

**“The long-term and generous support of the Max Planck Society was crucial to our success.”**



PHOTO: ANNA SCHROLL FOR MPG



# 2022 NOBEL PRIZE

SVANTE  
PÄÄBO



The circular DNA molecules in the mitochondria are a great deal smaller than the DNA in the cell nucleus and therefore, easier to analyze. After an organism dies, the genetic material breaks down into fragments of different lengths. However, most of the DNA comes from microorganisms.

Can DNA, the genetic material, survive in the bones of long-dead animals and humans and provide clues about their ancestry and relationships? That question has driven Svante Pääbo's research over the past forty years and has now landed him the Nobel Prize in Physiology or Medicine.

Isolating DNA from ancient bones is not easy, as the old DNA breaks down into small fragments, chemically modified and present in tiny amounts compared to the huge quantities of DNA from bacteria and fungi that colonized the bones when they were in the ground. Over many years, Pääbo's group has developed techniques to overcome these issues. This has created a new research field, paleogenomics, which centers on using museum or fossil material to gain direct insight into evolutionary relationships of animals, plants and pathogens.

Pääbo's own research at the Max Planck Institute for Evolutionary Anthropology in Leipzig has focused on extinct forms of humans. In 1997, he determined the first DNA sequences from a Neandertal by targeting its mitochondrial genome. The mitochondrial genome is present in many copies per cell, making it easier to sequence. The results showed Neandertals to be quite distinct from modern humans. The mitochondrial genome is a small piece of DNA passed only from mother to offspring, however; in order to get a complete view of the genetic history of Neandertals, it was necessary to study their entire genome.

In 2006, inspired by the development of new sequencing technologies, Pääbo initiated an ambitious collaborative project, supported by the Max Planck Foundation, to sequence the Neandertal genome. This culminated in the presentation of a draft version of the Neandertal genome in 2010. The data revealed that Neandertals mixed with modern humans. As a consequence, present-day people whose genetic roots are outside Africa carry about two percent Neandertal DNA. As

different people often carry different Neandertal DNA fragments, at least half of the Neandertal genome still exists in people today.

In the course of sequencing DNA from ancient human remains, Pääbo's research group discovered a previously unknown form of humans, which they named Denisovans – after the cave in southern Siberia where the small bone from which they determined the DNA sequence was found. They showed that Denisovans were distant relatives of the Neandertals, and have themselves contributed DNA to people who today live in Asia.

Svante Pääbo's and his team's work now seeks to understand the key differences distinguishing present day humans from Neandertals and Denisovans, as well as understanding the consequences in people today of genetic variants originating from Neandertals and Denisovans. For example, some Neandertal variants increase our sensitivity to pain, others decrease the risk of miscarriage during pregnancy, while yet others increase the risk of becoming severely ill when infected by Sars-CoV-2.

# MOMENTUM FOR INDUSTRY

A spin-off from the Max Planck Institute of Molecular Plant Physiology recently added some momentum to Bayer's crop protection research. The German biotech startup Targenomix, which uses innovative methods from systems biology and compu-

tational life sciences, will add momentum to the chemical and pharmaceutical company in its search for new mechanisms of action for crop protection products. With the acquisition, Bayer aims to accelerate the discovery and development of

molecules that have the potential to make agricultural production more sustainable, despite challenges such as climate change, and to increase weed, disease, and insect resistance in crops.

[www.mpg.de/19478039](http://www.mpg.de/19478039)



PHOTO: SHAIITH/ADOBE STOCK

From research to application: biotech start-up Targenomix is set to expand Bayer's capabilities in the area of crop protection.

10

## CENTER FOR GREEN CHEMISTRY

A concept developed by Max Planck scientists has prevailed in a competition to establish research centers in former coal-mining regions. The Federal Ministry of Education and Research, the Free State of Saxony, and the State of Saxony-Anhalt selected the concept of the Center for the Transformation of Chemistry (CTC), among others, from nearly one hundred proposals. The aim of the new center is to transform the chemical industry into a sustainable circular economy by developing sustainable production processes based on renewable natural resources and recycled materials. The idea for this came from Peter H. Seeberger and Matthew Plutschack at the Max Planck Institute of Colloids and Interfaces. The CTC will receive institutional funding of up to 170 million euros per annum.

