2020 was an extraordinary year in every respect. There is no doubt that it will go down in the history of humanity as the first year of the coronavirus pandemic. A pandemic that is not yet over as I write these words in mid-2021. And yet something crucial has changed: the availability of vaccines brings the end of the pandemic within reach.

That is not something that can be taken for granted. A look back at the Spanish flu, which spread across the globe after the catastrophe of World War I, makes this clear. There were no vaccines back then. It was not even known that it was a viral infection. The terrible result was 20 to 50 million deaths out of a world population of around 1.8 billion people. The fact that, after only one year in the fight against the coronavirus, there are several vaccines available will significantly shorten the pandemic and thus massively reduce the number of victims.

OVERCOMING THE PANDEMIC WITH SCIENCE

This is thanks to science in general and basic research in particular. Research into RNA-based vaccines, for example, goes back to the 1990s. The fact that mRNA vaccines against the coronavirus were developed in such a short time is largely thanks to this preliminary work in basic research. Not only vaccine research, but also other branches of science are helping to overcome the pandemic. At the Austrian Academy of Sciences alone, more than 40 research projects from a wide variety of subjects started in 2020, all of which have one goal: to provide more knowledge about the virus and its consequences for research, politics, and the public.

For example, our demographers investigated how far we are from herd immunity. Archaeologists and historians, looked into the past to analyze what we can learn from previous epidemics. Social scientists and economists from the Academy ascertained which population groups are most severely affected by the pandemic, including young people, and observed how COVID-19 is affecting societies in other parts of the world. Our life sciences researchers also grappled with SARS-CoV-2, developing innovative test methods at an early stage, and making an essential contribution to combating virus mutations with the help of viral genome sequencing.

EXCHANGE ACROSS DISCIPLINES

In all of this, a special feature of the Academy has again become apparent. It is a place where different perspectives come together and can be freely exchanged. Our researchers and, to a large extent, our members from Austria and around the world ensure this. The importance of bringing different perspectives together to see the bigger picture was shown, for example, at an event in the series “Science and Politics in Conversation”, at which researchers from a wide range of subjects meet with parliamentarians. In the summer of 2020, the series was devoted to the crucial question of what lessons we can learn from the corona crisis.

This Annual Report tries to convey how successful interdisciplinary exchange is in overcoming current
Challenges – which are by no means limited to the corona pandemic. We asked employees, members, and fellows with different professional backgrounds to talk to us. They exchanged ideas with one another in the “In Focus” chapter, which you can find in the German version of this report. In addition to the coronavirus, there are other important and socially relevant topics such as climate change, digitalization, migration, and scientific revolutions such as the “genetic scissors” CRISPR. If you read these interviews, it becomes clear that there are many urgent questions that can only be answered by working together. “More knowledge together” is therefore the motto of this Annual Report.

“More knowledge together” applies not only to our research activities, but also to our knowledge transfer. Although numerous events that had already been planned had to be canceled or postponed in 2020, we did not have to go without the latest findings from science and research. Lectures and conferences of the OeAW moved to the internet, as did participation in the Long Night of Research, the European Researchers’ Night, and the Academy of Sciences in Austria already had its own research institutes at the beginning of the 20th century, such as the Institute for Radium Research and the “Biologische Versuchsanstalt”. During the Cold War, the Academy consciously positioned itself between the Eastern European and Western academy models, taking over the institute structure from the former and the membership and funding structure from the latter. This proved to be a successful model and makes us the largest and most diverse non-university basic research institution in the Austria today.

NEW STANDARDS IN RESEARCH

With the new performance agreement for the years 2021 to 2023, we will continue to consistently pursue this special path, which enables us to fulfill our statutory mandate to “promote science in every way”. This is illustrated by two examples.

On the one hand, the Academy’s Cori Institute for Metabolism Research is to be built in Graz, where the Academy’s Space Research Institute is already located. It is named after the Austrian-US biochemist and Nobel Prize winning couple Gerty Theresa Cori (1896–1957) and Carl Ferdinand Cori (1896–1984) and will be operated in association with the universities of Graz. What is special about it is the planned close interweaving of experimental research with numerical biology and mathematical modeling in the research of human metabolism and its diseases. We also want to set new standards in the humanities and social sciences in the future. A research gap is to be closed with the establishment of a center for research on anti-Semitism in Vienna. Building on the historical work that the Academy has been doing for a long time, the new center will advance interdisciplinary basic research on the causes, manifestations, and effects of anti-Semitism in Austria and Europe in the present.

