CHEMWATCH

Bulletin Board

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19 October 2021

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19 October 2021

URL:

https://apvma.gov.au/node/92846

APVMA, 19 October 2021

https://apvma.gov.au/node/92846

China's draft action plan on 'new pollutants' targets phase out of 28 priority chemicals

2021-10-13

China's Ministry of Ecology and Environment (MEE) is consulting until 22 October on a draft action plan for new pollutants, which promises new regulations, guidelines, restrictions and bans on 'priority' chemicals by 2025. The move is expected to impact multiple industries.

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The plan, published on 11 October, identifies 28 substances or substance groups as 'new pollutants', defined as those that are caused by human activities, have a clear presence in the environment and endanger human health and the environment. However, because of their relatively short history of production and use – or because their hazards have been discovered at a later stage – there are no laws, regulations or standards in China to manage them.

Read More

Chemical Watch, 13 October 2021

https://chemicalwatch.com/351804/chinas-draft-action-plan-on-new-pollutants-targets-phase-out-of-28-priority-chemicals

South Korea to update quantity limits for hazardous chemicals that require submitting chemical accident prevention management plan

2021-10-14

Published on October 8, 2021, by MoE Notice No. 2021-676, South Korea's Ministry of Environment (MoE) is now consulting on the amendments to the Regulation on the Stipulated Quantities for Toxic Substances, Restricted Substances, Prohibited Chemical Substances, and Substances subject to Authorization (hereafter referred to as the Regulation). Public comments are welcome before October 28, 2021.

Public comments are welcome before October 28, 2021.

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Chemlinked, 14 October 2021

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AMERICA

Boston passes ambitious ordinance targeting zero emissions for large buildings by 2050

2021-10-07

Highlights

- Boston Acting Mayor Kim Janey has signed the Ordinance Amending City of Boston Code, Ordinances, Chapter VII, Sections 7-2.1 and 7-2.2, Building Energy Reporting and Disclosure (BERDO 2.0) into

law, making Boston one of the first cities in the nation to impose emissions performance standards on existing buildings, with the goal of achieving zero emissions from large buildings by 2050.

- BERDO 2.0 includes several significant changes from the existing BERDO, which was until now primarily an energy reporting and disclosure ordinance.
- Many major issues are left open for further definition in the regulatory process to follow.

Boston Acting Mayor Kim Janey signed an Ordinance Amending City of Boston Code, Ordinances, Chapter VII, Sections 7-2.1 and 7-2.2, Building Energy Reporting and Disclosure (BERDO 2.0) into law on Oct. 5, 2021. The amended ordinance, which was unanimously passed by the Boston City Council on Sept. 22, 2021, makes Boston one of the first cities in the nation, alongside New York and Washington, D.C., to impose emissions performance standards on existing buildings, with the ambitious goal of decarbonizing the city's large building stock by 2050. In addition, Environmental Justice concerns and the development of local renewable energy projects are emphasized throughout BERDO 2.0.

Read More

JD Supra, 7 October 2021

https://www.jdsupra.com/legalnews/boston-passes-ambitious-ordinance-5550348/

EPA draft FY 2022-2026 strategic plan includes ambitious goals to ensure safety of chemicals for people and the environment

2021-10-12

On October 1, 2021, the U.S. Environmental Protection Agency (EPA) announced the availability of the ***Draft FY 2022-2026 EPA Strategic Plan***. **86 Fed. Reg. 54448**. The draft Strategic Plan communicates EPA's priorities and provides the roadmap for achieving its mission to protect human health and the environment. The draft Strategic Plan outlines objectives within the following strategic goals:

- Goal 1: Tackle the Climate Crisis;
- Goal 2: Take Decisive Action to Advance Environmental Justice and Civil Rights;
- Goal 3: Enforce Environmental Laws and Ensure Compliance;

The draft Strategic Plan communicates EPA's priorities and provides the roadmap for achieving its mission to protect human health and the environment.

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- Goal 4: Ensure Clean and Healthy Air for All Communities;
- Goal 5: Ensure Clean and Safe Water for All Communities;
- Goal 6: Safeguard and Revitalize Communities; and
- Goal 7: Ensure Safety of Chemicals for People and the Environment.

Goal 7 includes two objectives. Objective 7.1, "Ensure Chemical and Pesticide Safety," is intended to protect the health of families, communities, and ecosystems from the risks posed by chemicals and pesticides. It includes the following long-term goals:

- By **September 30, 2026**, complete at least eight High Priority Substance (HPS) Toxic Substances Control Act (TSCA) risk evaluations annually within statutory timelines compared with the fiscal year (FY) 2020 baseline of one;
- By **September 30, 2026**, review 90 percent of risk mitigation requirements for TSCA new chemical substances compared to the FY 2021 baseline of none;
- By **September 30, 2026**, renew 40 percent of expiring lead-based paint Renovation, Repair, and Painting (RRP) firm certifications within 30 days compared to the FY 2021 baseline of 36 percent;
- By **September 30, 2026**, complete 78 pesticide registration review cases;
- By **September 30, 2026**, consider the effects determinations or protections of federally threatened and endangered species for new active ingredients in 90 percent of the risk assessments supporting pesticide registration decisions for new active ingredients compared to the FY 2020 baseline of 50 percent;
- By **September 30, 2026**, consider the effects determinations or protections of federally threatened and endangered species in 50 percent of the risk assessments supporting pesticide registration review decisions compared to the FY 2020 baseline of 25 percent; and
- By **September 30, 2026**, support Agricultural Worker Protection Standard (WPS) pesticide safety training for 20,000 farmworkers annually compared with the FY 2018-2020 annual average baseline of 11,000.

Read More

TSCA Blog, 12 October 2021

http://www.tscablog.com/entry/epa-draft-fy-2022-2026-strategic-plan-includes-ambitious-goals-to-ensure-sa

NNCO releases 2021 NNI strategic plan

2021-10-12

On October 8, 2021, the National Nanotechnology Coordination Office (NNCO) announced the release of the 2021 *National Nanotechnology Initiative Strategic Plan*, which outlines the goals, objectives, and actions for National Nanotechnology Initiative (NNI) over the next five years.

- Goal 1. Ensure that the United States remains a world leader in nanotechnology research and development (R&D): According to NNI, NNI agencies will continue to use their full suite of authorities and mechanisms to fund nanotechnology R&D. More deliberate mechanisms will be used to connect and build communities, both within NNI and with other initiatives and priorities. The Strategic Plan introduces National Nanotechnology Challenges to mobilize the nanotechnology community to help address global issues.
- Goal 2. Promote commercialization of nanotechnology R&D: NNI states that it will enhance efforts to accelerate the scale-up, translation, and commercial application of nanotechnology R&D into the marketplace to ensure that economic, environmental, and societal benefits are realized and to help the country build back better with high-paying jobs. NNI will make more explicit connections to broad agency efforts that support transition of nanotechnologies to the regional ecosystems that exist within the United States. NNI will expand the Nanotechnology Entrepreneurship Network as a forum to connect innovators and share best practices.
- Goal 3. Provide the infrastructure to support sustainably nanotechnology research, development, and deployment: According to NNI, the need for expensive, specialized tools remains a key requirement for nanotechnology R&D. NNI states that it will support the increasing role of the cyber infrastructure (*g*., models, simulations, and data) that is critical for nanotechnology innovation enhanced by artificial intelligence, machine learning, and advanced design tools. NNI notes that facilities that support prototyping and early stages of the manufacturing process are also important for the development community and will be explored in collaboration with the private sector.
- Goal 4. Engage the public and expand the nanotechnology workforce: NNCO and NNI agencies use a variety of mechanisms to support public outreach and education from "K to grey" and will emphasize opportunities and access to resources, especially for people in traditionally underserved communities. In recognition of the importance of education, workforce development, and public engagement to the entire nanotechnology enterprise, these areas are now a stand-alone goal.

Read More

Nano and Other Emerging Technologies Blog, 12 October 2021

https://nanotech.lawbc.com/2021/10/nnco-releases-2021-nni-strategic-plan/

The Strategic Plan introduces National Nanotechnology Challenges to mobilize the nanotechnology community to help address global issues.

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Biden roadmap signals new era of PFAS regulation

2021-10-20

On October 18, the Biden administration and the U.S. Environmental Protection Agency (EPA) announced new plans for regulation of per- and polyfluoroalkyl substances (PFAS). The announcements are unprecedented in their breadth and depth of PFAS regulation—covering eight agencies and a range of issues, including PFAS in drinking water, the country's food supply and consumer products. The announcements follow increased scrutiny of PFAS over the past five years under the Obama and Trump administrations and by a number of state governments. Much of the prior focus on PFAS has come from EPA and its state counterparts addressing a small group of intensely studied, environmentally ubiquitous, long-chain PFAS, including perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS), which have not been manufactured and sold in the U.S. since 2015 and 2000, respectively.

The Biden administration's interagency regulatory effort will include the Food & Drug Administration (FDA), U.S. Department of Agriculture (USDA), Department of Transportation (DOT), Department of Defense (DOD), Department of Homeland Security (DHS), Department of Health & Human Services (DHHS), White House Council on Environmental Quality (CEQ), and EPA. EPA will continue to take the lead on a number of efforts to address PFAS, which were announced on Monday concurrently with the administration's PFAS plans as part of an updated PFAS Roadmap. EPA's focus will include PFOA and PFOS but also will shift to dozens of other PFAS chemicals, including many short-chain PFAS that remain on the market in the U.S. The range of actions on PFAS will include accelerated designations of PFAS chemicals as hazardous substances under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), widespread sampling for dozens of PFAS in Americans' drinking water supplies and a number of new toxicological studies of PFAS.

The announcements follow increased scrutiny of PFAS over the past five years under the Obama and Trump administrations and by a number of state governments.

EPA's PFAS Roadmap includes, most notably:

- Establishing national primary drinking water standards for PFOS and PFOA with associated monitoring requirements and evaluation of additional PFAS chemicals.
- Developing and proposing a rulemaking to designate PFOA and PFOS as CERCLA hazardous substances by summer 2023, as well as issuing an advanced notice of proposed rulemaking seeking public input on whether to similarly designate other PFAS chemicals.
- Enhancing PFAS reporting under the Toxics Release Inventory by closing loopholes and removing exemptions and exclusions for toxic chemical reporting by spring 2022.
- Finalizing a PFAS reporting rule under the Toxic Substances Control Act (TSCA) Section 8 by winter 2022 in order to obtain a more thorough assessment of PFAS sources and quantities nationwide.
- Publishing the final toxicity assessments for PFAS chemicals, including short-chain PFAS, GenX, PFBA, PFHxA, PFHxS, PFNA and PFDA by fall 2021.
- Restricting PFAS discharges from industrial sources via Effluent Limitations Guidelines (ELGs)—which establish national technology-based regulatory limits on pollutants discharged into municipal treatment works and surface waters—by 2022.
- Reducing PFAS discharges and increasing PFAS monitoring via the existing National Pollutant Discharge Elimination System (NPDES) permitting regime.
- Publishing final recommended ambient water quality criteria for PFAS by winter 2022 for aquatic life and fall 2024 for human health.
- Developing the foundation for future designation of certain PFAS as Hazardous Air Pollutants (HAPs) under the Clean Air Act.
- Undertaking miscellaneous research and development of technology for assessing and remediating PFAS in the environment.

Read More

Lexology, 20 October 2021

https://www.lexology.com/library/detail.aspx?g=9a23f31b-8bf3-47d8-b144-3b8b721051cd

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EUROPE

Risk assessment of pesticides for amateur/home garden use

2021-10-21

An outline of the UK risk assessment scheme used to evaluate the risk to non-target organisms from plant protection products (PPPs) intended for use in private gardens by the amateur/home garden market.