[www.mpikg.mpg.de/6750322](http://www.mpikg.mpg.de/6750322)

## OUTSTANDING ★

SARAH O'CONNOR

Sarah Ellen O'Connor, Director at the Max Planck Institute for Chemical Ecology, has been awarded the Leibniz Prize of the German Research Foundation for her fundamental discoveries in plant biosynthesis. The chemist researches biosynthetic pathways in plants with the aim of deciphering the synthesis of complex natural products such as cancer-inhibiting or neuroactive substances.



PHOTO: SEBASTIAN REUTER

New research site: the visualization shows the Center for the Transformation of Chemistry on the land of the former sugar factory in Delitzsch near Leipzig.



PHOTO: HDR GERMANY

PHOTO: JÉRÉMIE BOISSIER / IRAM



An ear into space: the NOEMA observatory uses its antennas to scan the universe in the radio range.

## BROADENED HORIZONS

The NOEMA radio telescope on the Plateau de Bure in the French Alps is now equipped with twelve antennas, making it the most powerful radio telescope of its kind in the northern hemisphere. Eight years after the inauguration of the first NOEMA antenna, this large-scale European project is now complete. Thanks to its twelve antennas, which can be moved back and forth on a special rail system of up to 1.7 kilometers in

length, NOEMA is a unique instrument for astronomical research. During observations, the twelve antennas act like a single telescope. The NOEMA's maximum spatial resolution is so high that the observatory would be able to detect a cell phone from more than 500 kilometers away. The telescope is operated by the international institute IRAM, in which the Max Planck Society holds a stake.

[www.mpg.de/19315974](http://www.mpg.de/19315974)

## FOR FREEDOM IN IRAN

11

The Max Planck Society declares its solidarity with the students and scientists in Iran in their desire for greater freedom. It condemns the brutal actions of the security forces and demands the immediate release of all those arrested in the course of the protests. Civil liberties are precious. Freedom of expression, freedom of the press, and academic freedom are also prerequisites for successful international scientific cooperation. The Max Planck Society would like to maintain the relationships with its Iranian scientific partners that have been built up over decades and continue to collaborate with them even under these very difficult conditions.

[www.mpg.de/19437723](http://www.mpg.de/19437723)

## GENETICS OF DYSLEXIA

It is known that dyslexia occurs more frequently in some families – partly due to genetic factors – but until now, little was known about the genes involved. An international research team, including members of the Max Planck Institute for Psycholinguistics in Nijmegen, has now identified 42 genes that are clearly linked to dyslexia. About one-third of the genetic variants have previously been associated with general cognitive abilities and educational success.

[www.mpg.de/19385189](http://www.mpg.de/19385189)

## PROPULSION OF SOLAR WIND

Our sun constantly blows a stream of charged particles of varying speed into space, and a particularly strong solar wind can produce auroras or disrupt satellite communications. The fast solar winds with speeds of more than 500 kilometers per second originate from the interior of coronal holes, which are regions that appear dark in the ultraviolet radiation of the solar outer gas atmosphere (corona). The origin of slow solar winds, which also blow at supersonic speeds of 300 to 500 kilometers per second, has been less clear so far. But now, with the help of the U.S. satellite GOES, a team led by the Max Planck Institute

for Solar System Research has visualized a dynamic network of elongated, interwoven plasma structures in the central solar corona. The ultraviolet telescope looked into a region that had not been explored before. In combination with the measurement data of other space probes as well as computer simulations, a clear picture emerges: the hot solar plasma flows in the middle corona along the open magnetic field lines of the coronal network. Where the field lines cross and interact with each other, energy is released – and this accelerates the particles of the slow solar winds.

[www.mpg.de/19552630/1123](http://www.mpg.de/19552630/1123)

12

The atmosphere of the sun: ray-like structures in this snapshot from a computer simulation show the architecture of the observed coronal network.