With a view to the future, let me come back to the motto of this Annual Report. “More knowledge together” will soon occupy an impressive place in Vienna again. In 2021, we will return to our renovated main building in the center of the city and the adjoining Academy Campus will be officially opened as a revitalized historical gem as early as 2022 – as a place of research and as a place where science can be lived and experienced by young and old. Thanks to vaccinations, I am confident that this can also be done face-to-face on site and not just digitally.

ACKNOWLEDGEMENT AND THANKS

First-class basic research is only possible through the tireless efforts and committed cooperation of our researchers, employees, and members. We are indebted to our partners in science, politics, and society for their constant support. We would also like to thank everyone who were guests at the Academy as speakers, listeners, discussion participants, or visitors, often virtually in 2020, for their interest and commitment. I would like to express my special thanks to Austrian Science Minister Heinz Faßmann and our patron, Federal President Alexander Van der Bellen, for their constructive cooperation and mutual understanding of the paths and goals of basic research.

Vienna, June 2021

ANTON ZEILINGER
President of the Austrian Academy of Sciences
Supercomputers, quantum encryption under the sea, time travel in the ancient world, and more than 40 research projects on the coronavirus – an overview of the most important milestones of 2020 in science and research at the Austrian Academy of Sciences.

ON THE WAY TO THE SUN AND MARS

In the early hours of a February morning in 2020, an Atlas V rocket with the European Solar Orbiter probe on board was launched from the American spaceport Cape Canaveral. The European Space Agency mission is to last seven years with the aim of revolutionizing knowledge about the sun. Solar Orbiter has ten scientific devices on board. The Space Research Institute of the OeAW was involved in the development of some of them, such as the magnetometer, the antenna calibration, and the on-board computer for the radio wave instrument. While the Solar Orbiter travels to the sun, the Chinese Tianwen-1 mission set off on its way to Mars – here too, Austrian technology is on board. OeAW space research helped build the magnetometer.

QUANTUM ENCRYPTION UNDER THE SEA

The quantum internet of the future should enable completely tap-proof communication between users worldwide. Quantum physicists at the OeAW have taken two important steps towards this. They managed to create a quantum-encrypted connection under the sea, over 192 kilometers between Sicily and Malta. A quantum internet not only needs stable connections over long distances, but it must also be able to connect as many participants as possible. Here, too, a team with the participation of the OeAW achieved a milestone: they set up a network that allows quantum-encrypted communication between eight participants with the help of a central source for entangled photons.

OVER 40 RESEARCH PROJECTS ON THE CORONAVIRUS

More than 40 new research projects on the pandemic from a wide variety of disciplines were started at the OeAW. Social scientists, for example, dealt with the questions of how long an optimal lockdown should last, to what extent the corona crisis affects young people in particular, and how refugees deal with the crisis. Historians, on the other hand, looked at epidemics of the past and the question of what we can learn from them for the present. The life sciences institutes of the OeAW developed two new test procedures for SARS-CoV-2 and tracked the mutation paths and dynamics of the coronavirus in Austria with sequencing. The Academy was also active in advising politics and society: a specially set up website gathers scientifically proven facts about COVID-19, in the summer scientists and parliamentarians drew up an interim assessment on the corona crisis, and the OeAW asked the public prize question: “What can science achieve during pandemics?”.
EXPLORING NATURAL MONUMENTS WITH AN APP

Vienna is world-famous as a city of art and culture. But who knows that the Austrian capital is also home to around 400 natural monuments? Bringing these into public awareness in a playful way is the idea behind the app NDQUEST. It was developed by scientists from the GMI – Gregor Mendel Institute of Molecular Plant Biology of the OeAW together with the environmental protection department of the City of Vienna. With the help of the smartphone app, Vienna’s natural monuments can be easily located using a map function, and additional information on the landmarked trees, avenues, or bodies of water is available. The playful approach of the app also offers the opportunity to answer questions and collect points and is intended to bring the fascinating world of plants closer to children and young people in particular.

IMPORTANT ANCIENT GREEK EVENTS HAPPENED EARLIER

The formation of the Greek city-states, the invention of the Greek alphabet, Greek colonization, and the era of Homer – all of these could be dated 50 to 150 years earlier. This is suggested by a study published by researchers from the Austrian Archaeological Institute of the OeAW in the journal PLOS ONE. For the first time, the team checked the Greek historical time spans using modern natural science methods, namely precise radiocarbon data. For this purpose, sample materials were used that came from well-dated contexts from the North Aegean site of Sindos. The findings obtained in this way require a radical revision of the previously known Greek chronological order.

