

POLARSTERN

Dream Ship of Research

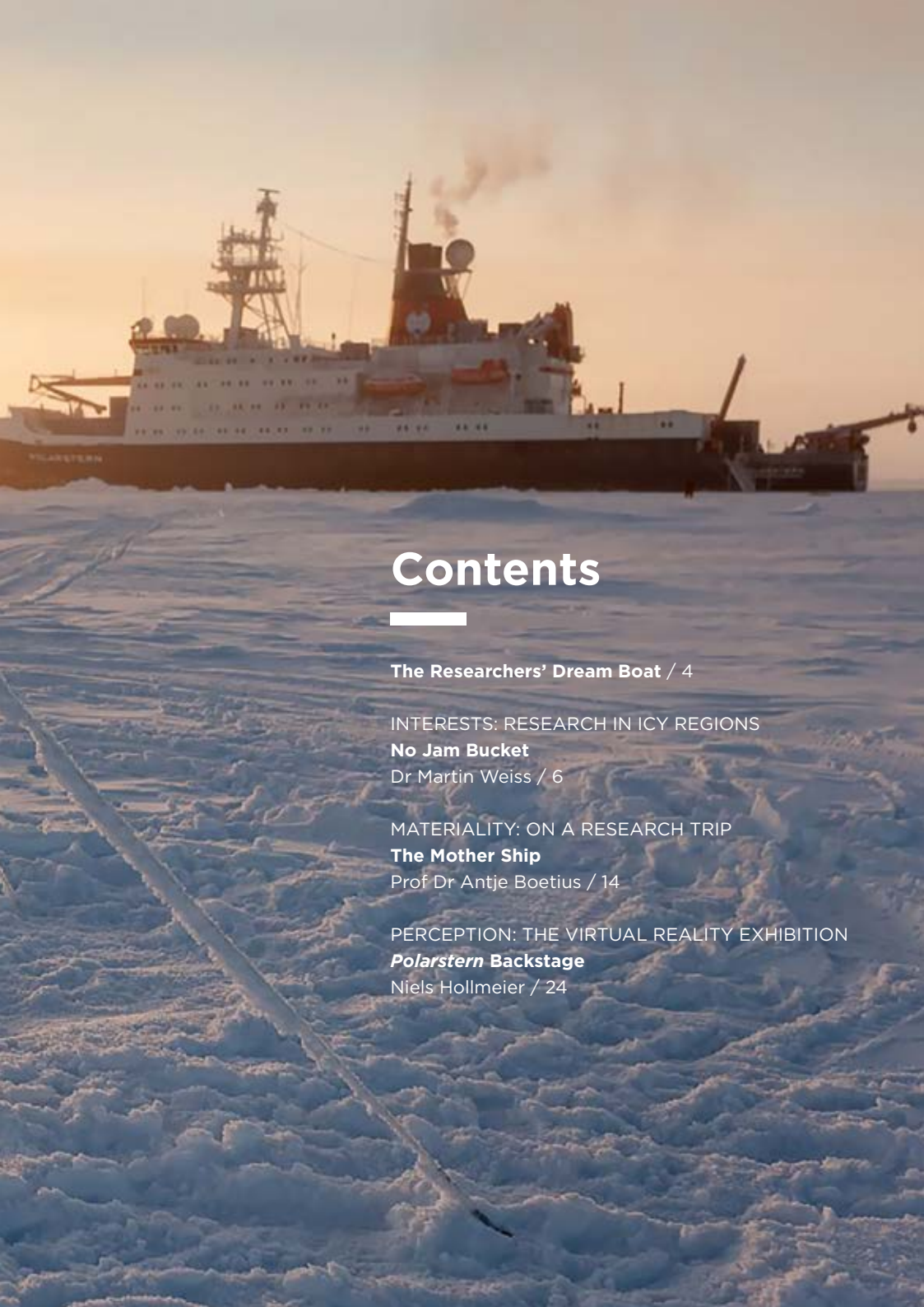
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POLARSTERN

Dream Ship of Research



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The Researchers' Dream Boat

Polarstern (i.e. polestar) is a unique type of ship. Polar research vessel, utility ship, icebreaker. Not only is it the largest German research vessel, it can also transport much freight for the German "Neumayer III" research station or the British "Rothera" station.

It is a floating research platform. With laboratories, winches, cranes, on-board helicopters, and a complete set of fishing gear. A multibeam enables deep sea measurement. This constitutes only part of the opportunities available to the ship scientists.

