

Bulletin Board

Contents

FEB. 19, 2021

(click on page numbers for links)

REGULATORY UPDATE

ASIA PACIFIC

Gazette No. 3, 9 February 2021	4
South Korea: Over 17,000 substances now pre-registered under K-REACH	4

AMERICA

US Department of Labor's OSHA issues proposed rule to update hazard communication standard	5
The ABCs of PFAS: What you need to know about liabilities for the "Forever Chemical"	6
Will the Pentagon continue to flout state standards for 'Forever Chemicals'?	8
OSHA's proposed updates to Hazard Communication Standard will include particle characteristics.....	9
GHS Regulation: New national electronic notification system for chemical substances manufactured and imported in Chile.....	10

EUROPE

Renewed interest in shore power due to EU and Environmental Regulation.....	11
German lawmakers call for ending exports of banned pesticides.....	12
(Title of Article).....	14
(Title of Article).....	14

INTERNATIONAL

(Title of Article).....	14
-------------------------	----

REACH UPDATE

Roadmap to address substances of very high concern complete	15
UK REACH registrations grow, but major obstacles remain on EU data.....	16

JANET'S CORNER

The Other Slide.....	19
----------------------	----

CONTACT US

subscribers@chemwatch.
net
tel +61 3 9572 4700
fax +61 3 9572 4777

1227 Glen Huntly Rd
Glen Huntly
Victoria 3163 Australia

*** While Chemwatch has taken all efforts to ensure the accuracy of information in this publication, it is not intended to be comprehensive or to render advice. Websites rendered are subject to change.**

Bulletin Board

Contents

FEB. 19, 2021

HAZARD ALERT

Sodium Bicarbonate.....20

GOSSIP

Anti-depressant found to promote healing in osteoarthritic joints28

Protein discovery promises powerful new muscle regrowth treatments ..29

Transparent wood is coming, and it could make an energy-efficient alternative to glass.....31

Devious sperm 'poison' their rivals, forcing them to swim in cericles until they die32

'Invisible killer': fossil fuels caused 8.7m deaths globally in 2018, research finds.....34

EPA alleges Trump officials interfered in toxic chemical assessment.....37

6 women who are changing chemistry as we know it38

Asteroid the size of the Golden Gate Bridge will whiz past Earth in March46

The race to treat a rare, fatal syndrome may help others with common disorders like diabetes48

CURIOSITIES

Prozac turns guppies into 'zombies'54

The environmental threat you've never heard of.....56

How paving with plastic could make a dent in the global waste problem58

Is there a limit to how much the coronavirus can mutate?.....63

Assisting evolution: how far should we go to help species adapt?68

Illicit centipede raises thorny question: Should journals have refused to publish a paper about it?73

Can privacy coexist with technology that reads and changes brain activity?75

Could there be a cluster of antimatter starts orbiting our galaxy?82

Lizards may be protecting people from Lyme disease in the southeastern United States85

Mardi Gras is an environmental disaster.....87

TECHNICAL NOTES

(Note: Open your Web Browser and click on Heading to link to section) ...91

CHEMICAL EFFECTS.....91

Bulletin Board

Contents

FEB. 19, 2021

ENVIRONMENTAL RESEARCH.....91

OCCUPATIONAL.....91

PHARAMACEUTICAL/TOXICOLOGY91

Bulletin Board

Regulatory Update

FEB. 19, 2021

ASIA PACIFIC

Gazette No. 3, 9 February 2021

2021-02-09

9 February 2021 - [PDF \(976.86 KB\)](#) | [DOCX \(133.79 KB\)](#)

Contents

Agricultural Chemical Products and Approved Labels – 4

Veterinary Chemical Products and Approved Labels – 18

Approved Active Constituents – 22

Content last updated:

9 February 2021

Content last reviewed:

9 February 2021

[Read More](#)

APMVA, 9 February 2021

<https://apvma.gov.au/node/79831>

South Korea: Over 17,000 substances now pre-registered under K-REACH

2021-01-21

Tally increases by 140 since July

South Korea's Ministry of Environment (MoE) has updated the list of pre-registered substances under K-REACH, which now stands at 17,045 substances – up from 16,905 in July.

Although the pre-registration deadline was June 2019, more substances have since been added to the list as companies began manufacturing or importing existing substances for the first time.

Published on 11 January, the revised list covers:

The list is designed to encourage joint registration, by helping companies to identify others looking to register the same substance. Under K-REACH, those manufacturing or importing one tonne or more of an existing

Bulletin Board

Regulatory Update

FEB. 19, 2021

substance each year must pre-register it to obtain a grace period for full registration.

[Read More](#)

Chemical Watch, 21 January 2021

<https://chemicalwatch.com/205170/south-korea-over-17000-substances-now-pre-registered-under-k-reach>

AMERICA

US Department of Labor's OSHA issues proposed rule to update hazard communication standard

2021-02-05

WASHINGTON, DC – The U.S. Department of Labor's Occupational Safety and Health Administration (OSHA) today issued a proposed rule to update the agency's Hazard Communication Standard (HCS) to align with the seventh revision of the Globally Harmonized System of Classification and Labelling of Chemicals (GHS).

OSHA expects the HCS update will increase worker protections, and reduce the incidence of chemical-related occupational illnesses and injuries by further improving the information on the labels and Safety Data Sheets for hazardous chemicals. Proposed modifications will also address issues since implementation of the 2012 standard, and improve alignment with other federal agencies and Canada.

Individuals may submit comments identified by Docket No. OSHA-2019-0001, electronically at <http://www.regulations.gov>, which is the Federal e-Rulemaking Portal. [Read the Federal Register notice for details. The deadline for submitting comments is April 19, 2021.](#)

OSHA has preliminarily determined that the proposed modifications would enhance the effectiveness of the standard by improving dissemination of hazard information so employees are more appropriately apprised of exposure to chemical hazards in the workplace.

Established in 1983, the Hazard Communication Standard provides a standardized approach to workplace hazard communications associated with exposure to hazardous chemicals. OSHA updated the standard in 2012 to align with the third revision of the United Nations' GHS to

The deadline for submitting comments is April 19, 2021.

9 February 2021 - PDF (976.86 KB) | DOCX (133.79 KB)

Bulletin Board

Regulatory Update

FEB. 19, 2021

provide a common and coherent approach to classifying chemicals and communicating hazard information.

Under the Occupational Safety and Health Act of 1970, employers are responsible for providing safe and healthful workplaces for their employees. OSHA's role is to help ensure these conditions for America's working men and women by setting and enforcing standards, and providing training, education and assistance. Learn more about OSHA.

[Read More](#)

US Department of Labor, 5 February 2021

https://content.govdelivery.com/accounts/USDOL/bulletins/2bfb902?ck_subscriber_id=1169090193

The ABCs of PFAS: What you need to know about liabilities for the "Forever Chemical"

2021-02-08

Perfluoroalkyl and polyfluoroalkyl substances, commonly referred to as PFAS or PFOS, have been a key ingredient in numerous industrial and consumer products for decades. These man-made chemicals are prevalent and are also known for their longevity in the environment. More recently, PFAS have been the focus of thousands of lawsuits alleging personal injury and property damage. Some insurers have already questioned whether PFAS could rival asbestos in scope and bottom-line impacts. It is a legacy that confronts manufacturers and other defendants and insurers today.

This article provides a primer on PFAS, including the current regulatory framework and litigation landscape. We also identify some key emerging coverage issues insurers should be aware of when dealing with PFAS claims under liability and first-party property policies.

Background on PFAS

PFAS are a group of synthetic chemicals that have been used in various industries since the 1940s.^[1] PFAS have a chemical structure that makes them useful for certain applications, but also particularly problematic as an environmental contaminant. In simple terms, PFAS molecules have an affinity for both water and soil.^[2] Once released into the environment, PFAS can cause significant and long-lasting contamination, such that they are commonly referred to as the "forever chemical."

Bulletin Board

Regulatory Update

FEB. 19, 2021

PFAS have been used in a multitude of products since they were created by a DuPont scientist in 1938.^[3] For example, PFAS have been utilized as stain resistant coatings (e.g., Teflon, Scotchguard and Gore-Tex); in chemical, automotive and electronic industries; in firefighting foam; in food packaging to resist oil and moisture; and in polishes, waxes and cleaning products. Studies suggest that up to 99% of all people have detectable levels of PFAS in their blood serum.^[4] Some studies have linked PFAS to such illnesses as kidney cancer, liver damage, testicular cancer, thyroid disease and pregnancy induced hypertension. There are also studies which suggest that PFAS affect birth weight, cholesterol levels and immune systems.^[5]

Regulatory Framework

Fueled by increasing public awareness of the threat from these substances, federal and state environmental authorities, along with legislative bodies, have begun to regulate PFAS under environmental statutes and regulations.

The federal government's response to the PFAS problem is summed up in the EPA's "Action Plan" adopted in April 2019.^[6] The Action Plan established several "priority actions" the EPA intends to undertake when feasible. One is to begin designating PFAS as "hazardous substances" under CERCLA (the Superfund statute). This would subject parties responsible for PFAS contamination to the suite of enforcement actions available to the EPA under CERCLA, including administrative orders to clean up PFAS contaminated sites. A second and related action item is to establish a "Maximum Contaminant Level" (MCL) for PFAS in soil and groundwater. This would provide the basis for enforcement and would serve as a guideline for state action, unless a state has set a more stringent standard.

It usually takes several years for a contaminant to be designated as a hazardous substance and to have an MCL assigned. In the meantime, the EPA has established a drinking water health advisory for water systems in the United States. The EPA advises that where concentrations of PFAS in drinking water exceed 70 part per trillion (PPT), the water system should advise consumers of the risk and consider taking action to remediate the contamination.^[7]

Congress has also gotten into the act. Pressure has been placed on Congress to address PFAS as a result of the widespread publicity and the increasing bodily injury litigation involving these substances. In 2020, Congress imposed new requirements and restrictions regarding PFAS in the National Defense Authorization Act, including requiring public water

Bulletin Board

Regulatory Update

FEB. 19, 2021

agencies to monitor for PFAS contamination.[8] Also, Congress has been pressuring the EPA to accelerate its process for formally designating PFAS as CERCLA hazardous substances and establishing an MCL.

There is also a great deal of regulatory activity at the state level. Fifteen states have established some type of standard and guideline for PFAS in soil and groundwater. For example, this past summer, New York and New Jersey listed PFAS as hazardous substances under their regulatory regimes and set an MCL of 10 PPT in the case of New York and 13-14 PPT in New Jersey, depending upon the particular substance.[9]

Also, a number of states have filed lawsuits or initiated enforcement actions against manufacturers and users of PFAS for causing contamination at various sites. Over the next several years, we can expect to see an acceleration of state regulation of PFAS and enforcement actions.

[Read More](#)

JD Supra, 8 February 2021

<https://www.jdsupra.com/legalnews/the-abcs-of-pfas-what-you-need-to-know-8584037/>

Will the Pentagon continue to flout state standards for 'Forever Chemicals'?

2021-02-10

In 2019, in the absence of enforceable federal limits, New Hampshire became one of the first states to set its own drinking water standards for the toxic "**forever chemicals**" known as PFAS.

But so far, the Department of Defense has refused to comply with these new state standards – reinforcing **the department's long history** of putting service members and nearby communities at risk from PFAS, a large family of fluorinated chemicals, some of which have been linked to cancer, reproductive harm, immune system damage and other **serious health problems**. A recent study by the **Centers for Disease Control and Prevention** showed that communities living near current or former military sites had, on average, significantly higher levels of **PFAS in their blood** than the average American.

Shortly after New Hampshire's standards went into effect, state officials **notified the Air Force**, which ran the former Pease Air Force Base in Newington, N.H, about the state standards, which are tougher than the **advisory levels** set by the federal Environmental Protection Agency.

Bulletin Board

Regulatory Update

FEB. 19, 2021

After reviewing the impacts of PFAS on the body, including harm to the immune system, reduced fertility, altered lipid metabolism and liver toxicity, New Hampshire officials set **legal limits** for PFAS in drinking water between 11 parts per trillion, or ppt, and 18 ppt – far lower than the 70 ppt health advisory levels the EPA set in 2016 for the two most notorious members of the chemical family, PFOA and PFOS.

[Read More](#)

EWG, 10/02/2021

<https://www.ewg.org/news-and-analysis/2021/02/will-pentagon-continue-flout-state-standards-forever-chemicals>

OSHA's proposed updates to Hazard Communication Standard will include particle characteristics

21-02-11

The Occupational Safety and Health Administration (OSHA) is scheduled to publish a notice of proposed rulemaking (NPRM) on **February 16, 2021**, that would modify the Hazard Communication Standard (HCS) to conform to the United Nations' Globally Harmonized System of Classification and Labelling of Chemicals (GHS) Revision 7 "to address issues that arose during the implementation of the 2012 update to the HCS, and provide better alignment with other U.S. agencies and international trading partners, without lowering overall protections of the standard." The NPRM notes that "the change in section 9 (physical characteristics to include particle characteristics) will identify exposure issues that are not addressed by the current format." According to the NPRM, "[t]his should, among other things, improve the hazard information required for nanomaterials."

The NPRM states that in addition to directly enhancing worker protections through improved hazard communication, updating the HCS will also improve the availability of information to support larger efforts to address workplace hazards such as the use of aggregate exposures and cumulative risk models for use in setting occupational exposure limits and assessing impacts on worker health. The NPRM uses the increased use of nanosilver in consumer products as a "real-world example of the potential effects of aggregate exposure." The NPRM cites a 2018 National Institute for Occupational Safety and Health (NIOSH) review of nanosilver and states that the review "indicates that the current OSHA [permissible exposure limit (PEL)] for silver is adequate to protect workers from silver's adverse health effects." The NPRM claims that the increased presence of nanosilver

According to the NPRM, "[t]his should, among other things, improve the hazard information required for nanomaterials."

Bulletin Board

Regulatory Update

FEB. 19, 2021

in consumer products, as well as the increased environmental exposures from the manufacture, use, and disposal of these consumer products, “indicates that the OSHA PEL may be inadequate to protect workers if nanosilver continues to be added to new consumer products.” According to the NPRM, “[t]his example highlights the importance of an effective overarching hazard communication strategy in understanding and managing exposures and risk.”

Comments on the NPRM, including requests for hearing, will be due 60 days after publication in the *Federal Register*. OSHA states that it will schedule an informal public hearing on the NPRM if a request is made during the comment period. If a hearing is requested, OSHA will announce the details in the *Federal Register*.

[Read More](#)

Nano and Other Emerging Chemical Technologies blog, 11/02/2021

<https://nanotech.lawbc.com/2021/02/oshas-proposed-updates-to-hazard-communication-standard-will-include-particle-characteristics>

GHS Regulation: New national electronic notification system for chemical substances manufactured and imported in Chile

2021-01-09

The GHS regulation (Globally Harmonized System of Classification and Labeling of Chemical Products) was published in the Official Gazette.

The regulation was prepared by the Ministry of the Environment in conjunction with the Ministry of Health, with an important participation and contribution from Civil Society and Industry.

The GHS regulation considers aspects such as the evaluation, notification and communication of hazards of chemical substances, a new national electronic notification system of chemical substances manufactured and imported in Chile, and a process of prioritization and risk assessment of those substances of greater Dangerous for the Environment.

This regulation will help reduce the risks to the environment and human health that dangerous chemical substances can cause, also to improve the environmental information available on chemical substances, and above all to reduce accidents and chemical emergencies, which will facilitate trade and export of chemical substances produced in Chile.

Bulletin Board

Regulatory Update

FEB. 19, 2021

[Read More](#)

Diario Sustentable, 9 January 2021

<https://www.diariosustentable.com/2021/02/reglamento-ghs-nuevo-sistema-nacional-de-notificacion-electronico-de-sustancias-quimicas-fabricadas-e-importadas-en-chile/>

EUROPE

Renewed interest in shore power due to EU and Environmental Regulation

2021-02-11

The EU parliament’s actions calling for a ban on greenhouse gas emissions from berthing ships at berth is adding a renewed impetus in the drive towards installing shore power capabilities on ships. While the technology for cold ironing is well established, the EU initiatives and the overall efforts to improve the environment around major ports are contributing to an increase in the market.

“We used to do shore power projects on ships some years ago, but the market was too slow,” says Aleksander Askeland CSO at Yara Marine Technologies. “Now, however, with new regulations and grants supporting shipowner’s shore power investments, we are back in the business of shore power.”

The EU proposed ban which would be in effect by 2030 was included in the first reading of the proposed revisions to the MRV Regulation. The ban would include any ships with a gross tonnage of 5,000 or more arriving at, within, or departing from ports under the jurisdiction of an EU Member State. Requiring the elimination of GHG emissions within less than nine years means ships connecting to power from shore, and possibly batteries.

In addition to the EU Parliament initiative, several ports are already introducing a ban on GHG emissions due to take effect by 2025. In China, they are setting the rules so that shore power shall be used if a cruise ship is at berth with onshore power supply capacity for more than three hours in the emission control areas. Numerous ports in Europe, North America, and Asia have also announced plans to install or expand their shore power capabilities.

“This is a major step for the industry,” says Askerland. “It will cut emissions tremendously. Both GHG emissions, but also local air pollution, like black

“Now, however, with new regulations and grants supporting shipowner’s shore power investments, we are back in the business of shore power.”

Bulletin Board

Regulatory Update

FEB. 19, 2021

carbon, SOx, and NOx, saving thousands of lives, cleaning up the air in our cities.”

Responding to the renewed opportunities, Yara Marine recently formed a partnership with NG3 to relaunch cold ironing in their green tech portfolio. “Yara Marine’s ship-to-shore technology can help to save fuel that would otherwise be used to power vessels while in port. According to the Fourth IMO GHG Study, shore power can reduce overall GHG emissions from ships quite a bit. In addition, it will contribute to better air quality in the proximate port area, facilitate maintenance of the ship’s engines and generators, and reduce noise from the vessel at berth,” Askeland explains.

[Read More](#)

The Maritime Executive

<https://www.maritime-executive.com/article/renewed-interest-in-shore-power-due-to-eu-and-environmental-regulation>

German lawmakers call for ending exports of banned pesticides

2021-02-11

Pesticides that are currently banned in Europe may still be exported to foreign countries, an issue which highlights the EU’s lack of coherence, according to the leftist Die Linke and the Greens. EURACTIV Germany reports.

What is harmful to people and nature in Europe cannot be good for the Global South, argues Eva-Maria Schreiber of the Die Linke’s parliamentary group in the Bundestag.

In a joint motion that will be debated in the Bundestag on Thursday (11 February), Die Linke and the Greens say 41 million unintentional pesticide poisonings are estimated to occur worldwide each year, of which up to 40,000 are fatal.

These figures are extracted from a report by Pesticide Action Network Germany, which covers all pesticides, not just those banned in the EU. It suggests the problem occurs primarily in the Global South.

“Although only about 25% of global pesticide use occurs in developing countries, 99% of all fatal pesticide poisoning incidents occur there,” the report says.

Bulletin Board

Regulatory Update

FEB. 19, 2021

To reduce the number of cases, the Greens and Die Linke are calling on the government to impose an export ban on pesticides banned for use in Germany.

Although there are international agreements on pesticide trade and guidelines on occupational health and safety in pesticide use, the two parliamentary groups argue these are neither legally binding on exporters. Moreover, the guidelines “only concern certain groups of substances or only provide for information obligations towards the importing country.”

BASF, one of Germany’s largest pesticide producers, defended its export practices. In emerging markets, the company sells crop protection products only “if they simultaneously meet the requirements of the Code of Conduct of the World Health Organization (WHO) and the Food and Agriculture Organisation of the United Nations (FAO),” the company told EURACTIV in a statement.

The German chemical multinational also says it provides training on safe storage and use of pesticides for employees in countries where it sells its products.

“BASF is confident in the safety of its products and their safe usability when used correctly according to label instructions and product stewardship guidelines,” the company said.

But according to Schreiber, safe handling of pesticides is almost impossible in some developing countries due to local temperatures or the working conditions prevailing on site. And even if they were handled safely, they would still be damaging to the environment, she told EURACTIV.

The parliamentary motion does not aim to amend the law, but simply calls for an existing law to be applied. §25 Section 3 sentence 2 of the Plant Protection Act allows the German Ministry of Agriculture, in consultation with other ministries, to “prohibit or restrict the export of certain plant protection products [...] to countries outside the European Union.”

In Europe, France is seen as a trailblazer, with a law banning the production, storage and export of unauthorised pesticides coming into force in 2022.

