RUSSIA Special

Contents


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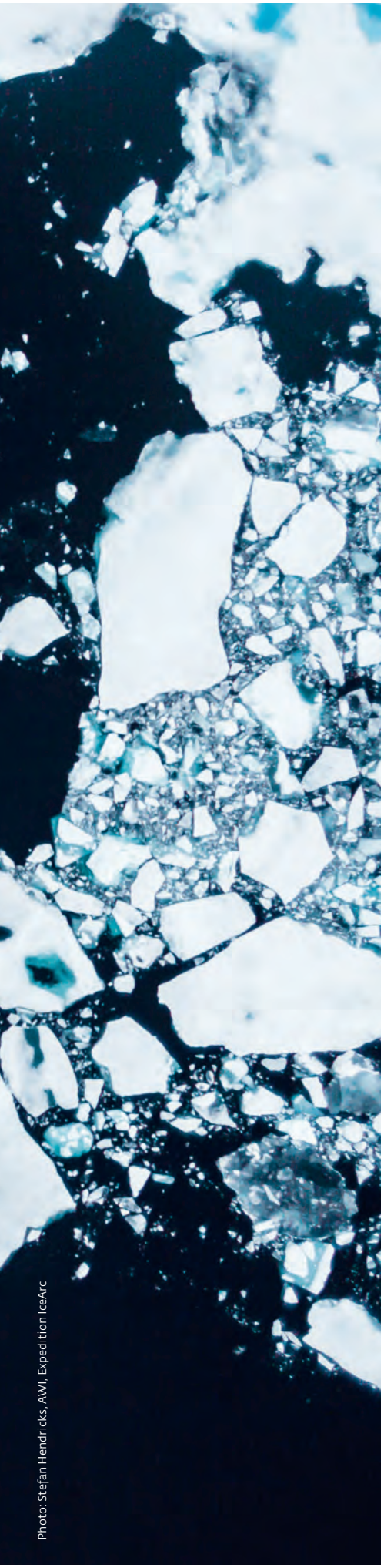


Photo: Stefan Hendricks, AWI, Expedition IceArc

4,000 Meters under the Ice

The Arctic is one of the habitats undergoing the most radical transformation as a result of climate change. Nobody can predict the effects it will have on biodiversity in the Arctic Ocean. **Antje Boetius** from the **Max Planck Institute for Marine Microbiology** in Bremen and the **Alfred Wegener Institute for Polar and Marine Research** in Bremerhaven traveled with an international team, including scientists from Russia, close to the North Pole, where they documented the effects of ice retreat and biodiversity in the Arctic deep sea.

TEXT **MAREN EMMERICH**

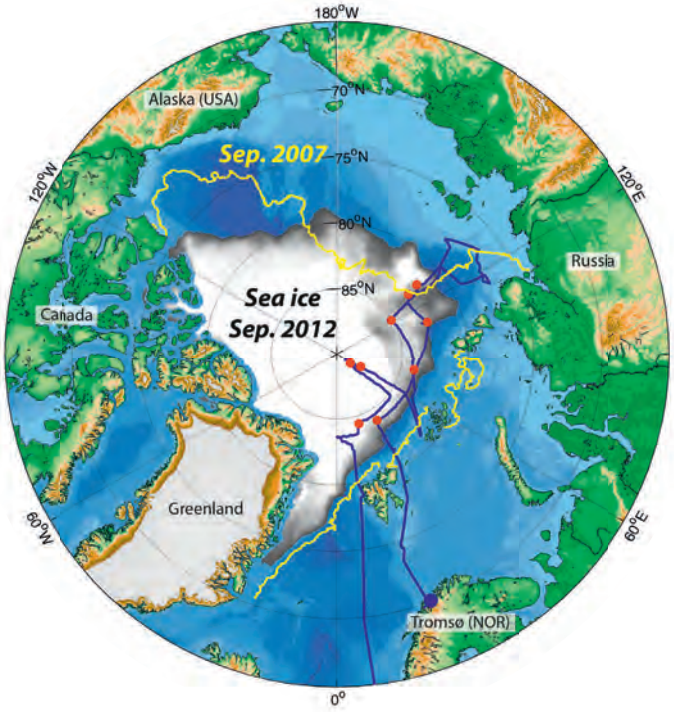
It is three o'clock in the morning and an ice-cold wind is blowing onboard the *Polarstern* research vessel. It is the end of September. Following weeks of midnight sun around the North Pole at this time, a dense darkness prevails. Given the conditions, there are certainly more pleasant ways of passing the time than sluicing out a load of sludge from the deck.

But Antonina Rogacheva, Elena Rybakova and Renate Degen do not tire of washing nine kilograms of marine sediment through fine sieves when the trawl net brings it on board the *Polarstern* from a depth of 4,100 meters. Their aim is to coax out even the smallest organisms from this valuable deep-sea sample. Then it's all hands on deck for cleaning up – the other scientists on the ship don't appreciate sludge in the objects that they are studying, and the sailors also need to have a fresh workplace.

DEEP-SEA CENSUS

Despite the effort involved in making the journey, the two-month expedition on the *Polarstern* provides the three

Icy anchorage site: Once the icebreaker *Polarstern* has dropped anchor at the edge of an Arctic ice floe, the researchers on board spread out to identify organisms.



In 2012, the voyage of *Polarstern* led from Tromsø in Norway 12,000 kilometers through Arctic waters and finally back to Bremerhaven. The chart shows the extension of the sea ice (in white & gray) in September 2012: only 3.41 million square kilometers were still covered in ice – the smallest value since the beginning of satellite records in 1973. The smallest sea ice cover of 2007 is circled in yellow.

young deep-sea biologists with a unique opportunity to continue working on the "Arctic Ocean Diversity Project." The researchers want to decipher the composition of the species living in the Arctic deep sea and find out where the animals derive their energy for life.

For Antje Boetius, who heads up the expedition, the time spent on the largest German research vessel is also a welcome change from her usual working day in the lecture hall and the office. The professor of geomicrobiology at the University of Bremen leads the Joint Research Group for Deep Sea Ecology and Technology, a collaboration between the Bremen-based Max Planck Institute for Marine Microbiology and the Alfred Wegener Institute for Polar and Marine Research in Bremerhaven. "Before we came along, nobody had ever studied the Arctic deep sea as a habitat in this way. We've been on site in the research vessel during the largest ice retreat since satellite records began, and we want to study the consequences. This is something that motivates the entire team," she says, summing up the attraction of the project.