Thank to its high ice category, the *Polarstern* is able to penetrate regions that only nuclear-powered icebreakers can otherwise reach. It was the first non-nuclear ship to reach the North Pole. Some of more than one hundred expeditions made international headlines. What a number: The *Polarstern* has been doing research trips for more than 1.7 million nautical miles.

Ships exposed to such extreme conditions usually go to the ship graveyard after a period of around thirty years. The mere fact that *Polarstern* is still running testifies of proper servicing,

careful maintenance and good seamanship. "The captains are especially skillful at navigating the ship through the ice," says Ralf Krockner, on-board marine engineer who once was one of the workers on the bridge.

Professor Antje Boetius describes life on a research vessel in her chapter entitled "Materiality". She has a special relationship with this ship. As the most famous deep-sea researcher from Germany, she is also marine biologist and director of the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research in Bremerhaven. She trusts the *Polarstern*, affectionately calling it the mother ship.

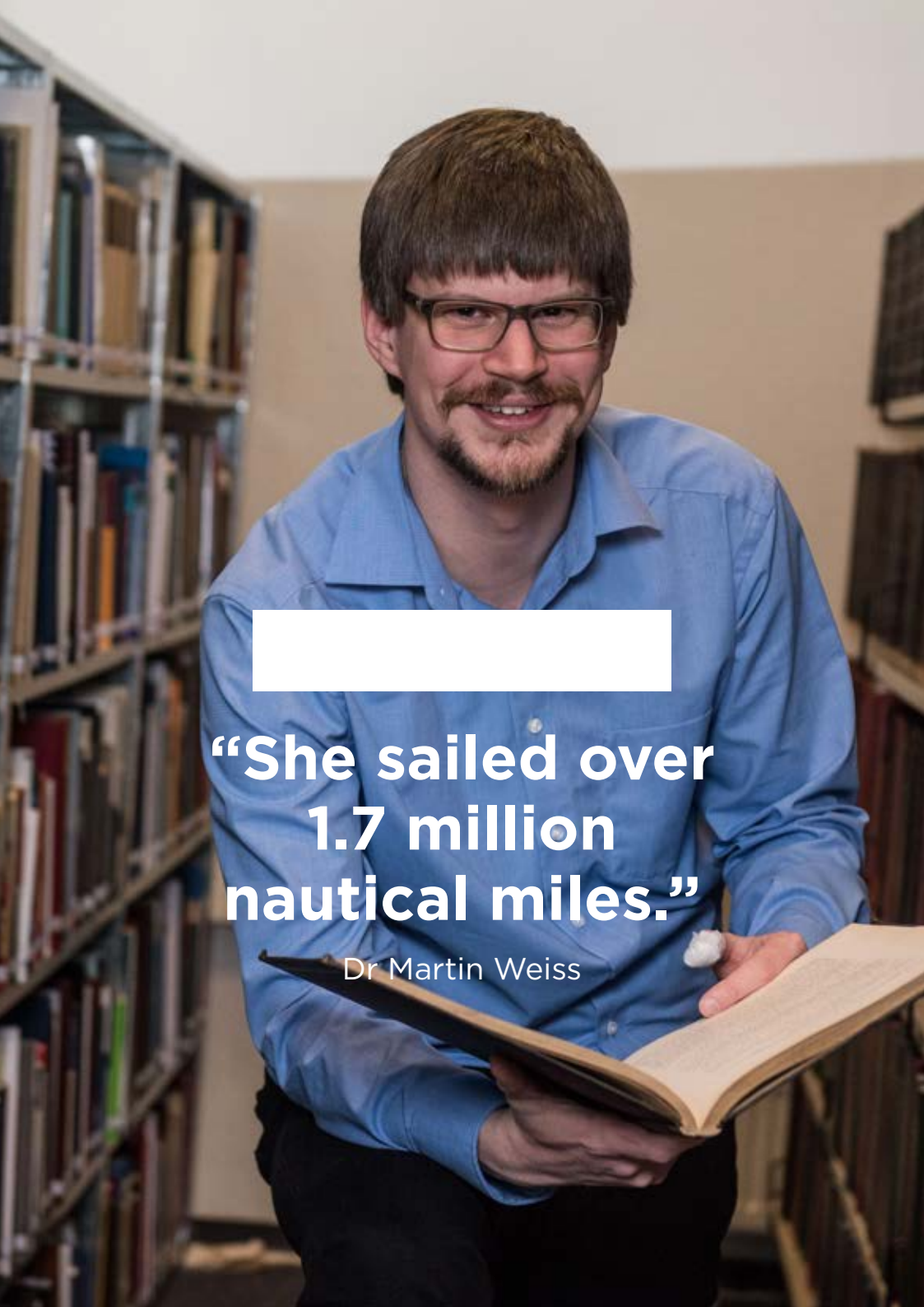
Dr Martin Weiss occupied himself with "interests" that led to the construction of the great icebreaker. A provocative question from a Member of the Bundestag was also due to the flagship of the German expedition shipping having been launched at that time, and it not being a "jam bucket".