Schreiber hopes that Germany will follow suit and is looking to Brussels where the issue has long been on the table.

To reduce the number of cases, the Greens and Die Linke are calling on the government to impose an export ban on pesticides banned for use in Germany.

Bulletin Board

Regulatory Update

FEB. 19, 2021

The European Commission is currently considering an export ban for substances that are banned in the EU as part of a chemicals strategy that includes pesticides.

[Read More](#)

EURACTIV, 11 February 2021

<https://www.euractiv.com/section/agriculture-food/news/germanys-die-linke-and-greens-want-to-prohibit-exports-of-banned-pesticides/>

(Title of Article)

YYYY-MM-DD

(Body of article – no highlighting, single space unless double space needed)

(source and date)

(source link)

(Title of Article)

YYYY-MM-DD

(Body of article – no highlighting, single space unless double space needed)

(source and date)

(source link)

INTERNATIONAL

(Title of Article)

YYYY-MM-DD

(Body of article – no highlighting, single space unless double space needed)

(source and date)

(source link)

Bulletin Board

REACH Update

FEB. 19, 2021

Roadmap to address substances of very high concern complete

2021-02-04

As part of the SVHC 2020 Roadmap launched by the Council of the EU in 2013, all relevant, currently known substances of very high concern have been identified and included on the Candidate List. Systematic screening of registered substances has been key in identifying new chemicals of concern.

Helsinki, 4 February 2021 – ECHA has today published a brochure summarising the achievements of the SVHC 2020 Roadmap, following its completion.

The goal of the SVHC Roadmap was to identify all relevant, currently known substances of very high concern (SVHCs) and include them on the Candidate List by 2020. SVHCs are chemicals that are carcinogenic, mutagenic or toxic to reproduction (CMRs), persistent, bioaccumulative and toxic or very persistent and very bioaccumulative (PBTs/vPvBs) and chemicals that pose an equivalent level of concern like endocrine disruptors (EDs) and sensitisers. The Candidate List now contains 211 substances.

The roadmap also aimed to efficiently identify new chemicals of concern. EU Member States and ECHA have systematically screened information on registered substances. By the end of 2020, Member States had carried out regulatory management option analysis (RMOA) on around 220 chemicals of potential concern and identified a need for further regulatory action for about 80 % of them.

As an example, *dibutylbis(pentane-2,4-dionato-O,O')tin*, which is used as a catalyst and an additive for producing plastics, was first picked up as a potential carcinogenic, mutagenic or reprotoxic (CMR) substance through screening and RMOA. Its human health hazards were then confirmed by harmonised classification and labelling and it was included in the Candidate List in 2020.

For a large proportion of screened chemicals, more information from registrants is needed for authorities to be able to conclude on their hazards. When the information becomes available through substance or dossier evaluations, some of the substances are expected to have SVHC properties and will be addressed with the best regulatory instrument (e.g. authorisation, restriction, or other legislation).

The Candidate List now contains 211 substances.

Bulletin Board

REACH Update

FEB. 19, 2021

The SVHC Roadmap has increased the speed at which new chemicals of concern are identified as ECHA and Member States have started focusing on groups of chemically similar substances. It has also made the work of authorities more transparent by, for example, providing an overview of their work on chemicals of concern through the public activities coordination tool (PACT).

Jack de Bruijn, Director for Risk Management sums up: *“While the SVHC 2020 Roadmap is complete, work will continue within ECHA’s Integrated Regulatory Strategy, which brings together various EU regulations to manage the risks of hazardous chemicals. The next goal has been set for 2027. By then, we aim to have screened all substances registered under REACH. This work contributes directly to the EU’s Chemicals Strategy for Sustainability and to the United Nations’ Sustainable Development Goals concerning chemicals.”*

Progress on the Integrated Regulatory Strategy is provided in annual reports, with the next one published in April 2021.

[Read More](#)

ECHA, 4 February 2021

<https://echa.europa.eu/-/roadmap-to-address-substances-of-very-high-concern-complete>

UK REACH registrations grow, but major obstacles remain on EU data

2021-02-05

UK REACH registrations are showing a “gradual, consistent growth” with companies so far submitting dossiers covering close to 1,250 chemicals under the independent regime, environment secretary George Eustace has said, while telling of major obstacles to gaining access to Echa-held data.

The dossiers consist of basic information needed as part of the process to complete the grandfathering of dossiers copied over from EU REACH. More substantive data is expected to be required over the coming years.

An oral evidence session on post-Brexit UK and EU environmental relations, in the House of Lords yesterday, heard that companies had long grace periods under the system to secure the data for registration, but that conditions imposed by the EU on data access may be more insurmountable than previously thought.

Bulletin Board

REACH Update

FEB. 19, 2021

Data sharing is “the most sensible thing to do”, Mr Eustace told the Lords’ EU environment subcommittee. But the European Commission refused to grant it during the Brexit trade negotiations due to the UK’s “clear stance” against regulatory alignment, on which it was conditional.

Industry and NGOs are still hoping for the government to clinch an agreement with the EU on data in return for alignment, or for UK authorities to relax the ‘no data, no market’ principle.

However, Mark Thompson, deputy director of EU strategy and negotiations at the Department for Environment, Food and Rural Affairs (Defra), said the EU’s demand for regulatory alignment is tied to the involvement of the European Court of Justice (ECJ) in dispute settlement – a red line for the UK.

Even if UK REACH closely followed EU REACH developments, he said, “what they are always looking for is to codify that and to have a role for the [ECJ] and all the other EU architecture. Without that, they wouldn’t accept and we wouldn’t be able to [get ...] that data.”

That said, Mr Eustace remained optimistic that because some EU entities also have to register under UK REACH, there is “a good prospect” for companies on both sides to come to an agreement on data during consortia discussions.

“They may, when they finally sit down and look at it, realise that there is not much for any of them to gain by trying to hold one another to ransom over data they might have,” he said.

As well as companies submitting dossiers for 1,250 chemicals, downstream users have made 350 notifications to UK REACH, he added.

Question of alignment

Responding to a question on how aligned the UK regime would be with EU REACH in the short to medium term, Mr Eustace said there would be “great similarities” between the two. While initially there would be a smaller number of chemicals registered under UK REACH, it would grow to be “quite similar” over time, he added.

However, he ruled out full alignment. “It’s just not appropriate for an economy of the size of the UK,” he said. But the government would keep an open door to the EU should the trade bloc “want to adopt a more constructive stance” on data.

But the European Commission refused to grant it during the Brexit trade negotiations due to the UK’s “clear stance” against regulatory alignment, on which it was conditional.

Bulletin Board

REACH Update

FEB. 19, 2021

He gave assurances on non-regression over environmental standards and protections, even though last week the UK Parliament rejected an amendment to the environment bill that provided more safeguards against regression. Industry and NGOs see non-regression as a way to secure alignment.

The bill means the UK will go further than the EU on those protections, Mr Eustace said, "so this is largely a theoretical concern".

However, the UK's commitment to environmental non-regression under the trade and cooperation agreement "certainly doesn't amount to regulatory alignment", he said.

Meanwhile, the UK will monitor if the EU makes any changes that retreat from current standards. It will also make sure that member states adequately enforce the EU law, and could escalate the issue to the European Commission if they fall short of their legal requirements, Mr Eustace added.

Prior to Brexit much of the expertise on chemical laws came from the UK, he said, and "we do have to make sure that the EU does not start behaving differently now that we have left".

The Lords' evidence session was the last for the subcommittee, which is dissolving following the end of the Brexit transition period.

[Read More](#)

Chemical Watch, 5 February 2021

<https://chemicalwatch.com/211440/uk-reach-registrations-grow-but-major-obstacles-remain-on-eu-data>

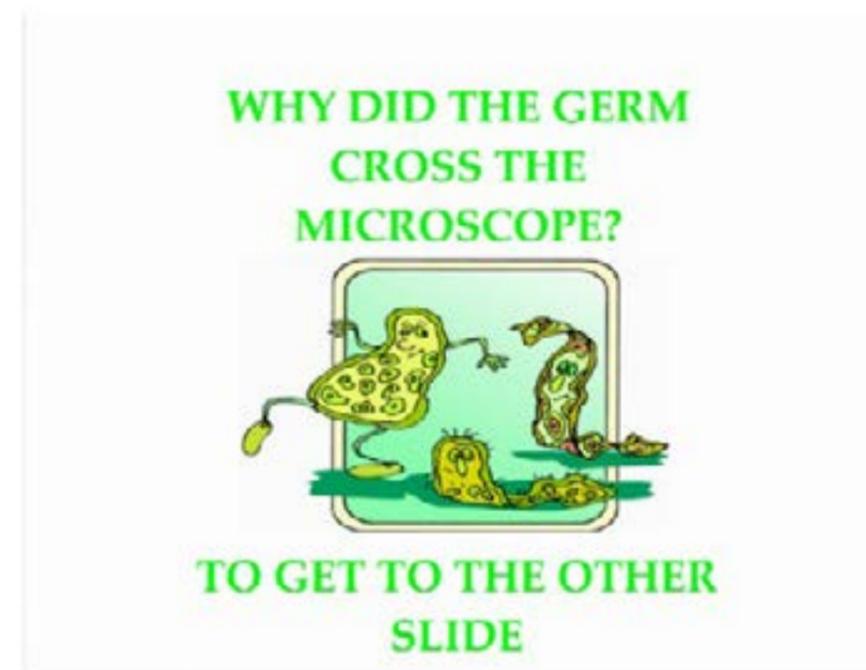
Bulletin Board

Janet's Corner

FEB. 19, 2021

The Other Slide

2021-02-19



<https://www.coolpun.com/topic/marine+biology#&gid=1&pid=19>

Bulletin Board

Hazard Alert

FEB. 19, 2021

Sodium Bicarbonate

2021-02-19

Sodium bicarbonate, aka baking soda, bicarbonate of soda or bicarb, is a white crystalline powder. Its formula is NaHCO_3 . In water, this chemical compound breaks down and forms sodium and bicarbonate, making an alkaline solution [1,2,3]

USES [1,2,3,4,5]

There are two major uses for sodium bicarbonate: as a baking ingredient (food additive E500), and as a medication. In baking, it is used as a leavening agent that becomes activated when it is combined with an acid and a liquid. For example, when making Irish soda bread, the buttermilk reacts with the baking soda to create carbon dioxide which pushes the batter up, making bread rise. In the medical world, sodium bicarbonate is used for a variety of conditions, including heartburn, indigestion and tooth discoloration. Sodium bicarbonate is also used in fireworks and in dry powder fire extinguishers.

ROUTES OF EXPOSURE [5]

- The primary route of sodium bicarbonate is via ingestion, either through a tablet or through food.

HEALTH EFFECTS

Sodium bicarbonate is not thought to produce any adverse health effects.

Acute Effects [5]

Severity of symptoms depends on the level and type of exposure.

- Following short term exposure, bicarb may cause mild skin irritation.
- If this bicarbonate of soda enters an open wound, lesion or abrasion, it could cause damage.

Chronic Effects [5]

Sodium bicarbonate is not thought to result in any kind of chronic negative health effects. However, as a matter of course, use of the chemical compound should be monitored.

Bulletin Board

Hazard Alert

FEB. 19, 2021

SAFETY

First Aid Measures [5]

- Ingestion: First aid for this chemical compound not usually required. If in doubt, contact a medical professional.
- Skin contact: Remove contaminated clothing and footwear. Do not re-wear until they have been thoroughly de-contaminated. Rinse skin with plenty of soap and water for at least 15 minutes. If irritation continues, contact a doctor.
- Eye contact: Rinse eyes for at least 15 minutes; don't forget to wash under both upper and lower eyelids. Removal of contact lenses should only be done by skilled personnel. Immediate medical attention is required.
- Inhaled: Remove person from contaminated area and take them to the nearest fresh air source and monitor their breathing. Other measures are usually unnecessary; if in doubt, contact the emergency service.
- General: Never administer anything by mouth to an unconscious, exposed person.

Exposure Controls/Personal Protection [5]

- Engineering controls: Emergency eyewash fountains and safety showers should be accessible in the immediate area of the potential exposure. Ensure there is adequate ventilation.
- Personal protection: Impervious protective clothing, including gloves, boots, a lab coat, and an apron or coveralls. Wear appropriate eye protection, such as chemical goggles. For specifications on PPE, check regulations in your jurisdiction.

REGULATION [6]

United States:

The Occupational Safety and Health Administration (OSHA) has set an 8-hour time weighted average (TWA) concentration for sodium bicarbonate of $5\text{mg}/\text{m}^3$.

Australia [8]

Safe Work Australia does not have a specific TWA for sodium bicarbonate.

Sodium bicarbonate, aka baking soda, bicarbonate of soda or bicarb, is a white crystalline powder.

Bulletin Board

Hazard Alert

FEB. 19, 2021

REFERENCES

1. <https://www.healthline.com/nutrition/baking-soda-vs-baking-powder>
2. https://en.wikipedia.org/wiki/Sodium_bicarbonate
3. <https://www.webmd.com/vitamins/ai/ingredientmono-1470/sodium-bicarbonate>
4. https://www.bbc.co.uk/food/bicarbonate_of_soda
5. Jr.chematch.net
6. <https://datasheets.scbt.com/sc-203271.pdf>

Bulletin Board

Gossip

FEB. 19, 2021

As scientists study tattoo ink safety, Europe bans two widely used pigments

2021-02-13

Tattoo artists in Europe are fighting a new ban on two commonly-used green and blue pigments, saying that losing these ink ingredients would be a disaster for their industry and their art.

Meanwhile, in the United States, where about a third of Americans have a tattoo, tattoo ink is almost completely unregulated and there's little known about what's in tattoo ink.

Some artists here say the European restrictions don't make any sense.

"It's strange. You almost feel that, how are you only allowed to use certain inks?" says Matt Knopp, owner of Tattoo Paradise in Washington, D.C. "You can't tell me that all these other inks are bad, especially when I'm using them in the states."

For years, individual countries in Europe have required labeling of tattoo ink ingredients and have limited certain chemicals that are thought to cause cancer, damage DNA, or trigger allergic reactions.

Now the European Union is harmonizing tattoo ink rules across the continent. The new rules say that pigments called Blue 15:3 and Green 7 must be phased out over the next year. «That just went into action but is highly disputed,» says Ines Schreiber, who studies tattoo ink at the German Federal Institute for Risk Assessment.

Her institute recently examined the two pigments and said they appeared to have «a comparatively low level of toxicity» but that it wasn't possible to provide a reliable health risk assessment because of a lack of data.

Mario Barth, the owner and founder of Intenze Tattoo Ink, made a video warning that the ban would have dire consequences. «It does not only affect all your green tones, or all your blue tones. It's also going to affect purples, some browns, a lot of the mixed tones, the muted tones, your skin tones, all this stuff,» he says. «You're talking about 65-70% of the palette that a tattoo artist uses.»

Barth previously helped found a group called the Coalition For Tattoo Safety, which has lobbied against proposed legislation that would strengthen oversight of tattoo inks in the U. S.

"You're talking about 65-70% of the palette that a tattoo artist uses."

Bulletin Board

Gossip

FEB. 19, 2021

Walter Liszewski, a dermatologist and cancer researcher at Northwestern University who treats reactions to tattoos, says he's in favor of government oversight to ensure public safety. But he says extrapolating from lab studies to potential real-world health dangers in people can be difficult.

"The EU has really moved to be on the cautious side, and really sort of ban anything that even has the slightest suggestion that it could be a carcinogen," he says.

All of this is happening as tattoos have surged in popularity in recent years. One survey found that 40 percent of Americans aged 18 to 34 have a tattoo.

The art form goes back thousands of years, with tattoos found on mummies. But the small number of researchers working on questions related to its safety say that a lot about tattooing remains mysterious.

"The whole kind of picture, right down to what a tattoo actually looks like in the body, is still a surprisingly open research question," says John Swierk, a chemist at Binghamton University who just got a grant from the National Institutes of Health to study how the chemicals in tattoo inks can be changed by exposure to light.

One basic question that scientists have is:

What is actually in the ink?

Knopp recalls that that 30 years ago, it was hard to come by any information about what a tattoo shop was using. "They poured stuff out of these bottles that were wrapped and hidden, and you couldn't know what it was or you didn't know where they got it from," he says.

Sometimes artists made their own ink, testing it on themselves. "And then they would see if there was any kind of reaction," Knopp explains. "You know, did it bubble up, did it just come out, did it cause itchiness, did it do stuff like that? That was, you know, kind of your trial and error."

These days, lots of manufacturers offer a rainbow of ink colors. People can even go online and order a bottle. The Food and Drug Administration has not regulated the pigments in tattoo inks so far, but agency officials will investigate and recall tattoo inks if they hear of a specific safety concern, like bacterial contamination that could lead to infections.

"We are still at a point where we don't know all the ingredients that are in the inks," says Schreiber. "And, unfortunately, it has to be said that it

Bulletin Board

Gossip

FEB. 19, 2021

appears that sometimes even some manufacturers might also have the same problem, even though they produce the inks."

Raw ingredients purchased to make ink can have impurities, she says. And when one of her colleagues tested tattoo inks sold in Europe, it turned out that a third had labels didn't accurately reflect the pigments inside.

A search of a European consumer safety website shows that dozens of tattoo inks have been pulled from markets there in the last few years, because of violations like excessive amounts of copper, nickel, lead, cobalt, and arsenic.

In the U. S., "ink manufacturers aren't even required to disclose what they put into the inks," says Swierk. "Within the U. S., there really hasn't been a lot of effort placed into understanding what goes into these inks."

Then there's the question of what happens to these inks over time, he says, and whether sunlight or the body can break the chemicals down into byproducts that have their own potential effects.

Swierk has been working to analyze commercially available inks and wants to make information about them public. «I want to empower artists and clients to really make informed decisions,» he says.

As his lab tries to break down the inks for analysis, some are proving resistant to techniques that involve acids, high pressure, and high temperatures. "We actually can't completely break down some of these inks, which is a little bit concerning," says Swierk. "Based on what is supposed to be in these inks, we should be able to break them down all the way."

All of this leads to a second open question that researchers are trying to answer:

How do the inks interact with the body?

It's only been in the last few years that scientists have understood which cells in the skin actually take up and hold tattoo pigment.

Sandrine Henri of the Centre d'Immunologie de Marseille-Luminy says that she and her colleagues were interested in melanin, a natural skin pigment, and as part of that work they started wondering how the skin deals with the injected pigments in a tattoo.

"We looked at the literature and nothing was known," says Henri.

Bulletin Board

Gossip

FEB. 19, 2021

Some thought tattoo ink colored a common type of skin cell called a fibroblast. Others noted that some ink was going into immune cells called macrophages, a type of white blood cell that engulfs foreign substances or microbes.

Henri knew that macrophages were not living for as long as a tattoo could persist. "There is no way macrophages in a tissue will live for 50 years," she says.

Her research team ended up doing a mouse study showing that macrophages do gobble up large amounts of tattoo pigment. But when these cells die, they release the pigment. It gets taken up by new macrophages in a continuous cycle of capture, release, and re-capture.

"We believe it's a constant turnover," says Henri. "It's a very dynamic process."

In a follow-up study, she and her colleagues found that fibroblasts also will take up tattoo ink, but they don't hold as much as the macrophages.

The body may try to break some tattoo ink components down, but the main strategy seems to seal it off and keep it in the skin. This isn't a perfect process.

Surgeons who do biopsies have long noted that tattooed people can have lymph nodes that are stained with color. A few years ago, Schreiber and her colleagues analyzed tattooed human skin and lymph nodes from corpses. They found evidence that smaller pigment particles can indeed migrate from the skin towards the lymph nodes.

What's more, during the tattooing process it's not uncommon for drops of blood to appear, showing that blood vessels can be damaged and give the ink access to the bloodstream.

"It's very, very likely that tattoo pigments will also end up in other organs, but in a very minor amount compared to the skin and lymph nodes," says Schreiber.

So, if some tattoo ink components can move through the body, researchers want to know:

Are there any long-term health risks?

Sometimes people have reactions to tattoo inks, and these can occur months or years after the ink goes in — although it's not clear why.

Bulletin Board

Gossip

FEB. 19, 2021

A survey of 300 tattooed people in New York's Central Park found that 6% reported having a chronic reaction — such as itchiness, swelling, scaliness, or raised skin — involving a specific color such as black or red that lasted for more than four months.

One participant "described a red reaction developing two weeks after a new tattoo, with subsequent development of a similar response in the red ink portion of an 8-year-old tattoo," the researchers wrote.