Document

Amateur/home garden products: UK risk assessment scheme (PDF)

PDF, 413KB, 14 pages

Details

This new guidance document applies to applications made to Northern Ireland and Great Britain. It enables applicants for products with an amateur use to risk envelope to a professional use risk assessment for which risk mitigation measures are in place for the aquatic compartment.

Products with buffer zones over a certain size will no longer be authorised for amateur use.

The document includes:

- details of the specific requirements for each area of the ecotoxicological risk assessment
- details of the labelling requirements for amateur/home garden products in relation to the ecotoxicological risk assessment
- a summary of the labelling requirements for amateur/home garden products when an exposure assessment for a corresponding professional use is referred to which requires risk mitigation for the aquatic compartment

Read More

HSE, 21 October 2021

https://www.hse.gov.uk/pesticides/pesticides-registration/data-requirements-handbook/ecotox-home-garden.htm

Products with buffer zones over a certain size will no longer be authorised for amateur use.

Formulation studies and combined risk assessment in ecotoxicology

2021-10-21

The Ecotoxicology Team of the Chemicals Regulation Division (CRD) of the Health and Safety Executive (HSE) has recently revised their Formulation Guidance document. The previous version was published in 2015 (visit CRD Formulation Guidance document) and since then there have been various developments. As a result of these developments, the Ecotoxicology Team considered it timely to incorporate these developments and to reformat the whole document so that it was more accessible. The overall aim was to consolidate the information required on formulations and the risk assessment for products containing more than one active substance.

- Ecotoxicology formulation draft guidance

Key new areas that have been either added or revised are:

- Information about chemical analysis in mixed active products (lines 947-1195)
- Revision of criteria for combined higher tier drainflow risk assessment – alignment with EFSA aquatic guidance document (2013) (lines 715-899)

Please note that additional information will be added to the next version regarding adjuvants (lines 657-663).

HSE welcome comments on these key sections, however you are more than

welcome to comment on the whole document. In commenting please could you reference the section via page numbers and line numbers.

This consultation will run for eight weeks and will close on 13.12.21.

Read More

HSE, 21 October 2021

https://consultations.hse.gov.uk/crd/9a5d0379/

The overall aim was to consolidate the information required on formulations and the risk assessment for products containing more than one active substance.

ECHA public consultations: call for comments

2021-10-12

DEADLINE: 3 December 2021

The Great Britain Mandatory Classification and Labelling (GB MCL) process includes the consideration of information gathered from public consultations, conducted by HSE or international bodies such as the European Chemicals Agency (ECHA).

ECHA has announced a public consultation on the following proposal for harmonised classification and labelling (CLH):

- Sodium 3-(allyloxy)-2-hydroxypropanesulphonate (EC: 258-004-5; CAS: 52556-42-0). Chemical registered under REACH.

View the details.

ECHA, 12 October 2021

https://echa.europa.eu/harmonised-classification-and-labelling-consultation

Undecafluorohexanoic acid (PFHxA), its salts and related substances

2021-09-22

SEAC was given an update on the outcome of the 60-day consultation on its draft opinion on the restriction proposal (submitted by Germany). This concerned the manufacture, use and placing on the market of PFHxA, its salts and related substances. SEAC agreed its draft opinion, while RAC had already adopted its opinion on this proposal in June 2021. SEAC is expected to finalise its opinion in December 2021.

Read More

ECHA, 22 September 2021

https://echa.europa.eu/-/highlights-from-september-rac-and-seac-meetings

Substances in single-use baby diapers

2021-09-22

RAC concluded discussions on this restriction proposal submitted by France, adopting its opinion, while SEAC agreed its opinion, which will now be subject to a consultation. The consultation started on 15

DEADLINE: 3 December 2021

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September and will close on 14 November 2021, after which SEAC will finalise its opinion in December 2021. The proposal concerns hazardous substances that may be present in single-use baby diapers. It aims to reduce health risks associated with wearing diapers for children and infants under the age of three. See news from 10 September 2021.

Read More

ECHA, 22 September 2021

https://echa.europa.eu/-/highlights-from-september-rac-and-seac-meetings

Highlights from September RAC and SEAC meetings

2021-09-22

The Committee for Risk Assessment (RAC) adopted 19 opinions on harmonised classification and labelling, including the substances resorcinol, lithium salts and tetrabromobisphenol A (TBBPA), and the environmental properties of lead.

Helsinki, 22 September 2021 – RAC adopted and SEAC agreed on its draft opinion on a restriction proposal on substances in single-use baby diapers. The committees also discussed their opinions on the restriction proposal concerning lead in outdoor shooting and fishing, and SEAC also discussed its first opinion on the restriction proposal concerning Dechlorane plusTM.

A six-month stake-holder consultation will start on 22 September 2021.

Both committees agreed that the restriction proposal for 2,4-dinitrotoluene conforms to REACH requirements. A six-month stakeholder consultation will start on 22 September 2021.

The committees also *agreed* on four opinions on one application for authorisation for a use of chromium trioxide and three review reports on uses of 1,2-dichloroethane, trichloroethylene and chromium trioxide.

Altogether, RAC adopted 19 opinions on harmonised classification and labelling. The opinions include those for:

Plant protection products:

- Clothianidin (ISO);
- Cymoxanil (ISO);
- Diuron (ISO);
- Picolinafen (ISO); and

Industrial chemicals:

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- 1-phenylethan-1-one (1-phenylethylidene)hydrazone);
- Basic Red 1;
- benzyl alcohol;
- dibutyltin maleate, dibutyltin oxide;
- dimethylpropylphosphonate;
- diphenyl(2,4,6-trimethylbenzoyl)phosphine oxide;
- hydrogen sulphide;
- lead (environmental properties (review under Article 77(3)c of REACH);
- lithium chloride, lithium carbonate and lithium hydroxide;
- resorcinol;
- TBBPA;
- nonylphenol short, medium and long chain ethoxylates (NPEOs).

In addition, SEAC agreed on a document detailing its approach to assessing changes in producer surplus. The document will soon be published on ECHA's website.

Lastly, the committees agreed on appointing new co-opted members to work with both committees for the next three years.

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ECHA, 22 September 2021

https://echa.europa.eu/-/highlights-from-september-rac-and-seac-meetings

Safer Chemicals Conference 2021

2021-10-21

Enrich. Engage. Network.

Europe is leading the way towards a more sustainable and toxic-free environment.

Europe is leading the way towards a more sustainable and toxic-free environment.

How are ECHA and its partners supporting companies on the path to sustainability?

What are the regulatory expectations in the evolving landscape and how can we help you meet them?

More than 2 000 people from all over the world joined us on 6 October 2021 to share insights on this.

REACH Update

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If you missed out, the materials and recordings are available here.

Thank you for joining us!

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ECHA, 21 October 2021

https://echa.europa.eu/-/safer-chemicals-conference

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Janet's Corner

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Chemistry

2021-10-29

CHEMYSTERY

because I don't know what's happening

https://www.calpaclab.com/science-jokes/

RDX

2021-10-29

RDX, which stands for Research Department explosive, is an explosive nitroamine widely used in military and industrial applications. It was developed as an explosive which was more powerful than TNT, and it saw wide use in World War II. RDX, also known as cyclonite, hexogen, and T4 has the chemical formula $C_3H_6N_6O_6$. Its chemical name is cyclotrimethylenetrinitramine. In its pure, synthesised state RDX is a white, crystalline solid. It is often used in mixtures with other explosives and plasticizers, phlegmatisers or desensitisers. RDX is stable in storage and is considered one of the most powerful and brisant of the military high explosives. [1] RDX is a synthetic chemical, it does not occur naturally in the environment. It creates fumes when it is burned with other substances. [2]

USES [1]

RDX was widely used during World War II, often in explosive mixtures with TNT such as Torpex, Composition B, Cyclotols, and H6. RDX was used in one of the first plastic explosives. Outside military applications, RDX is also used in controlled demolition to raze structures.

SOURCES & ROUTES OF EXPOSURE

Sources of Exposure [3]

- Exposure typically only occurs in people who work with RDX and can potentially breathe RDX dust or get it on their skin.
- You can be exposed if you breathe RDX fumes from explosions or bombing ranges of burning RDX.
- You may be exposed to RDX by drinking contaminated water or by touching contaminated soil if you live near facilities that produce or use RDX. RDX has been found in water and soil near some ammunition plants, current or former military installations and storage areas.
- You may be exposed to RDX by ingesting agricultural crops grown in contaminated soils irrigated with contaminated water.

Routes of Exposure [4]

- Inhalation – Minor route of exposure for general population. Predominant route of exposure for workers.

RDX, which stands for Research Department explosive, is an explosive nitroamine widely used in military and industrial applications.

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- Oral – Predominant route of exposure to for non-occupational exposure. Exposure can occur through ingestion of contaminated drinking water or consumption of agricultural products irrigated with contaminated water.
- Dermal – Skin contact may occur during manufacture of RDX.

IN THE ENVIRONMENT

- RDX can be released to the environment through spills, firing of munitions, disposal of ordnance, open incineration and detonation of ordnance, leaching from inadequately sealed impoundments and demilitarisation of munitions. The compounds can also be released from manufacturing and munitions processing facilities.
- In the atmosphere, RDX is expected to exist in the particulate phase and settles by wet or dry deposition.
- Low soil sorption coefficient (KOC) values indicate that RDX is not significantly retained by most soils and can migrate to groundwater. However, the rate of migration depends on the composition of the soil.
- RDX can migrate through the vadose zone and contaminate underlying groundwater aquifers, especially at source areas that have permeable soils, a shallow groundwater table and abundant rainfall.
- RDX dissolves slowly in water because of its slow rate of dissolution from the solid phase and does not evaporate from water readily as a result of its low vapour pressure.
- Phototransformation of RDX in soil is not significant; however, it is the primary physical mechanism that degrades RDX in aqueous solutions. Consequently, RDX is not expected to persist for a long period of time in surface waters.
- Based on its low octanol-water partition coefficient (KOW) and low experimental bioconcentration factor, RDX has a low bioconcentration potential in aquatic organisms.
- Results from a study indicate that RDX may bioaccumulate in plants and could be a potential exposure route to herbivorous wildlife.

HEALTH EFFECTS [4]

- The most sensitive target of toxicity is the nervous system. Seizures, convulsions, and tremors have been observed in humans and animals ingesting RDX.

- Some studies have found changes in serum chemistry parameters suggestive of impaired liver function; histological alterations have not been found in the liver and the changes in clinical chemistry parameters were not considered biologically significant.
- Small decreases in erythrocyte and haemoglobin levels have been found in rodents, but this has not been consistently found longer-term studies.
- EPA has determined that RDX is a possible human carcinogen based on the presence of liver tumours in mice exposed to RDX in the diet for 1–2 years. However, a re-evaluation of this mouse study resulted in a re-classification of some of the hepatocellular adenomas as foci of cytoplasmic alterations.

SAFETY [6]

First Aid Measures

- Inhalation: Remove victim from area of exposure - avoid becoming a casualty. Remove contaminated clothing and loosen remaining clothing. Allow patient to assume most comfortable position and keep warm. Keep at rest until fully recovered. Seek medical advice if effects persist.
- Skin Contact: If skin or hair contact occurs, immediately remove any contaminated clothing and wash skin and hair thoroughly with running water. A component of this material can be absorbed through the skin with resultant toxic effects. Seek immediate medical assistance.
- Eye Contact: If in eyes, wash out immediately with water. In all cases of eye contamination, it is a sensible precaution to seek medical advice.
- Ingestion: Immediately rinse mouth with water. If swallowed, give a glass of water to drink. Get to a doctor or hospital quickly.
- Medical attention and special treatment: Treat symptomatically. Explosive material.