ICE-FREE ZONE IN 20 YEARS

The 54 researchers come from all over the world, and all are engaged in very different projects. It is Antje Boetius' job to juggle the various interests. For this reason, a general meeting is held every day – in English, the language used on board for professional purposes.

One of the expedition's objectives is to make an inventory of life in the Arctic deep sea. "Current forecasts predict that all the ice in this region will have melted in 20 years," says Antje Boetius. Nobody can gauge what such a phenomenon would mean for biodiversity in the deep sea.

The scientists are also studying so-called ice algae. These are perfectly adapted to the solid, yet cold environment of the sea ice in which they grow. Other species can be found in the seawater. Sufficient sunlight is available only during the few summer months as

Chilly command center: From a tent on the ice near the icebreaker, the researchers navigate the remote-controlled dive robot across the seafloor (left, center). Ice algae (*Melosira arctica*) on the underside of ice floes (right). They live in bubbles with enclosed water and bind to the surface of the ice with special proteins. When the ice melts, the algae sink to the bottom of the sea, where they serve as food for a wide range of organisms.

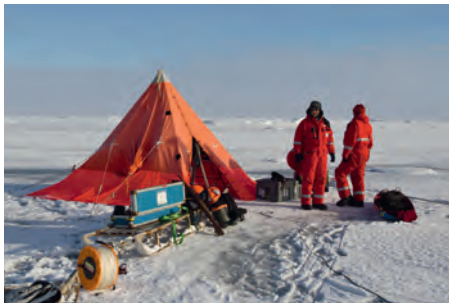


Photo: Marcel Nicolaus, Alfred Wegener Institute (above), ROV Ronia, Sea Ice Physics Section, Alfred Wegener Institute (bottom left, 2), SPL-Agentur Focus (bottom right)

» For over a century, zoologists in Russia have been participating in ice expeditions to map the fauna in the Arctic Ocean.

an energy source for photosynthesis. Various crustaceans, which need to store a lot of energy in order to lay eggs, are among the organisms that rely on this nutritional boost. Therefore, if the algal bloom suddenly occurred a lot earlier or didn't happen at all, the implications would be disastrous. The deep-sea inhabitants would have nothing else to eat, as they rely on sinking-down of the dead algal blooms as an important food source.

In order to study the relationship between the algae, ice and deep-sea life, the researchers are using a new method for observing marine fauna: the ice-breaker *Polarstern* first cuts a channel in the ice and then turns in a circle. At the spot where the ice channel begins, the researchers lower their trawl net over 4,000 meters to the ocean bed to collect the organisms living there and bring them on board.

US deep-sea researcher Alexander Agassiz was the first to come up with the idea of using a type of fishing net for research purposes. Using the so-called Agassiz trawl, the scientist reported on his initial findings as early as 1888; since then, his method has proven itself time after time – although the ice in the Arctic Ocean presents a challenge when it comes to obtaining good samples. The scientists have also placed measuring stations equipped with microsensors on the ocean floor of the Arctic, which they use to record bacterial respiration.

In addition to this, Antje Boetius' Group also relies on state-of-the-art optics. Her working group at the Alfred Wegener Institute has an extremely powerful piece of equipment, the Ocean Floor Observation System (OFOS). This device consists of a solid, stainless steel frame and a hydraulic cylinder that protects a sensitive interior consisting of a high-resolution, digital SLR camera, high-performance flashes, orientation lasers and transponders, which continuously report the camera's position to the scientists. This system enables deep-sea researchers to see more than 5,000 meters below sea level.

Antje Boetius, chief scientist of the 27th expedition of the *Polarstern* into the Arctic, in a summer outfit.

PHOTOGRAPHS AREN'T ENOUGH TO IDENTIFY SPECIES

"The OFOS was upgraded before our trip and now takes fantastic pictures of the deep-sea animals in their habitat," says Antje Boetius enthusiastically. "We are often asked why we still use the ancient Agassiz trawl rather than simply using modern imaging methods to find the deep-sea animals on the ocean bed. But even though the images are very valuable, in identifying large animals for example, a photograph on its own isn't enough to distinguish between the many species." Some organisms simply look too much alike.

The scientists from the Shirshov Institute, the Alfred Wegener Institute and the Max Planck Institute therefore also collect many samples of organisms and their DNA. In their laboratories, they use a combination of traditional and modern methods, namely taxonomic identification based on morphological features. This involves assigning the found items to the correct class, order, family and genus using an identification key. The results are compared at the molecular level, using, for instance, a DNA sequence similarity analysis. Ultimately, every species should be characterized uniquely by its own genetic barcode.

The Russian members of the team have the most experience in this area, especially when it comes to Arctic species. "For over a century now, zoologists in Russia have been participating in ice expeditions and ice camps to map the fauna of the Arctic Ocean," explains Antje Boetius. "The question of 'who

Photo: MPI for Marine Microbiology

Deep sea biologists Antonina Rogacheva, Elena Rybakova and Renate Degen, and oceanographer Ivan Rhyzov, search for organisms by carefully sifting through the mud brought up from the bottom of the sea by the Agassiz trawl.

lives where' is still of great scientific importance. Here in Germany, we have very few taxonomists in our universities. And because their knowledge is not passed on to young biology students, it is gradually becoming lost," laments the marine researcher. However, when scientists have to identify new species and understand their role in the ecosystem, observations in the habitat, molecular keys and taxonomic expertise must be combined. "We can make the most progress, of course, when we integrate the old and new methods. By doing this, we can reveal outwardly similar individuals as members of different species, for example, which may appear at different times or use other food sources," explains Boetius.

MELTING ICE RELEASES ALGAE

The scientists recently published their initial results about the energy source for life in the ice-covered deep sea – Antje Boetius and her colleagues actually wrote the article for the journal Science while they were onboard the ship. They were able to observe how large quantities of ice algae melted out of the ice during the productive summer season and sank to the bottom of the deep sea – the ocean floor near the North Pole was almost green with clumps of algae. The researchers don't yet know if they are observing a unique phenomenon or if they have documented the first signs of a new, more productive Arctic characterized by thin sea ice.

