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The View From the North

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.

Prof. Piotr Głowacki is a physicist and chemist, and earned his DSc and professorship in the field of Earth sciences. Chairman of the PAS Committee on Polar Research and a member of the PAS Committee on Geophysics. Since 2004 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 60 times.

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The establishment of the station on Spitsbergen certainly marks an important event in the history of Polish polar research. When was it first set up, exactly?

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

What was the motivation behind this? Especially in the 1950s, which do not seem to have been a particularly conductive time 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 a supporting element 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 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 120 years.

That does not bode well.

No, it does not. Because this fjord has *sund* in its name, which means "straights." Our research indicates that there really is a passageway between the Greenland Sea and Barents Sea, two bodies 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 Islandic 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 more visible on Spitsbergen, even literally so. The air is cleaner, nearly devoid of pollutants, the thermal variations are not so great, and

often the humidity is lower. We can keep an eye on what is happening even as far as 10 km away without binoculars.

Such a location has 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.

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 buying 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, 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

A Polar bear visiting the station, next to the lighthouse

Measuring water flow in the river Lorschelv

the researchers represent all the generations, including both experienced and quite young scientists. We really do have competent successors: e.g. more that 20 people have finished their doctorates at the Centre for Polar Studies. Even the 90-year-old Prof. Krzysztof Birkenmajer, a guru of Polish research in both polar regions, could 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 things 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 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 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

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.

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 20 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 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 the negative environmental impact would drastically increase. That is why the number of people who can stay is limited. We

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").

Reindeer grazing on the tundra

have a usually 10-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.

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

Our weather station, which is the most northward synoptic station in the European sector of the Arctic, performs several kinds of monitoring and relays 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 30 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 9 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 recent years, Polish polar scientists published more than 100 papers in top-ranked, ISI-listed journals plus 50 others in monographs and post-conference collections, and gave 150 conference presentations (three-quarters at international conferences). Every year sees about two DSc (*habilitation*) degrees one professorship, 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 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

Checking the density of snow to evaluate its accumulation on a glacier

Tundra cover comprises dwarf shrubs, mosses, lichens, and also mushrooms

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 stave off 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 stays below the horizon.

Interview by **Anna Zawadzka** and **Katarzyna Czarnecka**
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