Fire Fighting Information

- Hazards from combustion products: Explosive material. Avoid all ignition sources. Risk of explosion by shock, friction, fire or other sources of ignition. On burning will emit toxic fumes, including those of oxides of carbon and oxides of nitrogen.
- Precautions for fire fighters and special protective equipment: Explosive material. Severe explosive hazard when shocked or exposed to heat. Confinement of burning material may result in detonation. In case of small fire where the actual explosive is not involved, carefully remove explosive to a safe distance, otherwise evacuate area immediately and allow to burn. Do NOT fight fire.
- Hazchem Code: E

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Exposure Controls & Personal Protection

Engineering Controls

- Ensure ventilation is adequate and that air concentrations of components are controlled below quoted Exposure Standards.
- Natural ventilation should be adequate under normal use conditions.

Personal Protective Equipment

- It is recommended that to wear overalls, safety glasses and impervious gloves when handling RDX.
- Always wash hands before smoking, eating, drinking or using the toilet.

REGULATION

United States [7]

OSHA: The United States Occupational Safety & Health Administration has set the following Permissible Exposure Limit (PEL)for RDX:

- Construction Industry: 29 CFR 1926.55 Appendix A -- 1.5 mg/m3 TWA; Skin
- Maritime: 29 CFR 1915.1000 Table Z-Shipyards -- 1.5 mg/m3 TWA; Skin

ACGIH: The American Conference of Governmental Industrial Hygienists has set a Threshold Limit Value (TLV) for RDX of 0.5 mg/m3 TWA; Skin; Appendix A4 - Not Classifiable as a Human Carcinogen

NIOSH: The National Institute for Occupational Safety and Health (has set a Recommended Exposure Limit (REL) for RDX of 1.5 mg/m3 TWA, 3 mg/m3 STEL; Skin

Australia [8]

Safe Work Australia: Safe Work Australia has set a Time Weighted Average (TWA) concentration for RDX of 1.5mg/m3 for a 40-hour workweek.

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Gossip

Earth may be trapped inside a giant magnetic tunnel

2021-10-22

Our planet, along with the rest of the solar system and some nearby stars, may be trapped inside a giant magnetic tunnel — and astronomers don't know why.

A tube of vast magnetized tendrils, 1,000 light-years long and invisible to the naked eye, may encircle the solar system, astronomers propose in a new paper. Jennifer West, an astronomer at the Dunlap Institute for Astronomy and Astrophysics at the University of Toronto, made the proposal after an investigation into the North Polar Spur and the Fan Region — two of the brightest radio-emitting gas structures in our galactic neighborhood — revealed that the two structures might be linked even though they are located on different sides of the sky.

"If we were to look up in the sky, we would see this tunnel-like structure in just about every direction we looked — that is, if we had eyes that could see radio light," West said in a statement.

The curving tendrils — which are made of both charged particles and a magnetic field, and resemble long, thin ropes — project outward from the North Polar Spur and the Fan Region. Not only could the strange cosmic ropes link the two regions, but they could form something akin to "a curving tunnel" where the tendrils are like "the lines formed by the tunnel lights and road lane marker," the researchers said.

This would place our solar system along with a small chunk of the Milky Way, inside the giant magnetic tunnel.

The North Polar Spur, which appears as an enormous yellow cloud stretching above the plane of our galaxy, is a gigantic crest of gas emitting X-rays and radio waves. The Fan Region is less understood but produces a lot of polarized radio waves. Though these unusual regions in space were discovered in the 1960s, scientific understanding of them remains patchy, and most previous studies described each structure separately.

But by plugging data from radio wave observations into a new computer model, West and her colleagues mapped out the probable length and position of the gigantic ropes. The model estimated that the ropes were roughly 1,000 light-years long and that the structures were most likely about 350 light-years from the solar system.

West says that the inspiration for her model came when she was a student, seeing the tendrils upon her first inspection of a map of the radio sky.

"If we were to look up in the sky, we would see this tunnel-like structure in just about every direction we looked — that is, if we had eyes that could see radio light," West said in a statement.

Years later, she was told of a 1965 paper which speculated on the strange radio signals.

"Based on the crude data available at this time, the authors (Mathewson & Milne) speculated that these polarized radio signals could arise from our view of the Local Arm of the galaxy, from inside it," West said in the statement. "That paper inspired me to develop this idea and tie my model to the vastly better data that our telescopes give us today."

It's not just in our part of the universe that these cosmic filaments have been spotted. In fact, they're ubiquitous throughout the galaxy and can radiate many different types of light. The researchers note in their study that filamentary structures have been seen emitting optical light near remnants of gigantic stellar explosions, or supernovas; in molecular clouds; and in the walls of "galactic chimneys" — enormous cavities created by multiple supernova explosions, through which hot gas from the galactic disk flows to the galactic halo. In fact, some studies have even gone as far to suggest that spiraling filaments of molecular gas could be the "bones" that form the "skeleton" of the Milky Way.

The scientists' next steps are to confirm their findings by taking detailed observations of the regions they simulated, and to then use those observations to refine their model. West hopes that, by deepening the model, she can improve astronomers' ability to understand other magnetic filaments spotted around our galaxy. Another intriguing possibility is that the invisible magnetic ropes could be a small part of a much larger galactic structure.

"Magnetic fields don't exist in isolation. They all must connect to each other," West said. "So a next step is to better understand how this local magnetic field connects both to the larger-scale galactic magnetic field and also to the smaller-scale magnetic fields of our sun and Earth.

"I think it's just awesome to imagine that these structures are everywhere, whenever we look up into the night sky," West added.

The researchers published their findings Sept. 29 on the preprint server arXiv, which means it has yet to be peer reviewed.

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Saudi Arabia says it aims for 'net zero' emissions by 2060

2021-10-23

Saudi Arabia unveiled new green goals on Saturday, announcing that it aims to slash the nation's greenhouse gas emissions to "net zero" by 2060.

The announcement was made by Crown Prince Mohammed bin Salman in brief recorded remarks at the start of the Islamic kingdom's first-ever Saudi Green Initiative.

"The Kingdom of Saudi Arabia aims to reach zero-net emissions by 2060 under its circular carbon economy program in accordance with the kingdom's development plan [...] while maintaining the kingdom's leading role in strengthening security and stability of global oil markets," Prince Mohammed said.

To reach the goal, the crown prince announced plans to cut carbon emissions by more than 270 million tons per year.

Salman said the environmental initiative would see investments of more than 700 billion riyals ($187 billion, €160 billion).

Oil giant Saudi Aramco's chief executive Amin Nasser cautioned, however, against "demonizing" hydrocarbons.

Speaking at the conference, Nasser said there should also be enough investment for backup capacity, otherwise there would be potential for an "economic crisis." He recommended shared focus on new energy sources, along with existing ones.

Oil and gas, backbone of Saudi economy

The event comes just days before the 26th United Nations climate change conference, or COP26, which is set to take place in Glasgow from October 31 to November 12, where governments are expected to try to reach agreement on achieving deeper emissions cuts to tackle global warming and its challenges.

Saudi Arabia is the world's top oil exporter and its economy relies heavily on the fossil fuel industry. The country has announced plans to diversify away from its dependence on oil and gas, but little has been achieved on this front so far.

In March, Riyadh pledged to reduce carbon emissions by more than 4% of global contributions through initiatives including generating 50% of its

To reach the goal, the crown prince announced plans to cut carbon emissions by more than 270 million tons per year.

energy needs from renewables by 2030 and planting billions of trees in the desert state.

The country is also setting up more solar and wind projects. Megaprojects, such as futuristic city NEOM, also incorporate green energy plans including a $5 billion hydrogen plant, and Saudi state-linked entities are pivoting to green fundraising.

Saudi has high per capita emissions

Still, Saudi Arabia has been criticized for acting too slowly and inadequately to address the climate challenge.

The country has high per capita emissions at more than 19 tons annually compared to the global average of around 4.8 tons per person per year. This is partly due to people needing to cool their homes. The desert country faces extreme temperatures, water shortages and increasing desertification.

A 2019 YouGov poll found the majority of Saudis believe climate change would affect their lives. Of those surveyed, 41% believed the issue would have "a great deal of impact."

In 2019, the government announced a new renewable energy target, which aimed to achieve 27.3 GW of green power by 2023 and 57.8 GW by 2030.

According to Climate Action Tracker, progress has been slow, with just 0.4 GW of renewables capacity installed by 2019.

Pushback against phasing out fossil fuels

Although Saturday's announcement means the kingdom will aim to reduce its own emissions, it will continue to aggressively pump and export fossil fuels to nations around the world.

And Riyadh's "carbon circular economy" approach to address the problem focuses on still unreliable carbon capture and storage technologies over efforts to reduce global reliance on fossil fuels.

Critics have slammed Riyadh not only for its high contribution to climate change, but also for blocking attempts to tackle it.

Leaked documents emerged on Thursday showing how Saudi Arabia and other countries, including Australia, Brazil and Japan, have tried to

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pressure the authors of an upcoming UN climate report to make changes to suit their interests.

According to the leaks, Saudi Arabia has strongly pushed back against the recommendation to phase out fossil fuels.

The Organization of the Petroleum Exporting Countries (OPEC), a group of petroleum exporting countries dominated by Saudi Arabia, told the report authors to cut the sentence: "More efforts are required to actively phase out all fossil fuels in the energy sector, rather than relying on fuel switching alone."

sri/aw (AP, Reuters, AFP)

dw.com, 23 October 2021

https://www.dw.com

Human head carvings and phallus-shaped pillars discovered at 11,000-year-old site in Turkey

2021-10-22

Archaeologists in Turkey have found evidence that an 11,000-year-old prehistoric site was used for a ceremonial parade through a building containing phallus-shaped pillars and a carving of a human head.

Called Karahantepe, the site is located in southern Turkey, east of Şanlıurfa, and has a series of buildings that date back to long before writing was invented. Within the remains of the buildings, archaeologists found carvings of human heads, snakes and a fox, as well as several interestingly shaped pillars.

For instance, the archaeologists discovered 11 pillars near a carving of a human head. "All pillars are erected and shaped like a phallus," Necmi Karul, a professor of prehistoric archaeology at Istanbul University, wrote in a paper recently published in the journal Türk Arkeoloji ve Etnografya Dergisi.

In the journal article, Karul did not speculate as to why the heads and phallus-shaped pillars were built or what meaning they may have had.

This building is connected to three others to form a complex of sorts. Ancient people may have held a ceremonial parade through this complex, Karul said. Current evidence suggests that people used the complex for "a ceremonial process, entering the building from one end and exiting at the

"All pillars are erected and shaped like a phallus," Necmi Karul, a professor of prehistoric archaeology at Istanbul University, wrote in a paper recently published in the journal Türk Arkeoloji ve Etnografya Dergisi.

other end, having to parade in [the] presence of the human head" and the phallus-shaped pillars, Karul wrote in the journal article. More excavation and analysis will need to be done before

Rather than being abandoned, the buildings were filled in with dirt, possibly during a decommissioning ceremony of sorts.

The site dates to a similar time as Gobekli Tepe, another archaeological site that has large buildings and carvings of animals and human heads. Gobekli Tepe is also located near Şanlıurfa, and archaeologists are trying to determine the relationship between the two sites.

Although Karahantepe was discovered in 1997, excavations didn't start until 2019. Between those years, researchers completed several archaeological surveys of the site. Karul did not reply to requests for comment.

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COVID-19 pandemic drove flu to historic lows and may have eliminated one virus completely

2021-10-21

As COVID-19 spread to hundreds of millions of people around the world, another potentially lethal disease — influenza — hardly reared its head at all.

Key points:

- Historically low global flu rates during the pandemic may have eradicated one flu type
- Australia's 2022 flu vaccine will still include it, but it may be dropped the year after
- As the country opens borders, vaccination against flu will be more important than ever

And seasonal flu rates globally have been so low for the past 18 months, it looks as though one flu virus has been stamped out altogether.

Two studies — one published in Nature Reviews Microbiology in September and the other currently under review — show one of four flu

And seasonal flu rates globally have been so low for the past 18 months, it looks as though one flu virus has been stamped out altogether.