Even months after the end of the *Polarstern* expedition, the scientists are still in the middle of their analysis. "But now at least we can name the groups of animals that account for the most biomass in the Arctic deep sea," says Antje Boetius. "These include echinoderms, such as sea cucumbers and feather stars, but also sponges, amphipods and sea spiders." Deep-sea fish, on the other hand, are very rare in the Central Arctic Basin.

How many species in total inhabit the Arctic deep sea and how many of these are endemic, in other words, are not found anywhere else in the world, are questions that no one has yet dared to ask. "For example, if we find a starfish in the Arctic deep sea, but we don't know of any other related species, we can't rule out that one exists – maybe we just haven't discovered it yet. After all, not even one percent of the deep-sea floor has been explored."

The biodiversity of the Arctic Ocean therefore can't be exhaustively docu-

Left: Polar cod can be found in almost every catch when the researchers haul their under-ice nets on board (left). Sea cucumbers (center) and sea anemones (right) feed from algae that sank to the seafloor. In the Arctic deep sea, these representatives of megafauna occur at a surprising density, sometimes one to two animals per square meter.

Photos: Antje Boetius, Alfred Wegener Institute (top), Hauke Flores, Alfred Wegener Institute (bottom left), Antonina Rogacheva, Shirshov Institute; OFOS, Alfred Wegener Institute (bottom right, 2)

The Arctic researchers take samples from the ice and melting pools as well as the water beneath the ice – everything is investigated for plants, animals and microorganisms.

mented; the Arctic deep sea is simply too large to do this. Nevertheless, the scientists want to at least describe the basic features of the current biological diversity in this habitat. Future investigations can build on this information and detect any changes that occur.

AN ATLAS OF WORLD OCEAN SPECIES

The Arctic is not the only location where scientists are conducting an inventory of marine diversity. The Arctic Ocean Diversity Project began life in the year 2000 as one of a total of 18 smaller studies that together made up the Census of Marine Life Project. The Census project was originally intended to last ten years and was funded by a private foundation and various national subsidies. Between 2000 and 2010, approximately 2,700 scientists from 80 countries conducted a census of the seas and oceans. The researchers recorded their observations on the diversity, distribution and abundance of marine life in biogeographical databases.

Some of the participants saw the initial results as an incentive to continue the work independently once the official project period had come to an end. These include the scientists working with Andrey Gebruk at the P.P. Shirshov Institute of Oceanology in Moscow, the two Bremen-based institutes, the University of Fairbanks in Alaska and the University of Tromsø in Norway. Researchers from these various institutes formed a loose alliance and used their own funding to continue the Arctic Ocean Diversity Project.

The international character of the partnership benefits all participants. "We had a fantastic working relationship with the Russian biologists in particular," says Antje Boetius. "We had really great colleagues onboard with us and we look forward to analyzing the samples together. There are still too few scientists working on the pressing issue of the Arctic's future, including its biodiversity, and we urgently need the expertise of zoologists from Moscow, St. Petersburg and other institutes." ◀

TO THE POINT

- **Because the climate in this region is changing very rapidly, the composition of the species could possibly change over the coming years.**
- **Sea cucumbers, starfish, sponges, amphipods and sea spiders are the most common larger animals in the Arctic deep sea.**
- **The smallest organisms, such as bacteria, have the most biomass. They respond immediately to sinking ice algae, and rapidly break down the algae using oxygen.**

Photo: Mar Fernandez, Alfred Wegener Institute

Deep in the Sediments of **Integrated Culture**

When Russia's first branch of McDonald's opened in Moscow 23 years ago, the event was celebrated by many as a step in the direction of the free world of consumption. Others, however, immediately saw the arrival of the hamburger empire as a sign of the country's westernization. Yet there is nothing new about cultural transfer: At the **Max Planck Institute for Social Anthropology**, **Dittmar Schorkowitz** studies how this process unfolded during the encounters of Eurasian populations in the Middle Ages.

TEXT **BIRGIT FENZEL**

The fact that people in a community adopt individual ideas or entire systems from other communities is an old story – nevertheless, it remains a fascinating one. For scholars like historian and social anthropologist Dittmar Schorkowitz, cultural transfer is one of the processes that played and continues to play a crucial role in the formation of human societies – as well as in its schism.

After all, not just anything or any idea can make the leap from one cultural area to another. And not all social classes in the "importing" society are involved in the reception process. "A transfer of this kind also always involves the disintegration of other parts of the society," says Schorkowitz, alluding to the flip side of cultural integration. Large communities – be it Europe as a whole or its parts – only appear as uniform entities from a distance. Closer scrutiny reveals the image of a mosaic consisting of numerous individual elements.

For the social anthropologist, who works from a historical perspective, this unity in the diversity is very clearly the outcome of a process in which borders were not only geographically overcome or drawn, but also arose from the interplay of integration and disintegration over the course of history. Together with his research group at the Max Planck Institute for Social Anthropology in Halle, and based on the example of Russia and China as enormous multinational states, Schorkowitz studies how the ethnic diversity that arose there over the course of many centuries was officially regulated in the late 19th and early 20th centuries and controlled in the interest of imperial coherence.

"Cultural forms always represent a *mixtum compositum*," says the researcher. As he sees it, this patchwork nature of not only modern societies is a direct consequence of their permeability to external influences, on the one hand, and their social implications, on the other – as processes of group formation, demarcation and the safeguarding of identity, and of the negotiation and adoption of cultural values, goods and norms would unfold there.

"Over the course of time, cultural elements of varying origins are deposited like layers of sediment," says Schorkowitz, describing the characteristic structure of cultural forms – something that makes them particularly fascinating not only for anthropologists, but also for historians.

SLAVIA ASIATICA – CULTURAL ZONE PAR EXCELLENCE

When it comes to finding out what holds the European world together at its very core – or, indeed, divides it – Dittmar Schorkowitz goes far back in history and focuses on the transcontinental frontier in the east of medieval Europe. "Geographically speaking, it would be entirely acceptable to assign this area to Eurasia," he says in reference to the area he researches, which stretches from the Danube to beyond the Volga. "Thus, it extends far beyond what is often re-

Photo: Felix M. Hummel

Cultural fragments: *Glagolitsa*, the oldest known Slavic alphabet, is regarded as a textbook example of successful cultural transfer and acculturation. The scholar and monk Constantine from the city of Thessaloniki developed it around 863 on the basis of the Greek minuscule script, also incorporating Semitic and Caucasian script systems.