Red seems to be the color most often associated with reactions, says Liszewski, but he points out that lots of compounds could be used to make red.

"If someone is allergic to red, you've got no idea which one they're allergic to. Because individuals who are tattooed, they don't know the ink that was used," he explains. "There is no record keeping because their tattoo artist isn't required to, and tattoo artists may use multiple different inks. It's really hard to tell which ink is at play."

While an allergic reaction might not be a big deal for a small tattoo, that's not true if someone has a whole sleeve or any other kind of large tattoo. "That can be very, very uncomfortable. It alters your quality of life," says Liszewski. One study found the level of discomfort could be similar to that caused by skin diseases like psoriasis and eczema.

Liszewski, who also is a cancer epidemiologist, says it's hard to investigate whether or not tattoo pigments in the body lead to any long-term increased risk of diseases like cancer.

Any effort to find out would have to factor in all the different inks used, the differing amount of skin area covered, and the different amounts of time that people had their tattoos.

"I would love some way to get data to really look and see if there is an association between malignancy and tattoos," says Liszewski, "but there's just multiple layers of data that we don't have, and complexities that make it very, very difficult."

Still, some researchers in Europe are now looking to see if tattoos have any links to immune-related cancers or skin cancers.

Liszewski is not anti-tattoo. He says they can have a lot of personal meaning for people and that body art can be an important way to memorialize "someone who may have died, or an event that they had."

Bulletin Board

Gossip

FEB. 19, 2021

And tattooing is so common nowadays that the researchers studying tattoos, even if they aren't inked, know others who are.

"Some of the people working on the project have tattoos, other people working on different projects in the lab have tattoos," says Swierk. "It can make for some very uncomfortable group meetings, when you start talking about some of these potential health outcomes."

npr.org, 13 February 2021

<https://www.npr.org>

Anti-depressant found to promote healing in osteoarthritic joints

2021-02-11

As a degenerative disease that gradually wears away at the joint cartilage and causes great pain for sufferers, scientists are searching far and wide for potential cures for osteoarthritis. For researchers at Pennsylvania State University, that search has led them to an approved anti-depressant drug, which they've found interferes in the chain of events leading to the condition, halting its progress and even promoting the regeneration of cartilage.

The breakthrough that may provide the first-ever treatment for osteoarthritis centers on an enzyme called G protein-coupled receptor kinase 2 (GRK2). The Penn State team had established through earlier research that the activity of this enzyme plays a key role in the way cells proliferate in heart and kidney disease, which has some parallels with the way the pathological growth of cartilage cells leads to osteoarthritis. Scientists call this process chondrocyte hypertrophy, but have been unable to pinpoint the reasons behind it.

The Penn State researchers may now have found an answer. They started by exploring the activity of GRK2 in patients suffering from osteoarthritis or acute joint injuries and found high levels of the enzyme in their cartilage cells, or chondrocytes. It was found to be playing a central role in the deterioration of the cartilage, errantly leading the cells to destroy the surrounding cartilage rather than keeping it healthy.

"In other words, the cells receive a bad signal to destroy cartilage," explains Fadia Kamal, assistant professor of orthopedics and rehabilitation at Penn State College of Medicine.

The breakthrough that may provide the first-ever treatment for osteoarthritis centers on an enzyme called G protein-coupled receptor kinase 2 (GRK2).

Bulletin Board

Gossip

FEB. 19, 2021

Next up, the researchers engineered mice to be missing the gene for GRK2 in cartilage cells, finding that it prevented chondrocyte hypertrophy, halted progression of osteoarthritis and even promoted cartilage regeneration. In another experiment, they treated the mice with an FDA-approved anti-depressant called paroxetine, which is known to also be a potent GRK2 inhibitor. It had the same effect.

"We found that paroxetine could return cartilage cells back to a normal state and preserve the cartilage surface," says Kamal.

Follow-up experiments on cultured osteoarthritic cartilage harvested from patients undergoing knee replacement surgery again showed that paroxetine could halt chondrocyte hypertrophy and the degradation of cartilage. In light of these promising results, the scientists hope to soon gain approval from the FDA for clinical trials.

"If this trial works, we will have found a new solution to an age-old problem of joints in the body wearing out because of cartilage destruction and loss," says Kamal. "We hope to intervene with this disease-modifying treatment for the benefit of our patients."

The research was published in the journal Science Translational Medicine.

newatlas.com, 11 February 2021

<https://www.newatlas.com>

Protein discovery promises powerful new muscle regrowth treatments

2021-02-10

Although muscle stem cells are able to grow and repair torn muscle tissue after we sustain an injury, they become less effective as we age. Now researchers at the Australian Regenerative Medicine Institute at Monash University have discovered a novel protein that can trigger the proliferation of these stem cells and promote healing, offering hope not only to those who have torn a muscle, but also the elderly and those suffering severe muscle wasting diseases.

To study the regeneration of skeletal muscle, the research team, led by Professor Peter Currie, turned to zebrafish. The zebrafish is a popular animal model for studying cell regeneration due to their quick reproduction rate, the fact that they share at least 70 percent of their genes with humans, and the ease with which they can be manipulated

"Once they started this process, the macrophage would move on and cuddle then next muscle stem cell, and pretty soon the wound would heal!"

Bulletin Board

Gossip

FEB. 19, 2021

experimentally. They are also transparent, providing a convenient window for the viewing of actual regeneration in living muscle.

While studying the cells that migrated to the site of a muscle injury in zebrafish, the researchers noticed macrophages appeared to play a role in triggering the regeneration of muscle stem cells. Macrophages are a type of white blood cell that converge on the site of any injury or infection in the body to clear away debris and promote healing. Professor Currie calls them “the clean-up crew of the immune system.”

“What we saw were macrophages literally cuddling the muscle stem cells, which then started to divide and proliferate,” says Currie. “Once they started this process, the macrophage would move on and cuddle then next muscle stem cell, and pretty soon the wound would heal.”

Digging deeper, the team found that eight genetically different macrophages converged on the injury site. This was despite the fact that it was long thought that only two types of macrophages exist in the body: one that quickly arrived on the scene to remove debris, and another type that was slower to arrive and which hung around to perform longer-term clean-up duties.

One of the newly identified macrophage types was what the team dubbed the “cuddler” for its aforementioned behavior of cuddling the muscle stem cells one after another. On further analysis, they found that it was releasing a protein called NAMPT. Furthermore, when the macrophages were removed from the zebrafish and NAMPT was added to the aquarium water, the muscle stem cells were still stimulated to grow and heal.

The team then moved onto a mouse model of severe muscle wasting and found that a hydrogel patch containing NAMPT led to “significant replacement of the damaged muscle.” On the back of these promising results, the researchers say they are in talks with a number of biotech companies about taking NAMPT to clinical trials for the treatment of muscle wasting in disease, aging and injury.

The research was published in the journal [Nature](#).

[newatlas.com](#), 10 February 2021

<https://www.newatlas.com>

Bulletin Board

Gossip

FEB. 19, 2021

Transparent wood is coming, and it could make an energy-efficient alternative to glass

2021-02-10

Wood is an ancient material humans have been using for millions of years, for the construction of housing, ships and as a source of fuel for burning. It's also a renewable source, and one way to capture excess carbon dioxide from the Earth's atmosphere. Today, the main component of wood - cellulose - is produced annually at 20 times the volume of steel.

One thing you wouldn't use wood for is making windows. Instead we rely on glass and plastic, which are transparent and, when toughened, can give structural support. But buildings lose a lot of heat through glass, and while light can bring some heat through the material, it's not a good insulator. This is why we need double glazing. Wood, on the other hand, is highly insulating but it's not transparent. Usually.

In recent years, materials scientists have been experimenting with making wood transparent. Making wood see-through, and retaining its high mechanical properties, would provide a good alternative to glass from a sustainable and renewable source. Previous methods of doing this were highly energy intensive and used harmful chemicals, but a new study has shown a way to make wood transparent without using huge amounts of energy in the process.

Seeing through wood

Wood's lack of transparency comes from the combination of its two main components, cellulose and lignin. The lignin absorbs light, and the presence of chromophores - light activated compounds - in the material makes the wood look brown. The fibres in the wood, which mainly comprise cellulose, are hollow tube-like structures. The air in these hollow tubes scatters light, further reducing the material's transparency.

Previous work on making wood transparent has involved removing the lignin completely from the structure and replacing it with a resin material. The removal of lignin requires a lot of environmentally harmful chemicals, and it also considerably reduces the mechanical properties of the material. makes it weaker.

The new study, by researchers at the University of Maryland, demonstrates how to make wood transparent using a simple chemical - hydrogen peroxide - commonly used to bleach hair. This chemical modifies the

In recent years, materials scientists have been experimenting with making wood transparent.

Bulletin Board

Gossip

FEB. 19, 2021

chromophores, changing their structure so they no longer act to absorb light and colour the wood.

The chemical can be brushed onto the wood, and then activated using light to produce a brilliant white material – blond wood if you like. The chemical reaction of wood with hydrogen peroxide is well known. It's the basis for bleaching wood pulp used for paper making – one of the reasons why paper is brilliant white.

The other reason paper is white is because pores or holes in its structure scatter light, just like the hollow cellulose fibres in wood. Filling these fibres with resin reduces that scattering, allowing light to pass through the wood and making it transparent, while retaining its original mechanical properties.

Wooden windows

This is a very exciting development that uses well-known chemical reactions of hydrogen peroxide with lignin. The approach could also be applied to large pieces of material, leading to production of transparent building materials offering a real potential to replace glass.

Because the chemical is brushed onto the wood, there might be opportunities for decorative effects to be added to the material. This could make panels of material popular for indoor applications, while also offering additional insulation.

Further work needs to be done to optimise the reaction with wood, and to incorporate it into an industrially automated process. But one day, in the future, you might be sitting in a home or working in a building with wooden windows.

theconversation.com, 10 February 2021

<https://www.theconversation.com>

Devious sperm 'poison' their rivals, forcing them to swim in circles until they die

2021-02-08

Some sperm cells are ruthless manipulators that will literally poison their competition in the race to fertilize an egg, new research shows.

In a study published Feb. 4 in the journal *PLOS Genetics*, researchers from the Max Planck Institute for Molecular Genetics (MPIMG) in Berlin studied

Bulletin Board

Gossip

FEB. 19, 2021

mouse sperm cells under the microscope to better understand the effects of a particular DNA sequence known as the t-haplotype. The team knew from previous research that sperm cells carrying this sequence tend to swim straighter (rather than in circles of death) and faster on average than competing sperm without it.

Now, they've found that those highly-effective sperms' tactics are a little less than sportsmanly.

"Sperm with the t-haplotype manage to disable sperm without it," study co-author Bernhard Herrmann, director at the MPIMG, said in a statement. "The trick is that the thaplotype 'poisons' all sperm, but at the same time produces an antidote, which acts only in t-sperm [those with the t-haplotype] and protects them."

The result, Herrmann said, is sort of like a marathon "in which all the participants get poisoned drinking water," but only some of the runners have access to the antidote.

Nice sperm finish last

The t-haplotype is a series of linked genes occupying chromosome 17 in house mice all over the world. (Unlike humans, who have 23 pairs of chromosomes, mice have only 20). Herrmann and other researchers have called it a «selfish» gene — genetic material with a single mission: to make copies of itself. Because of the t-haplotype's ruthless effectiveness at passing from one generation to the next, according to the researchers, male mice carrying one copy of the t-haplotype will transmit it to up to 99% of their offspring.

After studying more than 100 mouse sperm cells, Herrmann and his colleagues learned more about the selfish haplotype's devious tactics. They found that the t-haplotype "poisons" all sperm cells during the early phases of sperm production, injecting every cell with certain genes that inhibit their ability to regulate movement.

It's not until a later phase, when each cell divides in half, that the "antidote" comes into play. After dividing, half of the sperm cells inherit the t-haplotype genes on chromosome 17. For those lucky sperm, the t-haplotype provides new genetic variants that reverse the inhibiting effects of the "poison" that every cell consumed during the previous phase of development.

For the other half of sperm cells, which don't carry the t-haplotype or its genetic "antidote," life becomes a lot harder. These poisoned cells have

Bulletin Board

Gossip

FEB. 19, 2021

a lot more trouble moving in a straight line (an important skill for a cell whose only job is to race full-speed-ahead to an unfertilized egg). In their study, the researchers saw that many sperm without the antidote literally swam in circles until they died, while their t-haplotype competitors charged straight ahead.

“Our data highlight the fact that sperm cells are ruthless competitors,” Herrmann said. “Genetic differences can give individual sperm an advantage in the race for life, thus promoting the transmission of particular gene variants to the next generation.” **PLAY SOUND**

Originally published on Live Science.

livescience.com, 8 February 2021

<https://www.livescience.com>

‘Invisible killer’: fossil fuels caused 8.7m deaths globally in 2018, research finds

2021-02-10

Air pollution caused by the burning of fossil fuels such as coal and oil was responsible for 8.7m deaths globally in 2018, a staggering one in five of all people who died that year, new research has found.

Countries with the most prodigious consumption of fossil fuels to power factories, homes and vehicles are suffering the highest death tolls, with the study finding more than one in 10 deaths in both the US and Europe were caused by the resulting pollution, along with nearly a third of deaths in eastern Asia, which includes China. Death rates in South America and Africa were significantly lower.

The enormous death toll is higher than previous estimates and surprised even the study’s researchers. “We were initially very hesitant when we obtained the results because they are astounding, but we are discovering more and more about the impact of this pollution,” said Eloise Marais, a geographer at University College London and a study co-author. “It’s pervasive. The more we look for impacts, the more we find.”

The 8.7m deaths in 2018 represent a “key contributor to the global burden of mortality and disease”, states the study, which is the result of collaboration between scientists at Harvard University, the University of Birmingham, the University of Leicester and University College London. The death toll exceeds the combined total of people who die globally each year from smoking tobacco plus those who die of malaria.

Bulletin Board

Gossip

FEB. 19, 2021

Scientists have established links between pervasive air pollution from burning fossil fuels and cases of heart disease, respiratory ailments and even the loss of eyesight. Without fossil fuel emissions, the average life expectancy of the world’s population would increase by more than a year, while global economic and health costs would fall by about \$2.9tn.

The new estimate of deaths, published in the journal Environmental Research, is higher than other previous attempts to quantify the mortal cost of fossil fuels. A major report by the Lancet in 2019, for example, found 4.2m annual deaths from air pollution coming from dust and wildfire smoke, as well as fossil fuel combustion.

This new research deploys a more detailed analysis of the impact of sooty airborne particles thrown out by power plants, cars, trucks and other sources. This particulate matter is known as PM2.5 as the particles are less than 2.5 micrometers in diameter – or about 30 times smaller than the diameter of the average human hair. These tiny specks of pollution, once inhaled, lodge in the lungs and can cause a variety of health problems.

“We don’t appreciate that air pollution is an invisible killer,” said Neelu Tummala, an ear, nose and throat physician at George Washington University School of Medicine and Health Sciences. “The air we breathe impacts everyone’s health but particularly children, older individuals, those on low incomes and people of color. Usually people in urban areas have the worst impacts.”

Instead of solely relying upon averaged estimates from satellite and surface observations that account for PM2.5 from a range of sources, the researchers used a global 3D model of atmospheric chemistry overseen by Nasa that has a more detailed resolution and can distinguish between pollution sources. “Rather than rely on averages spread across large regions, we wanted to map where the pollution is and where people live, so we could know more exactly what people are breathing,” said Karn Vohra, a graduate student at University of Birmingham and study co-author.

The researchers then developed a new risk assessment based on a tranche of new research that has found a much higher mortality rate from fossil fuel emissions than previously thought, even in relatively low concentrations. Data was taken from 2012 and then also 2018 to account for rapid improvements in air quality in China. Deaths were counted for people aged 15 and older.

Bulletin Board

Gossip

FEB. 19, 2021

The results show a varied global picture. “China’s air quality is improving but its fine particle concentrations are still staggeringly high, the US is improving, although there are hotspots in the north-east, Europe is a mixed bag and India is definitely a hotspot,” said Marais.

The death toll outlined in the study may even be an underestimate of the true picture, according to George Thurston, an expert in air pollution and health at the NYU school of medicine who was not involved in the research. “Overall, however, this new work makes clearer than ever that, when we talk about the human cost of air pollution or climate change, the major causes are one and the same – fossil fuel combustion,” he said.

Philip J Landrigan, director of the program for global public health and the common good at Boston College, said: “Recent research has been exploring the use of newer exposure-response functions, and several recent papers that use these newer functions have produced higher estimates of pollution-related mortality than the Global Burden of Disease analyses.” He added: “I consider it important that different risk assessment models are now being developed, because their development will force re-examination of the assumptions that underlie current models and will improve them.”

Ed Avol, chief of the environmental health division at the University of Southern California (USC), said: “The authors have applied improved methodologies to better quantify exposures and better document health outcomes in order to reach the unsettling (but not surprising) conclusion that fossil-fuels-combustion-related air pollution is more damaging to global human health than previously estimated. The remote satellite imagery exposure specialists and health epidemiologists on the research team are highly competent investigators and among the most talented scholars in this dynamic field.”

“Fossil fuels have a really large impact upon health, the climate and the environment and we need a more immediate response,” said Marais. “Some governments have carbon-neutral goals but maybe we need to move them forward given the huge damage to public health. We need much more urgency.”

[theguardian.com](https://www.theguardian.com), 10 February 2021

<https://www.theguardian.com>

Bulletin Board

Gossip

FEB. 19, 2021

EPA alleges Trump officials interfered in toxic chemical assessment

2021-02-10

Officials appointed by former President Trump interfered to overrule career scientists in a safety assessment for a toxic chemical linked to health issues at the Environmental Protection Agency, the EPA said Tuesday.

Why it matters: EPA career scientists found in a review that conclusions made by the officials in regards to the chemical, PFBS, «were compromised by political interference as well as infringement of authorship and the scientific independence of the authors’ conclusions,» according to a statement by President Biden’s EPA.

“This constitutes a violation of the agency’s Scientific Integrity Policy and the documents have been removed from the EPA website while the agency completes its review.”

— EPA statement

The chemical affected by the January changes to the safety assessment has been linked to the contamination of drinking water affecting some 860,000 Americans.

Politico reported at the time that Trump-appointed officials had «overruled the agency’s career scientists to weaken» the assessment.

What they’re saying: “Issuing documents, like the PFBS Toxicity Assessment, that include conclusions purporting to reflect science when in fact they are the product of biased political interference undermines the agency’s scientific integrity policy,” said Jennifer Orme-Zavaleta, acting assistant administrator for the Office of Research and Development and the agency’s acting science advisor.

It “erodes the trust that the American public has in EPA, the quality of our science, and our ability to protect their health and the environment,” she added.

What’s next: A Trump administration release and the agency’s website will be updated to indicate the removal of the assessment and provide transparency around the agency’s actions.

The big picture: Biden has ordered a government-wide review of over 100 Trump-era policies and direct agencies to prepare a suite of emissions and

It “erodes the trust that the American public has in EPA, the quality of our science, and our ability to protect their health and the environment,” she added.

Bulletin Board

Gossip

FEB. 19, 2021

energy efficiency rules, after four years of the former president rolling back a slew of Obama-era regulations.

Biden has issued a memorandum on restoring «trust in government through scientific integrity and evidence-based policymaking.»

For the record: The EPA's statement comes one day after CDC director Rochelle Walensky told the Washington Post that «minority» of the health agency's COVID-19 pandemic response guidelines had been «politically swayed» by some Trump-appointed staff.

The other side: In January, an EPA spokesperson with the Trump administration defended the changes, telling Politico it's "routine" to consult with others in the agency.

"This collaboration is important as other program offices have information and expertise that can improve the scientific quality of the work product under review," she said.

axios.com, 10 February 2021

<https://www.axios.com>

6 women who are changing chemistry as we know it

2021-02-11

From medical cures, biotechnology advances and even discoveries about the fundamental makeup of our Solar System, female chemists have made many major scientific breakthroughs in recent years.

Below we share the stories of six of the women at the frontiers of chemistry and their life-saving work.

Tu Youyou

Nobel Prize winner for treating malaria

Born in 1930, Tu Youyou is a phytochemist, meaning she specialises in the chemistry of plants. She was awarded the 2015 Nobel Prize in Physiology or Medicine for her research into plant compounds, leading to the development of a new therapy against malaria.