CLIMATE CHANGE INCREASES MIGRATION

In recent years, research has increasingly examined the effects of environmental changes, such as those caused by climate change, on migration in various countries. However, broader studies that offer an overview of the knowledge gathered in this way have been rare. Demographers from the OeAW and the Potsdam Institute for Climate Impact Research have now changed that. They carried out an extensive meta-study on 30 countries that confirmed a connection between environmental change and migration. Whether people leave their homes due to droughts, storms, or flood disasters also depends on a country’s level of prosperity: “If there is little prosperity, the resources that are necessary for migration, especially across national borders, are often lacking,” report the researchers in Nature Climate Change.

AUSTRIAN STUDIENSTIFTUNG TAKES OFF

Based on models in Germany and Switzerland, the OeAW has created the Austrian Studienstiftung, which aims to support committed and talented young people in their university careers. At the beginning of 2020, the Studienstiftung started with the first winter schools, at which a total of 105 high school graduates from all over Austria were able to exchange ideas with scientists from a wide range of subjects in seminars over several days. The young participants heard about scenarios for the future of alpine areas, dealt with the evolution of human bone structure, solved mathematical problems, and discussed the opportunities and risks of using artificial intelligence.
ON THE WAY TO THE FUTURE OF CERN

The largest machine in the world will continue to generate groundbreaking insights into the origin of the universe in the coming decades. We are talking about the particle accelerator at CERN near Geneva, in which Austrian science is also involved. In a new strategy paper, Europe’s particle physicists have now set the course for the future of the “world machine”, which has already won three Nobel prizes for CERN researchers in its history. The plans, in which the OeAW played a leading role, provide for a particle accelerator to produce Higgs bosons, as well as studies for the construction of a successor to the current Large Hadron Collider. This Future Collider is to achieve seven times the energy and thus advance into new dimensions of physics.

NEOLITHIC TWINS IDENTIFIED

For around 31,000 years, a Neolithic double grave lay well protected under the shoulder blade of a mammoth. What is special about it: the burial is of infants who were discovered by archaeologists from the OeAW in 2005 during excavations on the Wachtberg in Lower Austria. Now, after genetic, morphological, and chemical studies, an international team with the participation of the OeAW was able to identify the infants as male, identical twins. Both lived only briefly: while one boy survived the birth for up to 8 weeks, the other died during or shortly after the birth. This also means that the older brother was a “secondary burial”, indicating that the grave was reopened and representing a cultural-historical finding of great relevance for this period.

NEW VIDEO SERIES: “SCIENCE BITES”

Public lectures are an essential element in conveying the latest scientific findings. Due to the corona pandemic, however, numerous events that had already been planned had to be canceled in 2020. But those who wanted to experience science at the OeAW did not have to do without – the Academy quickly launched a new series of videos. In lectures of 10–15 minutes each, the “Science Bites” bring science closer to those interested. Scientists at the OeAW – mostly from their own home office – talk about their research in a generally understandable way and thus offer “knowledge to go” for viewers at home – from dark matter and solar storms to conspiracy theories and virus mutations.

123 NEW FELLOWS

A wide variety of innovative research projects are being funded by the OeAW with new grants: research is carried out on questions of ideological warfare, entangled photons, deep learning in precision medicine, and the cellular development of lung cancer. “The special thing about the OeAW scholarships is the message: ‘You can research completely openly, driven only by your curiosity and your creativity!’ This is how new ideas really come about,” says OeAW President Anton Zeilinger. A total of 10.43 million euros are available for the research projects of the young fellowship recipients.

AMONG THE MOST CITED RESEARCHERS

Twenty-eight researchers who work at the OeAW or are closely associated with it as members in Austria or abroad are again among the internationally most influential minds in science. This is the result of the 2020 ranking of the world’s most frequently cited researchers, published by Clarivate Analytics. The annual survey examines how often publications by a researcher from a field of medicine or the natural and social sciences were cited by peers in their publications between 2009 and 2019. A total of 44 people from Austria are among the most cited, 14 of whom are employees or members of the OeAW.
TRACKING DOWN MICROCEPHALY

Human brain development is one of the most complex processes in biology. Just a few cells give rise to around 87 billion nerve cells in the adult brain. Using new technology, researchers at the IMBA – Institute of Molecular Biotechnology of the OeAW – screened hundreds of genes at once in brain organoids to track down brain diseases. In particular, the team looked at microcephaly, a genetic disorder in which the brain does not grow to the right size. As a result, the scientists were able to show that microcephaly is triggered by a certain defective signaling pathway in cells, as they report in Science.