Mongols worshipping Batu Khan, the ruler (1227 – 1255) of the Golden Horde, here depicted in a book illumination from Rashid-al-Din's *History of the World*. The appearance of Mongols led to innovations in the administrative and chancery systems as well the communication and supply systems and made a crucial contribution to the cultural molding of *Slavia Asiatica*.

ferred to abridged as the field of conflict of the Kievan Rus' and the steppe," he adds, pinpointing the location of this contact zone, which became a multicultural meeting point at a very early stage.

"In fact, for a long time it was nothing less than the Eastern European section of the Eurasian highway for people from Central Asia, whose westward migration emerged as a constituent force in the formation of the European state landscape," says Schorkowitz, describing the role of the region during the migration period and cultural encounter of the Middle Ages. Due to its special cultural interface function, *Slavia Asiatica* would be a more appropriate name than Eurasia.

Starting in 860, as a result of the not-always-peaceful contact between the inhabitants of the Kievan Rus' and those in the three cultural areas of neighboring Scandinavia, Central Asia and Byzantium, an overlapping cultural area with fluid borders formed. This provides a rich source of material for the colleagues working with Schorkowitz, and opens up a very broad research field. "The *Slavia Asiatica* is a cultural contact zone par excellence, a laboratory in which forms of cultural transfer and cultural exchange can be studied."

Working as a historian is akin to completing an archaeological jigsaw puzzle. A large part of it is based on sources that are distributed all over the world and compiled in different languages and characters. In addition to decoding and translating, the philological analysis of the finds assembled by Schorkowitz from archives, state collections and libraries has become a routine task. "These enable us to access testimonies of intercultural communication, which, in turn, is a crucial precondition for cultural change," says Schorkowitz, in explanation of his particular interest in the old languages, written forms and loanword stock.

For instance, the Old Russian word for "scribe" is a classical example of the sometimes very expressive force of linguistic forms. "From an etymological

Photo: akg-images

» Въ лѣто 6476 (...) единъ отрокъ изиде изъ града с уздою, и ристаше сквозѣ Печенѣги, глаголя: «не видѣ ли коня никтоже?» бѣ бо умѣя Печенѣжьски, и мняхуть и своего (...)

In the year 968 [...] one young man left the town [Kiev] with the bridle [in hand], and he passed through the Pechenegs, asking: "Did anybody see my horse?" Since he understood the Pecheneg's tongue, and he was believed to be one of them [...]

perspective, it can be traced back to the Greek word for deacon, *diákonos*," he explains. Apart from providing evidence of the far-reaching influence of Greece during the early Middle Ages and beyond, this word also encapsulates information about a major cultural achievement: the invention of the Glagolitic alphabet, the precursor of the Cyrillic alphabet, by the monk Constantine, known as St. Cyril, from Thessaloniki.

CULTURAL TRANSFER THANKS TO NEW LETTERS

Around 863, this man of the church devised an alphabet for the language of the southern and eastern Slavs. "Up to then, they didn't even have a runic script, although hypotheses to this effect arise time and again," says Schorkowitz. For his Glagolitic alphabet, the monk adapted the Greek minuscule script. However, he modified it by incorporating Caucasian and Semitic script systems, accommodating the phonetics of the Slavs, which were covered only to a limited extent by the Greek alphabet. "The development of the Cyrillic alphabet from the Glagolitic one is a textbook example of successful cultural transfer and acculturation," says Schorkowitz.

Scholarship has another man of the church to thank for the Primary Chronicle, or Nestor's Chronicle, an old account of Russian history up to Biblical times – about which, however, there is little accurate information. What is certain is that it was compiled between 1110 and 1112 by the monk Nestor of Kiev and was later revised and extended. It has provided Schorkowitz with pages of evidence to the fact that the inhabitants of Kievan Rus' were completely familiar with the customs and traditions of their non-Slav neighbors. In this context, the Halle-based researcher refers to the story of the rescue of Kiev.

Multiethnic contact zone *Slavia Asiatica*. The research area of the historical anthropologist Dittmar Schorkowitz stretches from the Danube River through the North Pontic region, to the Volga River and beyond.

According to the Chronicle, in 968 the city was so heavily blockaded by the Pechenegs, a nomadic group from the steppe, that the surrounded royal family was on the verge of surrender. However, a young man offered to go through the enemy lines to fetch reinforcement. "With a bridle in his hand and asking the Pechenegs in their own language about his supposedly lost horse, so that they would think he was one of their own, he crossed the enemy camp and the Dnieper River unchallenged," says Schorkowitz, summarizing the daring escapade.

The royal military leader Pretich hurried to the aid of Kiev and the city was saved. "It is clear that the young man was assisted in his daring feat not only by his language skills, but also by the fact that he – and probably most of his Kievan contemporaries – must have been familiar with the living conditions and nomadic habits of the neighboring Pechenegs," concludes Schorkowitz, in relation to the cultural skills of the youth of the time.

During the course of his research, the historian has come across a variety of discoveries that prove that the cultural contact in the *Slavia Asiatica* encompassed nearly all of the essential areas of society: law and religion, knowledge and values, skills and institutions, material and intellectual goods. Starting around the early 9th century, for exam-

Photo: MPI for Social Anthropology

Рече же князь Печенѣжьский къ Прѣтичю: «буди ми другъ»; онъ же рече: «тако створю». И подаста руку межю собою, и въдасть Печенѣжьский князь Прѣтичю конь, саблю, стрѣлы; онъ же дасть ему бронѣ, щитъ, мечь.

And the Pecheneg prince [Khan Kurya] said to Pretich: "Be my friend"; and he himself said "Let it be that way". And they shook hands, and the Pecheneg ruler presented to Pretich a horse, a saber, arrows; he in turn offered armor, a shield, and a sword.

1 | After the battle of Prince Igor against the Cuman-Qipchaqs: This painting by Viktor Vasnetsov (1880), which originated in a highly patriotic context, depicts the war-torn epoch of this Kiev ruler (1151 – 1201), who was immortalized in the Medieval epic poem *The Tale of Igor's Campaign*. Alexander Borodin also remembered him in his 1890 opera *Prince Igor*.