She studied pharmacology at Beijing Medical College before transferring to the Academy of Traditional Chinese Medicine in 1959. Here, she gained training in traditional Chinese medicine for the purposes of modern Western medical applications. This training provided a basis for her future work applying traditional Chinese medicine to modern drug development.

Bulletin Board

Gossip

FEB. 19, 2021

From 1967, Tu led a team of researchers in Project 523, work initiated by the Chinese government for the discovery of a treatment of malaria. Using her phytochemistry background, Tu managed the team in their investigation of plants with potential anti-malarial activity.

The team extracted 380 compounds for testing from 200 of the 640 plant species initially identified. They were looking for compounds that would target the *Plasmodium* parasites that infect red blood cells and cause malaria.

In 1971, Tu Youyou refined the extraction of the non-toxic component from leaves of the sweet wormwood plant. Following some failed experiments, she proposed that the compound may be being deactivated during its extraction process at high temperature.

To test this, she prepared the extraction from wormwood using a different solution which boiled at lower temperatures, enabling extraction without potential temperature-based damage to the active compound.

This was subsequently proven to reduce parasite levels in the blood and lower fevers in patients with malaria. A year later, the team isolated the active compound, artemisinin.

Tu's findings were published in the early 1980s and by the early 2000s, the World Health Organization was recommending artemisinin-based combination drug therapies for malaria treatment.

Continuing her work, Tu later developed dihydroartemisinin, a second antimalarial drug, which alongside artemisinin, has saved millions of people.

Professor Raychelle Burks

Forensic chemist and science communicator

Prof Raychelle Burks, or Dr Rubidium as many know her, is a forensic chemist and science communicator. She focuses her work on developing sensors for a range of compounds at American University in Washington, DC.

There, she is an Associate Professor of Chemistry where she runs an analytical lab and teaches both general chemistry and criminalistics, at the intersection of forensic science and society.

Burks emphasises the importance of engaging students in applied chemistry to solve real-world problems. Growing up in the 80s, Burks

Bulletin Board

Gossip

FEB. 19, 2021

says the Space Shuttle Era was not particularly engaging to her. She says she wasn't interested in pursuing science at first, not seeing the daily importance of exploring space.

"I was not tempted by space and I did not see the practical application of science – until I had a great trip to Washington, DC that showed me the power and reach of STEM," she said during a [presentation at the Department of Defence](#).

On this trip, a science interaction challenge was presented to students to solve a real-world problem by using chemistry, biology and engineering skills. It was this challenge that sparked Burks's interest in forensic chemistry at just aged 12.

She pursued an undergraduate degree in Chemistry at Iowa University before moving to Nebraska for a masters in forensic science. Following this, Burks worked as a forensic analyst in the evidence unit of a police department alongside criminal investigations.

She went on to complete a PhD in forensic chemistry from the University of Nebraska. Having worked with [low-tech sensors used for processing crime scene evidence for the police department](#), she moved from policing to her postdoctoral research at Doane College in 2013. There, and in her current role, Burks has been working on developing these sensors and their imaging-based detection at a low cost.

She was appointed Associate Professor at American University in 2020 and currently runs a lab concentrating on a range of colourful techniques that take advantage of the chemistry of light for [detection and analysis](#).

Burks's team combines chemistry and computational methods to take detection and analysis to our smartphones. Improving the portability of these tools will help with image collection and processing.

In her science communication work, she writes regularly for Chemistry World and has appeared in various TV and podcast episodes, as well as the documentary *Picture a Scientist*. She is involved in [STEM outreach](#) in her university and on national and international committees and projects for social justice and STEM.

Professor Ewine van Dishoeck

Astrochemist investigating the building blocks of life

Professor Ewine van Dishoeck was almost put off chemistry by space science, but is now fascinated by the intersection of chemistry and

Bulletin Board

Gossip

FEB. 19, 2021

astronomy. van Dishoeck's work helped us to understand how the chemistry of our cosmos has created life.

Her fascination for chemistry in particular was first sparked by an encouraging school teacher. Born in Leiden in 1955, van Dishoeck studied chemistry at Leiden University and had been intending to pursue a PhD in quantum or theoretical chemistry.

She switched focus after realising there was no professor to support her in a PhD within these areas of chemistry. Instead, van Dishoeck has brought her unique chemistry perspective to astronomy and investigating the mysterious inner workings of tenuous gas clouds gliding through space.

"You look up at the sky on a beautiful summer's night. You see maybe Orion, you see some of the planets – Mars, Jupiter – but very few people think of what is in between there. And it's that very, very tenuous gas out of which we are formed," she explained on [BBC 4's The Life Scientific](#).

These 'interstellar clouds' exist between stars and planetary objects are made up of different gaseous molecules and were relatively unexplored until a few decades ago. This meant there were few people in the field of astrochemistry for her to talk to, but after meeting with [Professor Alexander Dalgarno](#) at a conference, she made the move to Harvard.

Supervised by Dalgarno in Harvard and [Prof Harm Habing](#) in Leiden, van Dishoeck completed her PhD in astrochemistry before moving to the USA for her postdoctoral studies in 1984.

In 1990, van Dishoeck returned to Leiden to run her own astrochemistry lab. She has pioneered work in finding and analysing these molecules, and further advancing our understanding of how stars form.

She has created models of interstellar clouds to find the chemical signatures of molecules in the clouds. Specifically, she looks at carbon monoxide, as this gas can react with other molecules to form longer carbon chains that are the basis of life on Earth.

van Dishoeck's work helped to overcome the conundrum of how carbon monoxide can actually exist in space. This was a big question in the field because lab studies on Earth had already shown that carbon monoxide is broken down and destroyed by UV light. Interstellar clouds are much closer to these stars, like our Sun, which give off strong rays of UV light.

So, how exactly do these molecules of carbon monoxide survive in space? By studying these clouds, van Dishoeck began to understand the answers.

Bulletin Board

Gossip

FEB. 19, 2021

Not all UV light will break the carbon monoxide bond – only light that matches the bond's energy closely enough to be absorbed. In fact, even if this destructive light is close enough to the carbon monoxide, the gas can be shielded by other molecules that first interact with the light.

Collaborating with [Professor John Black](#) in 1988, van Dishoeck advanced the field using this understanding that particles can act as buffers to UV light. Together, they dug into the chemistry of interstellar clouds in more detail.

They identified that [dust particles on the surface of these clouds act to protect carbon monoxide](#) by absorbing this light first. As such, the carbon monoxide can exist long enough to react with other molecules to create life.

Now, she has turned her focus to the search for water and understanding water cycles in space. By finding water molecules and explaining their origins in space, van Dishoeck will contribute to answering the question of on many astronomers' minds: is there life on other planets?

Clarice Phelps

Nuclear chemist synthesising new elements

A nuclear chemist working at the Oak Ridge National Laboratory (ORNL) in the United States, Clarice Phelps helped synthesise element 117, tennessine. This finding helped spur further research in elemental discovery, proving that the periodic table is not as complete as once thought.

A collaborative effort across five research institutes, tennessine was discovered in 2010 and finally named in 2016. This superheavy element was named after the US state Tennessee, which is not only where three of these institutes are based, but also where Clarice Phelps grew up.

Phelps fell in love with science as a child and was inspired by a school teacher to pursue chemistry. She earned a bachelor's degree from the University of Tennessee in 2003, but struggled to find work following university. She enrolled in the US Navy's Nuclear School and graduated in the top 10 per cent of her class.

She worked in Chicago for a year before joining ORNL in Tennessee as a technician in 2009. She was involved in the preparation for the experiments which produced tennessine, working on calculations and purification experiments for the isotope berkelium-249.

Bulletin Board

Gossip

FEB. 19, 2021

Phelps has since been promoted to associate researcher and program manager for two other industrial isotopes, nickel-63 and selenium-75.

Only isolated in 1958, berkelium-249 was key to the work of Phelps and her colleagues at ORNL as it is just stable enough to be kept for 330 days without significantly decaying. This was necessary for the collaborative work which involved the transport of berkelium-249 from the US institutes to Russia's Joint Institute for Nuclear Research.

In January 2020, Clarice Phelps and the team at ORNL published their work on the [separation and purification of berkelium-249 and einsteinium-254](#), two key element isotopes for the future of nuclear chemistry and elemental discovery. Once isolated and transported, berkelium-249 was bombarded with calcium-48 (a neutron-rich isotope of calcium) for 150 days.

The result: six atoms of element 117, among other decay products.

There are currently 118 elements in the periodic table, and tennessine is the second heaviest after oganesson (element 118) and only exists for fractions of a second.

Yet, nuclear chemists like Phelps hope to one day reach the superheavy elements predicted to have a special stability associated with them. These elements have so far only been predicted, existing in a theoretical 'island of stability'.

Though there's no mention of palm-trees or sunsets, this island is thought to be a section of the periodic table where new elements will emerge and exist longer than fractions of a second. It is predicted that at a certain point these super-heavy new elements will deviate from the tendency to immediately decay.

Phelps is also involved in elemental work elsewhere, [researching plutonium and neptunium for NASA](#) and investigating californium-252 as part of a broader team.

In 2019, Phelps was acknowledged in the [Periodic Table of Younger Chemists](#) for her "outstanding commitment to research and public engagement, as well as being an important advocate for diversity," by the International Union of Pure and Applied Chemistry.

Phelps has been involved in outreach work for years, serving on ORNL's Educational Outreach Committee and as Vice President of the board of

Bulletin Board

Gossip

FEB. 19, 2021

Youth Outreach in Science, Technology, Engineering and Mathematics (YO-STEM).

Professor Emmanuelle Charpentier

Nobel Prize winner for CRISPR-Cas9

Prof Emmanuelle Charpentier is a biochemist, geneticist, microbiologist and the director of the Max Planck Unit for the Science of Pathogens since 2018. Along with Prof Jennifer Doudna, she won the [2020 Nobel Prize winners for Chemistry](#) for her work on CRISPR-Cas9.

Known widely as ‘genetic scissors’, the CRISPR-Cas9 research offers the potential to precisely change DNA in living cells. Doudna and Charpentier’s collaboration is hailed as revolutionising the field of genome editing.

Born in 1968, Juvisy-sur-Orge in France, she grew excited even as a child to learn at university after her sister began her studies.

“According to my mother, when I was 11 or 12 years old, I told her that I would work at the Pasteur Institute – and that is where I actually did my doctorate. But I actually enjoyed all my subjects at school, so I could have followed a very different path,” Charpentier shared in a [2017 interview with the Max Planck Society](#).

The path she did follow led her from studying biochemistry, genetics and microbiology at Sorbonne University to a PhD at the Pasteur Institute and post-doctoral studies in the USA.

In her PhD, she explored the ways bacteria develop resistance to antibiotics. After this, she moved to the USA in 1996 to pursue postdoctoral research studying skin development and infections. Specifically, she looked at the tiny organisms (bacteria, fungi and viruses) that contribute to skin infections in mice.

In 2002, she was invited to start her own research group in the Biocenter at the University of Vienna, where her studies of RNA and virus relationships developed.

Charpentier was appointed Associate Professor in 2006 before moving to Umeå University in Sweden three years later to head a molecular infections lab.

Sitting on the plane from Vienna to Sweden, she began thinking about how she could combine her knowledge of RNA with CRISPR. At the time,

Bulletin Board

Gossip

FEB. 19, 2021

researchers were still trying to unravel the way this intriguing pattern of DNA works to help bacteria defeat invading virus.

Her formidable collaboration with Doudna began after the pair met at a conference in Puerto Rico. Just before this, in 2011, Charpentier published her pioneering discovery of the [role of tracrRNA in the formation of CRISPR RNA](#), which we now know helps guide these genetic scissors.

Charpentier continues to research bacteria and viruses to advance biotechnology.

Professor Jennifer Doudna

Nobel Prize winner for CRISPR-Cas9

Since the prize-winning development into CRISPR with Prof Emmanuelle Charpentier, her team in the school of chemistry have continued work into genome editing. They have discovered [CRISPR-CasΦ](#) which they report is ‘hypercompact’, at half the molecular weight of its Cas9 predecessor and used by [bacteriophages](#) to fight off other viruses.

Born in 1964 in Washington, DC, her family moved and she grew up in Hawaii and first became interested in chemistry in school, studying the chemistry of biological systems. This grew into a passion after reading James Watson’s *The Double Helix*, as well as hearing a female scientist give a lecture on how cancer cells develop from normal cells.

She followed her intrigue for biochemistry to Pomona College, California, graduating in 1985 before moving to Harvard Medical School to complete her PhD with [Prof Jack W Szostak](#), another Nobel laureate. There, Doudna focused on improving the efficiency of a self-replicating form of RNA.

She has continued exploring the molecular interactions of RNA in her postdoctoral studies in the same group. Doudna then moved to the lab of Prof Thomas Cech, becoming an assistant professor at Yale University in 1994. With Cech, she completed work solving the structure an important [‘reaction site’](#) in RNA.

From this, Doudna went on to unravel similar structure, including those in the [hepatitis delta virus \(HDV\)](#), contributing to understanding how this tiny virus infects humans. In 2002, Doudna was appointed Professor of Biochemistry and Molecular Biology, and continued to explore the molecular mysteries of RNA.

In 2009, after two months in industry, Doudna returned to Berkeley and – met with a fairly clear schedule – she delved into the world of CRISPR.

Bulletin Board

Gossip

FEB. 19, 2021

After meeting Charpentier in 2011, they decided to pool their knowledge and work together to more fully understand exactly how this bacterial system works.

From this, they then advanced their research by reprogramming this system, combining two components observed in the bacterial system into one for a singly guided, efficient DNA snipping tool.

Doudna described the “pure joy of discovery” when they managed to engineer this system, which has since been adapted and used in plant and animal research. CRISPR-Cas9 has also been utilised to correct the mutation which causes sickle cell anaemia.

CRISPR-Cas9 entered the field of gene editing as a faster, easier and more efficient technology, similar to how Charpentier described their partnership in one interview, saying “the collaboration was short and intense”.

Doudna is now developing a CRISPR-Cas9 technology for rapid detection of COVID-19 and other potential viruses.

Making history as the first time two women have won the Nobel Prize for Chemistry is not something either dismisses.

“I think for many women there’s a feeling that no matter what they do, their work will never be recognised as it might be if they were a man. I’d like to see that change and I think this is a step in the right direction,” said Doudna at her Nobel press conference.

In a phone interview shortly after hearing the news, Charpentier added: “It was a very positive message for the girls and the young women who wish to start science, and continue in science and it really provides a clear message that it is possible to achieve recognition even if you are a female.”

sciencefocus.com, 11 February 2021

<https://www.sciencefocus.com>

Asteroid the size of the Golden Gate Bridge will whiz past Earth in March

2021-02-10

An asteroid as wide as the Golden Gate Bridge is long will hurtle past Earth next month. But although it will be the biggest and speediest asteroid to fly by our planet this year, there’s no reason to panic.

Bulletin Board

Gossip

FEB. 19, 2021

The space rock, officially called 231937 (2001 FO32), is about 0.5 to 1 mile (0.8 to 1.7 kilometers) in diameter and will come within 1.25 million miles (2 million kilometers) of Earth at 11:03 a.m. EST (1603 GMT) on March 21 — close enough and large enough to be classified as “potentially hazardous,” according to a database published by NASA’s Jet Propulsion Laboratory.

An asteroid is designated as “potentially hazardous” when its orbit intersects with Earth’s at a distance of no more than about 4.65 million miles (7.5 million km) and it is bigger than about 500 feet (140 meters) in diameter, according to NASA’s Center for Near-Earth Object Studies (CNEOS).

PLAY SOUND

Small asteroids pass between Earth and the moon several times a month, and their fragments enter and break up in Earth’s atmosphere almost daily, according to NASA’s Planetary Defense Coordination Office (PDCO).

Telescopes in New Mexico that are part of the Lincoln Near-Earth Asteroid Research (LINEAR) program — an MIT Lincoln Laboratory program funded by the U.S. Air Force and NASA — detected the asteroid on March 23, 2001, according to EarthSky. Observatories have monitored it ever since. Scientists used these observations to calculate the asteroid’s orbit and determine how close the space rock will come to Earth when it whizzes by at almost 77,000 mph (124,000 km/h).

No known asteroid poses a significant risk to Earth for the next 100 years. The current biggest known threat is an asteroid called (410777) 2009 FD, which has a 1 in 714 (less than 0.2%) chance of hitting Earth in 2185, according to NASA’s PDCO.

NASA is studying methods of deflecting asteroids that do end up on a collision course with Earth, such as by using the gravity of a flying spacecraft to slowly pull asteroids off their trajectory to a safe distance, according to NASA’s PDCO.

If you have a telescope with an aperture of at least 8 inches (20 centimeters), you might be able to spot the fast-moving space rock, according to EarthSky. To catch a glimpse in the southern U.S., point your telescope south-southeast between the constellations of Sagittarius and Corona Australis at 4:45 a.m. EST on March 20.

Bulletin Board

Gossip

FEB. 19, 2021

Originally published on Live Science.

livescience.com, 10 February 2021

<https://www.livescience.com>**The race to treat a rare, fatal syndrome may help others with common disorders like diabetes**

2021-02-11

Maureen Marshall-Doss says the first sign that her vision was deteriorating came when she misidentified the color of a dress. At a backyard get-together about 20 years ago, the Indianapolis resident pointed out an attractive yellow dress another woman was wearing. "You see that as yellow? She's wearing a pink dress," Marshall-Doss recalls her husband responding.

Today, Marshall-Doss is virtually blind. With help from custom made eyeglasses that magnify objects 500 times, "I can see shapes," she says. But she can no longer drive and had to quit the job she loved as a school librarian. Along with her dimming vision, she has type 1 diabetes and has lost her sense of taste and smell.

Marshall-Doss is one of 15,000 to 30,000 people around the world with Wolfram syndrome, a genetic disease. For decades, the condition remained enigmatic, untreatable, and fatal. But in the past few years, insights into its mechanism have begun to pay off, leading to the first clinical trials of drugs that might slow the illness and sparking hopes that gene therapy and the CRISPR DNA-editing tool might rectify the underlying genetic flaws. "Here is a rare disease that the basic science is telling us how to treat," says physiologist Barbara Ehrlich of the Yale School of Medicine.

The research could also aid more than the relatively few patients with Wolfram syndrome. Driving the disease's many symptoms is a malfunction of the endoplasmic reticulum (ER), the multichambered organelle that serves as a finishing school for many cellular proteins. Known as ER stress, the same problem helps propel far more common illnesses, including type 2 diabetes, amyotrophic lateral sclerosis (ALS), Parkinson's disease, and Alzheimer's disease. "Wolfram syndrome is the prototype of an endoplasmic reticulum disorder," says medical geneticist Fumihiko "Fumi" Urano of Washington University School of Medicine in St. Louis. Because Wolfram syndrome is "simpler," says Scott Oakes, a cell biologist and pathologist at the University of Chicago, researchers think it could

"Here is a rare disease that the basic science is telling us how to treat," says physiologist Barbara Ehrlich of the Yale School of Medicine.

Bulletin Board

Gossip

FEB. 19, 2021

illuminate the mechanisms of other ER-disrupting diseases, which affect hundreds of millions of people worldwide.

IN THE LATE 1930S, four children with diabetes were going blind, and doctors were stumped. Like many other people in the United States struggling through the Great Depression, the siblings ate a paltry diet, subsisting on potatoes, bread, oatmeal, and a little milk. But after examining three of the children, Donald Wolfram, a physician at the Mayo Clinic in Rochester, Minnesota, and an ophthalmologist colleague ruled out malnutrition as the cause of their puzzling condition. Lead poisoning and syphilis—though common enough—weren't to blame, either. When Wolfram and his partner wrote up the cases in 1938, they concluded that the symptoms could be "manifestations of an hereditary or acquired cerebral lesion."

The physicians were right that the syndrome eventually named for Wolfram is hereditary. Recessive mutations in the gene for a protein called wolframin are responsible for most cases, with glitches in a second gene causing most of the rest. However, the pair was wrong to think the defect lies only in the brain. Instead, the symptoms stem from widespread cell death. "It's definitely a disease that affects the whole body," Marshall-Doss says.

The first sign of the illness, appearing when patients are children, is usually diabetes mellitus, or faulty sugar metabolism, sparked by the demise of insulin-secreting beta cells in the pancreas. Most patients also develop the unrelated condition diabetes insipidus, in which the pituitary gland doesn't dole out enough of a hormone that helps control the body's fluid balance, causing the kidneys to produce huge amounts of urine.

