebrate it at the "Arctowski." After all, this had been our dream, even back in the days at Spitsbergen.

Everyday life

Although a distance of 16,252 km separates the stations, the average day of the people working at the two locations is in fact quite similar. It consists of daily shared meals, of work and completing their individual tasks, and – in their free time and in good weather – of trips to explore the area. The fact that everyone is away from their loved ones, in an inaccessible place where there are no planes landing or boats mooring on a daily basis, brings people closer together. They get used to the place and each other, and they miss it all when they return home. They miss the frosty beauty of the polar regions, the Northern Lights in the Arctic, the amazing Antarctic fauna, and the slower pace of life. They also miss the clean air. When we came back to Kraków we really felt the difference. In the polar world, the only sources of pollution are generators or waste incinerators, whereas natural scents are produced by penguin colonies and clusters of seals and sea lions. The air in the polar regions is refreshing, and it takes on a characteristic scent when the tide goes out.

The Arctic and Antarctic change people. Spending time there made us feel more confident. We realized that we can do many things in life, and we are only limited by our imagination. We were in a place that many people will never visit, much less spend an entire year there. We have represented Poland at both the most northern and southern points of the Earth. We have worked for the good of education, and in our spare time we pursued our passions. We were far from civilization, but we felt we were at the center of the universe. When we returned, working at a corporation no longer satisfied us, as time sitting behind a desk felt even longer than usual.

We certainly want to go back. But in the meantime we have our memories, we have the polar friendships we made in such distant places in the world. And we have our book, slated to come out in the autumn, about how we found our home-away-from-home at Spitsbergen and on King George Island. And about how a long stay away from civilization did not turn out to be just a hard-to-explain "gap in our resumes."

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