2 | Learning from loanwords: The Russian currency ruble, derived from the verb "rubit" (to hack off), refers to hack silver as a weight-based currency.

ple, not only knowledge associated with warfare and the military and its practices and objects, like weapons, boat building and the art of navigation, but also social and legal structures originated from the Scandinavian Norsemen.

In this vein, the anthropologist found evidence – again through the analysis of the loanword stock – pointing to the fact that Slavic princes adopted the organizational form of the Varangians or Varyags as the model for their retinue *(druzhina)*. "And silver finds from graves and hoards originating from the time show that trade contact existed with the Middle East and Central Asia, Baghdad, Tashkent, Samarkand and Bukhara," he reports.

WORDS ARE INDICATIVE OF THE MONETARY SYSTEM

This silver gradually replaced payment-in-kind until the monetary system was finally introduced into Eastern and East Central Europe around 880/890. "However, while coinage had long existed in Western Europe, a weight-based currency using hack silver initially emerged there," confirms Schorkowitz. "In contrast to the Russian term *dengi* or money, which is derived from the Tatar or Chagatai term *tängkä* and refers to subsequent Tatar-Mongol cultural transfer in the 13th century, ruble or *rubit* in Russian means chopped off or hacked off."

Like many of the adopted material goods, hack silver only enjoyed a comparatively small cultural half-life as a currency until it relinquished its function and was deposited in the sediments of an integrated culture. According to Dittmar Schorkowitz, the fate of goods of an intangible nature, as adopted not least from the Byzantine-Greek cultural area, is not dissimilar.

Photo: OH (top), Wikipedia – Bullenwächter

Writing, religion, ideology, painting and architecture weren't transferred on the basis of straightforward, one-to-one exchange, but were adapted and socially negotiated. Although Byzantine architects were commissioned with the design of new churches and cathedrals, local architects were involved in the task of building them. Their function was to introduce secular elements into the structures quasi as a bit of local color. "Their tasks included the staging of the representative needs of the competing appanage principalities," says the researcher. Due not least to this and the use of regional construction materials and techniques, no copies of Byzantine models were built in the Kievan Rus', but rather distinctive cathedrals and churches with their own unique character.

THE MONGOLS ARE COMING: NEW RULERS, NEW CUSTOMS

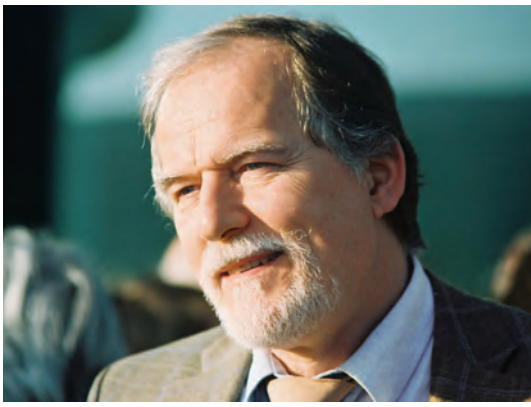
According to Schorkowitz, the cultural goods that flowed into the region since the arrival of the Mongols in Eastern Europe in the early 13th century tended to be more secular in nature. "Their appearance meant a rapid increase in cultural forms of Asian origin for *Slavia Asiatica*, new orientations and wide-ranging acculturation and assimilation processes," he explains, in reference to the enduring impacts of the Mongol invasion and the subsequent peace under the empire of Genghis Khan. "The *Pax Mongolica* conveyed cultural goods from China, Central Asia and Iran to the very self-interested elite, and in this way made a crucial contribution to the cultural molding of *Slavia Asiatica* and Eastern Europe."

The source-critical analysis of edicts issued by the Golden Horde shows that the process of cultural transfer involved here went far beyond innovations in the area of warfare; the *Pax Mongolica* also resulted in the introduction of an administrative and chancery system, which included a taxation system, communication and supply systems, and census taking.

A side glance at comparable contact zones in the history of Europe is also very informative. "Multiple cultural transfer, multilingualism, intercultural competency and many of the other characteristics observed for *Slavia Asiatica* also arise on the western and eastern margins of East Central Europe, namely in *Germania Slavica* (Germany-Slavia) and *Polonia Ruthenica* (Poland-Kievan Rus'), and also in the southwest of Europe in Al-Andalus on the Iberian peninsula," explains Schorkowitz.

The fact that tried-and-tested practices clearly exist that lead to integration should also be of interest to the doctoral students and Schorkowitz's colleagues from the International Max Planck Research School for the Anthropology, Archaeology and History of Eurasia (ANARCHIE), which focuses on developments in the societies and cultures of the Old World.

The first phase to be carried out at this graduate school, which was established last year, concerns collective identities in the context of the development and culture of the Old World. Conclusions obtained by such research ultimately extend from history into the present. Or as Schorkowitz himself puts it: "Such patterns and dependencies also explain the character of a region that only became integrated into Europe in the early modern era." ◀



Searching sideways glance: Dittmar Schorkowitz examines which characteristics of *Slavia Asiatica* occur in comparable contact zones of Europe.

TO THE POINT

- **Linguistic, historical and archaeological sources provide examples of cultural contact and cultural transfer in *Slavia Asiatica*, the eastern periphery of medieval Europe that extends deep into Eurasia. They demonstrate the cultural interface of an area in which many ethnic groups acted as transmitters.**
- **The Old Russian loanword stock, in particular, helps the researchers identify the scale of the cultural transfer, which extended to all areas of society.**
- **Cultural forms always represent a conglomeration of processes involving group formation, demarcation and the safeguarding of identity, along with the negotiation and adoption of cultural values, goods and norms. As part of this process, cultural elements of varying origins are – as time goes by – deposited in layers like sediment.**

GLOSSARY

Acculturation: According to the classical anthropological definition, this refers to phenomena that arise when groups of people from different cultures come into direct and enduring contact with each other, and changes arise in the original cultural patterns of one or both groups as a result.