Ellie White, 19, of Centennial, Colorado, who was diagnosed with Wolfram syndrome 12 years ago, says she hasn't had a full night of sleep since she was 3 years old. She gets up again and again to use the bathroom and monitor her blood sugar.

Yet she and other patients say that as disruptive as those problems are, they are not the disease's most dismaying consequence. "The biggest symptom of Wolfram syndrome that affects me the most is my vision," White says. Because neurons in the optic nerve perish, patients usually go blind within 10 years of their first visual symptoms.

Other neurons die as well. As the disease progresses, brain cells expire, and walking, breathing, and swallowing become difficult. Most people with Wolfram syndrome die before age 40, often because they can no

Bulletin Board

Gossip

FEB. 19, 2021

longer breathe. At 57, Marshall-Doss is one of the oldest patients; one of her mutated genes may yield a partly functional version of wolframin, triggering a milder form of the disease, Urano says.

TWO ADVANCES have made it possible to begin to tackle those symptoms. The first was Urano's discovery nearly 20 years ago that linked Wolfram syndrome to ER stress. The ER is where about one-third of a cell's newly made proteins fold into the correct shapes and undergo fine-tuning. Cells can develop ER stress whenever they are under duress, such as when they don't have enough oxygen or when misfolded proteins begin to pile up inside the organelle.

In test tube experiments, Urano and his colleagues were measuring the activity of genes to pinpoint which ones help alleviate ER stress. One gene that popped up encodes wolframin, which scientists had shown in 1998 was mutated in patients with Wolfram syndrome. Following up on that finding, Urano and his team determined that wolframin takes part in what's known as the unfolded protein response, which is a mechanism for coping with ER stress in which cells take steps including dialing back protein production.

Scientists think wolframin plays a key role in the unfolded protein response, though they haven't nailed down exactly how. When wolframin is impaired, cells become vulnerable to ER stress. And if they can't relieve that stress, they often self-destruct, which could explain why so many neurons and beta cells die in the disease.

Defective wolframin may harm cells in other ways. The ER tends the cell's supply of calcium, continually releasing and absorbing the ion to control the amount in the cytoplasm. Changes in calcium levels promote certain cellular activities, including the contraction of heart muscle cells and the release of neurotransmitters by neurons. And wolframin affects calcium regulation.

Beta cells genetically engineered to lack functional wolframin brim with calcium, Ehrlich and colleagues reported in July 2020 in the *Proceedings of the National Academy of Sciences*. When exposed to lots of sugar, the altered cells release less insulin and are more likely to die than healthy beta cells, the team found. The cells share that vulnerability with beta cells from patients with Wolfram syndrome. "We think that excess calcium is leading to excess cell death," Ehrlich says.

ER malfunctions could hamstring other organelles as well. The ER donates calcium to the mitochondria, the cell's power plants, helping them

Bulletin Board

Gossip

FEB. 19, 2021

generate energy. In 2018, a team led by molecular biologist Cécile Delettre and molecular and cellular biologist Benjamin Delprat, both of the French biomedical research agency INSERM, discovered that in cells from patients with Wolfram syndrome, mitochondria receive less calcium from the ER and produce less energy. Those underpowered mitochondria could spur the death of optic nerve cells, the researchers speculate.

The link between ER stress and Wolfram syndrome has been crucial for identifying potential treatments because "otherwise we would have nothing to target," Urano says. But a second development was also key, he says: the advocacy and support of patient organizations, such as the Snow Foundation and the Ellie White Foundation, headed by its namesake's mother. The foundations have stepped up with money for lab research and clinical trials when other sources, including government agencies, didn't come through.

Scientists, patients, and their advocates say Urano also deserves much of the credit. Besides treating patients, he heads the international registry of cases and has taken the lead in organizing clinical trials, screening compounds for possible use as treatments, and devising potential therapies. "Fumi is clearly the driving force," says Stephanie Snow Gebel, co-founder of the Snow Foundation, who about 10 years ago helped persuade him to forgo a plum job as department chair at a Japanese university and take over the Wolfram program at Washington University.

PATIENTS COULD SOON start to reap the benefits. In 2016, Urano and colleagues started the world's first clinical trial for the disease: a phase 1/2 study of dantrolene, an approved muscle relaxant. The molecule was a top performer when they screened 73 potential treatments for their ability to save cells with terminal ER stress. Dantrolene didn't improve vision in the 22 participants, including White, the scientists reported in an October 2020 preprint. But in some patients, beta cells appeared to be working better and releasing more insulin. The drug is safe, but Urano says it will need to be chemically tweaked to target its effects before future trials are warranted.

Researchers are pursuing other possible treatments targeting ER stress or calcium levels. In 2018, U.K. scientists launched a trial that will include 70 patients to evaluate sodium valproate, a therapy for bipolar disorder and epilepsy that, in the lab, prevents cells with faulty wolframin from dying. Last year, another compound that emerged from Urano's screens, the diabetes drug liraglutide, entered a clinical trial. Also last year, an experimental drug developed by Amylyx Pharmaceuticals for Alzheimer's

Bulletin Board

Gossip

FEB. 19, 2021

disease and ALS received orphan drug designation from the U.S. Food and Drug Administration for Wolfram syndrome because it curbs ER stress. That designation offers tax breaks and other incentives, and it will get trials started sooner, Urano says.

Ehrlich and her team have a candidate of their own that they have begun to test in rodents: the drug ibudilast, which is approved in Japan to treat asthma. The researchers found it reduces calcium levels in beta cells lacking wolframin and boosts their survival and insulin output. New screening projects may reveal still more candidates.

But Urano knows that even if a treatment receives approval, it would be only “a Band-Aid for Wolfram syndrome.” Hoping to develop a genetic cure, he and colleagues are introducing replacement genes into cells from patients and from mice engineered to replicate the disease. The researchers are endowing the cells with healthy copies of the gene for wolframin or the gene for a protein that reduces ER stress to determine whether they restore cellular function and reduce cell death. At INSERM, Delettre and colleagues are also evaluating whether directing a working gene into optic nerve cells can curtail vision loss in mice with faulty wolframin. The scientists are still gathering data, but early results suggest the treatment can halt the deterioration.

Urano and his collaborators have also turned to the genome editor CRISPR, deploying it to correct the gene defect in patients’ stem cells and then growing them into beta cells. When the researchers transplanted the revamped cells into mice with diabetes, the animals’ blood sugar returned to healthy levels, the team reported in April 2020 in *Science Translational Medicine*.

Stem cell biologist Catherine Verfaillie of KU Leuven is collaborating on the CRISPR research. But she notes that because the faulty wolframin gene affects so many tissues, researchers will have to figure out how to deliver the CRISPR components to most cells in large organs such as the brain and liver—a prospect she calls “pretty daunting.” Urano agrees, predicting that CRISPR-based Wolfram therapies might take 10 to 20 years to develop. The alternative approach, gene therapy, could reach clinical trials more quickly, in 3 to 10 years, he says, because researchers have more experience with gene therapy and have created several treatments that have already been approved for other illnesses.

Because it stems from a single genetic glitch, Wolfram syndrome could also help scientists tease out the role of the ER in more complex diseases, including neurological conditions, type 2 diabetes, and cancer. The ER also

Bulletin Board

Gossip

FEB. 19, 2021

falters in those diseases, causing cells to die, but the mechanism is harder to discern because they stem from myriad genetic and environmental factors. In Alzheimer’s disease, for instance, neurons develop ER stress as misfolded proteins accumulate inside and outside the cells.

Besides deepening researchers’ understanding of other conditions, the research on Wolfram syndrome might even deliver candidate treatments. “Everyone would be very excited if we can make advances in targeting ER stress in Wolfram syndrome,” Oakes says. “It would open up the whole field to doing this in other degenerative diseases.”

sciencemag.org, 11 February 2021

<https://www.sciencemag.org>

Bulletin Board

Curiosities

FEB. 19, 2021

Prozac turns guppies into ‘zombies’

2021-02-09

Prozac might need a new warning label: “Caution: This antidepressant may turn fish into zombies.”

Researchers have found that long-term exposure to the drug makes guppies act more alike, wiping out some of the typical behavioral differences that distinguish them. That could be a big problem when the medication—technically named fluoxetine—washes into streams and rivers, potentially making fish populations more vulnerable to predators and other threats.

In recent decades, scientists have uncovered a plethora of ways that pharmaceuticals affect animals in the lab and in the wild, such as by altering [courtship](#), [migration](#), and [anxiety](#). The drugs find their way into the environment through water that pours from sewage treatment plants, which is rarely filtered to remove the chemicals.

But the findings are usually based on an average taken from combining measurements of all the individual animals in a group. Giovanni Polverino, a behavioral ecologist at the University of Western Australia, Perth, and colleagues wondered whether this calculation obscured important but subtle insights about individual animals. Did the drug change behavior similarly in all the creatures in a group? Or were certain kinds of “personalities” affected more strongly?

To find out, Polverino’s team captured 3600 guppies (*Poecilia reticulata*)—a common silvery fish often used in labs that grows to half the length of an average human’s pinkie—from a creek in northeastern Australia. In the laboratory, the fish and their offspring—as many as six generations—spent 2 years in tanks filled with either freshwater, water with fluoxetine at levels common in the wild, or a higher dose similar to places near sewage outflows.

Then the scientists placed the fish one at a time into a new tank with a white background. In one corner, a dark patch offered a simulated hiding spot, similar to the shade under a rock that the small fish often seek out to avoid predators.

Fish raised in drug-free water displayed a wide range of behaviors. Some darted about, whereas others were much “lazier.” [But fish exposed to fluoxetine showed fewer differences](#); most were moderately active, making them all more like an average fish, the team reports today in

Bulletin Board

Curiosities

FEB. 19, 2021

the *Proceedings of the Royal Society B*. The drugged guppies were like zombies who did “not have their individuality anymore,” Polverino says.

All told, there was half as much variation in activity levels among drugged fish, making for a much narrower spectrum of personalities. “It’s an enormous drop [in variability], something I have never seen before,” Polverino says.

Strangely, however, he says not all behavior was affected in the same way. Although the medication appeared to squash individuality when it came to how much the fish swam around, it didn’t reduce variation in how much time individuals spent hiding in the dark spot.

It’s not clear why the hiding behavior wasn’t altered in the same way, Polverino says. One possibility is that hiding from predators is more critical to immediate survival, so that behavior is less sensitive to drug-induced changes.

The discovery could extend to other animals, which have already shown they are sensitive to fluoxetine in the environment. Kathryn Arnold, an ecologist at the University of York, has studied how fluoxetine-laced worms affect starlings, [making them less interested in mating](#)—something also seen in humans.

The new findings also show long-term drug exposure can modify behavior, Arnold says. In the past, some scientists have questioned whether behavioral changes seen after brief exposures might fade as animals become accustomed to the drugs. But the new work shows effects persist through multiple generations raised in drug-tainted water.

It’s not clear how the effects seen in the lab would translate to the wild. It could depend on the particular threats confronting a group of fish. Ones that move around more might benefit from finding more food or mates. But they also might run into predators more often, Polverino says. Determining those real-world impacts is now “sort of the \$64,000 question,” Arnold says.

Such work is already underway. In Sweden, ecologist Tomas Brodin of the Swedish University of Agricultural Sciences is preparing to study whether an anti-anxiety drug alters relationships between predatory pikes and the perch and roach they eat. The researcher is implanting a slow-release form of the drug into some of the fish before they are dumped into a lake and tracked. But the Prozac results have prompted Brodin to consider first

The drugs find their way into the environment through water that pours from sewage treatment plants, which is rarely filtered to remove the chemicals.

Bulletin Board

Curiosities

FEB. 19, 2021

observing the drugged fish before they are released, to see whether they display any uniform, zombielike behaviors that could skew the results.

sciencemag.org, 9 February 2021

<https://www.sciencemag.org>

The environmental threat you've never heard of

2021-02-10

Coastal waters around the world are steadily growing darker. This darkening—a change in the color and clarity of the water—has the potential to cause huge problems for the ocean and its inhabitants.

“It’s affecting the quality of the sea we know,” says Oliver Zielinski, who runs the [Coastal Ocean Darkening project](#) at the University of Oldenburg in Germany. These “changes in the physics will lead to biological changes,” he adds.

Some of the causes behind ocean darkening are well understood: fertilizer enters the water and causes an algal bloom, or boats stir up light-blocking silt as they move. But other causes are murkier. During heavy rains, for instance, organic matter—primarily from decaying plants and loose soil—can enter the ocean as a brown, light-blocking slurry. This process is [well documented in rivers and lakes](#), but has largely been overlooked in coastal areas.

Maren Striebel, an aquatic ecologist also with the Coastal Ocean Darkening project, showed in a large-scale experiment the [power of this phenomenon](#).

In the study, Striebel and her team filled huge metal vats with water, phytoplankton, and silt. From peat, the team extracted a brown liquid as an approximation of the dissolved organic matter found in coastal waters. They put low, medium, and high concentrations of the liquid in the vats, and hung lamps above them to mimic the sun’s rays.

Over the first few weeks, the peat extract decreased the light’s ability to penetrate the water by 27 percent, 62 percent, and 86 percent, respectively, for the low, medium, and high concentrations. The phytoplankton suffered from the lack of light—primarily in the medium- and high-concentration vats.

However, and perhaps more importantly, the organic matter not only caused the raw biomass of phytoplankton to drop, it also favored some

These “changes in the physics will lead to biological changes,” he adds.

Bulletin Board

Curiosities

FEB. 19, 2021

species over others. As phytoplankton form the base of the ocean’s food web, this could have stark implications. Some species of zooplankton, for instance, have adapted to eat one kind of phytoplankton. Any change in phytoplankton composition could result in winners and losers throughout the ecosystem.

Over time, Zielinski says, coastal darkening could have widespread effects beyond those on microorganisms. Decreased light availability, he says, would benefit creatures that don’t rely on sight to hunt, such as jellyfish, and hinder species such as fish that hunt better when they can see.

As the experiment progressed, Striebel says that the murkiness dissipated as light and microscopic life forms in the water began to degrade the dissolved organic matter, allowing the phytoplankton to fully recover. However, she says that in the real world, this relief may be unlikely. In the experiment, the water was contaminated with a singular addition of the peat extract. But under normal circumstances, rain would continue to push new dissolved organic matter into the ocean.

There were some other quirks of the experiment, too, that might have mitigated the effects of coastal darkening.

The organisms that lived on the bottom of the tank, for example, were largely unaffected. The vats had chambers that changed the water level to mimic the rise and fall of the tides. Striebel suspects the decrease in water depth at low tide meant more light could reach the life on this artificial seafloor. This wouldn’t necessarily be the case in some places that do not receive much natural light even at low tide.

According to [research](#) by Amanda Poste, an aquatic ecologist at the Norwegian Institute for Water Research, darkening could also have a pronounced chemical effect.

Along with various microorganisms, sunlight breaks down some toxic chemicals, including methyl mercury, that end up in some waterways. Poste’s study showed that if light is less able to penetrate the water, methyl mercury sticks around longer, potentially giving the pollutant enough time to transfer through the food web to fish and, eventually, humans.

Though researchers are only beginning to study its effects in detail, there’s strong evidence that coastal darkening is happening—and has been for a long time.

Bulletin Board

Curiosities

FEB. 19, 2021

Over the past 100 years, the North Sea has been growing markedly darker, according to a [2019 study](#) by biologist Anders Frugård Opdal at the University of Bergen in Norway.

This darkening, Opdal shows, may have already caused up to a three-week delay in the usual “bloom” of phytoplankton in the North Sea, when lengthening daylight and an influx of nutrients cause rapid population growth. The timing of these blooms is essential to some species, such as fish that rely on [phytoplankton for food](#) when they spawn.

All in all, it’s difficult to pin down any specific consequences of coastal darkening, says Opdal. The darker water may even be having some benefits, such as sheltering some species from predators. Somewhat ironically, while global warming is expected to push plankton to bloom earlier in the year, in the North Sea that change may have been somewhat mitigated by the darker water. It’s a tricky thing to study with many moving parts, Opdal says.

Environmental regulations around fertilizer use, and efforts to tackle greenhouse gas emissions, mean that in some places—such as the North Sea, parts of North America, and the Mediterranean Sea—the situation is already improving. There, the water is either staying at the same level of murkiness or even getting clearer. But such improvements are not the case everywhere, Zielinski says: more data is needed from around the world to really understand the breadth of the phenomenon.

[hakaimagazine.com](#), 10 February 2021

<https://www.hakaimagazine.com>

How paving with plastic could make a dent in the global waste problem

2021-02-11

A road running through Accra, Ghana’s capital, looks like any other blacktop. Yet what most drivers don’t realize is that the asphalt under them contains a slurry of used plastics — shredded and melted bags, bottles, and snack wraps — that otherwise were destined for a landfill.

The impetus for many similar road projects underway in Ghana was an ambitious plan announced by President Akufo-Addo in 2018. It calls for Ghanaians to strive for a circular model, to recycle and reuse as much plastic waste as they produce each year — roughly 1.1 million tons — by 2030.

Bulletin Board

Curiosities

FEB. 19, 2021

Barely 5 percent of the 5,000 tons of plastic that Ghanaians discard each day makes it to recycling facilities. The rest winds up in landfills, illegal dumps, streets, and waterways, or is burned in open pits, poisoning the air. In a developing nation, “it’s difficult to recycle plastic,” noted Heather Troutman, program manager of the [Ghana National Plastic Action Partnership](#). “It’s expensive, complicated, technical, and much easier just to burn it. But if you could put value on recycled plastic,” by turning it into fishing nets, fuel, or paving material, “it won’t get buried; it won’t get burned; it won’t make it to the ocean.”

First appearing in [India](#) two decades ago, [plastic roads](#) are being tested and built in more and more countries as the world’s plastic pollution problem becomes more acutely felt. India has installed over 60,000 miles of these roads. The technology, meanwhile, is gaining ground in Britain, Europe, and Asia. Several countries — South Africa, Vietnam, Mexico, the Philippines, and the United States, among them — have built their first plastic roads only recently.

A growing number of studies say that roads containing waste plastic have the potential to perform as well or better than traditional roads. They can last longer, are stronger and more durable in respect to loads and rutting, can tolerate wide temperature swings, and are more resistant to water damage, cracking, and potholes. The technology also has the potential to reclaim anywhere from a small to a sizeable amount of plastics from landfills and random dumping, researchers are finding, while providing a significant amount for road paving and repair. In a small nation like Ghana, where only [23 percent](#) of roads are presently paved, waste plastic could go a long way.

“We have to be realistic at some point in how we try to remediate the vast problem of plastic pollution,” Doug Woodring, the founder of [Ocean Recovery Alliance](#), said in an email. “I believe plastic roads, if done to scale, in combination with other uses for reclaimed plastic, like concrete and fuel, will offer an opportunity to absorb hundreds of thousands of tons, almost overnight.”

The technology of incorporating waste plastic into paving materials is likely to take a long time to evolve. While widely in use in India, it is still in its nascent stages in other countries. However, given that only 9 percent of the 350 million tons of plastic that humans produce each year is recycled, advocates see the technology as one of many strategies that can help humans quit the habit of blindly sending waste downstream and adopt the practices essential for a circular economy: reduce, reuse, recycle.

Bulletin Board

Curiosities

FEB. 19, 2021

“The beauty of roads is that there are lots and lots of them,” said Greg White, a paving engineer at Australia’s University of the Sunshine Coast. Four companies have so far constructed hundreds of miles of plastic roads in Australia, “primarily smaller local roads,” he noted. “That’s mainly because the local councils are far more willing to try things that are viewed as sustainable, as opposed to government departments that oversee big highways.” Added White, who has studied products from the Scottish company MacRebur, a leading manufacturer of plastic paving materials, “For those properties we can test, there’s absolutely no doubt that if you put the right plastic in the asphalt, you can improve the properties of the surface.”

What’s missing, he and others caution, are data on how well plastic roads age and endure over time, since in most countries the technology has been in use for less than seven years.

While different companies are pursuing different approaches, the general idea is that waste plastic is melted and mixed with other ingredients for making road asphalt. Ordinarily, asphalt is composed of 90 to 95 percent aggregate — whether gravel, sand, or limestone — and 5 to 10 percent bitumen, the black goopy substance extracted from crude oil that binds the aggregate together. When contractors add waste plastics — which can serve as an even stronger binding agent than bitumen — they often replace just 4 to 10 percent of the bitumen, though some methods call for much more. Plastic roads, therefore, are not solid ribbons of plastic — far from it.