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viruses that infect humans each year hasn't been detected anywhere in the world since April 2020.

So does that mean it's gone for good? It's still too early to say.

There is a chance this particular virus — the Yamagata virus — might be lurking in a pocket of the world somewhere, according to Ian Barr, deputy director of the World Health Organization's Collaborating Centre for Reference and Research on Influenza at the Doherty Institute, and co-author of one of the studies.

"It may re-emerge, but we haven't had a single detection of that virus in 18 months.

"That's unusual, so it could be gone. We hope it's gone."

Which is good news. But ... while Australia's historically low flu count over the pandemic has undoubtedly saved lives, it also means the population may be a sitting duck when autumn and winter roll around next year.

But more on that later. First: how did the Yamagata virus disappear?

A fraction of the flu

The extent to which the flu has been crushed by the COVID-19 pandemic is extraordinary.

On average, around 100,000 flu cases are detected in Australia each year, and a few hundred people die from it, although those numbers do bounce around year to year.

In 2019, one of our worst flu seasons in recent times, more than 300,000 people became sick and more than 900 died from flu.

This year so far in Australia, there have been just 550 reported flu cases — and not a single flu death.

"We did have early cases in 2020, going up 'til about March, April," Professor Barr said.

"But after that, the cases dropped off, and haven't really reappeared since."

Some parts of the world, such as countries in the Middle East, East Asia and West Africa, still endured flu outbreaks during the pandemic.

But Australia's experience isn't an outlier either. Europe, China and the US also reported extremely low flu rates over the past two years.

The vanishing virus

The Yamagata virus belongs to the influenza B group of flu viruses. With very rare exceptions, this group only infects humans.

Because they don't jump between humans and other animals, they won't cause a pandemic, unlike influenza A viruses, such as the one that causes swine flu.

But influenza B viruses are still behind roughly a quarter of total flu infections each year.

Something else that sets them apart from influenza A viruses is they mutate slowly.

Viruses that mutate quickly are more likely to evade the protection we get from vaccines.

The Yamagata virus, Professor Barr says, "has slowed down in terms of evolutionary change over the last 10 years".

This, plus the fact that it doesn't hide out in animals, had some scientists thinking the Yamagata virus might eventually be wiped out by vaccination alone.

Then COVID-19 hit. Social distancing, better hygiene and masks all contributed to driving flu levels down, and finished off the Yamagata virus faster than expected.

But what had the biggest effect, Professor Barr said, was closed borders.

Flu viruses generally don't survive summer, so each country's flu season is kicked off and sustained by a constant influx of new viruses brought in from travellers abroad during autumn and winter.

When international arrivals are put in quarantine for two weeks, that chain is broken.

Space to play or pause, M to mute, left and right arrows to seek, up and down arrows for volume.

"The quarantine stations have been a bit of a godsend for us, especially the one at Howard Springs," Professor Barr said.

"The majority of [flu] viruses we've had this year in Australia have come through the quarantine station.

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"So the viruses are coming in, but they're just not getting out — or if they are getting out, they're only getting out in very small numbers."

How does this affect the flu jab?

The Yamagata virus is one of four we're protected against by the yearly quadrivalent flu vaccine in Australia.

The flu vax protects against four viruses

- Two influenza A:

o H1N1 was first detected in the Americas in 2009 and caused the 2009-10 swine flu pandemic

o H3N2 was behind the 1968 flu pandemic, which killed an estimated 1 million people worldwide.

- Two influenza B:

o B/Victoria tends to infect younger people

o B/Yamagata may now be eradicated.

Despite not being seen for 18 months, the Yamagata virus might yet make a comeback, so will be included in next year's flu vaccine.

"We don't have sampling in every corner of every village in every country of the world, so there is probably a good chance that the virus is still out there," Professor Barr said.

"Whether it gets back into the mainstream or not remains to be seen.

"I think we need to be cautious. This virus, only a couple of years ago, was one of the dominant viruses in circulation. It can circulate widely, and it can cause illness and hospitalisations and death."

But if it's still undetected next year, then 2023's flu vaccine may drop the Yamagata component, and become a trivalent or three-part vaccine.

And that would be a good thing in some ways, Professor Barr added, because a vaccine made with three components is cheaper to make, and could help get more flu vaccines into developing countries.

And what about the 2022 flu season?

As Australia begins to reopen borders and NSW ditches hotel quarantine next month for passengers fully vaccinated against COVID-19, new flu viruses will trickle in and spread.

"But we're in a situation now, which we've never been before, where flu viruses haven't circulated, essentially, in two winters in Australia," Professor Barr said.

Because we've not been exposed to the flu for a couple of years, the population doesn't have much in the way of flu immunity at the moment.

The longer borders are closed, the more that herd immunity wanes.

On top of this, flu vaccine uptake has been particularly low this year.

Only around a third of the total population is vaccinated against the flu, Professor Barr says.

"While older people have held up well — 75 to 80 per cent of people over 65 are vaccinated — it's the kids and adults who are way down on their vaccinations compared to previous years.

"And that makes us more susceptible."

Getting as many people as possible vaccinated against the flu next year will be the best way to keep a lid on flu numbers over winter as viruses inevitably arrive on our shores.

"2022 could be a very interesting year," Professor Barr said.

"I'm sure influenza will be back once borders are open. And then it's just a numbers game, whether we have a moderate season or we have a big season."

abc.net.au, 21 October 2021

https://www.abc.net.au

Tiny 'immortal' crab entombed in amber discovered in a first of its kind

2021-10-25

For the first time ever, scientists have discovered an "immortal" crab fossilized in amber. Dating back to the Cretaceous period, this perfectly-preserved crustacean might be among the earliest examples of a crab occupying a freshwater habitat.

Researchers named the newfound species Cretaspara athanata — "athanata" meaning "immortal;" "Cret-" for the Cretaceous; and "aspara" for the legendary Southeast Asian spirits of the clouds and water, an homage to its amphibious lifestyle and place of discovery.

What these species have in common, though, is that they're all land-dwelling animals.

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Arthropods, like insects, spiders, scorpions and millipedes, show up preserved in amber on a fairly regular basis in the fossil record. On rare occasions, scientists stumble across something bigger, like a small bird or snake, trapped in a tomb of this hardened tree resin. What these species have in common, though, is that they're all land-dwelling animals.

PLAY SOUND

Most crabs, on the other hand, spend their lives in the water — not nesting in trees or buzzing through the forest. "It's not very often you come across an aquatic animal in amber," Javier Luque, a postdoctoral researcher at Harvard University and co-author of the study, told Live Science.

At just a fraction of an inch (2 millimeters) across, the fossil crab is a minuscule but exquisitely preserved specimen. Oftentimes, paleontologists have the difficult task of trying to reconstruct an extinct animal from bits of bone or fragments of carapace. Not so in this case. "It's the entire animal," Luque said, "to the level of not missing a single hair on the legs or the mouth, which is mind-blowing."

Luque and his team used a type of X-ray scan called a micro-CT to create a 3D digital model of the crab in order to study its physiology in detail. Based on the shape of the legs and carapace, they determined that the tiny crustacean belonged to the same lineage as modern-day "true" crabs.

Not all crabs are technically crabs. So-called false crabs — including hermit crabs, king crabs and porcelain crabs — are members of a group called Anomura, and they can be distinguished by the fact that they walk on three pairs of legs rather than four like true crabs in the group Brachyura.

Scientists believe that crab-like body plans — in both true and false crabs — have independently evolved at least five times in Earth's history, researchers wrote in March in the journal BioEssays. This convergent evolution has happened often enough that in 1916, the English zoologist Lancelot Alexander Borradaile coined a term for it: carcinization. The first crabs appeared around 200 million years ago in the early Jurassic period, and experienced a renaissance in the Cretaceous period, an event now known as the Cretaceous crab revolution.

The newly discovered crab dates to between 95 million and 105 million years ago, placing it squarely in the middle of the revolution. But that still leaves the mystery of how it wound up encased in amber to begin with. "I would guess that very likely it was a freshwater or semi-terrestrial crab," said John Campbell McNamara, an evolutionary physiologist at

the University of San Paolo in Brazil, who was not involved in the study. "The idea that it's in amber is a good indication" that it lived partially on land and partially in freshwater, he added, since the coniferous trees that produced amber resin couldn't survive in close proximity to saltwater environments.

Luque agreed with that assessment. Based on its robust gills, the little crustacean appears to neatly fill a gap in the fossil record between marine and freshwater crabs.

The fossil was originally discovered by Burmese miners in Myanmar in 2015. Northern Myanmar has some of the richest fossil amber mines in the world. However, over the course of the past six years, a horrific wave of politically-motivated violence and genocide has engulfed the country, leading the Society of Vertebrate Paleontology to issue a moratorium on studying amber specimens collected after 2017. In a 2021 statement, the group extended the moratorium, citing further human rights violations by Myanmar's military during the force's recent coup. "As much as this is discouraging from a scientific standpoint," they wrote, "it is one readily actionable solution for us — the paleontological community — towards reducing our contribution to the ongoing humanitarian crisis."

Even though C. athanata was collected before the moratorium went into effect, Luque hopes that its discovery might help draw attention to Myanmar's struggle. "This is not something we should keep quiet," he said. "Before being scientists, we're humans."

The discovery was published Oct. 20 in the journal Science Advances.

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https://www.livescience.com

Cities aren't adapting to climate change fast enough

2021-10-23

Climate change is magnifying threats such as flooding, wildfires, tropical storms and drought. In 2020 the U.S. experienced a record-breaking 22 weather and climate disasters that each caused at least $1 billion in damage. So far in 2021, the count stands at 18.

In 1950, only 30% of the world's population lived in urban areas; today that figure is 56%, and it is projected to rise to 68% by 2050.

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I study urban issues and have analyzed cities' relationship with nature for many years. As I see it, cities are quickly becoming more vulnerable to extreme weather events and permanent shifts in their climate zones.

I am concerned that the pace of climate change is accelerating much more rapidly than urban areas are taking steps to adapt to it. In 1950, only 30% of the world's population lived in urban areas; today that figure is 56%, and it is projected to rise to 68% by 2050. Failure to adapt urban areas to climate change will put millions of people at risk.

EXTREME WEATHER AND LONG-TERM CLIMATE ZONE SHIFTS

As the Intergovernmental Panel on Climate Change shows in its latest report, released in August 2021, global climate change is widespread, rapid and accelerating. For cities in temperate latitudes, this means more heat waves and shorter cold seasons. In subtropical and tropical latitudes, it means wetter rainy seasons and hotter dry seasons. Most coastal cities will be threatened by sea level rise.

Around the globe, cities will face a much higher probability of extreme weather events. Depending on their locations, these will include heavier snowfalls, more severe drought, water shortages, punishing heat waves, greater flooding, more wildfires, bigger storms and longer storm seasons. The heaviest costs will be borne by their most vulnerable residents: the old, the poor and others who lack wealth and political connections to protect themselves.

Extreme weather isn't the only concern. A 2019 study of 520 cities around the world projected that even if nations limit warming to 2 degrees Celsius (about 3.6 degrees Fahrenheit) above preindustrial conditions, climate zones will shift hundreds of miles northward by 2050 worldwide. This would cause 77% of the cities in the study to experience a major change in their year-round climate regimes.

For example, the study authors predicted that by midcentury, London's climate will resemble that of modern-day Barcelona, and Seattle's will be like current conditions in San Francisco. In short, in less than 30 years, three out of every four major cities in the world will have a completely different climate from the one for which its urban form and infrastructure were designed.

A similar study of climate change impacts on more than 570 European cities predicted that they will face an entirely new climate regime within

30 years–one characterized by more heat waves and droughts, and increased risk of flooding.

MITIGATING CLIMATE CHANGE

Cities' responses to climate change fall into two broad categories: mitigating (reducing) emissions that drive climate change, and adapting to effects that can't be averted.