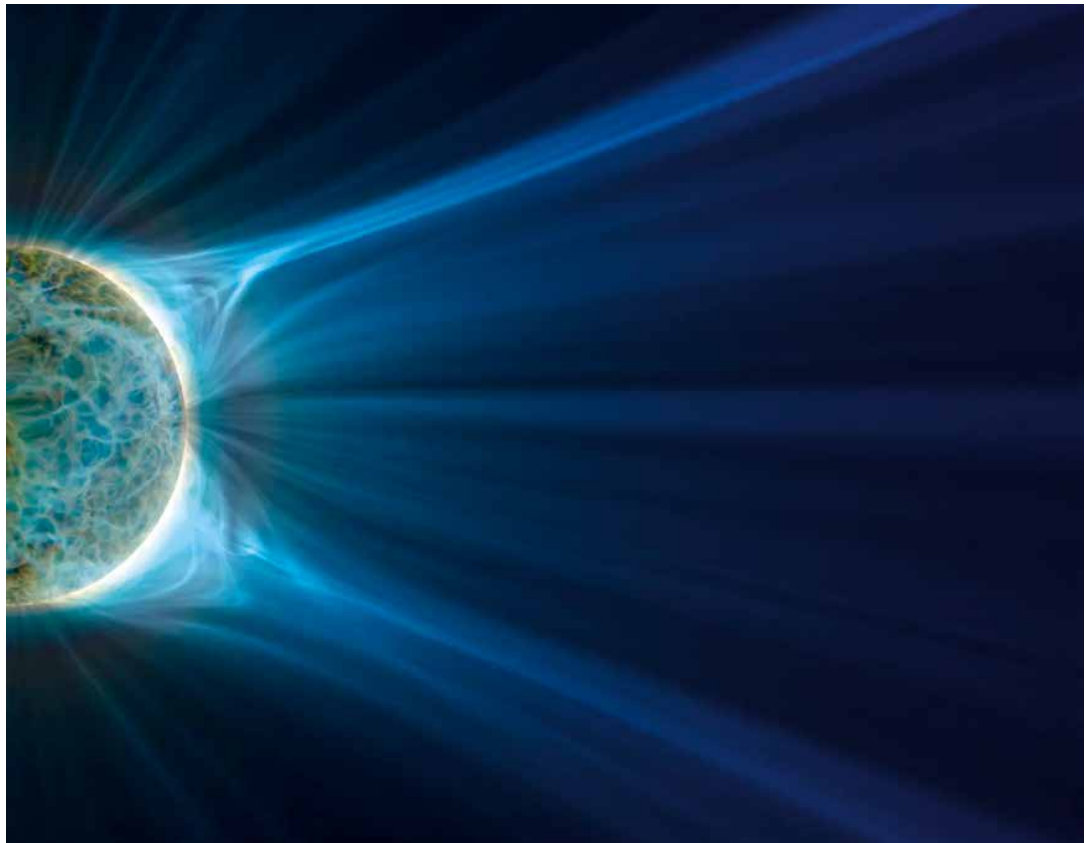


IMAGE: NATURE ASTRONOMY, CHITTA ET AL.

## ENERGY BOOST FOR BATTERIES

An invention by researchers at the Max Planck Institute for Medical Research could make batteries much lighter, more efficient, and safer in future. The team has found a way to create very fine metal fleeces that could serve as current collectors in the electrodes of rechargeable batteries and replace the aluminum and copper foils used so far. The metal fleeces make it possible to increase the thickness of battery cells to ten times that of cells commonly used today, thus saving material and weight. Since the metal

fleeces have a much larger surface area than conventional current collectors, batteries with these kinds of current collectors can be charged and discharged much faster. What's more, the metal mesh reduces the electrical resistance of the electrodes and increases their mechanical stability, making the batteries safer. Batene GmbH, a spin-off of the Institute, has licensed the invention and is now marketing it, having received ten million euros in start-up funding from investors.