The German Maritime Museum now breaks new ground with the *Polarstern* exhibition. The event organizers are looking to connect the real world with



the virtual. Head-mounted displays let visitors to the research museum explore areas of the ship that would otherwise have remained closed to the public. Niels Hollmeier, digital curator at the German Maritime Museum (DSM), explains in the chapter “Perception” what it’s all about.

Now you can experience the one-of-a-kind story of the “researchers’ dream boat”, the *Polarstern*. We hope you enjoy this booklet!

A man with brown hair, a beard, and glasses, wearing a blue button-down shirt, is smiling and holding an open book. He is standing in a library with bookshelves filled with books in the background. A white rectangular box is positioned above the main text.

**“She sailed over
1.7 million
nautical miles.”**

Dr Martin Weiss

No Jam Bucket

Dr Martin Weiss

It was a certain provocative matter that helped the *Polarstern* break through. This would be the beginning of a highly successful story. The crew of the large research vessel since cast off the ropes for in excess of 100 expeditions. Dr Martin Weiss, on the question which interests would be related to the researchers' dream boat.

Would it have been a single sentence that would then dictate the story of the largest ever German expedition ship? A question that would be somewhat provocative and get the Chancellor to thinking? That's in any case how things turned out.

“So: Do we want to build a jam bucket or actually a solid, presentable ship?” That is the question that Bundestag member Horst Grunenberg (SPD) asked Chancellor Helmut Schmidt. Grunenberg, citizen of Bremerhaven, had been involved in a new research vessel project for years. It was July 1978 and the question was what the budget for the research vessel should be. It would be a ship that would supply research stations. An icebreaker that would be built for significant expeditions to some of the most hostile regions in the world. So, no jam bucket.

This was a striking question that seemed to deeply affect Chancellor Schmidt. And also involved a doubling

of the originally planned investment for *Polarstern*. The Social-Liberal Federal Government would ultimately provide 110 million deutschmarks for the construction of the polar exploration vessel. That was a large sum at the time, and would catapult the project into the forefront of international research shipping.

By the end of 1978 already, the Hamburg development office Schiffko would take over the design. The laying of the keel took place in September 1981 at the Howaldtswerke-Deutsche Werft in Kiel. The ship was equipped with interior fittings in the Rendsburg Nobiskrug shipyard. The ice-breaking method was from the Hamburg Shipbuilding Research Institute (HSVA). The *Polarstern* was put into service on December 9, 1982. It was indeed the “presentable ship” that Grunenberg advertised so profusely.

The *Polarstern* is 117.91 meters in length and 25 meters wide. The maximum draft is 11.2 meters. An icebreaker with

two outer walls, it can be used at temperatures as low as -50 degrees celsius. The vessel can break up to more than a meter thick ice at a speed of almost five knots. Thanks to its reinforced outer shell, even thicker ice is no insurmountable problem for *Polarstern*.

The vessel offers plenty of space and is built for a diversity of tasks. Supplying the German Antarctic research station "Neumayer III", it is designed to survive the winter also if necessary. The storage capacity is big enough. Thanks to its solid construction, the ship is not crushed by the ice when it freezes. The *Polarstern* is designed for 44 crew members and 55 researchers from all over the world. They enjoy ideal conditions for their scientific work in the on-board laboratories.

By that time, some had already named it the researchers' dream boat.