Cities produce more than 70% of global greenhouse gas emissions, mainly from heating and cooling buildings and powering cars, trucks and other vehicles. Urbanization also makes people more vulnerable to climate change impacts.

For example, as cities expand, people clear vegetation, which can increase the risk of flooding and sea level rise. They also create impermeable surfaces that don't absorb water, such as roads and buildings.

This contributes to flooding risks and produces urban heat islands–zones where temperatures are hotter than in outlying areas. A recent study found that the urban heat island in Jakarta, Indonesia, expanded in recent years as more land was developed for housing, businesses, industry and warehouses.

But cities are also important sources of innovation. For example, the inaugural Oberlander Prize for landscape architecture was awarded on Oct. 14, 2021, to U.S. landscape architect Julie Bargemen for re-imagining polluted and neglected urban sites. And the prestigious Pritzker Architectural Prize went this year to French architects Anne Lacaton and Jean-Phillipe Vassal for creating resilient buildings by transforming existing structures instead of demolishing them to make room for new construction.

Just 25 of the world's cities account for 52% of total urban greenhouse gas emissions. This means that focusing on these cities can make a huge difference to the arc of long-term warming.

Cities worldwide are pursuing a rich variety of mitigation measures, such as electrifying mass transit, cooling with green buildings and introducing low-carbon building codes. I see these steps as a source of hope in the medium to long term.

ADAPTATING TOO SLOWLY

In contrast, adaptation in the shorter term is moving much more sluggishly. This isn't to say that nothing is happening. For example,

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Chicago is developing policies that anticipate a hotter and wetter climate. They include repaving streets with permeable materials that allow water to filter through to the underlying soil, planting trees to absorb air pollutants and stormwater runoff, and providing tax incentives to install green roofs as cooling features on office buildings. Similar plans are moving forward in cities around the world.

But reshaping cities in a timely manner can be extremely expensive. In response to levee failures that inundated New Orleans during Hurricane Katrina in 2005, the U.S. government spent more than $14 billion to build an improved flood control system for the city, which was completed in 2018. But many other cities around the world face similar threats, and few of them–especially in developing countries–can afford such an ambitious program.

Time is also a critical resource as the pace of climate change accelerates. In the European Union, about 75% of buildings are not energy efficient. A 2020 report from the European Commission predicted that it would take 50 years to make those buildings more sustainable and resilient to shifting climate conditions.

At best, urban infrastructures that were built for previous climate regimes and less extreme weather events can only be changed at a rate of about 3% per year. At that rate, which would be difficult even for the wealthiest cities in the world to maintain, it will take decades to make cities more sustainable and resilient. And the most vulnerable city dwellers live in fast-growing cities in the developing world, such as Dhaka, Bangladesh, Lagos, Nigeria, and Manila, Philipines, where local governments rarely have enough resources to make the expensive changes that are needed.

Remaking cities worldwide quickly enough to deal with more extreme weather events and new climate regimes requires massive investments in new ideas, practices and skills. I see this challenge as an ecological crisis, but also as an economic opportunity–and a chance to make cities more equitable for the 21st century and beyond.

fastcompany.com, 23 October 2021

https://www.fastcompany.com

Now, scientists think they've identified a potential trigger: Rogue antibodies may have mistakenly attacked the teens' brains, rather than the coronavirus.

'Rogue' antibodies found in brains of teens with delusions and paranoia about COVID-19

2021-10-26

Two teens developed severe psychiatric symptoms such as paranoia, delusions and suicidal thoughts during mild COVID-19 infections. Now, scientists think they've identified a potential trigger: Rogue antibodies may have mistakenly attacked the teens' brains, rather than the coronavirus.

The researchers spotted these rogue antibodies in two teens who were examined at the University of California, San Francisco (UCSF) Benioff Children's Hospital after catching COVID-19 in 2020, according to a new report on the cases published Monday (Oct. 25) in the journal JAMA Neurology. The antibodies appeared in the patients' cerebrospinal fluid (CSF), which is a clear liquid that flows in and around the hollow spaces of the brain and spinal cord.

But while such antibodies may attack brain tissue, it's too early to say that these antibodies directly caused the troubling symptoms in the teens, the researchers wrote in the new study. That's because many of the identified antibodies appear to target structures located on the inside of cells, rather than on the outside, co-author Dr. Samuel Pleasure, a physician-scientist and professor of neurology at UCSF, told Live Science in an email.PLAY SOUND

"So, we suspect that either the COVID autoantibodies" — meaning antibodies that attack the body rather than the virus — "are indicative of an out of control autoimmune response that might be driving the symptoms, without the antibodies necessarily causing the symptoms directly," he said. Future studies will be needed to test this hypothesis, and to see whether any other, undiscovered autoantibodies target structures on the surface of cells and thus cause direct damage, he added.

The study's results demonstrate that COVID-19 may trigger the development of brain-targeting autoantibodies, said Dr. Grace Gombolay, a pediatric neurologist at Children's Healthcare of Atlanta and an assistant professor at Emory University School of Medicine, who wasn't involved in the new study. And they also hint that, in some cases, treatments that "calm down" the immune system may help resolve psychiatric symptoms of COVID-19, she told Live Science in an email.

Both teens in the study received intravenous immunoglobulin, a therapy used to essentially reset the immune response in autoimmune and

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inflammatory disorders, after which the teens' psychiatric symptoms either partially or completely remitted. But it's possible the patients would have "improved on their own, even without treatment," and this study is too small to rule this out, Gombolay noted.

Possible mechanism found, but many questions remain

Other viruses, such as herpes simplex virus, can sometimes drive the development of antibodies that attack brain cells, trigger harmful inflammation and cause neurological symptoms, Gombolay said. "Thus, it is reasonable to suspect that an association could also be seen in COVID-19."

Prior to their research in teens, the study authors published evidence of neural autoantibodies in adult COVID-19 patients. According to a report published May 18 in the journal Cell Reports Medicine, these adult patients experienced seizures, loss of smell and hard-to-treat headaches, and most of them had also been hospitalized due to the respiratory symptoms of COVID-19.

But "in the case of these teens, the patients had quite minimal respiratory symptoms," Pleasure said. This suggests that there's a chance of such symptoms arising during or after cases of mild respiratory COVID-19, Pleasure said.

Over the course of five months in 2020, 18 children and teens were hospitalized at UCSF Benioff Children's Hospital with confirmed COVID-19; the patients tested positive for the virus with either a PCR or rapid antigen test. From this group of pediatric patients, the study authors recruited three teens who underwent neurological evaluations and became the focus for the new case study.

One patient had a history of unspecified anxiety and depression, and after catching COVID-19 they developed signs of delusion and paranoia. The second patient had a history of unspecified anxiety and motor tics, and following infection they experienced rapid mood shifts, aggression and suicidal thoughts; they also experienced "foggy brain," impaired concentration and difficulty completing homework. The third patient, who had no known psychiatric history, was admitted after exhibiting repetitive behaviors, disordered eating, agitation and insomnia for several days, when they hadn't shown these behaviors previously.

As part of their neurological examinations, each teen underwent a spinal tap, where a sample of CSF is drawn from the lower back. All three

patients had elevated antibody levels in their CSF, but only the CSF of patients 1 and 2 carried antibodies against SARS-CoV-2, the virus that causes COVID-19. In those two teens, it's possible the virus itself infiltrated their brains and spinal cords, the study authors noted. "I would suspect that if there is direct viral invasion it is transient, but there is still a lot of uncertainty here," Pleasure noted.

These same patients also carried neural autoantibodies in their CSF: In mice, the team found that these antibodies latched onto several areas of the brain, including the brain stem; the cerebellum, located at the very back of the brain; the cortex; and the olfactory bulb, which is involved in smell perception.

The team then used lab-dish experiments to identify the targets the neural antibodies grabbed onto. The researchers flagged a number of potential targets and zoomed in on one in particular: a protein called transcription factor 4 (TCF4). Mutations in the gene for TCF4 can cause a rare neurological disorder called Pitt-Hopkins syndrome, and some studies hint that dysfunctional TCF4 may be involved in schizophrenia, according to a 2021 report in the journal Translational Psychiatry.

These findings hint that the autoantibodies might contribute to a runaway immune response that causes psychiatric symptoms in some COVID-19 patients, but again, the small study cannot prove that the antibodies themselves directly cause disease. It may be that other immune-related factors, apart from the antibodies, drive the emergence of these symptoms.

"These autoantibodies may be most clinically meaningful as markers of immune dysregulation, but we haven't found evidence that they are actually causing the patients' symptoms. There's certainly more work to be done in this area," co-first author Dr. Christopher Bartley, an adjunct instructor in psychiatry at the UCSF Weill Institute for Neurosciences, said in a statement.

In future studies, "it would … be helpful to examine CSF of children with COVID-19 who did not have neuropsychiatric symptoms," as a point of comparison to those who did, Gombolay said. "However, obtaining CSF from those patients is challenging as CSF has to be obtained by a spinal tap, and a spinal tap is not typically done unless a patient has neurological symptoms."

That said, the team is now collaborating with several groups studying long COVID, who are collecting CSF samples from patients with and without

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neuropsychiatric symptoms, Pleasure said. "In adults, it is not uncommon to have patients be willing to undergo a spinal tap for research purposes with appropriate informed consent and institutional review." Using these samples, as well as some studies in animal models, the team will work to pinpoint the autoimmune mechanisms behind these troubling neuropsychiatric symptoms, and figure out how autoantibodies fit into that picture.

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Parasitic birds 'exercise' in their eggs, hatch…and then pulverize their nestmates

2021-10-27

Newly hatched birds might seem like delicate, feeble creatures, but some chicks burst out of their eggshells ready to brawl. These little fighters exercise in their eggs before hatching to build up the strength needed to maim and murder their nestmates, a new study suggests.

These little fighters exercise in their eggs before hatching to build up the strength needed to maim and murder their nestmates, a new study suggests.

The baby birds are part of a group of species known as brood parasites, whose moms lay their eggs in other birds' nests, leaving them for other bird parents to raise. Rather than expending the energy and time to rear their own offspring, brood parasite parents use both clever tricks and brute strength to give their babies a fighting chance with their foster family.

For example, the brown-headed cowbird (Molothrus ater) lays eggs that resemble those of its various hosts, while greater honeyguide (Indicator indicator) moms take the more aggressive approach of puncturing many of their hosts' eggs, thus killing the hosts' chicks and leaving their own offspring with less competition.

Although these bird moms set their kiddos up for success, once hatched, the chicks take matters into their own wings. Now, a new study, published Tuesday (Oct. 26) in the journal Proceedings of the Royal Society B: Biological Sciences, suggests that so-called embryonic movements — or egg exercise — may give the chicks a competitive edge over their foster siblings.

PLAY SOUND

Past studies in domestic birds, like chickens, have demonstrated that embryonic movements are key to growing chicks' development, said first author Stephanie McClelland, a doctoral candidate at the Royal Holloway, University of London in Egham. Studies suggest that hyperactivity in the egg results in a beefy, muscular chick, while other studies have shown that paralysis in an embryo causes stunted bone growth, malformed joints and reduced muscle tone.

So all birds benefit from embryonic movement, as it prepares them for the world beyond their eggshells. But the early lives of avid brood parasites tend to be uniquely strenuous.

Take, for example, the common cuckoo (Cuculus canorus). "Within just a day or two of being born, they lift an egg that's almost their own weight onto their back, and they shove it out [of] the nest," McClelland said. "Think of … a human baby trying to lift a bowling ball or something."

McClelland and her team wondered how newly hatched chicks pull off such feats of strength. They theorized that egg exercise might have something to do with it.