[www.mpg.de/19463528/1107](http://www.mpg.de/19463528/1107)



PHOTO: HANNAH ROWLAND

The peacock butterfly (*Aglais io*) has eyespots on each forewing and hindwing, which appear to be staring directly at onlookers.

## BUTTERFLY WINGS WITH THE MONA LISA EFFECT

Some butterflies have striking markings on their wings, eye-like spots that are supposed to deter predators from attacking. Researchers at the Max Planck Institute for Chemical Ecology in Jena, Germany, studied the deterrent effect of the spots and observed the way newly hatched chicks attacked artificial moths with eyespots on their wings. The inner circles of the spots were oriented so that the mock eyes appeared to look forward, to the left, or to the right. The researchers found that the chicks were then more hesitant to attack their

prey when they approached from the perceived line of sight of the eyespots. With moths that had concentric circular eyes, the chicks approached with great caution from all directions. The reason for this is apparently the so-called Mona Lisa effect – named after the portrait by Leonardo da Vinci, whose pupils are symmetrically positioned in the iris and thus seem to follow the observer everywhere. Similarly, the eyes on the butterfly's wings seem to stare at predators in all directions.

[www.mpg.de/19378715/1018](http://www.mpg.de/19378715/1018)

Neanderthal father with his daughter.



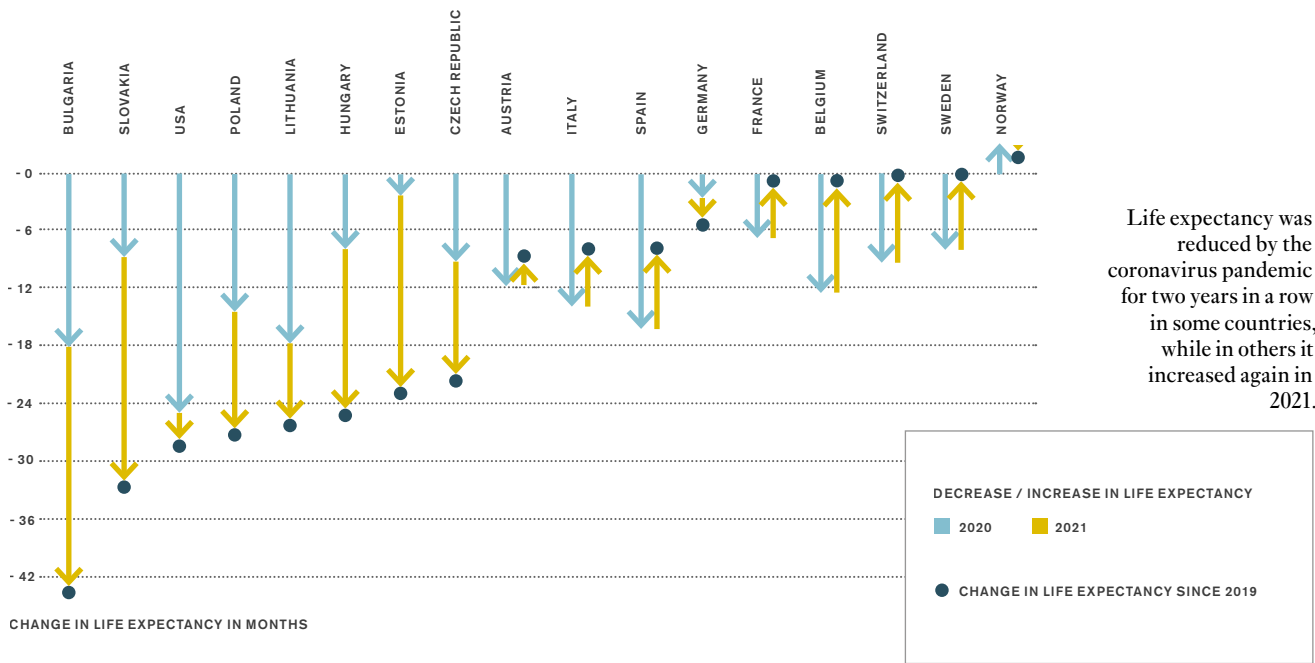
IMAGE: TOM BJORKLUND

## FAMILY FROM PREHISTORIC TIMES

13

Fifty-four thousand years ago, southern Siberia was home to a group of Neanderthals consisting of at least eight adults and five juveniles. The clan included a father with his daughter and a young boy along with his cousin, aunt, or grandmother. These early humans hunted ibex, horses, and bison in river valleys and gathered the material for their stone tools. Researchers at the Max Planck Institute for Evolutionary Anthropology in Leipzig came across this extended family when they analyzed the DNA of bones found in two caves in the Altai Mountains in Central Asia. The extremely low genetic diversity suggests that the clan consisted of only ten to twenty individuals who had little genetic exchange with other groups. The connecting links between different extended families were primarily women – they apparently moved from their natal group to another more frequently than men.

[www.mpg.de/19367938/1014](http://www.mpg.de/19367938/1014)



Life expectancy was reduced by the coronavirus pandemic for two years in a row in some countries, while in others it increased again in 2021.

## THE CORONAVIRUS SHORTENS LIFESPAN

14

Due to the coronavirus pandemic, period life expectancy fell in 2021 for the second year in a row in many Western countries. This is the result of a study conducted with the participation of the Max Planck Institute for Demographic Research in 27 European countries as well as the USA and Chile. Period life expectancy is a measure of the risk of death to which a population is exposed within a year. In Germany, the loss of period life expectancy was greater in 2021