The list of *Polarstern* expeditions is impressive. There are more than 105 exploratory trips to the coldest regions of the world. All over the Arctic and Antarctic, these trips have covered over 1.7 million nautical miles (equivalent to more than 3 million kilometres and more than 75 orbits around the equator). The vessel is normally in the Antarctic from November to March, and from April to October it traverses the northern polar regions. The vessel sails tirelessly for about 320 days of the year, focusing on research. A deep-sea trench in the Antarctic, the "Polarstern Canyon", was

actually named after the vessel whose home port is Bremerhaven. There is also a reef rock now named "*Polarstern* Knoll". Together with the Swedish icebreaker *Oden*, *Polarstern* was the first conventionally propelled vessel to reach the North Pole in September 1991. Only atomic-powered icebreakers and submarines had previously achieved this.

The following statement summarizes the long list of expeditions and what their purposes were: The idea for the *Polarstern* originated from a time when people were very interested in how to exploit the ocean. Today, it's more about how the ocean is to be protected.

Political considerations also played a role in the launching of the *Polarstern*: The Federal Republic desired the role of being a consultative member in the Antarctic Treaty. To have a serious voice in the matter, those who wanted to have some say in the debates, including a nuclear weapon-free area, were required to engage in research. The prerequisite would be a long-term Antarctic research program. The construction of a research station and an ice-breaking research vessel gave it both credibility and sustainability. Right from the outset, the *Polarstern* idea would also stipulate that as many international scientists as possible could also make use of the vessel. The effect of such a large order on the German shipbuilding industry was also not to be underestimated in a time when shipyards in Northern Germany were in a poor state

of repair. Political, economic and scientific interests all came together.

In the early years it was about krill also. Crustaceans, many of which lived in the Southern Ocean, would offer an alternative to fishing. Krill later proved to be nutrient-poor and so tasteless that customers would simply reject it.

What's unique about the *Polarstern* is its ability to collect data in difficult-to-reach regions with impressive

regularity and reliability. The media has also labelled some expeditions as “spectacular”. Those include the North Pole Expedition in 1991 and the Iron Fertilizer Experiment (EisenEx) in 2000, which investigated the effect of ferric sulphate fertilization on algae growth in Antarctic waters. An expedition planned for the fall of 2019 is now receiving much attention. *Polarstern* will be in freezing ice for a year as it drifts through the central Arctic. The MOSAiC research trip aims to collect





data to better understand the global climate system.

Two major tragic helicopter accidents in 2008 and 2011 show that polar regions are not always safe for humans despite their outstanding technology. The division between earth and sky gets blurred, resulting in disorientation and dramatically hampers safe landings. Such blurring can be attributed to “whiteout”, a weather phenomenon which eliminates almost all contours.

A vessel in extreme conditions has to be maintained permanently and carefully. The *Polarstern* was completely overhauled between 1998 and 2001 and brought to a state-of-the-art condition. More than 36 years after commissioning, however, it is now time for new solutions. In 2008, initial plans for an additional polar exploration ship failed thanks to the financial crisis. Nevertheless, the Science Council also recommended that a successor to the *Polarstern* be produced. At the end of

2015, the Federal Ministry of Education and Research announced the project under the name “*Polarstern II*”.

Whatever ship ends up following in the footsteps of the *Polarstern*: It would follow a great tradition that was founded by her.

■
Dr Martin Weiss was born in Hanover in 1985. He studied in Aachen and Utrecht, completing his doctorate in Leiden, the Netherlands. He joined the German Maritime Museum in 2015 as a research associate, after working at the European Commission in Brussels and the Deutsches Museum in Munich. He specializes in the history of science. He lives with his family in Bremerhaven.





Polarstern in the central Arctic, summer of 2015.



**“More people
have gone to space
than the deep sea.”**

Prof Dr Antje Boetius

The Mother Ship

Prof Dr Antje Boetius

A research vessel must be reliable. That is what Professor Antje Boetius says. The marine biologist has participated in more than 50 expeditions worldwide. She has a very special relationship with the *Polarstern*.

For me, the *Polarstern* is the mother ship. A reliable vessel that is firm and round. A ship with character. After a number of trips, I am now quite familiar with it. I feel comfortable when I'm on board, and that's important. Expeditions often involve very remote locations. The scientists and crew members are on their own, in a hostile environment. So it helps a lot when you find your "home" reliable.

The *Polarstern* therefore feels like home to me.

Participating in an expedition is a privilege. We go where nobody has gone before. We get to experience our earth in a way we never have before. It's an adventure every time. You can be astonished by the beauty of nature again and again. But we also experience and recognize how, even in remote areas, man impacts the environment. We find plastic waste in the depth of the sea at the uttermost ends of the earth. We get a first-hand look at climate change.