To test this idea, the team analyzed 437 eggs from 14 bird species, including five brood parasite species, their hosts, and several closely related, nonparasitic species, for comparison. McClelland plucked some birds' eggs from roosts on her university campus in the U.K., where domestic homing pigeons (Columba livia), a nonparasitic species, lay their eggs. But for the rest of the roughly 35 dozen eggs, she trekked to the U.S., the Czech Republic, Tanzania and Zambia, dropping in on field sites run by her collaborators.

To monitor each chick's movement within its egg, the researchers used a device called an Egg Buddy, which shines a beam of infrared light through the egg and records when that beam gets disrupted — for instance, when the bird's muscles twitch. For each egg, the team calculated the "embryo movements per minute" at five time points within its incubation period, to see how the growing chicks' rate of movement changed through time. The team standardized these time points across species so they would match specific stages of embryonic development.

In general, avian brood parasites have very short incubation periods; for example, the brown-headed cowbird's entire incubation period lasts about 10 days, according to McClelland. "These birds have a really short amount of time in the egg to go from really a bunch of goo into a real bird," she said. This is thought to be another survival strategy, in that

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short incubation periods give the host bird less time to spot and reject the eggs. Plus, by hatching early, the more murderous parasites get a chance to destroy the host birds' eggs, or kill off the host chicks as soon as they hatch. And gentler species, like the brown-headed cowbirds, use their muscles to perform "exaggerated begging" behaviors for their foster parents, monopolizing the food supply before their nestmates hatch.

Overall, in their brief incubation periods, the parasitic species showed higher rates of embryonic movement than did the hosts and nonparasitic species, the team found. And in general, the parasites' movement increased at a steeper rate over the course of their incubation periods, compared with the other birds. This was especially evident in the later embryonic stages, just before hatching; the common cuckoos, brown-headed cowbirds and lesser honeyguides (Indicator minor) wriggled with particular gusto at this stage of development.

This trend held across the parasitic species. But overall, there was some variation in the movement rates between species. For example, the lesser honeyguides showed a far higher rate of movement than the greater honeyguides, even though both are parasitic species that murder their foster siblings.

Perhaps the difference is due to the early lives of these two honeyguides, which differ drastically: Not only do greater honeyguide moms poke holes in the host chicks' eggs, leaving their parasitic babies with less competition, and on top of that, the honeyguide chicks are larger than their hosts, little bee-eaters (Merops pusillus). Meanwhile, lesser honeyguides slip their eggs into the nests of black-collared barbets (Lybius torquatus), a larger bird species. Once hatched, the lesser honeyguides massacre the hefty host chicks by snagging them with a beak hook and shaking them vigorously.

"So birds have quite a hard task when they hatch in a nest full of big, chunky barbet nestmates that they then have to bite and shake with their hook," McClelland said. This may explain why the lesser honeyguides do more egg exercise before hatching than the greater honeyguides, which have no trouble shaking their puny nestmates to death. And in fact, greater honeyguides' embryonic movement is very similar to that of their hosts, suggesting that the birds don't need much muscular training to take out the little bee-eaters.

Looking forward, McClelland said she plans to study what factors actually trigger embryonic movement in the various bird species. Perhaps environmental factors, like temperature, play a role in when and how

vigorously the developing chicks move, she said. But because the parasites and hosts share a nest, McClelland suspects that hormonal and genetic factors may be the primary drivers behind egg exercise. The team is also looking into birds' energy usage during this critical period of development, given that they're limited to using the yolk within their eggs.

"It's quite a mystery what's going on inside these eggs," McClelland said. The new study is "really a starting step … There will definitely be a lot more work [that] needs to be done to really connect how this movement is shaping these birds."

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Epidemics have happened before and they'll happen again. What will we remember?

2021-10-27

The emergency hospital, a partially demolished building hastily enclosed with wooden partitions, was about to open. It was the fall of 1918 in Philadelphia, and influenza was spreading fast. With many of the city's doctors and nurses serving in World War I, 23-year-old Isaac Starr and his third-year classmates at the University of Pennsylvania School of Medicine needed to help tend the sick. They'd had just one lecture on influenza. Their first job was to assemble the hospital beds, about 25 to a floor.

Starr's shift was 4 p.m. to midnight. The beds soon filled with patients who had fevers, he recalled in a 1976 essay for Annals of Internal Medicine. Many who developed influenza recovered. But Starr witnessed some patients become starved for air, their skin turning blue. Soon, they were "struggling to clear their airways of a blood-tinged froth that sometimes gushed from their nose and mouth," he wrote. "It was a dreadful business."

There were no effective treatments. Patients, desperate for breath, became delirious and incontinent and would die within days. "When I returned to duty at 4 p.m., I found few whom I had seen before," Starr wrote. "This happened night after night." In October, around the pinnacle of the pandemic, roughly 11,000 Philadelphians perished.

Some who died in the makeshift hospital stuck with Starr. There was Mike the piano mover, who in a frenzy left his bed and was about to leap from a window before medical staff grabbed him. Mike died shortly after. There

"We are living through a historic pandemic," says Anthony Fauci, director of the National Institute of Allergy and Infectious Diseases in Bethesda, Md.

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was the young woman, "flushed with fever," whose large family kept vigil at her bedside, hoping for a recovery that never came.

An estimated 50 million people worldwide died of influenza during the 1918 pandemic. The century since has seen many vaccines and treatments become available to combat infectious diseases. But beyond those medical feats, the story of epidemics remains a story about people: people who become sick, people who die, people whose lives are upended, people who care for others. And ultimately, people who remember what happened and people who forget.

The public memory of the 1918 pandemic, which lasted into 1919, faded quickly in the United States, with few historical accounts or memorials to victims in the aftermath. One of the first major histories of the pandemic, by Alfred Crosby, didn't arrive until 1976, the same year Starr published his reflections on serving in an influenza ward. Crosby's book was eventually reissued with the fitting title America's Forgotten Pandemic: The Influenza of 1918.

Since 1918, we have faced many epidemics, but COVID-19 has been the first to rival the great flu in how it has changed everyone's daily lives. "We are living through a historic pandemic," says Anthony Fauci, director of the National Institute of Allergy and Infectious Diseases in Bethesda, Md.

But a hundred years' worth of advances in virology, medical understanding and vaccine development has made a difference. It was 11 months from the discovery of the SARS-CoV-2 virus to "having a vaccine that you could put in people's arms," Fauci says, "a beautiful testimony to the importance of investing in biomedical research."

The COVID-19 pandemic is also a stark reminder of what hasn't changed. "Pandemics just surface all the muck," says internist, medical humanities scholar and historian of medicine Lakshmi Krishnan of Georgetown University in Washington, D.C. Ever present but often ignored societal inequities become unavoidable. The disproportionate weight of COVID-19 disease and death on Black, Latino and Native American communities in the United States — "we better not forget," says Fauci. "We really need to address the social determinants of health that lead to these very, very obvious disparities."

Yet outbreak after outbreak, our collective memory falters. The urgency of the predicament eventually fades. The families mourning the loss of loved ones, people struggling with unmet medical needs, with stigma,

become small islands of remembrance ever threatened by vast seas of forgetfulness and indifference.

Sometimes forgetfulness comes from a lack of reckoning. The United States moved on from the 1918 pandemic without addressing what was lost. Sometimes the success of vaccines obscures their power. The fear that surrounded polio subsided in the United States after the country rolled up its sleeves for polio vaccines. The dread of many other childhood illnesses, such as diphtheria and measles, has also diminished, leaving some to take prevention measures for granted.

To look back at infectious diseases since 1918 is to observe what we've learned about the viruses, bacteria and fungi with which we share our world, and observe the strides made in lessening their harms. But it's also a call to listen to the stories of how infectious diseases have shaped people's lives.

Outbreaks "have occurred throughout history and they occur now," Fauci says. "And they will continue to occur."

Vaccine victories

On February 24, 1947, Eugene Le Bar, an American merchant, boarded a bus in Mexico City. During the trip, his head began to ache and he broke out with a rash. He arrived in New York City on March 1 still not feeling well. Four days later, he was admitted to the hospital. His stay overlapped with a mumps patient named Ismael Acosta and a little girl, almost 2, who had croup.

Le Bar deteriorated while doctors searched for a diagnosis. He died March 10. Acosta and the little girl had been discharged, but returned later in March with rashes. The results of tests for those two led to a review of Le Bar's autopsy. The diagnosis was smallpox, a disease that kills about 30 percent of those sickened and leaves survivors disfigured by prominent scars.

More victims turned up. A little boy with whooping cough who had been at the hospital developed a rash. So did Acosta's 26-year-old wife, Carmen, who died days later. Soon the number of people with smallpox reached 12. New York City embarked on a massive vaccination campaign.

At the time, Anthony Fauci was 6 years old, growing up in Brooklyn. He remembers his parents talking about a huge event that would be happening in the city. "We all had to get vaccinated, and vaccination means somebody would get a little needle and prick it multiple times in

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your arm." (The smallpox vaccine wasn't given as a shot; instead, a drop of vaccine was placed on the skin and a needle poked the skin repeatedly to usher the vaccine into the body.) Fauci and his family were among the millions of New Yorkers immunized that spring, bringing the smallpox outbreak to a close without another person added to the count.

Throughout history, smallpox was one of the most feared infectious diseases. A British historian, writing about the 1694 death of Queen Mary II from smallpox at age 32, described the disease as "always present, filling the churchyards with corpses, tormenting with constant fears all whom it had not yet stricken, leaving on those whose lives it spared the hideous traces of its power."

Smallpox is also a starring character in the story of vaccines. At the end of the 18th century, the English physician Edward Jenner extracted fluid from a sore caused by cowpox on a dairymaid's hand and inoculated a young boy with it, a test of the belief among some farmers that getting sick with cowpox protected against smallpox. The experiment propelled forward the concept of vaccination. By giving the immune system a preview of the pathogen, the body's defenses were prepared for the main event.

What followed exemplifies the fullest power of vaccination. After a worldwide campaign, smallpox was the first infectious disease to be declared eradicated from the globe, in 1980 (SN: 11/03/79, p. 310). A scourge that had plagued humankind for at least 3,000 years was consigned to the history books.

Other vaccine-preventable diseases — especially those that afflict children — harm many fewer around the world today than in the near past. During the 20th century in the United States, after vaccines became widely used for nine diseases, including polio, measles and Haemophilus influenzae type b, cases declined by 95 to 100 percent. Yet there can be "a lack of appreciation for what vaccines have done in terms of getting rid of or managing many infectious diseases," says virologist A. Oveta Fuller of the University of Michigan in Ann Arbor.

For many people today, an understanding of polio only comes from history books (SN: 1/20/51, p. 42). But others who grew up when summers meant polio outbreaks have sharp recollections.

Paul Offit, a pediatric infectious disease specialist at Children's Hospital of Philadelphia, was 5 years old in 1956. After surgery on his foot, he stayed for about six weeks in a Baltimore hospital's chronic care facility. It was

primarily a polio ward. He was surrounded by children whose limbs were suspended in traction or whose bodies were swallowed in iron lungs.

"It was a lonely, frightening experience," Offit says. Parents were allowed to visit only one hour a week. He could see "how vulnerable and helpless and alone all of those children were." Offit's bed was next to a window, which gave him a view of the building's front door. He'd stare at the entrance, "waiting for someone to come save me."

Offit later trained at that same hospital as a medical student. The ward he had languished in as a child was now a suite of offices. The room looked the same, even the molding, "and that window was still there," Offit says. "I remember walking up and looking out that window and seeing the same thing I saw 20 years earlier and just fighting back tears."

Memorial Day weekend in the United States used to herald a season of polio fear, as cases rose in summertime. Children were barred from swimming pools and crowds. Fauci's parents wouldn't allow him and his sister to go to the beach at Coney Island. "All of us as kids knew somebody who'd been paralyzed," says David Morens, Fauci's senior scientific adviser, who grew up in the 1950s.