than in 2020, at 3.1 months, but the overall decline for both pandemic years combined was comparatively moderate, at 5.7 months. In parts of Eastern Europe, meanwhile, the mortality crisis worsened considerably. In Bulgaria, for example, period life expectancy decreased by 2.1 years in 2021, which represents a drop of 3.6 years compared to the pre-pandemic level. More than a quarter of the loss was due to increased mortality among 40- to 60-year-olds. Bulgaria had the

lowest vaccination rate of all the countries studied by the fall of 2021 and this, along with poorer health care and significantly more difficult living conditions, is likely to play a role there, as in other Eastern European countries. Only in France, Belgium, Sweden, and Switzerland did period life expectancy return to pre-pandemic levels in 2021. In Norway, it even increased slightly despite the pandemic.

[www.mpg.de/19355241/1011](http://www.mpg.de/19355241/1011)

## SAVING ENERGY BEGINS IN THE BRAIN

Winters aren't easy for the European mole: its metabolism – one of the fastest among mammals – constantly demands large quantities of food, more than is available during the cold winter months. Since it cannot hibernate or migrate, it solves this problem in an unusual way: it shrinks its brain. Researchers at the Max Planck Institute of Ani-

mal Behavior in Constance have discovered that the European mole shrinks its skull, and thus its brain, during the winter by eleven percent in the first year of its life, and then enlarges it again by four percent by summer. In the years that follow, the increase and decrease probably balance each other out. Iberian moles, on the other hand, do not change the

size of their brains, even though they also find little food in the dry summer in their home country. The researchers conclude that not only scarce food but also cold weather drives brain size reduction. In addition to the European mole, shrews, stoats, and weasels can also shrink their brains in winter.

[www.mpg.de/19235031/0919](http://www.mpg.de/19235031/0919)

11

is the percentage by which the European mole's brain shrinks in its first winter.

## CHIRPING FOR GOOD CHEER

A research team from the Max Planck Institute for Human Development and the University Medical Center Hamburg-Eppendorf has studied how traffic noise and birdsong affect the psyche. In an online experiment, nearly three hundred healthy test subjects were given either traffic noise or birdsong to listen to. Their mental health was recorded before and after the listening sessions. Even healthy people can have anxious thoughts or occasional paranoid perceptions. In the study, listening to traffic noise exacerbated depressive tendencies, while the sound of bird calls reduced anxiety and paranoia in participants. One possible explanation for these positive effects is that bird calls are subliminally associated with an intact natural environment, which diverts attention away from

psychological stress and creates a feeling of safety and security. At the same time, however, birdsong seems to have little influence on manifest depressive states.