I am director of the Alfred Wegener Institute and marine biologist.

My focus is on deep-sea research. The ocean depths represent a diverse, unknown world. There we find answers to how our planet, and life, works and how adaptable it is. Our understanding is still so limited. More people have gone to space than the deep sea. Exploring our seas and oceans is a task for all generations.

During my voyages with the *Polarstern*, I have seen first-hand how quickly habitats change and how fast the Arctic ice melts. When the *Polarstern* breaks thick ice for the first time it feels strange. It crashes and crunches and jerks around. The *Polarstern* may freeze, which is actually not unusual. One's sense of smell changes during the expedition. The Arctic and the Antarctic are void of odours. It gets finer, as you start to recognize the slightest of scents. One can sense land from far, far away.

That far north, the world is unique. At sea, there is no internet reception beyond 72° North. So you get fewer e-mails and hardly any other digital distractions also. After a while you get

used to it. You actually start to enjoy the seclusion.

Many people get downright addicted to expeditions. I have sailed on 50 such journeys as a researcher, not only on the *Polarstern*, but also on the *Sonne* or the *Meteor* and international ships. I spent a few birthdays at sea, and two Christmases also. I've had the privilege of sailing all the seas, especially the South Seas. I've especially sailed the Atlantic, Pacific, the Mediterranean, the Arctic, Antarctic, the Arabian Sea, the Gulf of Mexico, the Black Sea, the South China Sea. I've also spent a lot of time sailing the North Sea.

Research trips are lots of hard work, and require discipline. Scientists work hard to be able to get on board. Projects are meticulously prepared. Everyone is anxious to achieve the best possible research outcome. You get into a focused tunnel of work and concentration sometimes. You focus on the experiments or samples. An expedition is just another reality of life that bears little resemblance to life on land.

The meals ensure everyday routine on board. The feeling fades for a while after a few weeks. You can tell what day of the week and what time of day it is based on the food alone. When you travel far up north in the summer months, it becomes especially difficult to distinguish between day and night. It is bright around the clock. It is then that meal times help to orient you.

Breakfast is served from 7 am to 7.45 am, lunch from 11.30 am to 12.30 pm, coffee time is in between, and dinner is served from 5.30 pm to 6.30 pm. Thursday is traditional and, as on most ships, you have "Sailor's Sunday", when a particularly good meal is served. Saturday is stew day. All in all, the food on the *Polarstern* is generally extremely good. I especially like the traditional nautical dishes like curry or "Strammer Max". The chefs know their craft. After a week, however, the fruit no longer tastes right. There are hardly any fresh vegetables. The longer the journey, the more creative they have to get. The social component of the shared meals are just as important. The "Red Salon" mess hall on board the *Polarstern* is a place to meet when it comes to everyday life on board the vessel.

Sailing for three months in a confined space with a team of different people can test your patience also. As chief scientist, it is always my job to "bring along" everyone on board. There can be conflict at times too, of course. Problems are always possible. Everyone wants to take home the best possible result, and never seems to be enough time. At those times, it is important to enter into dialogue in a way that considers all points of view. And not hide the resentment. I like to have clear rules on board. I expect participants to behave accordingly. It is important to respect and appreciate each other and strive to get along with others.





Even as a student, I learned the importance of “icebreakers” at the start of an expedition. Very few people are acquainted with each other at the start, but nevertheless have to work closely together. I got into the habit of providing a keg of beer shortly after departure in the so-called “Zillertal”, the other mess hall. Here the expedi-

tion participants and sailors get the opportunity to meet each other and talk. Often, we also organize activities such as table tennis tournaments or a costume party. You have to be able to relax every now and then. The growing sense of community on the *Polarstern* has also actually led to many lifelong friendships.

The ship, of course, also provides one with the opportunity to exercise. There is a fitness room with a sauna as well as a small swimming pool. I really don't like the slow elevator. I only use it when carrying equipment or other heavy items. I would rather take the stairs. Often that means going up and down five decks, a few times a day. Put it this way: Returning from sea, I usually end up with a first-class condition.

The relationship between captain and chief scientist has been written about before, but to summarize: The captain always has the last word. He is responsible for the safety of the ship as well as everyone on board. We work together as a team. The chief scientist's role is to get the most possible value out of the scientific expedition. I have worked with many different captains, and we have always gotten along. Of course, the tone has changed completely: When I was a student, I would blow up at times, but that no longer happens. It is important to be honest and address conflicts immediately, however. Farm life has also taught me a lot about this.