Research suggests that “using waste plastic in road construction helps to improve substantially the stability, strength, fatigue life, and other desirable properties of bituminous mixes, leading to improved longevity and pavement performance,” Michael Burrow, an engineer at the University of Birmingham and senior author of a global study of the technology, said in an email. “Albeit, it may be too early for many of the reported applications to show premature failure.”

According to Toby McCartney, cofounder and CEO of MacRebur, using waste plastics in road paving can absorb a significant volume of discarded plastic. “Of the waste plastics that are a problem for municipalities, we could use about 40 percent of it, if we got every road containing waste plastic,” said McCartney. “At the moment, we’re lobbying to try to get waste plastics included within the standards. Until that happens, it’s on a smaller scale than we would like it to be.” According to the company’s website, every ton of MacRebur mix contains the equivalent of 80,000

Bulletin Board

Curiosities

FEB. 19, 2021

plastic bottles; every kilometer of road paved with its product contains the weight of nearly 750,000 plastic bags.

MacRebur’s plastic material is crumbed down to the size of rice grains, bagged, and sold to construction and asphalt companies globally. Since MacRebur’s launch in 2016, its materials have gone into hundreds of miles of roads, paths, driveways and parking lots in Turkey, Japan, Saudi Arabia, Dubai, Australia, New Zealand, and elsewhere. In the U.S., the company is establishing a presence on both coasts, with a factory planned for Tampa, Florida, and manufacturing agreements in California.

Pursuing a different approach, PlasticRoad in the Netherlands avoids traditional asphalt altogether. In 2018, the company completed a 100-foot pilot project in Zwolle, billed as the world’s first recycled plastic bike path. A second one followed in Giethoorn. Cheap to produce and easy to install, these paths are built with hollow modules made of single-use discarded plastics. In Ghana, Nelplast mixes shredded plastic waste with sand and molds the mixture into pavement blocks.

Piling Up: How China’s ban on importing waste has stalled global recycling. [Read more.](#)

In India, where 50 percent of the country’s roads were unpaved only a few years ago, as many as 14,000 miles of new roads have been installed since India’s Minister for Road Transport made it mandatory, in 2016, to add waste plastic into bituminous roads. India’s plastic road technology grew out of experimentation done in 2001 by R. Vasudevan, a chemistry professor at the Thiagarajar College of Engineering in Madurai. Recognizing the similarities between plastic and bitumen, both derived from petroleum, he mixed shredded plastic with gravel, then bitumen, and saw a good bonding effect. Vasudevan’s method reportedly employs two types of plastic: LDPE, or low-density polyethylene used in plastic bags, and PET, polyethylene terephthalate, used in soda bottles. MacRebur’s McCartney recalls being in India in 2016 and noticing people repairing potholes by plugging them with plastic bags and lighting them on fire. It gave him the idea behind MacRebur.

How environmentally friendly are plastic roads? One concern is that heating plastic for making asphalt can create carbon emissions, thus negating any emissions savings from using less bitumen. Vasudevan says that for his own method, it’s only necessary to heat plastic to 170 degrees Celsius (338 degrees Fahrenheit), which is well within a safe range. “Plastics, as they’re heated, go from solid to liquid to gas, and it’s only above 270 degrees C, when they’re at their gassiest, that they

Bulletin Board

Curiosities

FEB. 19, 2021

release gases,” explained Troutman, who is also an environmental scientist. McCartney calculates that for every ton of bitumen left out of asphalt, as much as a ton in CO₂ emissions is saved, since less petroleum is heated for bitumen’s extraction. The processing of petroleum-based asphalt is responsible for sizable greenhouse gas emissions each year.

Another concern about plastic roads is that they will shed microplastics. No one has yet reported that this has occurred, and those interviewed for this article say they don’t see microplastics as a problem. “Road material is relatively inert, a solid block of asphalt,” noted Troutman. “In fact, the largest source of microplastics on the planet is abrasion of tires.”

Last summer, a pilot project in California drove home just how much rigorous testing has to occur before a road, if paved with a novel material like plastic, is deemed drivable and safe, especially a major highway driven over by big rigs with heavy loads. Highway 162 in Oroville was in the [headlines](#) last August when Caltrans, the California Department of Transportation, working with TechniSoil Industrial, which supplied the liquified plastic, paved a 1,000-foot test strip. It was Caltrans’ first time using this new approach. “I hate plastic,” said Tom Pyle, who heads Caltrans’ Office of Asphalt Pavement Program. “I won’t even drink out of a plastic bottle — and if there’s a way of using waste plastic to make a road last longer, let’s do it.”

Their machines went out, ground up the top layer of old road, turned it to gravel, mixed in PET from recycled soda bottles — which has the consistency of “Gorilla Glue,” Pyle noted — and lay the mixture back down. No extra gravel or bitumen was used. Later, an engineer checking the job sent word that the new surface “moved” and felt unsafe. Caltrans ended up replacing it with traditional asphalt. “That was our first trial section for plastic,” said Pyle. “We didn’t want any accident for any reason to taint the goal of building a plastic road.”

Far from being deterred, Caltrans likely will install another test section in Oroville next spring. Pyle said that they will use new construction methods and aim for “higher strength.” “We don’t yet know how thick this material needs to be to carry thousands of trucks a day,” he said.

The Plastics Pipeline: A surge of new production is on the way. [Read more.](#)

Troutman views plastic roads as “a promising advance,” especially in a country like Ghana with a backlog of road projects. And yet, with the looming [prospect](#) that by 2050 the world will produce over three times as much plastic waste as it ever has, she stresses the importance of Ghana’s

Bulletin Board

Curiosities

FEB. 19, 2021

curtailing all unnecessary use of new plastics. “That’s the first step,” she noted. “If we keep pumping out more and more plastic, we’ll never be able to manage it in a sustainable way.”

e360.yale.edu, 11 February 2021

<https://www.e360.yale.edu>

Is there a limit to how much the coronavirus can mutate?

2021-02-11

The coronavirus is mutating, picking up genetic changes as the world races to vaccinate people as fast as possible.

It’s normal for viruses, including SARS-CoV-2, to mutate. But is there a limit to how much the virus can mutate and still make people sick — or can the virus just continue to evolve indefinitely?

It turns out there is a limit, but we don’t exactly know what it is; and we can’t begin to predict all of the possible mutations the virus could undergo, virologists told Live Science. The number of possible genetic mutations is greater than all the [atoms](#) in the visible universe, said Vincent Racaniello, a professor of microbiology and immunology at Columbia University in New York City. “A good fraction of the genome can be replaced.”

PLAY SOUND

The coronavirus’s genetic code — made up of four different chemical bases or molecules that can be thought of as a four letter alphabet — is [29,881 letters long](#). Those letters provide instructions to make the 9,860 amino acids that are the building blocks of the virus’s [proteins](#). When those chemical bases change, amino acids also change, which can affect the shape of the virus’s proteins; those shape changes, in turn, can affect how the virus functions, such as how it binds to human cells.

Previous studies on other [RNA](#) viruses — which like SARS-CoV-2 have a single strand of RNA as their genetic material — have found that more than half of the bases in these viruses can be changed, Racaniello told Live Science. Mathematically, that means that if a virus is 10,000 base pairs long, there are 4⁵⁰⁰⁰ genetic sequence possibilities.

That’s incredibly big, considering there are 4¹³⁵ atoms in the visible universe. If the equation holds true for a virus like SARS-CoV-2, which has

It turns out there is a limit, but we don’t exactly know what it is...

Bulletin Board

Curiosities

FEB. 19, 2021

a genetic code three times as long, there could be $4^{14,941}$ different possible combinations for its genetic sequence. And that's only counting basic letter changes — one chemical replacing another; there are also other mutations such as deletions or insertions in the genome that would further increase the number of possibilities, Racaniello said.

But most of these mutations don't matter — and a huge fraction would be weeded out immediately. "Some mutations are lethal so we never see them," he said. And "many of them are neutral; they just accumulate and they're carried along." The mutations that matter are typically on the coronavirus's spike protein, the weapon it uses to latch onto the ACE2 receptors on the surfaces of human cells. The spike itself is made up of 1,273 amino acids, which are coded by 3,831 chemical bases; so by that same mathematical logic, there are 4^{1916} ways the spike protein's code could vary, which is still nearly infinite. Still, many of these mutations are redundant and code for the same amino acids.

What's more, not every mutation will be identified as a new "variant," said John Moore, a professor of microbiology and immunology at Cornell University in Ithaca, New York. "Mutations that are silent happen, but they're not relevant." The variants that are identified and are given a name will usually have noteworthy properties — such as a greater ability to transmit to humans or to escape vaccines.

Robust surveillance can help scientists scan for changes in the virus's genome through random sampling of the infected population. Once they identify potentially important mutations — for example based on where the changes appear in the genome — they can plug those mutations into a computer model of the spike protein interacting with the ACE2 receptor to make predictions on how the variant will behave. But to ultimately understand how the mutation changed the behavior of the virus, they have to do experiments on the virus or proteins, Moore said.

Past mutations

The very first SARS-CoV-2 variant was identified last spring when the original virus first detected in Wuhan was replaced by a new variant called D614G, which likely emerged in Europe, [according to a JAMA perspective](#) that Moore co-authored. Not until late summer did scientists discover that the main mutation in that variant likely increased its ability to replicate and spread, Moore said.

While SARS-CoV-2 doesn't mutate as much as HIV or influenza does, "you put a virus like this in 100 million people and mutations are going to

Bulletin Board

Curiosities

FEB. 19, 2021

occur," Moore told Live Science. In August, another variant called B.1.1.7 emerged in the U.K., and its spread accelerated in November. Early studies suggest that the variant's major mutation, called N501Y, again increased transmissibility, but likely didn't evade neutralizing antibodies that developed in response to D614G and other earlier strains of the novel coronavirus.

Separately, a more worrying mutation took hold in South Africa. This one, called B.1.351 or N501Y.V2, has a similar mutation to the U.K. variant; but this one also has other mutations located close to the receptor binding site of the spike protein — the spot where the spike protein binds to ACE2 on human cells. The key mutation here is one called E484K, which changes the shape of the receptor binding domain (RBD) enough that antibodies that recognized earlier strains might have a hard time recognizing this new one.

Several early studies have suggested that vaccines, such as those by Moderna, Pfizer, Novavax and Johnson & Johnson, still protect against this variant but don't work as well against it as they do for the earlier variants, which they were designed to target.

Another similar variant to B.1.351, called P.1, also cropped up in Brazil, and because of its similarities to the South Africa variant, it could also be concerning. Now, scientists are finding a handful of B.1.1.7 variants that have also mutated to include the E484K mutation.

The RBD domain is one — but not the only — concerning spot where mutations can occur. It's made up of 223 amino acids, 22 of which make contact with the ACE2 receptor on human cells, Racaniello said. Any one of these amino acids can change (due to mutations in the domain's underlying genetic sequence) and increase its contact with human cells, and thus its ability to invade.

Why are all these mutations happening?

Mutations sometimes reflect the so-called founder effect. The virus mutates and a variant becomes dominant because it happened to hop into a person who spread the virus widely. That doesn't necessarily mean that there's an advantage to the mutation.

But sometimes the same — or very similar — mutations, such as N501Y, pop up in different parts of the world. That normally means that the mutation confers an advantage to the virus, said Mohsan Saeed, an assistant professor of biochemistry at Boston University School of

Bulletin Board

Curiosities

FEB. 19, 2021

Medicine and an investigator in the university's National Emerging Infectious Diseases Laboratories.

The virus is already extremely good at infecting people, so any future advantage it gains from mutations, will likely not be dramatic, he said. "If your radio is already very loud at volume 10, turning it up to 11 is not going to make a huge difference," Saeed told Live Science.

Still, "we will see what happens when the vaccine is administered at a massive scale," he said. In such situations, the vaccines may spur the viruses to develop «escape mutations» to block the ability of neutralizing antibodies.

Future mutations

SARS-CoV-2 has been circulating in the human population for only a short time, so "scientists are not yet in a position to make predictions about what variants will emerge in the future," based on simulations or past history with the virus, Saeed said. "It is mainly stochastic," or random, he said.

We're not calling the shots, we're reacting, Moore said. In other words, mutations are occurring in the wild and scientists are then figuring out what their impact will be on transmissibility, lethality or vaccine escape. Though it would be nice to be one step ahead of the virus — for instance predicting, based on simulations, what other mutations could emerge — that's likely not feasible given the extent to which the virus can mutate.

"Proteins are very flexible in their abilities to interact with receptors or antibodies; they are capable of [tolerating] mutation in quite a number of different ways to achieve the same endpoint," Moore said. And so "you cannot predict what's going to happen."

Scientists may be able to predict some very obvious mutations that can pop up, such as certain amino acid changes on the spike protein that impact antibody binding or alterations in the spike's RBD which would impact the virus's ability to stick to and enter human cells, Racaniello said. "But that is only part of [the] spike and many other changes can impact fitness."

Though scientists can't predict which mutations will give the virus an edge, they know those mutations will emerge the more the virus spreads.

"You're going to see variants that are selected for greater transmissibility and/or antibody resistance because they're the two biggest selection pressures," Moore said.

Bulletin Board

Curiosities

FEB. 19, 2021

Strong selection pressure, such as with very high efficacy vaccines, may reduce the number of chances for the virus to replicate and mutate. Meanwhile a really weak selection pressure means the virus doesn't have to mutate, so any change will provide a negligible advantage, Moore said.

The trouble comes when we put an intermediate level of selection pressure on the virus. For instance, widespread use of weak vaccines, or stretching out the time between the first and second doses of the vaccine, when you don't have a strong antibody response could be a "breeding ground for new variants," Moore said. "We're aware of that."

So to prevent future variants, we need to make sure we are giving people vaccines on schedule, to stop so-called escape mutants from emerging. And we need to stop the spread of the virus, which allows the coronavirus more chances to mutate.

These viruses "haven't suddenly grown scissors that will cut their way through masks, they haven't grown spring-heeled boots that will bounce them 50 yards between people," Moore said. "They're still coronaviruses and they're still stoppable by the standard procedures that we should all be doing."

Because we can't predict in advance which specific mutations will emerge. The only way to stay two steps behind the virus, rather than 20, is to dramatically ramp up surveillance for new variants, Moore said. That way, scientists can catch and test the impact of new variants in the lab before they become widespread.

If the variants become impervious to our vaccines, it's pretty simple to modify Pfizer's and Moderna's mRNA vaccines, to create booster shots by swapping out the genetic sequence used to teach the body to recognize the spike protein with the new mutated sequence, [Live Science previously reported](#).

"The other point to remember is that when you're talking about these variants they haven't suddenly grown scissors that will cut their way through masks; they haven't grown spring-heeled boots that will bounce them 50 yards between people," Moore said. "They're still coronaviruses and they're still stoppable by the standard procedures that we should all be doing."

Bulletin Board

Curiosities

FEB. 19, 2021

Originally published on Live Science.

livescience.com, 11 February 2021

<https://www.livescience.com>**Assisting evolution: how far should we go to help species adapt?**

2021-02-09

I spent 15 years removing cats from fenced reserves and national parks," Katherine Moseby was saying. "And then, all of a sudden, I was putting them back in. It felt very strange to be doing that."

It was a hot, intensely blue day in the Australian Outback, about 350 miles north of Adelaide. I was tagging along with Moseby as she checked the batteries on the motion-sensitive cameras that dot Arid Recovery, an ecosystem restoration project she and her husband launched in 1997. The project sprawls over 47 square miles of red earth and scrub. It's entirely surrounded by a six-foot-tall fence, which is designed to keep out feral cats and foxes.

Inside the main fence is a series of smaller fenced-in paddocks. Several years ago, Moseby decided to start adding cats into some of these. Her reasoning was simple and, in its own way, radical. The outback ecosystem had been so fundamentally changed, that, if the native animals were to survive, they would have to change, too. Perhaps they could be trained to avoid cats, which were introduced to the country by the British colonists and now can be found virtually everywhere in Australia, including most islands.

"A lot of the focus has been on trying to come up with methods of killing cats better," Moseby, who holds a PhD in reintroduction biology, said. "And we sort of started looking at it from the prey perspective, like, what about if we make prey better? Will that help? Because ultimately coexistence is where we're trying to get to. We're not going to ever get rid of every cat in the whole of Australia." It's estimated that there are as many as 6 million feral cats in the country, and that they kill some 800 million native animals annually. (Foxes, also introduced by the British, are very nearly as widespread; they are somewhat easier to control, though, because they will more readily eat poison bait.)

Over the last several years, Moseby and her colleagues at Arid Recovery have experimented with two threatened marsupial species: the greater

It's estimated that there are as many as 6 million feral cats in the country, and that they kill some 800 million native animals annually.

Bulletin Board

Curiosities

FEB. 19, 2021

bilby, which looks like a small rabbit with a long nose, and the burrowing bettong, also known as the boodie, which has a squirrel-like face, skinny hind legs, and a long tail. They've added a small number of cats to some of the paddocks and then painstakingly recorded the results. The idea is to put enough pressure on the marsupials to produce behavioral or — even better — evolutionary change, but not so much pressure that all the animals wind up dead.

"There's a lot of evidence to show that evolution can occur over very short time periods, particularly when there's strong selection," Moseby observed.

Of course, cats and foxes are already putting strong selective pressure on Australia's native species — so strong that many are no longer around. Among mammals, the country's extinction rate is the highest in the world. The lesser bilby — the greater bilby's cousin — disappeared sometime in the mid-20th century. The crescent-tailed wallaby, the desert bandicoot, and the Lake Mackay hare-wallaby vanished around the same time. All, it's believed, were done in by introduced predators. The greater bilby, for its part, was once abundant throughout most of Australia; today the total population is estimated at fewer than 10,000. The burrowing bettong was one of the most common animals in the country; it's now restricted to islands and reserves like Arid Recovery.

One of the reasons cats and foxes have been so deadly is they were abetted by introduced prey. European rabbits were imported to Australia in 1859; they multiplied and spread so quickly that within a few decades the population numbered in the hundreds of millions. Not only did the rabbits compete with native mammals, but also they allowed the number of cats and foxes to similarly explode. The predators could hunt native mammals to extinction and still do just fine.

The Fear Factor: How the peril of predators can transform a landscape. [Read more.](#)

"Normally, if you have a predator-prey relationship, the prey doesn't go extinct because they rely on each other," Moseby observed. As it was, "the cats and foxes increased into hyper-abundance." Creatures like the lesser bilby and the desert bandicoot "didn't have a chance to evolve because it all happened very quickly."

The hope that motivates Moseby's work is that given a chance, which is to say more time, species may be able to adapt to introduced predators. The results so far have offered some encouragement, but have also proved difficult to interpret.

Bulletin Board

Curiosities

FEB. 19, 2021

In one experiment, Moseby and her colleagues released five cats into a fenced-in paddock with a few hundred greater bilbies and left them there for two years. They then caught some of the surviving bilbies and as well as some bilbies from a “predator-free” paddock and attached radio transmitters to their tails. The two groups of radio-tagged bilbies were transferred to another paddock with more cats. After 40 days, only a quarter of the “naïve” bilbies were still alive. By comparison, two-thirds of the “predator-exposed” bilbies had managed to avoid predation. This showed that the bilbies who’d been exposed to cats had better survival skills. But whether these skills were learned or involved selection for bilbies with more cat-savvy genes was — and remains — unclear.

Meanwhile, bettongs that were exposed to cats for 18 months showed changes in behavior that suggested they’d become more predator-wary; for instance, they approached food that had been left out for them more slowly. Once again, though, it was hard to know what these changes indicated.

“The mechanisms are there, but there’s the question: How fast can it happen?” Moseby said. “People say to me, ‘Oh, this could take a hundred years.’ And I say, ‘Yeah, it could take a hundred years. What else are you doing?’ I might not be alive to see it, but that doesn’t mean that it’s not worth doing.”

Moseby “is the most innovative conservation scientist alive, as far as I’m concerned,” Daniel Blumstein, a professor of ecology and evolutionary biology at the University of California, Los Angeles., who has worked with her on several research papers, told me. “She is just so creative.”

Moseby’s is one of a growing number of conservation projects that proceed from the premise it’s no longer enough to protect species from change. Humans are going to have to intervene to *help* species change.