Vaccines provided an exit from this recurring nightmare. The two vaccines developed to thwart polio each drew on different advances. First came Jonas Salk's "killed" polio vaccine, approved in 1955 (SN: 4/16/55, p. 242). Made with poliovirus that had been treated with formaldehyde, the virus could no longer cause harm, but the body could still mount an immune response against it. About seven decades earlier, Louis Pasteur had demonstrated that rabies virus could be inactivated to develop a rabies vaccine.

The second vaccine, Albert Sabin's oral polio vaccine, became available in 1961 (SN: 12/14/63, p. 370). Often delivered on a sugar cube, Sabin's easily digested vaccine was the inspiration for the song "A Spoonful of Sugar" in the movie Mary Poppins. Sabin's approach was to weaken the poliovirus by making it replicate in nonhuman cells. Forced into an unfamiliar environment, the virus made genetic changes that diminished its ability to cause disease. This method, called attenuation, had first been used about 25 years earlier to create a yellow fever vaccine.

Vanishing ailments

Life before and after polio vaccines was like night and day. In 1952, polio paralyzed more than 21,000 people in the United States. Thirteen years later, that number had plummeted to 61. By 1979, polio was eliminated in the country. With new immunizations, one by one, common childhood ailments all but vanished in the United States: measles, rubella, chicken pox, and meningitis caused by bacteria.

When Kathryn Edwards trained in pediatrics in Chicago in the mid- to late 1970s, "we were really in the grips of Haemophilus influenzae meningitis." (H. influenzae, formerly Bacillus influenzae, is the misnamed bacterium that had once been suspected of causing influenza.) She remembers seeing four or five children at a time hospitalized with this dangerous swelling of the membranes covering the brain and spinal cord, says Edwards, an infectious disease pediatrician and vaccine researcher at Vanderbilt University School of Medicine in Nashville. Some children with H. influenzae meningitis were left with brain damage, while about 5 percent died. Edwards still remembers a young patient lost to the disease the last night of her training.

The first vaccine against H. influenzae type b, the type that most commonly caused meningitis and other severe infections, became available in the United States in 1985. More effective vaccines came a few years later, evaluated by Edwards and colleagues. Again the impact was unmistakable. Before 1985, close to 20,000 children, most of them under age 5, developed severe infections from H. influenzae type b each year, including 12,000 with bacterial meningitis. By 1994 and 1995, the incidence of severe disease had fallen 98 percent in children age 4 or younger. With the availability of vaccines against H. influenzae and other pathogens, "the practice of pediatrics is much different now than when I began 40 years ago," Edwards says.

The scope of infectious diseases that children face worldwide is slowly changing too. From 2000 to 2018, 23 million deaths globally were prevented by measles vaccination. But there are still millions of children around the world missing out on basic immunizations that are routine in the United States. The COVID-19 pandemic has worsened the problem: An estimated 23 million children worldwide did not receive childhood vaccines in 2020; that's about 3.7 million more than in 2019.

Big impact

Vaccines that came into wide use in the 20th century against diphtheria, polio, measles and other diseases drastically reduced or, in the case of polio, eliminated the illnesses by the end of the century in the United States. Smallpox was globally eradicated by 1980.

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Disease	Annual cases pre-vaccine*	Annual cases in 1998
Smallpox	48,164	0
Diphtheria	175,885	1
Pertussis	147,271	6,279
Polio	16,316	0
Measles	503,282	89
Mumps	152,209	606
Rubella	47,745	345
Haemophilus influenzae type b	20,000	54

*Annual pre-vaccine cases are from the 3–5 years before vaccine approval, except for mumps and smallpox. Mumps cases are reported the first year after the vaccine was licensed. Smallpox cases are from the early 1900s, when the vaccine was not yet in widespread use.

NATIONAL IMMUNIZATION PROGRAM, CDC/MMWR 1999

The work of developing vaccines against COVID-19 began shortly after researchers worked out the genetic sequence of the new coronavirus, SARS-CoV-2, in January 2020. Previous studies of the coronaviruses behind Severe Acute Respiratory Syndrome, or SARS (SN: 3/29/03, p. 198), and Middle East Respiratory Syndrome, or MERS (SN: 5/31/14, p. 6), had identified a viral protein that would effectively ramp up an immune response.

And the basic research that would underpin a new vaccine technology, which would be used for two of the first COVID-19 vaccines, had been going on for decades. The approach is based on messenger RNA, or mRNA, which carries out of the cell nucleus the instructions for making a protein. The vaccines have the guide for the viral protein; the body makes that protein and produces antibodies against it. Some of the crucial work, modifying the instructions for the viral protein so the body wouldn't see the guide as an invader, came from RNA biologist Katalin Karikó, immunologist Drew Weissman and colleagues working at the University of Pennsylvania Perelman School of Medicine in the mid- to late 2000s.

COVID-19 vaccines were created and tested in the shortest timeline for any vaccines yet. But that efficiency wasn't matched in the distribution. While there haven't been enough shots available globally (SN: 3/27/21, p. 6),

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the United States, a country awash in supply, has struggled to immunize everyone eligible. Some people haven't been vaccinated because they can't take time off work to recover from side effects or are worried they'll have to pay for the shots. Others don't see COVID-19 as a threat and don't see the need for the vaccine.

COVID-19 has killed millions of people worldwide. Yet perhaps it would be more terrifying if it primarily threatened children. The horror of polio was that it could leave children paralyzed for the rest of their lives, Offit says; it was as though children had been injured in war.

Michigan's Fuller thinks that seeing the harm that polio could do to children helped make Americans eager for polio vaccines. During the COVID-19 pandemic, "because we were all isolated, we didn't see each other really suffering or dealing with the effects of this virus," she says.

One person vaccinated feels like such a victory.

Katherine Spindler

When virologist Katherine Spindler of the University of Michigan was growing up, she had measles, mumps and rubella. The vaccines for those afflictions "came along too late for me," Spindler says. She still remembers the name of her older brother's classmate who died in eighth grade of an infectious disease. The routine immunizations that are now regular parts of pediatrician appointments mean that most of us "don't know what it's like to have polio or to die from measles."

Spindler found getting the COVID-19 vaccine "so meaningful," thinking about all of the science that came together to develop it. People have e-mailed her with questions about the vaccine. One woman who had an appointment but wasn't sure she wanted to keep it wrote several times. Spindler spent a few hours responding. Finally, she got an e-mail back with a picture of the woman in her car getting the shot. "Tears came to my eyes," Spindler says. "One person vaccinated feels like such a victory."

The aftermath

At the start of the COVID-19 pandemic, Lakshmi Krishnan and S. Michelle Ogunwole were internists at Johns Hopkins Hospital in Baltimore. Patients were dying. There wasn't enough personal protective equipment for staff. So much about COVID-19 was still unknown. "It was terrifying," says Krishnan, now at Georgetown University. Some of her colleagues were writing their wills.

And the patients were largely alone. Ogunwole, also a health disparities researcher at Johns Hopkins University School of Medicine, remembers an older Black woman who had been hospitalized with COVID-19 for months. She was well enough to move out of the intensive care unit but was extremely debilitated because she hadn't walked in so long, Ogunwole says. A tube in her windpipe made talking difficult as well.

The woman's family was not there. "There was nobody to speak for her," Ogunwole says. It made Ogunwole think of her own mother, "an incredibly vibrant person … the life of the party." If it was her mom in that bed, no one would have known who she is. That she likes to dance for no reason. That she picks up a different sport every year.

Ogunwole felt her patient's sorrow and loss. Millions are reckoning with the pandemic's cost to their physical and mental health. The toll is not unlike that of tuberculosis, AIDS, fungal diseases, childhood infectious diseases or the many other outbreaks and epidemics of the last century.

We should know by heart how lives — and whose lives — are changed by infectious disease outbreaks. But time and again, there's a clamor to leave outbreaks behind us. And the trauma and the inequities linger. The question this time, says historian Nancy Bristow of the University of Puget Sound in Tacoma, Wash., is, "Can we do a better job of continuing to hear the stories of those who have been affected?"

The stories of children who have lost one parent or both, for example. For her book American Pandemic: The Lost Worlds of the 1918 Influenza Pandemic, Bristow interviewed Lillian Kancianich, born in a small town in North Dakota. Kancianich's mother died of influenza when Kancianich was a baby. The story was that her mother was out sweeping the porch on Armistice Day and then was never seen again, Bristow says.

Kancianich bounced among extended family members' houses for two years before she was able to call one home. She told Bristow that as a child, when asked what she wanted to be when she grew up, her answer was, a stepmother. "The loss of that parent changed her life completely," Bristow says.

These stories have continued. In roughly the first year of the COVID-19 pandemic, an estimated 1 million children worldwide experienced the death of a mother, a father or both, researchers reported in July in the Lancet. The number is staggering, and yet it is a fraction of the estimated 17 million children who have lost one or both parents to AIDS in roughly the last three decades, according to the United States Agency for

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International Development. Ninety percent of those children live in sub-Saharan Africa.

Outbreak after outbreak, our collective memory falters. The urgency of the predicament eventually fades.

Nearly 105,000 children in the United States are facing life without one or both parents due to COVID-19, the study in the Lancet found. "Evidence from previous epidemics shows that ineffective responses to the death of a parent or caregiver, even when there is a surviving parent or caregiver, can lead to deleterious psychosocial, neurocognitive, socioeconomic and biomedical outcomes for children," the authors wrote.

An earlier study on parental death due to COVID-19 in the United States took race and ethnicity into account. While Black children make up only 14 percent of children in the United States, they made up 20 percent of those who had lost a parent, researchers reported in April in JAMA Pediatrics.

When Krishnan was treating patients early in the pandemic, she remembers noting, "It's all my Black and brown patients that are getting upgraded to the intensive care unit." Research has revealed a disproportionate impact among Black, Latino and Native Americans in terms of infection, hospitalization and death.

"COVID has unveiled disparities in health," but the pandemic didn't create them, Fuller says. "This is not new."

At the turn of the 20th century, Black Americans' death rates were higher than white Americans for tuberculosis, pneumonia and, in children, diarrheal disease and diseases of malnutrition, W.E.B. Du Bois wrote in 1906, "an indication of social and economic position." Racism and segregation restricted access to health care, housing and wealth for Black Americans.

The accounts from 1918 in Black newspapers in Philadelphia and Chicago "gave the impression that the epidemic did not substantially disrupt life in black communities," wrote Vanessa Northington Gamble in Public Health Reports in 2010. Yet it was clear that the number of Black people who did have flu "overwhelmed the medical care facilities that were available to them," says Northington Gamble, a physician and medical historian at George Washington University in Washington, D.C. White hospitals wouldn't accept Black patients or would send them to the basement or other segregated areas. Black hospitals didn't have the capacity for

everyone who needed care. So Black communities came together to provide for their own, she says.

When every one of the 75 beds at Frederick Douglass Memorial Hospital in Philadelphia filled up, its medical director, with no support from the city's board of health, managed to open an emergency annex for Black patients. Black women volunteers in Chicago made house visits to tend to the sick.

Black nurses also cared for Black influenza patients in their homes. Bessie B. Hawes, a 1918 graduate of the Tuskegee Institute's nursing program, described her experience caring for a family of 10, "dying for the want of attention," in a rural area of Alabama. "As I entered the little country cabin, I found the mother dead in bed, the father and the remainder of the family running temperatures of 102 to 104˚. Some had influenza and others had pneumonia…. I saw at a glance that I had much work to do…. I milked the cow, gave medicine, and did everything I could to help conditions."

One of the legacies of the 1918 pandemic is "this long-standing tradition of the Black community of standing up and taking care of itself," says Northington Gamble. The tradition continues, she says, with the work of organizations including the Black Doctors COVID-19 Consortium, created to make it easier for Black communities in the Philadelphia area to receive COVID-19 testing and vaccination.