Cultural exchange: Unlike cultural transfer, cultural exchange refers to a flow of goods that is nowhere near as purposeful, intentional and one-dimensional as cultural transfer, which involves the import of very particular goods by a specific group at a particular period of time. In contrast, as an accidental, alternating and changing phenomenon, cultural exchange manifests as interactive, diffuse and, in part, non-binding.

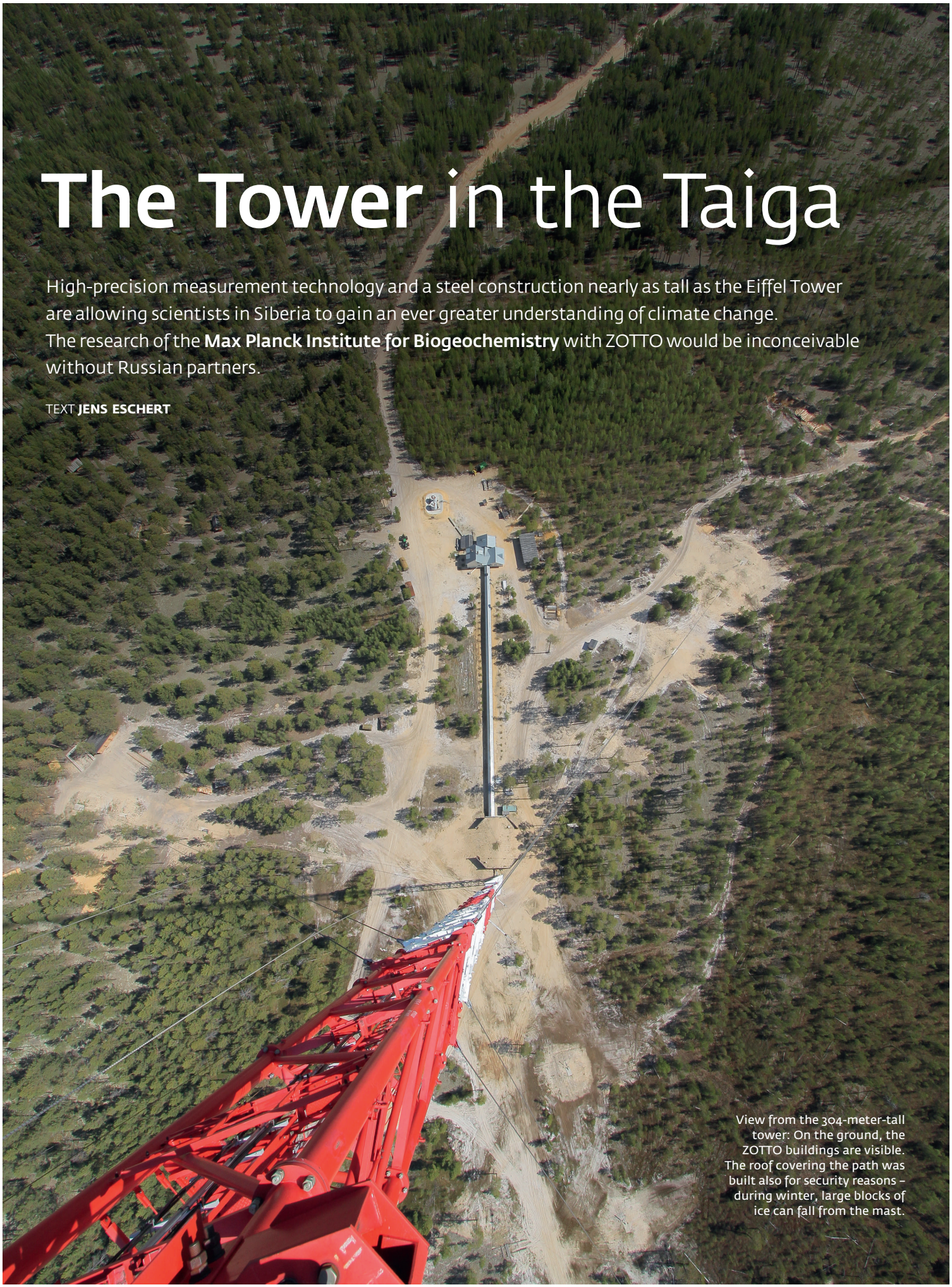
Slavia Asiatica: This term refers to an area in medieval Eurasia from the Danube River, through the North Pontic region, to the Volga River and beyond. The region was the cultural contact zone between the populations of the Kievan Rus' and the bordering steppe, with ethnic groups from Scandinavia, Central Asia and Byzantium.

Photo: Private

The Tower in the Taiga

High-precision measurement technology and a steel construction nearly as tall as the Eiffel Tower are allowing scientists in Siberia to gain an ever greater understanding of climate change. The research of the **Max Planck Institute for Biogeochemistry** with ZOTTO would be inconceivable without Russian partners.

TEXT **JENS ESCHERT**



View from the 304-meter-tall tower: On the ground, the ZOTTO buildings are visible. The roof covering the path was built also for security reasons – during winter, large blocks of ice can fall from the mast.

The mighty Ural truck carries him piggy-back up the last stretch, lumbering over dirt tracks – trails in the Siberian wilderness. The fact that it takes the vehicle a full one and a half hours for the barely 20-kilometer journey into the depths of the taiga has long since ceased to bother Jošt Lavrič. After all, the Group Leader from the Max Planck Institute for Biogeochemistry in Jena has already been on the road for three days as his longest business trip now approaches its goal: ZOTTO, or the *Zotino Tall Tower Observatory,* named after the nearest town, Zotino.

There, scientists use a 304-meter-tall tower to continuously measure the amount of greenhouse and other trace gases and aerosols in the atmosphere. "Of course it's a strain, no doubt about it. But the research we can carry out there with our Russian partners is crucial to understanding the mechanisms and consequences of climate change," says Lavrič, a geochemist.

The boreal and arctic land masses of Siberia are, after all, a so-called hotspot – a place that has a relatively strong influence on the global climate and, at the same time, where the effects of change can have a particularly strong impact. "Such locations show very clearly that the entire climate system, with all of its factors, is dependent on both positive and negative feedback," says Lavrič.

To name one example: The Siberian coniferous forests comprise around 10 percent of the carbon stored in vegetation and soils worldwide. In addition, more than half of the Siberian forests are located in the permafrost, where, in turn, massive amounts of carbon are stored. And it is a known fact that the average temperature in large parts of Siberia in summer has risen by up to 2 degrees Celsius in the past 45 years.