PEERING OVER RESEARCHERS’ SHOULDERS ONLINE

Inquisitive children who run through the halls of the Academy or adults who immerse themselves in the world of science in direct conversation with researchers – major events such as the Vienna Children’s University and the Long Night of Research were only possible online in 2020 due to corona. However, that did not dampen the enthusiasm of the scientists or the active participation of the audience. The OeAW was present at both events as well as at the European Researchers’ Night with several video lectures, interactive chats, and live talks. One of the highlights of the Long Night of Research: in cooperation with CERN, physicists from the Academy invited people to take a virtual tour of the Geneva research center.

NOBEL PRIZE IN CHEMISTRY FOR MEMBER EMMANUELLE CHARPENTIER

The French biochemist and geneticist Emmanuelle Charpentier, who has been a member of the OeAW abroad since 2016, was awarded the Nobel Prize in Chemistry in 2020 together with the US biochemist Jennifer Doudna. The CRISPR/Cas9 method for modifying the genome, developed by the two researchers, represents a groundbreaking innovation in biomedical research. There is hardly a molecular biological laboratory that does not work with CRISPR/Cas9, including the research institutes of the OeAW. Researchers at the IMBA – Institute of Molecular Biotechnology of the OeAW and the Vienna BioCenter Core Facilities even succeeded in developing an “upgrade” for the genetic scissors. The physicist Reinhard Genzel was also awarded a Nobel Prize for his research on black holes. Genzel is a member of the Research Board of the OeAW.

FOUR JOURNALISTS RESEARCH WITH OEAW GRANTS

In times of the corona pandemic and conspiracy theories, independent science journalism plays a particularly important role in public discourse. The OeAW aims to promote this role with the “Research & Journalism Scholarship”. The program was developed to support journalists in devoting themselves to scientific topics without time pressure and in a journalistically informed manner. Started for the first time in 2019, it went into the second round in 2020. The successful scholarship holders are the freelance journalists Saskia Blatakes, Sarah Yolanda Koss, Patricia McAllister-Käfer, and Sonja Bettel. They deal with topics as diverse as birth rates in the crisis, evolutionary biology, the cultural history of the Danube, and prison life in the pandemic.

NEW SUPERCOMPUTER CLUSTER STARTED

Scientists today often have to deal with large and complex amounts of data. Suitable computing power for their processing is therefore becoming more and more important. Together with the Research Institute of Molecular Pathology (IMP) and the Vienna BioCenter, the OeAW has created the Cloud Infrastructure Platform (CLIP): the largest non-university supercomputer cluster in Austria. Its task is to help scientists from different fields such as physics, mathematics, acoustics research, space research, and life sciences to solve their various problems. The time normally required for calculations can be drastically reduced with CLIP. A task that would otherwise take hours can now be completed in just a few seconds.
THE STATE OF THE CONSTITUTION

The Austrian Federal Constitution turned 100 years old in 2020. In its anniversary year, it was put to the test by Covid-19, for example by restrictions of basic rights during lockdowns. The current state of the constitution was discussed in a virtual panel discussion. After a welcoming speech from Alma Zadić, Austria’s Minister of Justice, there was a livestream debate between Elisabeth Holzleithner, legal philosopher at the University of Vienna; Gertrude Lübbe-Wolff, judge at the German Federal Constitutional Court; Felix Uhlmann, legal scholar at the University of Zurich; Magdalena Pöschl, constitutional and administrative law expert at the University of Vienna and full member of the OeAW; and Clemens Jabloner, former Vice Chancellor of Austria and honorary member of the OeAW. If you missed the debate, you can look it up on the OeAW’s YouTube channel.

CONSTRUCTION WORK AT THE ACADEMY CAMPUS IN FULL SWING

Meeting areas, multifunctional event rooms, barrier-free access, a revitalized library, and modern research infrastructures: at the Academy Campus, the OeAW is creating a new center of knowledge in Vienna’s old university district. Construction and renovation work began in early 2020. During an inspection of the construction site, OeAW President Anton Zeilinger, CEO of the Bundesimmobilienegellschaft (BIG) Hans-Peter Weiss, Austrian Science Minister Heinz Faßmann, and District Chairman Markus Figgl looked at the progress of the construction operation, which is in full swing. Together with the Wiener Postsparkasse, which is also to become an OeAW location, “science in all its diversity is coming to the heart of the city,” President Zeilinger says.

FACTS AND FIGURES

THE ACADEMY AT A GLANCE

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