More than 1,000 miles northeast of Arid Recovery, at the Australian Institute of Marine Science’s National Sea Simulator, near the city of Townsville, researchers are working to produce corals that can survive warmer temperatures. The effort involves crossing corals from the central part of the Great Barrier Reef, where the water is cooler, with corals from the northern part of the reef, where it’s hotter. The offspring of these crosses are then subjected to heat stress in the labs of the Sea Simulator. The hope is that some of them will prove better able to withstand higher temperatures than either of their parents. As part of this effort, researchers are also subjecting generations of coral symbionts to heat stress, in an attempt to select for hardier varieties. (The symbionts — tiny algae from

Bulletin Board

Curiosities

FEB. 19, 2021

the genus *Symbiodinium* — provide corals with much of the food they need to build reefs.) The approach has been dubbed “assisted evolution.”

When I visited the SeaSim, as it’s called, it was coral spawning season and a post-doc named Kate Quigley was in charge of the crosses. “We’re really looking for the best of the best,” she told me.

As with bilbies and bettongs, corals are already under strong selective pressure. As the oceans warm, those that can’t take the heat are dying, while those that can persist. (According to a recent report by Australia’s ARC Centre of Excellence for Coral Reef Studies, over the past 30 years, the Great Barrier Reef has lost half of its coral populations, mainly owing to climate change.) Many scientists are skeptical that humans can really “assist” corals in the process of evolution. They note that during their annual spawning, the corals themselves perform millions upon millions of crosses; if some of the products of these unions are particularly hardy, they’ll go on to produce more corals, and evolve on their own.

Meanwhile, if the process succeeds, it won’t preserve reef diversity, but might produce the opposite: reefs dominated by a few unusually adaptable species. “One of my main objections is it’s more likely to do more harm than good,” Andrew Baird, an ecologist at James Cook University, has argued.

Then there’s the issue of scale. A few corals that can withstand higher temperatures aren’t going to repopulate the Great Barrier Reef, which is the size of Italy. To overcome this obstacle, even more radical forms of intervention would be needed. With the advent of the gene editing technology CRISPR, these are now also conceivable. If, for instance, genes associated with better heat tolerance could be identified, then corals could, in theory at least, be gene edited to carry them. Using what’s known as “gene drive” they could also, potentially, be edited to pass that trait on to their offspring. (Gene drive is a form of gene editing that overrides the normal rules of heredity.)

Already, several groups are looking into the possibility of harnessing gene drive for conservation. Genetic Biocontrol of Invasive Rodents, or GBIRd, is studying the use of gene drive to rid remote islands of rats and mice. (The group is a consortium of organizations that includes North Carolina State University, Australia’s Commonwealth Scientific and Industrial Research Organization, and New Zealand’s Biological Heritage.) Scientists in New Zealand are researching the use of gene drive to eradicate invasive wasps, and scientists at Michigan State University are investigating the possibility of using gene drive to control invasive sea lampreys in the Great Lakes. In

Bulletin Board

Curiosities

FEB. 19, 2021

Australia, it's been proposed that gene drive could be used to reduce or even eliminate feral cats. Though all of these gene-drive-for-conservation projects are now in very early stages, it seems likely that, in coming years, at least some of them will prove to be workable.

The idea of using gene editing to preserve natural systems seems, from a certain perspective, crazy. What could be less natural than a creature created in a lab? And the perils of releasing gene-edited organisms — particularly those equipped with gene drive — are clearly enormous.

But at a time when the border between the natural and the manmade, the wild and the synthetic, is becoming increasingly blurred, gene editing animals to protect them — or to protect other species from them — may become increasingly appealing. Already, researchers at the SUNY College of Environmental Science and Forestry in Syracuse, New York have produced a genetically-modified American chestnut tree that's resistant to chestnut blight, the fungal pathogen that, in the early decades of the 20th century, killed off nearly every chestnut tree in North America. (The modified tree contains a key gene borrowed from wheat.) The tree has been submitted for federal approval, and a decision is expected sometime in the next year or so.

As for "assisted evolution," such efforts, it could be argued, were already underway long before the term was invented. The American Chestnut Foundation, for instance, has been working for decades to create a blight-resistant chestnut tree via conventional breeding methods. These trees would be hybrids — American chestnuts crossed with Chinese chestnuts — and so, they, too, would contain genes from two different species, albeit closely-related ones.

As Kent Redford, a conservation consultant, and Bill Adams, a professor of conservation and development at Cambridge, put it in their forthcoming book, *Strange Natures*: "The idea that conservation must protect what is 'natural' is understandable." However, "the distinction between what is natural and what is artificial no longer provides a sound guide to thinking about people and nonhuman life."

e360.yale.edu, 9 February 2021

<https://www.e360.yale.edu>

Bulletin Board

Curiosities

FEB. 19, 2021

Illicit centipede raises thorny question: Should journals have refused to publish a paper about it?

2021-02-10

In 2018, a new species of centipede graced the pages of the prominent taxonomy journal *Zootaxa*. More than 14 centimeters long, with striking teal-colored legs, it lives in the montane and mossy forests of the Philippines. Now, however, the centipede is in a harsh spotlight. The Philippine government says the Spanish neurologist and amateur biologist who described the species acquired his specimens illegally.

Neither the journal's editors nor its peer reviewers caught the lapse—and the journal has no policy requiring documentation that specimens have been collected with proper permits. Some editors tell *Science* that should change. Others worry about hampering research when undescribed species are vanishing fast. And all agree that journals would struggle to enforce any such rules, given the wide variation in countries' legal requirements. "There is simply no way for a journal to police this," says Maarten Christenhusz, an independent botanist and editor-in-chief of the *Zoological Journal of the Linnean Society*.

Carles Doménech of the University of Alicante in Spain had contacted Filipino collectors after seeing images of the centipede online. One, Michael Andrew Cipat, caught wild centipedes and sold them—dead and alive—to Doménech in 2016 and 2017. Cipat tells *Science* he had collecting permits and that a friend with export permits shipped the specimens. But the Philippine Department of Environment and Natural Resources says it is illegal to sell specimens to a foreign researcher who has not signed an agreement with DENR. "The Philippine government does not tolerate such illegal acts," a representative wrote to *Science*. The collectors could be imprisoned or fined under a Philippine wildlife protection law.

Doménech says he didn't know he needed permits to export the centipedes, calling himself a "newbie" who worked largely alone. After he submitted his paper describing the new species, which he named *Scolopendra paradoxa*, neither *Zootaxa* nor any of the five reviewers of his manuscript asked about permits, he says. "Now I know it [was] a mistake," he wrote in an email. "Now I capture my specimens and don't let anybody do it for me without the corresponding legal permits."

Zhi-Qiang Zhang, editor-in-chief of *Zootaxa*, who studies mites at Landcare Research in New Zealand, says that even though the journal

The Philippine government says the Spanish neurologist and amateur biologist who described the species acquired his specimens illegally.

Bulletin Board

Curiosities

FEB. 19, 2021

does not impose permit requirements, individual editors may reject manuscripts that lack permits. He says the journal's editors had previously discussed whether it should instruct authors to follow permit requirements and could not agree. "Most editors had negative views about 'permits' or 'legal requirements' for specimens," Zhang says, citing opinions that such regulations curb biodiversity research and conservation.

One reviewer of Doménech's manuscript, Carlos Martínez, a centipede taxonomist at the University of Turku's Zoological Museum, says he was "really mad" to learn about the origins of the centipede specimens. "As reviewers, we have the right to know if the specimens were illegally obtained," he says. "We have the right to refuse to review the paper." Martínez says he interviewed four of the five Filipino collectors named in the paper and confirmed the specimens were illegal. But he says reviewers can't be expected to routinely probe the legality of specimens. "We reviewers are not supposed to be the police."

Illegal specimens in research have been exposed occasionally, but journal editors disagree about the magnitude of the problem. One editor described it as "insignificant"; another said it is "impossible to know." They also disagree on what to do about it. Louis Deharveng, deputy editor-in-chief of *ZooKeys* and an emeritus arthropod researcher at the National Museum of Natural History in Paris, says an editorial policy on permits "is essential."

But among five respected taxonomy journals, two—the *Zoological Journal of the Linnean Society* and *Zootaxa*—do not instruct authors to abide by specimen-collecting laws. (*Science* will soon add such compliance with legal requirements to its editorial policy.)

Shaun Winterton, editor-in-chief of *Systematic Entomology* and an entomologist at the California Department of Food and Agriculture, says his journal tells authors to follow the law, but adds, "If we as editors suspected that material was illegally collected, it could be difficult for us to confirm." (He notes that he is speaking on behalf of the journal, not his employer.) The complex and varying legal conditions that countries impose on research are one obstacle.

A further complication is the international Nagoya Protocol, which aims to ensure "fair and equitable sharing of benefits arising from the utilization of genetic resources." The agreement may govern the import of some specimens, but whether it applies to taxonomy specimens is unclear. The Nagoya Protocol allows each signatory country to define what constitutes

Bulletin Board

Curiosities

FEB. 19, 2021

use of genetic resources; Spain says the EU legislation that enforces the Nagoya Protocol does not apply to taxonomic studies such as Doménech's.

Gonzalo Giribet, editor-in-chief of *Invertebrate Systematics* and a zoologist at Harvard University, adds that reviewers can't take on the responsibility either. "They are doing this altruistically," he says, making him leery of adding legal concerns to their reviewing burden. "Journals should have clear statements about the origins of the biological materials and ethics, and the ultimate responsibility [for legality] should lie with the authors."

Clear information about legal requirements would help reviewers, editors, and researchers, says Caroline Fukushima, an arachnologist at the Finnish Museum of Natural History. In June 2020, in *Conservation Biology*, she and colleagues recommended creating a platform for countries' legal requirements for wildlife research. "We are facing habitat destruction, so we must make life easier and faster for scientists," she says.

sciencemag.org, 10 February 2021

<https://www.sciencemag.org>

Can privacy coexist with technology that reads and changes brain activity?

2021-02-11

Gertrude the pig rooted around a straw-filled pen, oblivious to the cameras and onlookers — and the 1,024 electrodes eavesdropping on her brain signals. Each time the pig's snout found a treat in a researcher's hand, a musical jingle sounded, indicating activity in her snout-controlling nerve cells.

Those beeps were part of the big reveal on August 28 by Elon Musk's company Neuralink. "In a lot of ways, it's kind of like a Fitbit in your skull with tiny wires," said Musk, founder of Tesla and SpaceX, of the new technology.

Neuroscientists have been recording nerve cell activity from animals for decades. But the ambitions of Musk and others to link humans with computers are shocking in their reach. Future-minded entrepreneurs and researchers aim to listen in on our brains and perhaps even reshape thinking. Imagine being able to beckon our Teslas with our minds, Jedi-style.

Some scientists called Gertrude's introduction a slick publicity stunt, full of unachievable promises. But Musk has surprised people before. "You can't

"In a lot of ways, it's kind of like a Fitbit in your skull with tiny wires," said Musk, founder of Tesla and SpaceX, of the new technology.

Bulletin Board

Curiosities

FEB. 19, 2021

argue with a guy who built his own electric car and sent it to orbit around Mars,” says Christof Koch, a neuroscientist at the Allen Institute for Brain Science in Seattle.

Whether Neuralink will eventually merge brains and Teslas is beside the point. Musk isn’t the only dreamer chasing neurotechnology. Advances are coming quickly and span a variety of approaches, including external headsets that may be able to distinguish between hunger and boredom; implanted electrodes that translate intentions to speak into real words; and bracelets that use nerve impulses for typing without a keyboard.

Today, paralyzed people are already testing brain-computer interfaces, a technology that connects brains to the digital world (*SN*: 11/16/13, p. 22). With brain signals alone, users have been able to shop online, communicate and even use a prosthetic arm to sip from a cup (*SN*: 6/16/12, p. 5). The ability to hear neural chatter, understand it and perhaps even modify it could change and improve people’s lives in ways that go well beyond medical treatments. But these abilities also raise questions about who gets access to our brains and for what purposes.

Readers’ thoughts

We asked members of the public for their take on the ethics of new brain technology. A sampling of their quotes are on the following pages.

Because of neurotechnology’s potential for both good and bad, we all have a stake in shaping how it’s created and, ultimately, how it is used. But most people don’t have the chance to weigh in, and only find out about these advances after they’re a fait accompli. So we asked *Science News* readers their views about recent neurotechnology advances. We described three main ethical issues — fairness, autonomy and privacy. Far and away, readers were most concerned about privacy.

The idea of allowing companies, or governments, or even health care workers access to the brain’s inner workings spooked many respondents. Such an intrusion would be the most important breach in a world where privacy is already rare. “My brain is the only place I know is truly my own,” one reader wrote.

Technology that can change your brain — nudge it to think or behave in certain ways — is especially worrisome to many of our readers. A nightmare scenario raised by several respondents: We turn into zombies controlled by others.

Bulletin Board

Curiosities

FEB. 19, 2021

When these types of brain manipulations get discussed, several sci-fi scenarios come to mind, such as memories being wiped clean in the poignant 2004 film *Eternal Sunshine of the Spotless Mind*; ideas implanted into a person’s mind, as in the 2010 movie *Inception*; or people being tricked into thinking a virtual world is the real thing, as in the mind-bending 1999 thriller *The Matrix*.

Today’s tech capabilities are nowhere near any of those fantasies. Still, “the here and now is just as interesting ... and just as morally problematic,” says neuroethicist Timothy Brown of the University of Washington in Seattle. “We don’t need *The Matrix* to get our dystopia.”

Today, codes of ethics and laws govern research, medical treatments and certain aspects of our privacy. But we have no comprehensive way to handle the privacy violations that might arise with future advances in brain science. “We are all flying by the seat of our pants here,” says Rafael Yuste, a neurobiologist at Columbia University.

For now, ethics questions are being taken up in a piecemeal way. Academic researchers, bioethicists and scientists at private companies, such as IBM and Facebook, are discussing these questions among themselves. Large brain-research consortiums, such as the U.S. BRAIN Initiative (*SN*: 2/22/14, p. 16), include funding for projects that address privacy concerns. Some governments, including Chile’s national legislature, are starting to address concerns raised by neurotechnology.

With such disjointed efforts, it’s no surprise that no consensus has surfaced. The few answers that exist are as varied as the people doing the asking.

Electrode bracelet

A bracelet studded with electrodes can detect tiny nerve impulses on the wrist. The bracelet (shown) uses electromyography, which picks up the behavior of nerve cells that control muscles, to eavesdrop on signals that move from the brain to hand muscles. Developed by New York City-based CTRL-Labs, a neural interface company acquired by Facebook Reality Labs in 2019, the bracelet allows users to play chess in a virtual room, control a hand avatar and type with tiny movements from inside a pocket, for instance, without a keyboard, mouse or touch screen. The technology is still in development.

Reading thoughts

Bulletin Board

Curiosities

FEB. 19, 2021

The ability to pull information directly from the brain — without relying on speaking, writing or typing — has long been a goal for researchers and doctors intent on helping people whose bodies can no longer move or speak. Already, implanted electrodes can record signals from the movement areas of the brain, allowing people to control robotic prostheses.

In January 2019, researchers at Johns Hopkins University implanted electrodes in the brain of Robert “Buz” Chmielewski, who was left quadriplegic after a surfing accident. With signals from both sides of his brain, Chmielewski controlled two prosthetic arms to use a fork and a knife simultaneously to feed himself, researchers announced in a press release on December 10.

Robert “Buz” Chmielewski, who has had quadriplegia since his teens, uses brain signals to feed himself some cake. Via electrodes implanted in both sides of his brain, he controls two robotic arms: One manipulates the knife and the other holds the fork.

Other research has decoded speech from the brain signals of a paralyzed man who is unable to speak. When the man saw the question, “Would you like some water?” on a computer screen, he responded with the text message, “No, I am not thirsty,” using only signals in his brain. This feat, described November 19 at a symposium hosted by Columbia University, is another example of the tremendous progress under way in linking brains to computers.

“Never before have we been able to get that kind of information without interacting with the periphery of your body, that you had to voluntarily activate,” says Karen Rommelfanger, a neuroethicist at Emory University in Atlanta. Speaking, sign language and writing, for instance, “all require several steps of your decision making,” she says.

Today, efforts to extract information from the brain generally require bulky equipment, intense computing power and, most importantly, a willing participant, Rommelfanger says. For now, an attempt to break into your mind could easily be thwarted by closing your eyes, or wiggling fingers, or even getting drowsy.

What’s more, Rommelfanger says, “I don’t believe that any neuroscientist knows what a mind is or what a thought is,” she says. “I am not concerned about mind reading, from the existing terrain of technologies.”

Bottom of Form

Bulletin Board

Curiosities

FEB. 19, 2021

But that terrain may change quickly. “We are getting very, very close” to having the ability to pull private information from people’s brains, Yuste says, pointing to studies that have decoded what a person is looking at and what words they hear. Scientists from Kernel, a neurotech company near Los Angeles, have invented a helmet, just now hitting the market, that is essentially a portable brain scanner that can pick up activity in certain brain areas.

For now, companies have only our behavior — our likes, our clicks, our purchase histories — to build eerily accurate profiles of us and estimate what we’ll do next. And we let them. Predictive algorithms make good guesses, but guesses all the same. “With this neural data gleaned from neurotechnology, it may not be a guess anymore,” Yuste says. Companies will have the real thing, straight from the source.

Even subconscious thoughts might be revealed with further technological improvements, Yuste says. “That is the ultimate privacy fear, because what else is left?”

Laser helmets

A helmet sends laser beams through the skull and into the brain. After bouncing off tissue and blood, the particles of light return to detectors that measure oxygen levels. Those levels indicate where in the brain nerve cells are active, thus giving clues about mental processes. This technology, called functional near-infrared spectroscopy, is the same that allows pulse oximeters to measure oxygen levels in the blood. In early 2021, the neurotechnology company Kernel, based near Los Angeles, began selling Kernel Flow helmets (shown) to researchers who are using the tools to study concussions, language and even dreaming.

Rewrite, revise

Technology that can change the brain’s activity already exists today, as medical treatments. These tools can detect and stave off a seizure in a person with epilepsy, for instance, or stop a tremor before it takes hold.

Researchers are testing systems for obsessive-compulsive disorder, addiction and depression (*SN: 2/16/19, p. 22*). But the power to precisely change a functioning brain directly — and as a result, a person’s behavior — raises worrisome questions.

The desire to persuade, to change a person’s mind, is not new, says Marcello Ienca, a bioethicist at ETH Zurich. Winning hearts and minds is at the core of advertising and politics. Technology capable of changing

Bulletin Board

Curiosities

FEB. 19, 2021

your brain's activity with just a subtle nudge, however, "brings current manipulation risks to the next level," Ienca says.

What happens if such influence finds a place outside the medical arena? A doctor might use precise brain-modifying technology to ease anorexia's grip on a young person, but the same might be used for money-making purposes: "Imagine walking into McDonald's and suddenly you have an irresistible urge for a cheeseburger (or 10)," one of our readers wrote.

Is the craving caused by real hunger? Or is it the result of a tiny neural nudge just as you drove near the golden arches? That neural intrusion could spark uncertainty over where that urge came from, or perhaps even escape notice altogether. "This is super dangerous," Yuste says. "The minute you start stimulating the brain, you are going to be changing people's minds, and they will never know about it, because they will interpret it as 'that's me.'"

Precise brain control of people is not possible with existing technology. But in a hint of what may be possible, scientists have already created visions inside mouse brains (*SN: 8/17/19, p. 10*). Using a technique called optogenetics to stimulate small groups of nerve cells, researchers made mice "see" lines that weren't there. Those mice behaved exactly as if their eyes had actually seen the lines, says Yuste, whose research group performed some of these experiments. "Puppets," he calls them.

What to do?

As neurotechnology marches ahead, scientists, ethicists, companies and governments are looking for answers on how, or even whether, to regulate brain technology. For now, those answers depend entirely on who is asked. And they come against a backdrop of increasingly invasive technology that we've become surprisingly comfortable with.

We allow our smartphones to monitor where we go, what time we fall asleep and even whether we've washed our hands for a full 20 seconds. Couple that with the digital breadcrumbs we actively share about the diets we try, the shows we binge and the tweets we love, and our lives are an open book.

Those details are more powerful than brain data, says Anna Wexler, an ethicist at the University of Pennsylvania. "My e-mail address, my notes app and my search engine history are more reflective of who I am as a person — my identity — than our neural data may ever be," she says.

Bulletin Board

Curiosities

FEB. 19, 2021

It's too early to worry about privacy invasions from neurotechnology, Wexler argues, a position that makes her an outlier. "Most of my colleagues would tell me I'm crazy."

At the other end of the spectrum, some researchers, including Yuste, have proposed strict regulations around privacy that would treat a person's neural data like their organs. Much like a liver can't be taken out of a body without approval for medical purposes, neural data shouldn't be removed either. That viewpoint has found purchase in Chile, which is now considering whether to classify neural data with new protections that would not allow companies to get at it.