The accommodation, or so-called cabins, are simple but functional, and shared by the scientific crew members. As chief scientist, I get a single cabin with a meeting room. I always bring things from home just to make it a little more cosy and homely. Photos, books, and appliances for making coffee and tea also help. You also have to prepare yourself for the fact that it can get quite

uncomfortable. The strongest storm I have experienced on the North Sea was a hurricane that raged for three days and we had to stop working. The waves were so violent that you couldn't walk straight on board. That was on the *Heincke*. Still, I never felt uncomfortable. My most challenging time ever on an expedition was on the *Polarstern*. A scientist got injured in a security exercise, as a lifeboat was being lifted up. We were far up north in the Arctic. Our position, very close to the North Pole, made it impossible to fly the injured out. Along with the doctor, the captain and the logistics team, we decided to cancel the expedition.

The highlight of my time on the *Polarstern* was also a highlight of my work as a scientist. We were on the lookout for "black smokers" in the Arctic deep-sea. Put simply: These are mineral vents spewing "black smoke". Several chimneys together would create hydrothermal fields that span several square kilometres. Such an environment results in unique habitats deep down. Bacteria generate energy from the escaping gases such as hydrogen and the sulphur compounds. Until our expedition there had been merely hints thereof, but no actual evidence of such "black smokers" in the Arctic. Day by day, we searched the seabed with a remote-controlled robot, but found nothing. Eventually we ran out of time. I had hardly slept, because I was convinced that we were close. The captain wanted to return home, especially as the weather got







worse. I joined him on the bridge to negotiate a last “time schedule modification“. He agreed, but at four in the morning (“Then the equipment must be on deck at the latest!”) it would definitely all be over. It was clear that he would not agree to any more changes.

A few minutes before we had to break off, I finally saw what I had been looking for. Black smokers! We did it.

It was a magical moment that I will never forget.

Prof Dr Antje Boetius, born in 1967 in Frankfurt am Main, is a marine biologist and professor at the University of Bremen. Since November 2017, she has also been heading up the Bremerhaven-based Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research. Antje Boetius has been awarded numerous prizes, including the German Environmental Award, the Leibniz Prize and the Communicator Prize. She resides in Bremen.



**“The idea is
to connect the real world
with the virtual.”**

Niels Hollmeier

Polarstern Backstage

Niels Hollmeier

Not only the researchers, but also the exhibition organizers of the DSM now enter new territory: Their concept makes it possible to experience the *Polarstern* virtually via “head-mounted displays”. Even areas that would otherwise be closed off to visitors to the actual research vessel: *Polarstern* backstage. Niels Hollmeier, digital curator of the museum, on the task of connecting the real world with the virtual.

The *Polarstern* is a unique ship that generates a great amount of fascination. Our exhibition aims to take visitors directly on board the large research and supply ship. Even when, at the time, it may be sailing distant seas or be on the way to a station in the Arctic or Antarctic. Our first “Virtual Reality Special Exhibition” brings to life what the scientists on board the *Polarstern* actually experience quite often: We enter uncharted territory to gain new insights – in our case via virtual reality application.

No other exhibition allowed us to orient ourselves right from the start. The idea is to connect the real world with the virtual against the themed background of marine research. It is a joint project being done by DSM and the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research. In our museum we demonstrate the technical possibilities of virtual augmented reality applications. Visitors set up so-called “head-mounted displays” at various lo-

cations. The augmented reality applications make use of reconstructed Oculus Rift goggles to explore a digital projection of the *Polarstern* in the museum. The wireless Oculus-Go glasses are available at several locations within the museum. Here visitors can board the *Polarstern* virtually. You dive off into another world. Turn your head and get a 360° perspective of the ship. The application is realistic and there is even a low probability of getting “seasick”. In this case, it would be the so-called “simulator sickness” that VR applications can cause.

This unique type of exhibition also provides our guests with the opportunity to explore areas of the ship that would otherwise be closed to the public. In a sense, they become researchers themselves for a few minutes. They get to familiarize themselves with the laboratories and the microscopy room on one of the decks. They can also feel what it feels like to be part of the crew, for

example, watching the captain and first officer on the bridge in their everyday work.