[www.mpg.de/19373671/1017](http://www.mpg.de/19373671/1017)



PHOTO: AXEL GRIESCH

Chirping keeps you chirpy: listening to birdsong reduces anxiety and paranoid perceptions.

## THE MYSTERY OF THE CLOSEST BLACK HOLE TO THE EARTH

There are an estimated hundred million black holes in our Milky Way Galaxy. So far, however, researchers have only directly observed the mass monster in the galactic center, while some other, much smaller ones have only been observed using indirect methods. Recently, the astrometry satellite Gaia achieved another success: it noticed tiny changes in the position of a star – as if an invisible companion object were tugging at it. This is evidently a double system, consisting of a visible, sun-like star and the invisible black hole with about ten solar masses. At a distance of 1560 light-years, it is the closest to Earth. The system, known as Gaia

BH1, poses a number of puzzles for the team led by Kareem El-Badry of the Max Planck Institute for Astronomy. It is unclear, for example, how it could have formed at all. The progenitor star, which later mutated into a black hole, would have had a mass of at least twenty solar masses and a very short lifespan. It would have transformed into a supergiant before its lower-mass partner even had time to become a true star. How did the companion survive this episode? And shouldn't it have ended up in a much closer orbit than can be seen today? Now it's up to the theorists to explain the scenario.

[www.mpg.de/19443006/1103](http://www.mpg.de/19443006/1103)

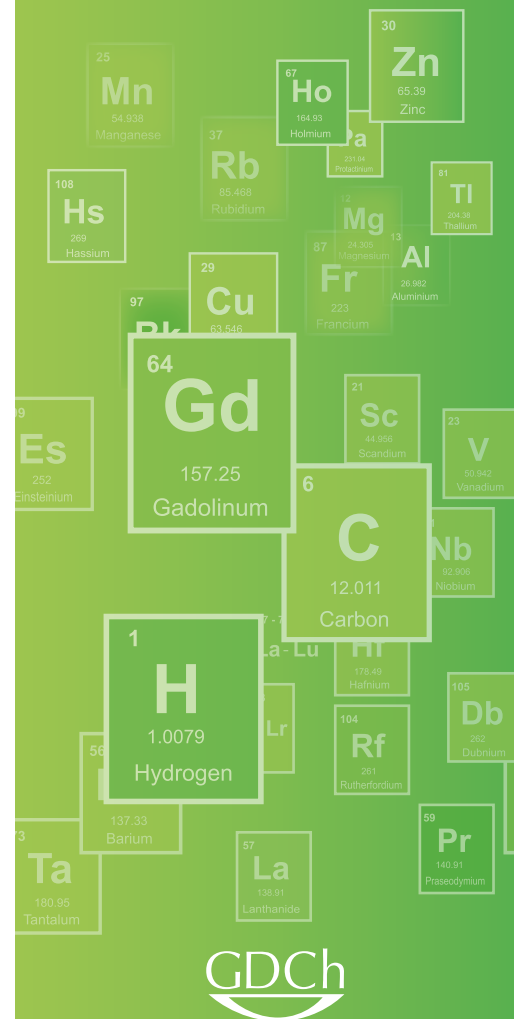
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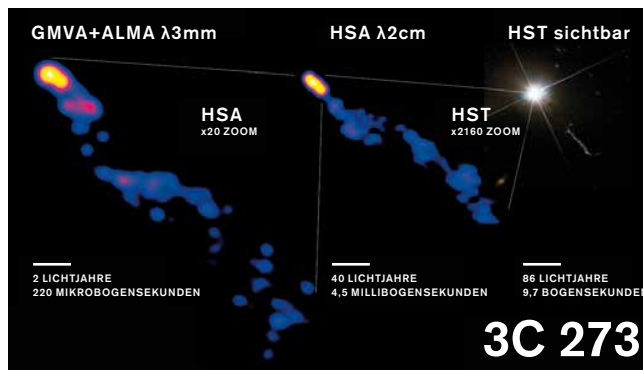
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Zooming into the center: the left image shows the best view yet of the plasma jet of quasar 3C 273.