"But then there are many unanswered questions – such as how the temperature increase affects the carbon sinks in the region: Does the warming climate lead to additional carbon storage in more rapidly growing forests due to longer vegetation periods? Or is more soil carbon released to the atmosphere due to faster microbial decomposition," asks Jošt Lavrič.

Because of its special location, the ZOTTO tower, which was jointly constructed by the Max Planck Institute for Biogeochemistry and the partners from the Sukachev Institute of Forest of the Russian Academy of Sciences, takes measurements at six different altitudes. The first sensors are below the treetops. "This allows us to better understand and describe the local signals," says Lavrič.

UNDERSTANDING A HOTSPOT OF GLOBAL CLIMATE PROCESSES

But because the researchers are interested in the interactions with the atmosphere and the processes that occur there, they had to set their sights quite high: one has to go up to an altitude of about 300 meters to reach air layers that are free from local influences and permit conclusions regarding climate processes of much larger regions. It is this spectrum of high-precision measurements of greenhouse gases such as carbon dioxide and methane, but also of the oxygen content and general meteorological indicators, that offer research the decisive extra value.

To even more accurately detect the influence of the vegetation in the interaction with the atmosphere, the scientists from the institute in Jena additionally set up two small sibling towers in the taiga in recent years. These register the so-called carbon fluxes of the forests and of the swamp areas. "The two measurement approaches – that of the large tower and that of the smaller stations – complement each other. Taking all of the data together gives us a detailed picture and can put the local processes in a larger context," says Lavrič.

ZOTTO has been in operation since 2006. The first studies have been published, providing facts that replace the earlier suppositions. For instance, the question of whether the Siberian forests are, on annual average, rather a source of carbon or a carbon sink, or in other words, whether they take up more carbon than they release: "The data shows that the picture varies. When summers are very dry, the vegetation activity can slow down so much that almost no more photosynthesis takes place. If this is then compounded by fires, we see special effects that have a major impact," says Lavrič.

But there are also other years in which the forests contribute to a positive annual result, or in other words, when they store more carbon than they release. "The longer the recordings run, the smaller the error indicators in this calculation become," says the researcher.

And that is the scientific core of the high-precision measurements: The numbers illustrate concrete climate situations. For the modelers trying out the widely varying scenarios, this is important information. After all, this is what makes it possible to better describe the causes of climate change, forecasts become more precise. That is why stationary atmosphere monitoring has become established around the world, more and more stations are being built. The goal is to create a global measurement network that covers all relevant regions of the world.

This is a task for the entire community, and the Max Planck Institute for Biogeochemistry is involved. The Jena-based institute recently commissioned an observatory in Namibia, and Jošt Lavrič's group, which belongs to Max Planck Director Martin Heimann's department, runs a total of five measurement stations worldwide.

Another Max Planck project, the construction of ATTO, a similarly tall tower in the Amazonas region, is being

Photo: MPI for Biogeochemistry – Michael Hielscher

In the Siberian wilderness: The ZOTTO tall tower station is located about 600 kilometers northwest of Krasnoyarsk. Technicians and scientists of the Max Planck Institute for Biogeochemistry go there twice a year on working campaigns. On such occasions they meet their Russian partners – as here in the group picture taken in the summer 2012.

headed by the Max Planck Institute for Chemistry in Mainz. Together with the Max Planck Institute for Meteorology in Hamburg and the Potsdam Institute for Climate Impact Research, these institutes make up the core of the Earth System Research Partnership (ESRP) and form international networks with leading research institutes.

ZOTTO is a German-Russian project of the International Science and Technology Center (ISTC). The groundwork was financed largely by the Max Planck Society, but both sides are now involved in the operation. "Our research would be inconceivable without local partners," stresses Lavrič – already because the team from his group or the institute engineers working with Olaf Kolle can seldom be on site. The Russian partners from the Institute of Forest, in contrast, are permanently at the station. They conduct their own research, but they also maintain the measuring instruments and ensure, for instance, that the diesel generators supply constant electricity for continuous delivery of the measurement data. The scientists in Jena then retrieve the data via a server in Krasnoyarsk.

NEW COLLABORATIVE PROJECTS WITH RUSSIAN EXPERTS

"We're over there no more than two or three times per year," says Lavrič, but he is regularly in touch with the coordinator at the Institute of Forest, Alexey Panov. There are also additional projects being conducted on the Russian side – such as an independent measuring station for detecting ozone locally, run by the Moscow Institute of Atmospheric Physics of the Russian Academy of Sciences.

According to Jošt Lavrič, there are additional plans for future collaborative projects. Beginning in summer, the group led by Mathias Göckede at the Max Planck Institute for Biogeochemistry will build a new observation station near Chersky, in northeastern Siberia. This region lies above a deep permafrost near the arctic tree line. In cooperation with the Northeast Scientific Station (NESS) of Sergey and Nikita Zimov, they will study how climate change impacts the immense carbon stores in this ecosystem.

This is about more than just rising temperatures: by systematically dewatering one part of the measurement area, they aim to record the influence of changes in the water cycle. Through this experiment, the researchers are essentially opening a "window to the future," allowing them to measure the suspected consequences of climate change now.

In fall of this year, Jošt Lavrič wants to once again take his team on his longest business trip. This will take him from Jena to Berlin, flying from there to Moscow, then another plane to Krasnoyarsk. There, Lavrič will transfer to a minibus and head north along the Yenisei River. After an overnight stay, he will then get on a speedboat that will take him on an eight-hour ride to the village of Zotino, where that final stage of the journey in the Ural truck begins.

No, he is not particularly looking forward to the trip itself. But then, actually being there – that is something special. Of course there is always a lot of strenuous work. This affects him and his colleagues alike, who in recent years had to lay cables through the middle of the swamp in order for the small measuring towers to be able to transmit their data to the station. "That is a feat in itself, with thick copper cables, especially in 30-degree heat, with insects everywhere," says Lavrič. The conditions were oppressive for him, too – but nevertheless: "The landscape is an absolute treasure. There, you experience an incredible sense of vastness." ◀

Photos: MPI for Biogeochemistry – Martin Heimann (above), MPI for Biogeochemistry – Steffen Schmidt (below)

All about Plasma

International center opened in spring at the Bauman Moscow State Technical University

The Research and Educational Centre for Plasma Science and Technology is dedicated to the investigation of different types of plasmas. The Centre is international – there is a cooperation agreement between the Bauman Moscow State Technical University and the Max Planck Institute for Extraterrestrial Physics in Garching near Munich, and a number of scientists from Garching are coming to Moscow to teach and to conduct research there.