We designed a total of 14 different scenarios with different purposes and visitor routes during the six months of the exhibition. The main focus remained on the 360° film footage of the *Polarstern*. It was created during a journey from Bremerhaven to Las Palmas. A Berlin-based software agency (Playersjourney) captured the images with a panoramic camera – which in turn has six built-in cameras – and the images were then “stitched together” with a “stitching” computer program. The effect is rather startling: You can turn around and feel like you are actually on board. Transitions between the six films are no longer perceptible. The footage comes across as a unified whole.

Visitors can stand on the observation deck and watch as the bow of the *Polarstern* cuts through the calm sea on a sunny day. On another level, you can enjoy the famous “Red Salon”, which is on-board jargon for the cosy lounge. Virtual access to the laboratories and the microscopy room provide visitors with an insight into the scientists’ everyday life.

Polarstern has an entire range of laboratories for scientific work in meteorology, biology, geophysics, glaciology, oceanography, geology and chemistry. Additional laboratory containers are available for storing equipment if necessary.

The *Polarstern* has two crane arms. One has a range of 24 meters and can be lowered to the water level. The other one on the front deck can move heavy equipment and supplies weighing up to 25 tons. A frame at the stern makes it possible to tow nets or equipment behind the ship. Scientists feel the ship provides ideal conditions: Aquaria and cold rooms cooled down to -32 degrees celsius are used for testing samples and living marine animals. The working deck is heated, ensuring safety when working even at low temperatures under an open sky, and ensuring that the surfaces remain free of ice.

Underwater gliders and deep-sea robots are often also part of the *Polarstern*’s on-board equipment. Two helicopters can land on a platform on the stern. Snow vehicles are parked below deck. They are stored on the ice shelf edge using one of the cranes.

But now back to our virtual on-board tour. “Sailing”, “researching”, and “living” are the three key themes. The “living” area provides insights into everyday crew life. Visitors explore the crew’s accommodation. Not even the captain’s rooms are excluded. We were so pleased when the *Polarstern* crew also got involved in the concept. You simply can not get any closer to the research vessel.

The *Polarstern* is known for offering those on board a balance between research and leisure. There is room for a



maximum of 44 crew members and 55 scientists on board. While researchers usually leave the ship after four to six weeks – depending on the length of the research trip – the crew may be at sea for up to three months. Two scientists will share a cabin that has a small bathroom. Single cabins are made available to crew members as well as officers and chief scientists. There is an international team of women and men on

board. Languages spoken on board include English and German.

The virtual tour brings museum guests to the mess hall also, which is one of the on-board social meeting points during the journeys.

A quick tour of the engine room can be illuminating, especially for those who find technology interesting. Four



machines produce a total of 14,116 kW, which is the equivalent of just below 20,000 hp. Two wave generators generate electricity. There are also two auxiliary diesels named “Jonathan” and “Amanda”. The machines are even labelled with these names. The four main engines were previously also named “Frieda”, “Dolly”, “Bodil” and “Maria”. They drive the *Polarstern*'s two propellers. They can bring the ship up to a top speed of 16.5 knots (equivalent to 31 km/h).

Take the display off, and you have embarked on an expedition aboard the *Polarstern*, without having even left Bremerhaven. We hope that our virtual journey will further promote a fascination with research – and that our project will provide new insights into the use of VR technologies in museums.

■
Niels Holmeier, born in Düsseldorf in 1987, is the digital curator of the German Maritime Museum. He resides near Bremerhaven.


Polarstern

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Editing: Erik Hoops, Deutsches Schifffahrtsmuseum

Concept & idea: Ankerherz Verlag GmbH

Texts: Stefan Kruecken

German-English translations: transmit-Deutschland

Title illustration: Hans Baltzer

Photos: Alfred Wegener Institute/Esther Horvath
(CC-BY 4.0): p. 22; Alfred Wegener Institute/Folke Mehrtens
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Andree Kaiser: p. 6, 10, 24, 28

Graphics: Daniela Greven

Corporate design: GfG/Gruppe für Gestaltung



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Dream Ship of Research

In a state of change: the German Maritime Museum – Leibniz Institute for Maritime History – is presently redesigning its exhibition in close correspondence with the research and exhibition programme “Man & The Sea”. A number of important objects play a key role here and are also featured in a series of booklets.

In each booklet, experts take a look at the respective object from three research perspectives – “Interests – Materiality – Perception” –, ask it questions and shed light on its fascination.

German Maritime Museum

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Supported by
Förderverein Deutsches
Schiffahrtsmuseum e. V.