## QUASAR IN FOCUS

Quasars are the bright cores of galaxies, each containing a supermassive black hole. Most of these mass monsters emit so-called jets, high-energy streams in which matter shoots into space at nearly the speed of light. A group including researchers from the Max Planck Institute for Radio Astronomy have now taken a closer look at quasar 3C 273, which is about 1.9 billion light-years away from us. For their observations, the astronomers used a worldwide network of radio telescopes, which they combined with each other. This Very Long Baseline Interferometry (VLBI) provided images of the jet's point of origin near the black hole – where the hundreds of thousands of light-years-long plasma stream is focused into a narrow jet. A look inside the quasar's engine room shows that the plasma jet's aperture angle is slowly narrowing. The jet is narrowing even outside the region where the gravity of the black hole dominates. This behavior has also been observed in less active black holes. Now the researchers are tackling the question of why the bundling of the jets is so similar in different systems.

[www.mpg.de/19564279](http://www.mpg.de/19564279)

## DRIVERS OF POPULISM AND POLARIZATION

Some consider digital media to be a threat to democracy, while others emphasize the opportunities for greater participation. Whether and how digital media really affect political behavior was the subject of a meta-study that also involved the Max Planck Institute for Human Development. The researchers found both positive and negative effects: on the one hand, online media foster the possibility of political participation and the mobilization of voters, which strengthens the democratic legitimacy of governments and parliaments. They can also impart political knowledge and ensure a more diverse news offering. On the other hand, communication among like-minded people in so-called echo chambers on

social networks in particular can damage trust in politics and in democratic institutions. Trust in traditional media such as newspapers and TV stations is also declining. Furthermore, digital media promote populism and polarization among the population, although the effects differ from country to country: what is potentially destabilizing in established democracies can be beneficial for those that are emerging and can strengthen the opposition in authoritarian regimes. The positive impact of digital media is most pronounced in emerging democracies in South America, Africa, and Asia, while the negative effects can be seen most notably in Europe and the USA.

[www.mpg.de/19475420/1108](http://www.mpg.de/19475420/1108)

## MUSIC WITH LIMITED COVID RISK

Wind music has long been suspected of promoting infection with the coronavirus. Indeed, playing the clarinet can release relatively large numbers of pathogens such as Sars-CoV-2 – significantly more than playing the flute, for example. Otherwise, however, the risk of infection posed by an infected person playing a wind instrument is significantly lower than that of someone who is singing or speaking – given

the same amount of time spent in their vicinity in each case. This is the conclusion of a comprehensive study conducted by the Max Planck Institute for Dynamics and Self-Organization in Göttingen and the University Medical Center Göttingen. The researchers determined the particle emission and the associated maximum risk of infection from the playing of twenty different wind instruments. According to the re-

sults, the particularly infectious larger respiratory droplets, above all, remain trapped in the wind instruments. Nevertheless, five to fifty times more aerosol enters the environment when a person plays a wind instrument than when they breathe. The results provide clues as to how concerts or rehearsals can be organized with the lowest possible risk of infection, even during the pandemic.

[www.mpg.de/19306683](http://www.mpg.de/19306683)

## ESCAPING THE BANGS

Many humans look forward to the fireworks on New Year's Eve; birds, meanwhile, react to them with fear and flight.



PHOTO: HELMUT KRUCKENBERG

For two years, Germany was largely silent as the new year began. This year quite literally started with a bang as private New Year's Eve fireworks were once again allowed almost everywhere throughout the country. A study by the Max Planck Institute for Animal Behavior in Constance shows it is not only humans that suffer from the immense noise and pollution caused by fireworks. The researchers equipped more than 300 coots, barnacle geese, pink-footed geese, and bean geese in Germany, Denmark, and the Netherlands

with GPS transmitters and recorded the birds' flight movements for eight years in the weeks before and after the turn of the year. The GPS data show that the wild geese leave their roosts more frequently than usual on New Year's nights, sometimes flying up to 500 kilometers. This flight takes its toll: to regain their strength, the geese have to rest for several weeks longer and eat more. For birds that do not manage to replenish their energy reserves, the fireworks can, therefore, prove fatal.