Other experts fall somewhere in the middle. Ienca, for example, doesn't want to see restrictions on personal freedom. People ought to have the choice to sell or give away their brain data for a product they like, or even for straight up cash. "The human brain is becoming a new asset," Ienca says, something that can generate profit for companies eager to mine the data. He calls it "neurocapitalism."

And Ienca is fine with that. If a person is adequately informed — granted, a questionable if — then they are within their rights to sell their data, or exchange it for a service or product, he says. People ought to have the freedom to do what they like with their information.

General rules, checklists and regulations are not likely to be a good path forward, Rommelfanger says. "Right now, there are over 20 frameworks, guidelines, principles that have been developed since 2014 on how to handle neuroscience," she says. Those often cover "mental privacy" and "cognitive liberty," the freedom to control your own mental life.

Those guidelines are thoughtful, she says, but the technologies differ in what they're capable of, and in their possible ethical repercussions. One-size-fits-all solutions don't exist, Rommelfanger says.

Under-skull implants

Thin tendrils laced with hundreds or thousands of electrodes will spread out in the brain to listen in on — and perhaps even stimulate — nerve cells. So far, Elon Musk's company Neuralink, based in Fremont, Calif., has tried the method on rats and pigs in the lab. Other labs are testing implanted electrodes in people with paralysis. To make the surgery less risky and more efficient, Neuralink is building a robot that can quickly sew the electrode threads (shown attached to a charging disk) into the brain, ultimately linking people with computers.

Bulletin Board

Curiosities

FEB. 19, 2021

Instead, each company or research group may need to work through ethical issues throughout the development process. She and colleagues have recently proposed five questions that researchers can ask themselves to begin thinking about these ethical issues, including privacy and autonomy. The questions ask people to consider how new technology might be used outside of a lab, for instance.

Moving forward on the technology to help people with mental illness and paralysis is an ethical imperative, Rommelfanger says. "More than my fear of a privacy violation, my fear is about diminished public trust that could undermine all of the good this technology could do."

A lack of ethical clarity is unlikely to slow the pace of the coming neurotech rush. But thoughtful consideration of the ethics could help shape the trajectory of what's to come, and help protect what makes us most human.

sciencenews.org, 11 February 2021

<https://www.sciencenews.org>

Could there be a cluster of antimatter starts orbiting our galaxy?

2021-02-09

We don't know why the universe is dominated by matter over antimatter, but there could be entire stars, and maybe even galaxies, in the universe made of antimatter.

The anti-stars would continuously shed their antimatter components out into the cosmos, and could even be detectable as a small percentage of the high-energy particles hitting Earth. **PLAY SOUND**

Unbalanced birth

Antimatter is just like normal matter, except not. Every single particle has an anti-particle twin, with the exact same mass, exact same spin and exact same everything. The only thing different is the charge. For example, the anti-particle of the electron, called the positron, is exactly like the electron except that it has positive electric charge.

Our theories of fundamental physics point to a special kind of symmetry between matter and antimatter — they mirror each other almost perfectly. For every particle of matter in the universe, there ought to be a particle of antimatter. But when we look around, we don't see any antimatter. Earth

Bulletin Board

Curiosities

FEB. 19, 2021

is made of normal matter, the solar system is made of normal matter, the dust between galaxies is made of normal matter; it looks like the whole universe is entirely composed of normal matter.

There are only two places where antimatter exists. One is inside our ultra-powerful particle colliders: When we turn them on and blow up some subatomic stuff, jets of both normal and antimatter pop out. The other place is in cosmic rays. Cosmic rays aren't really rays but rather are streams of high-energy particles streaking in from across the cosmos and hitting our atmosphere. Those particles come from ultra-powerful processes in the universe, like supernovae and colliding stars, and so the same physics applies.

But why is antimatter so rare? If matter and antimatter are so perfectly balanced, what happened to all the anti-stuff? The answer lies somewhere in the early universe. **PLAY SOUND**

The anti-galaxy

We're not exactly sure what did it, but something went off balance in the young cosmos. Presumably in the good old days (and I'm talking when the universe was less than a second old here), matter and antimatter were produced in equal amounts. But then something happened; something caused more matter to be produced than antimatter. It wouldn't take much, just a one part per billion imbalance, but it would be enough for normal matter to come to dominate essentially the entire universe, eventually forming stars and galaxies and even you and me.

But whatever that process was — and I should mention that the detailed physics of that antimatter-killing mechanism in the early universe are currently beyond known physics, so there's a lot up in the air here — it may not have been entirely perfect. It's totally possible that the early universe may have left large clumps of antimatter alone, floating here and there throughout the universe.

Those clumps, if they survived long enough, would grow up in relative isolation. Sure, when matter and antimatter collide, they annihilate each other in a flash of energy, and that would've caused some headaches in the early universe, but if the antimatter clumps made it through that trial, they would've been home free.

Over the course of billions of years, those clumps of antimatter could have assembled together and grown larger. Remember that the only difference between antimatter and matter is their charge — all other operations of

Bulletin Board

Curiosities

FEB. 19, 2021

physics remain exactly the same. So you can form anti-hydrogen, anti-helium, and anti-all-the-other-elements. You can have anti-dust, anti-stars fueled by anti-fusion, anti-planets with anti-people drinking refreshing anti-glasses of anti-water, the works.**PLAY SOUND**

Counting backward

Astronomers don't suspect that there are entire anti-galaxies floating around out there, because their interactions with normal matter (say, when two galaxies collide) would release quite a bit of energy — enough for us to notice by now. But smaller clumps could be possible. Smaller clumps like globular clusters.

Globular clusters are small, dense clumps of fewer than a million stars orbiting larger galaxies. They are thought to be incredibly old, as they are not forming new stars in the present epoch, and are instead filled with small, red, aged populations. They are also relatively free of gas and dust — all the fuel you need to make new stars. They just sort of hang around, orbiting lamely around their larger, more active cousins, remnants of a bygone and largely forgotten era. The Milky Way itself has a retinue of about 150 of them.

And some of them may be made of anti-stars.

A team of theoretical astrophysicists calculated what would happen if one of the globular clusters orbiting the Milky Way was actually an anti-cluster, as reported in a paper recently appearing in the preprint journal arXiv. They asked a simple question: what would happen?

Unless the globular cluster plunged right through the disk of the Milky Way, it wouldn't really blow up. Since the anti-cluster would just be made of stars, and stars don't take up a lot of volume, there aren't a lot of opportunities for big booms. Instead, the anti-stars in the anti-cluster would go about their normal lives, doing normal star-like things.

Things like emitting a constant stream of particles. Or having huge flare and coronal mass ejection events. Or colliding with each other. Or dying in fantastic supernova explosions.

All those processes would release tons of antiparticles, sending them flowing out of the anti-cluster and into the nearby volume of the universe, including the Milky Way. Including our solar system, where those antiparticles would appear as just another part of the cosmic ray gang.

Bulletin Board

Curiosities

FEB. 19, 2021

So could some of the anti-particles hitting our atmosphere every single day have been launched by an anti-star millions of years ago? Right now it's too difficult to tell. There are certainly anti-particles mixed in as a part of the total cosmic ray population, but because our galaxy's magnetic field alters the paths of charged particles (normal and anti alike), it's hard to tell exactly where a particular cosmic ray actually came from.

But if astronomers are able to pinpoint a globular cluster as a particularly strong source of anti-particles, it would be like opening a time capsule, giving us a window into the physics that dominated the universe when it was only a second old.

We also couldn't ever visit the anti-cluster, because as soon as we did we would blow up.

[livescience.com](https://www.livescience.com), 9 February 2021

<https://www.livescience.com>

Lizards may be protecting people from Lyme disease in the southeastern United States

2021-02-05

Lyme disease is one of the most devastating tick-borne infections in the United States, affecting more than 300,000 people each year. It's also one of the most mysterious: The creature that spreads it—the black-legged tick—lives throughout the country. Yet the northeastern United States is home to far more cases than anywhere else. Now, researchers have identified an unexpected reason: lizards.

Black-legged ticks (*Ixodes scapularis*), also known as deer ticks, carry corkscrew-shaped bacteria that cause Lyme disease. The ticks pick up the pathogens—spirochetes that belong to the genus *Borrelia*—when they suck the blood of animals like mice, deer, and lizards. In the next stage of their life cycle, the ticks may latch onto an unlucky human. But every host transmits the microbes differently. Reptiles are worse transmitters than mammals, so ticks that have lived on reptiles are less likely to make people sick.

The north-south divide in Lyme cases is a fairly sharp line right along the border of Virginia and North Carolina. Researchers have hypothesized that disparity in cases stems from ticks feeding on different hosts in the two regions.

Reptiles are worse transmitters than mammals, so ticks that have lived on reptiles are less likely to make people sick.

Bulletin Board

Curiosities

FEB. 19, 2021

To test the idea, Jean Tsao, a disease ecologist at Michigan State University, and colleagues conducted an extensive study of eastern ticks—their abundance, behavior, and hosts—over 2 years at eight field sites across the United States. They found a clear divide in ticks' preferred hosts and behavior south of Virginia, matching the pattern of both tick infections and Lyme disease.

Tick tracker

The distribution of Lyme disease-causing bacteria in black-legged ticks in the United States. Counties where ticks carry pathogens are orange and light blue, counties in dark blue and green harbor ticks, but have no record of tick infections.

Black-legged ticks (eastern U.S.) without record of infection
Western black-legged ticks without record of infection
Ticks infected with spirochete bacteria
No records

U.S. CENTERS FOR DISEASE CONTROL AND PREVENTION; JOURNAL OF MEDICAL ENTOMOLOGY; ENTOMOLOGICAL SOCIETY OF AMERICA

The stark difference seems to be tied to one host in particular. In the northeast, black-legged ticks latch onto small mammals like the white-footed mouse, which are notorious for transmitting the Lyme disease bacteria to the bugs. But in the south, the ticks prefer to feed on lizards, particularly skinks. These sleek, smooth-scaled reptiles often live in leaves and twigs that have fallen on the ground—so-called leaf litter—and are particularly poor transmitters of the Lyme pathogens. So **fewer southern ticks are infected** and fewer people get sick—the team reported last week in *PLOS Biology*.

The researchers took the right approach to solving the mystery, says Andrea Swei, a disease ecologist at San Francisco State University who was not involved with the study. “They’re comparing apples to apples here, and this allows them to say a lot about host association patterns across a large geographic area.”

In a previous study, Tsao and her colleagues observed that northeastern and southeastern ticks also seek hosts differently. In the south, the bugs stayed under the forest litter to avoid dehydration from the heat. Northern ticks were more outgoing, climbing onto leaves and twigs, where they were much more likely to encounter and bite humans. That, combined with fewer lizards, makes ticks “a double whammy” in the northeast, Tsao says.

Bulletin Board

Curiosities

FEB. 19, 2021

“The quirks of tick ecology have consequences for human health,” says study co-author Howard Ginsberg, an ecologist at the U.S. Geological Survey’s Patuxent Wildlife Research Center. He hopes the work will inform efforts to both track and reduce the spread of Lyme disease.

Climate change may alter these patterns, Swei notes. Observations show northeastern ticks have already been expanding their ranges. At the same time, the researchers speculate that a warming climate could alter tick behaviors and the presence of particular hosts, upending the patterns of Lyme disease incidence. It is important to keep an eye on the regions around the north-south divide, Swei says. “As that zone shifts,” she says, “it would really change the disease risk for people that live right on that border.”

sciencemag.org, 5 February 2021

<https://www.sciencemag.org>

Mardi Gras is an environmental disaster

2021-02-11

Residents and businesses along the Gulf Coast may be missing the Mardi Gras festivities canceled due to the pandemic this year. The planet probably isn’t.

Shiny Mardi Gras beads used to be few in number and relatively high in quality. But in the past few decades, as numerous articles have now pointed out, the practice has gotten out of control, in a region already courting environmental disaster. Unlike other “throws” you might catch from a float, like cups and blinky toys, Mardi Gras beads aren’t safe to put in your mouth or even handle without washing your hands afterward. Last year, an [Ann Arbor Ecology Center](#) study found most Mardi Gras beads to be made of the dead electronics and computer equipment that America ships to China for disposal. Chinese companies, under more lax environmental regulations, crush and melt the electronics into beads, cover them in shiny lead paint, then ship them back to the United States glowing with neurotoxins, flame retardants, arsenic, cadmium, and other cancer-causing agents.

Environmentalists and researchers who study the Gulf are hoping cities will take the opportunity in this strangely quiet Carnival season to change how Mardi Gras is celebrated going forward. “Mardi Gras beads are polycarbonate, which is what plexiglass is made of, and it’s very dense, meaning most beads don’t float,” oceanography professor Mark

...Somewhere off the Mississippi Delta, there’s gotta be an enormous quantity of Mardi Gras beads sitting on the seafloor.”

Bulletin Board

Curiosities

FEB. 19, 2021

C. Benfield, who studies the effect of litter on the Gulf of Mexico, told me. "A lot of the beads from the parades get into the storm drains and are pumped out into canals and bayous that drain into the Mississippi River. They drop to the bottom of the river, where they're carried along the channel out into very deep water. Somewhere off the Mississippi Delta, there's gotta be an enormous quantity of Mardi Gras beads sitting on the seafloor."

New Orleans typically absorbs the fame and the blame for thousands of tons of Carnival garbage. But in fact, the entire Gulf Coast from Texas to Florida celebrates Mardi Gras by throwing poisonous beads.

American Mardi Gras was born in Mobile, Alabama, in 1703, fifteen years before New Orleans was founded. To this day, Mobile hosts parades almost every night for weeks during the pre-Lenten Carnival season, culminating on the Tuesday for which Mardi Gras is named. In 2020, Mobile's Mystics of Time parade had 138,600 people clamoring for beads thrown from 19 floats by almost 1,000 riders. "We cleaned up One Mile Creek storm drain, and it was chockablock full of Mardi Gras beads," said Casi Callaway of Mobile Baykeeper, an environmental group that received a grant specifically to reduce Mardi Gras waste in Mobile. "And all the way to the river we found beads, cups, little plastic footballs, and stuff, all headed to the Gulf of Mexico."

Pensacola, Florida's Mardi Gras last year drew around 90,000 revelers, while Carnival krewes (as the folks riding the floats are called) at Galveston, Texas's 11-day celebration threw three million beads to around 250,000 visitors. Not to be out-trashed, the state of Mississippi's 20 parades last year left behind 5,406 pounds of wasted beads. Anna Harris, executive director for the Coastal Mardi Gras Museum and a member of the Gulf Coast Carnival Association, which has paraded in Biloxi since 1908, estimates her krewe alone buys around \$500,000 worth of beads each year to throw from its 100-plus floats. "The cleanup is a war zone," Harris says. "It takes them a whole day to clean it all up. They have to vacuum out the storm drains." Similar celebrations play out in most Mississippi cities: Pass Christian, Bay St. Louis, Long Beach, Ocean Springs, and Pascagoula.

Mardi Gras could be considered one of the region's top petrochemical polluters.

Given the sheer quantity of poisonous beads dumped, all at once, year after year, along the entire Gulf Coast, Mardi Gras could be considered one of the region's top petrochemical polluters. "The chemical levels are

Bulletin Board

Curiosities

FEB. 19, 2021

sublethal, but they are adding to the overall toxin loading in the Gulf's waters," said Dr. Benfield.

Those of us missing Mardi Gras right now can take heart that at least this year, this one little year, we aren't adding to this massive problem. And in that pause, there's an opportunity to work toward a greener celebration next year.

"A beadless Mardi Gras has been hard to implement krewe-wide, because our audience likes their beads," said Maureen Shuh, recycling coordinator for Krewe of Muses, who claims that her popular ladies-only krewe is done using plastic beads.* "Through the years, we've been slowly making a conscious effort to decrease the number of beads, or anything that looks like beads." The popularity of Muses' signature throw, the hand-painted high-heel shoe, proves that homemade throws rarely end up in landfills. "All my friends give me their old shoes, we paint them, and people go crazy for them," says Shuh, who pays \$800 in dues each year to ride among 1,200 krewe members, and then spends another \$1,000 on throws. "But Muses throws are all things you can take home and use. Last year we threw out bike bells, pocketbooks, cell phone cases. We only throw beads if you can wear them every day: real jewelry."

Muses and several other large krewes are in talks with Glass Half Full, New Orleans's only glass recycler (the city recycles only plastic and aluminum). Glass Half Full collects and recycles unwanted glass into sand and glass cullet (fine crushed glass) that is used for disaster relief projects and coastal restoration, and also to make glass Mardi Gras beads, not unlike the imported Czechoslovakian beads originally thrown at parades before the 1970s plastics explosion. "We have a waste problem with glass, and we have a waste problem with beads," says Glass Half Full's Franziska Trautmann. "Some of the bigger krewes don't want to change up unless we can match China's prices for the same volume of beads, which won't happen, because we want to pay fair wages. But we have Muses, and Krewe of Red Beans is partnering with us. Rex, the 'King of Carnival', is a potential buyer. People are waking up and getting on board."

In the last several years, many small, eco-friendly, local bead companies have popped up, such as Bayou Throws and Atlas Handmade Beads. Scientists at Louisiana State University even developed biodegradable Mardi Gras beads made from algae. Concerned krewes also try to throw goodies that people will keep: Some krewes talk of switching from beads to wooden doubloon coins that people can cash in with local businesses, as Popeyes chicken restaurant did in the 1970s. The company Grounds

Bulletin Board

Curiosities

FEB. 19, 2021

Krewe sells green throws like jute sacks of local coffee, rice, and jambalaya mix.

Most of these alternatives have been around for a while now, though, and I've still never caught any algae beads along the parade routes. For now, the krewes still prefer the cheap, useless fireworks display of poisonous polycarbonates.

New Orleans city government never discusses a ban on these beads. Recycling still seems like the only "solution" most city governments are willing to try. Every city along the Gulf Coast collects used beads at the post office, library, or City Hall. The Arc of Greater New Orleans hires adults with developmental disabilities to refurbish and repackage used beads to be resold to krewes. Recycling, though, just keeps the poisonous beads in rotation.

All these beads continue to land upon a region already suffering under the thumb of Big Oil. And the threat of hurricanes. And sea-level rise. And a 6,000–7,000-square-mile "dead zone" in the Gulf where almost no living thing can breathe. One of Dr. Benfield's colleagues at LSU, Stephen Midway, has discovered high levels of polyethylene in both Louisiana seafood and Mardi Gras beads.

Coronavirus may not have too many upsides, but for this one year, the Gulf Coast isn't throwing millions of tons of poisonous beads into landfills and waterways. For just this one year, we don't have to tell our kids, "Don't put that in your mouth!" For this one year, we are not exacerbating the massive environmental problem along the banks of America's most beautiful water body. Surely that feeling is worth a few policy changes, so that Mardi Gras is a bit less toxic when it returns.

newrepublic.com, 11 February 2021

<https://www.newrepublic.com>

Bulletin Board

Technical Notes

FEB. 19, 2021

(NOTE: OPEN YOUR WEB BROWSER AND CLICK ON HEADING TO LINK TO SECTION)

CHEMICAL EFFECTS

Reduction of Pesticide Toxicity Under Field-Relevant Conditions? The Interaction of Titanium Dioxide Nanoparticles, Ultraviolet, and Natural Organic Matter

Varying attenuation of trace organic chemicals in natural treatment systems - A review of key influential factors

ENVIRONMENTAL RESEARCH

Evaluation and optimization of blanket production from recycled polyethylene terephthalate based on the coordination of environment, economy, and society

OCCUPATIONAL

Analysis of neurotransmitters associated with neuropsychiatric status in workers following lead exposure

Low-level exposure to lead dust in unusual work schedules and hematologic, renal, and hepatic parameters

Occupational Exposure to Electromagnetic Fields and Health Surveillance According to the European Directive 2013/35/EU

Is Chronic Exposure to Raw Water a Possible Risk Factor for Amyotrophic Lateral Sclerosis? A Pilot Case-Control Study

PHARMACEUTICAL/TOXICOLOGY

Gestational Exposure to Phthalates and Social Responsiveness Scores in Children Using Quantile Regression: The EARLI and HOME Studies

Exposure to perfluoroalkyl substances in early pregnancy and risk of sporadic first trimester miscarriage

Changes in the levels of headspace volatiles, including acetaldehyde and formaldehyde, in red and white wine following light irradiation