Plasma is an ionized gas. The so-called "cold plasma" contains neutral gas, charged particles, excited atoms and molecules and reactive species; "hot plasma" is fully ionized and millions of degrees hot. Plasmas play an enormous role in many areas of technology.

The Centre will provide a natural transition from teaching and training to basic research and applications. It consists of three laboratories covering a broad range of modern plasma research. People involved on both sides are world-class experts in various fields ranging from theoretical plasma physics to plasma technologies, addressing diverse problems of fundamental science and applications.

The principal research directions include – among others – complex (dusty) plasmas, medical plasmas, modern nanocomposite coatings, plasma diagnostics and plasma sources.The laboratories, equipped with the most modern standards, include unique experimental setups for such research. Soon, a working prototype of the complex plasma setup currently operating onboard the International Space Station ISS will be installed at the Centre.

There is also a broad range of educational activity conducted at the Centre. The focus is on the physics of complex plasmas, where four different lecture courses are currently taught. The teaching is accompanied by lab exercises and design of new experiments. In addition, students study new plasma technologies, assist in developing new plasma sources, and take part in the synthesis and control of new nanostructured materials.

http://plasmacenter.bmstu.ru/?lang=en

Under Microgravity

At the Max Planck Institute for Extraterrestrial Physics, scientists prepare for a new plasma crystal experiment onboard the International Space Station

In March 2001, the Plasmakristall-Experiment PKE-Nefedov of the Max Planck Institute for Extraterrestrial Physics – in collaboration with the Russian Space Agency and the Institute for High Energy Densities (today: Joint Institute for High Temperatures), Moscow – was the first scientific experiment to be flown on the International Space Station ISS. When it was decommissioned in 2005, it had been used in 45 successful complex plasma experiment sessions in microgravity. Only under these conditions can stress-free plasma crystal systems exist and provide us with unique and new insights into the physics of complex plasmas.

Since December 2005, the successor of PKE-Nefedov has been transferred onboard the International Space Station: PK-3 Plus. Because of a highly improved setup and more accurate diagnostic means, PK-3 Plus allows the scientists to explore new areas in the parameter space of complex plasmas. For the first time, so-called electro-rheological plasmas and the behavior of binary mixtures can be studied. PK-3 Plus also enables the researchers to create and investigate huge three-dimensional plasma crystals, transitions to the liquid phase and re-crystallization in detail. These examples point out the future way of complex plasma science: interdisciplinary research beyond pure plasma physics.

While research with PK-3 Plus is ongoing, the next-generation complex plasma experiment is already under construction at the Max Planck Institute for Extraterrestrial Physics: PK-4. It will be sent to the Space Station in

Ready for space: Cosmonaut Yury Gidzenko onboard the ISS beside the PKE-Nefedov Telescience Unit (left).

Photo: RosaviaKosmos

2014. As with the former experiments, PK-4 will allow scientists to study complex dusty plasmas (made up of ions, electrons, neutral gas and micron sized "dust" particles) in a weightless or microgravity environment.

With PK-4, for the first time a DC-operated plasma chamber with an observable length of 30 centimeters and a diameter of 3 centimeters will be used to study effects that can't be seen with the PKE-Nefedov and PK-3 Plus RF chambers. The main difference of a DC chamber compared with an RF discharge is the elongated geometry of the chamber that allows the study of more fluid systems than static plasma crystals, as in the RF setups.

The tubular design provides high accessibility for watching and recording the experiment, as well as for manipulation with additional RF fields or intense laser beams. The well known physics of glow discharges helps to change and to control the plasma parameters because they depend primarily on pressure, current and geometry.

The effects that are planned to be studied on the kinetic level are laminar and turbulent flow; the transition between the two; thermodynamics and self-organization of complex plasma flows; solitons and shocks; interfaces and plasma instabilities; agglomeration and disagglomeration. Modulated RF coils and high-voltage supplies are foreseen for low-frequency excitation and confining particles.

The expected results will be of fundamental interest for the understanding of complex plasmas, but also for the physics of condensed matter and fluid dynamics. Further applications might be in the field of solar system sciences and astrophysics.

http://www2011.mpe.mpg.de/theory/plasma-crystal/PK4/index.html

Science Tunnel 3.0 in Moscow

The Max Planck Society's multimedia exhibition is an impressive demonstration of the relevance of basic research

The premiere in the German city of Paderborn was a resounding success: more than 20,000 curious visitors came to check out the Science Tunnel 3.0. The Max Planck Society hopes that the Tunnel will draw a similarly large crowd in Russia. The exhibition is set to open its doors on April 10 in Artplay Design Center Moscow and will be on display until the beginning of May. Afterwards, the Science Tunnel will go on show in St. Petersburg.

A journey of discovery: The Science Tunnel, currently on tour in Moscow and St. Petersburg, provides fascinating insights into basic research.

Photo: Archimedes

With its motto "Creating knowledge, shaping the future," the exhibition illustrates the relevance of basic research through eight themed multimedia sections that use images, video and real objects, and reveals how the Max Planck Society is engaged in this pursuit. It also conveys the beauty and fascination of science, presenting the eight topics of Universe, Matter, Life, Complexity, The Brain, Health, Energy and Society as convergent fields of knowledge.

The interactive presentations allow each topic to be approached from different perspectives and illuminated by different disciplines, generating a unique picture of basic research in today's world and its importance for solving the key challenges of the future. Some stand-out areas here are research into climate change and the development of sustainable energy.

The Science Tunnel was open to the public until February 24 in Paderborn, and was then packed away in preparation for its next stop, Moscow, where the mobile exhibition is due to open on April 10. Moscow will also play host to another event on April 9 and 10, when Max Planck President Peter Gruss and Siemens CEO Peter Löscher open the international Future Dialogue forum for exchange between business and science.