[www.mpg.de/19528005/1127](http://www.mpg.de/19528005/1127)

Fruit flies can move the retinas in their eyes with the help of two muscles. This enables them to better estimate distances.

17

## EYE MOVEMENT

The eyes of insects and other arthropods are firmly attached to their heads. Researchers at the Max Planck Institute for Biological Intelligence have discovered that, despite their fixed eyes, fruit flies can follow movements without having to turn their heads or bodies. They merely shift the retinas containing the visual sensory cells, thereby changing the image section that is displayed on the retina. The researchers also found that flies with less mobile retinas are less able to estimate the width of crevices in the substrate. The movements of the retinas, therefore, also seem to be important for spatial vision.

[www.mpg.de/mpr-2022-041](http://www.mpg.de/mpr-2022-041)

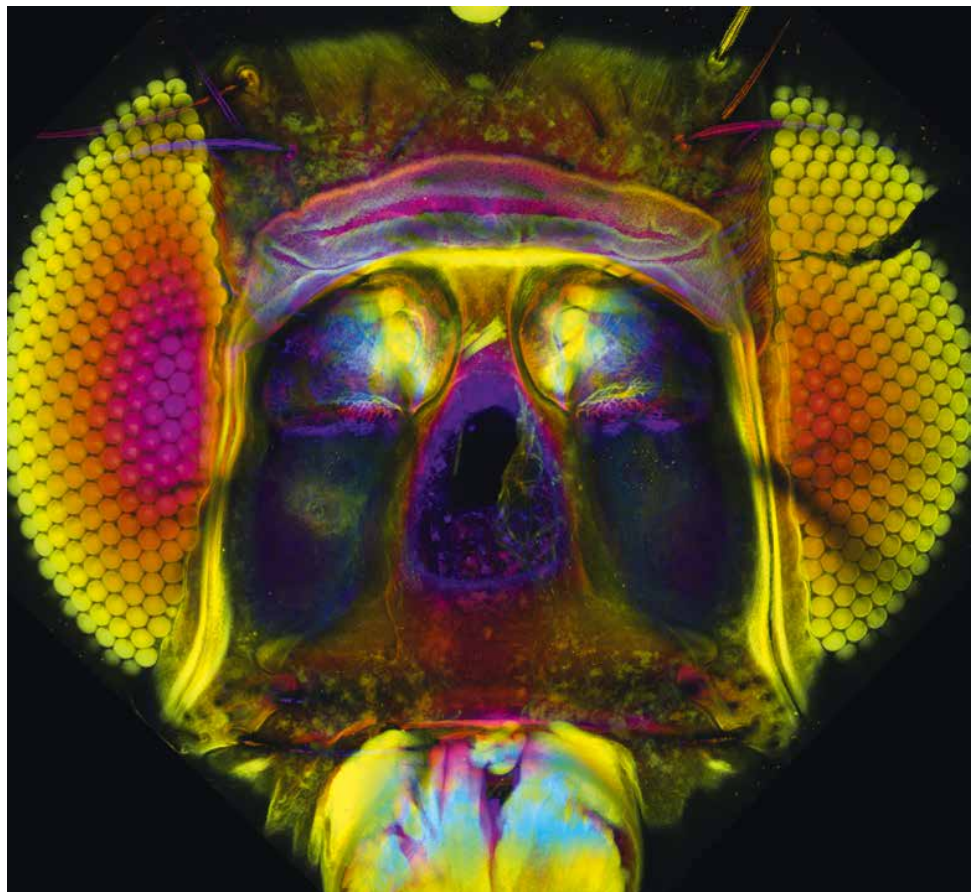


PHOTO: MAX PLANCK INSTITUTE FOR BIOLOGICAL INTELLIGENCE, IN FOUNDATION/ANJA FRIEDRICH