When Black people became ill with influenza in the 1918 pandemic, they were more likely to die than white people with influenza, researchers reported in 2019 in the International Journal of Environmental Research and Public Health. That higher likelihood of death "could be attributed to several factors still present today: higher risk for pulmonary disease, malnutrition, poor housing conditions, social and economic disparities, and inadequate access to care," Krishnan, Ogunwole and their colleague Lisa Cooper of Johns Hopkins University wrote last year in Annals of Internal Medicine.

The societal systems that foster racial discrimination and lead to health inequities must be addressed, Ogunwole says. "There is no amount of resilience that overcomes that."

We cannot forget because it will happen again.

Lakshmi Krishnan

The suffering of the 1918 pandemic was overshadowed by the end of World War I, Bristow says. The war was publicly memorialized with monuments and a holiday. "The pandemic goes unspoken," she says,

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because it doesn't fit with the victorious narrative of the war. Only a few fictional works that drew upon the 1918 pandemic were published in the following decades.

But those books — such as the 1939 Pale Horse, Pale Rider, by Katherine Anne Porter, who survived an influenza illness but whose fiancé died — as well as private letters reveal deep loss, Bristow says.

"It's very clear that the trauma stayed with people, even if there's not public grieving, and that's what's so sad about it," she says. "There was no public acknowledgment of all of this loss." The country marched ahead, and people "were expected to hop in line and march along too."

Krishnan, a historian of medicine, says we must preserve a record of the COVID-19 pandemic. A hopeful sign that stories of how people felt, lived, loved and died won't be lost are the many oral history projects spearheaded by universities and libraries. "We cannot forget," Krishnan says, "because it will happen again."

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Potential planet may have been discovered outside the Milky Way galaxy

2021-10-26

Astronomers say they may have detected a potential planet outside of our galaxy — although the chances of it being confirmed in the next 70 years are slim.

Key points:

- Astronomers have detected dips in X-rays coming from in front of a pair of bright stars in the Whirlpool Galaxy
- They believe it may be a planet the size of Saturn
- But not everyone's convinced and much more work — and time — will be needed to confirm the observation

The international team of astronomers spotted what they believe is a planet in an arm of the spectacular Whirlpool Galaxy, some 28 million light-years away.

The international team of astronomers spotted what they believe is a planet in an arm of the spectacular Whirlpool Galaxy, some 28 million light-years away.

The potential planet, dubbed M51-ULS-1b, was detected using the Chandra X-ray Observatory, the team reported on Tuesday in the journal Nature Astronomy.

"This work demonstrates a new method with the potential to discover planets in a wide range of systems hosting [X-ray sources]," they report.

But it is not the first time potential planets have been reported in other galaxies.

And not everyone is convinced this observation is a planet either.

Dips in X-rays detected in the Whirlpool

The object, which is roughly the size of Saturn, orbits around a massive star and a smaller dense core of a dead star known as a neutron star, or a black hole.

As it passed in front of its binary stars, it caused a dip in X-ray emissions produced by the neutron star or black hole sucking gas off its companion.

The transit lasted about three hours.

Astronomers use dips in visible light — known as the transit method — to detect alien planets in our own galaxy, but the team said using X-rays could allow them to find objects that are hard to spot.

"We are trying to open up a whole new arena for finding other worlds by searching for planet candidates at X-ray wavelengths, a strategy that makes it possible to discover them in other galaxies," said the study's lead author Rosanne Di Stefano of the Center for Astrophysics Harvard & Smithsonian in a statement.

Is it really a planet?

But while the team say they've picked up tantalising hints of a potential planet, much more work will be needed to confirm if it is one, and not a patch of dust.

Jonti Horner, an astrophysicist who studies alien planets, is sceptical that they've captured either.

"There's something going on, and it could be a planet, but we'd have to be incredibly fortunate to have captured it at just the right time," Professor Horner of the University of Southern Queensland said.

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That's because the potential planet takes 70 years to orbit its suns, travelling at a distance that is twice that of Saturn to our sun.

"A planet going around every 70 years means it's bonkers far away [from its suns]."

For us to see it, it would also have to line up in the right position, at the right time.

"If you took observations a million times at random over that 70 years, only on four of those times would you see this thing transiting it," Professor Horner said.

The only confirmed planets that we've spotted within our own galaxy, the Milky Way, using the same technique have orbits of around 10 years, he added.

"It seems too much an outlier, especially with a new technique," he said.

To make things even harder, it is extremely difficult to spot objects orbiting binary targets blasting off high energy.

"In the past I've looked at a number of proposed planets in circumbinary systems and killed them because they didn't make sense," Professor Horner said.

"There's always a chance they got lucky, but I think it's more likely that there's something else going on causing this signal."

abc.net.au, 26 October 2021

https://www.abc.net.au

These households are ditching gas, slashing bills and going 'net zero'. Here's how

2021-10-25

In February 2020, just before the pandemic, Annabelle and Alex bought a typical Melbourne home in Brunswick East — almost a century old, draughty, and with gas heating and hot water.

After receiving a $400 gas bill in their first month, they began a process of improving insulation, swapping out gas appliances for electrical ones, and generally making the house "net zero" in terms of energy use, meaning it produces as much energy as it consumes over a period of time.

They now have no gas bills and, over the course of a year, export more electricity to the grid than they import.

All up, the transition cost them $12,000.

And within just a few years, they're likely to make that money back.

"Having a net-zero house always seemed so impossible — it seemed that we'd have to make big lifestyle sacrifices," says Annabelle, who works as a doctor in a COVID unit.

"But the more we learned about the technology that's now available, we realised you don't have to be a martyr."

Alex adds: "Nothing changed. We just got different appliances."

The couple in their early 30s are part of a worldwide movement that envisions a future where more people are living in comfortable, low-emissions homes and spending less on energy.

Advocates say there's a basic health argument for this as much as a climate one: the poor quality of Australia's housing is one reason the country has a higher death rate due to cold weather than Sweden.

The catch, of course, is the up-front cost of these new electric appliances, solar panels, insulation, and other investments.

Many Australians are also locked out of the housing market, which means they have to pay the energy bills but have little say in whether or not their house is insulated, or what appliances it runs.

So how do you make a house net zero, what does it cost, and could these houses be made available for everyone?

The catch, of course, is the up-front cost of these new electric appliances, solar panels, insulation, and other investments.

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Stop the draughts and insulate

Back in early 2020, looking for ways to be "warm and comfortable" in their old and draughty house, Annabelle and Alex turned to the My Efficient Electric House (MEEH) Facebook group.

Formed six years ago, the group is now 35,000 users strong. Members seek and share advice and post accounts of their battle with a common enemy: household energy loss.

"The first cold weekend in south-east Australia and boom, all these people want to join the Facebook group," says Tim Forcey, the founder of the MEEH group and a trained engineer and energy adviser.

"For 90 per cent of people who join the group, the driver is comfort.

"It is possible to tighten our houses up by a factor of 10 when it comes to 'leakiness'."

By leakiness, Mr Forcey means thermal energy loss. Draughty doors and poorly insulated roofs, walls and floors add to the cost of heating and cooling and multiply the dangers of extreme temperatures.

In general, Australian houses are very leaky; the Climate Council recently slammed Australian homes as "glorified tents".

The average energy performance of homes in Victoria, for instance, is 1.8 stars on the Nationwide House Energy Rating Scheme. A house rated 1.8 stars costs 70 per cent more to heat or cool than a home rated to 6 stars, which has been the minimum standard for new homes since 2010.

The more leaky the house, the harder it is to make it net zero.

Improving insulation is the place to start, says Mr Forcey.

"You can spend a couple of thousand dollars on getting professional draught-proofing done, or you can spend $10,000 on a solar PV system," he says.

In East Brunswick, Annabelle and Alex added insulation in the roof, replaced the louvres in the bathroom with an airtight sheet of perspex, and stopped-up the vents in the walls that had been originally installed to avoid the build-up of carbon monoxide from gas heaters and coal fires.

All up, this cost $700.

"The temperature of the house increased by 4C in winter," Annabelle says.

Swap gas appliances for electric ones

Perhaps the easiest way to reduce energy consumption, says Mr Forcey, is to "find the heat button on the air conditioner".

"Millions of Australians haven't found that yet," he says.

"The air-con is there in the lounge room but they put the remote control away after summer."

Most air-con units sold today are reverse cycle; they're able to heat as well as cool. On top of this, they're several times more efficient at heating than a gas heater, which makes them cheaper to run.

According to one study, using a reverse cycle air conditioner over an efficient gas heater reduces energy costs by 45 per cent.

Annabelle and Alex stumped up $6,000 to install a split system air-conditoner.

For another thousand dollars, they replaced the gas cooker with an electric induction cooktop.

Finally, they splurged $4,000 on a top-of-the-range electric hot water heater, which was partly covered by Victorian government rebates.

Replacing this last gas appliance meant they could disconnect from the gas grid, which saved them the $1.50 daily service fee.

Consider rooftop PV solar panels

Next, Annabelle and Alex paid $1,000 (after rebates) to upgrade their existing 3.5kW rooftop solar panels to a 5kW system, which meant they were producing more energy than they consumed.

Their house's energy needs are now effectively "net zero".

"We're in credit even in winter," Annabelle says.

"We're not stingy with electricity and we have all the modern appliances."

The transition has cost them about $12,000 and this is entirely offset by the savings from a discounted interest rate on their home loan.

Their mortgage provider offers the special rate for customers undertaking ambitious green upgrades to their home.

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Then there's the reduced energy bills: a 2018 report found all-electric homes with a 5kW solar system save $9,000-$16,000 over 10 years, compared to gas-electric homes with no solar.

This month, a second report estimated that electrifying heating, cooking and hot water, swapping petrol cars for EVs, and installing "oversized solar" would save the average household up to $6,000 per year.

And so when Annabelle's petrol car broke down, they bought an EV.

The Nissan Leaf EV, imported second-hand from Japan, cost $36,000.

"Most of the time we can charge the car off our panels too," Annabelle says.

"Our personal energy use from where it was two years ago has exponentially decreased and we don't pay any gas bills or any grid electricity bills. We don't even pay any petrol bills."

Putting these ideas to the test in new housing developments

Two hours south-east of Melbourne, at Cape Paterson, a housing development is testing the market for energy-efficient homes.

"I said, 'Why can't we build more energy-efficient homes?' And the answer was always that there was no real market for it," says Brendan Condon, director and founder of the development, named The Cape.

"I would say, 'Where did you test that?' No-one had really had a go at building a whole integrated estate."

The 60 houses so far constructed at The Cape average 8-star energy efficiency, have 5kW of solar, and are all gas free.

"Operationally, these homes are the cheapest homes in Australia," Mr Condon says.

A recent study of the housing development conducted by Richard Keech, an energy efficiency expert, tested that assertion.

He modelled the energy use of a two-person household in a 6-star rated house with gas heating and a petrol car with the same number in an 8-star rated house with solar, battery and an EV.

Those in the solar house spent $5,066 less per year on energy.

They also emitted 84 per cent less greenhouse emissions, the study found.

"If every house was 8-star rated and had solar and a battery, then it's possible that the statewide savings would be in the order of millions of dollars in avoided petrol and electricity costs," Mr Keech says.

"That's not a trivial chunk of change."

So what do these more efficient homes cost to build?

"There's a slight premium to build to this higher standard," Mr Condon says.

"I would say it's under 5 per cent."

Property giant Mirvac estimates the premium is lower than that.

In the south-west Melbourne suburb of Altona North, Mirvac is building a "net-zero energy" housing estate named The Fabric, partly funded by the Australian Renewable Energy Agency (ARENA).

The fully electric homes here have a minimum 7-star energy rating, at least 3.8kW rooftop solar, and battery storage.

These homes each cost about $15,000 more to build than conventional ones, says Elysa Anderson, Mirvac general manager for Residential Victoria.

As a proportion of the cheapest two-bedroom townhouse for sale in the Fabric, that's about 2.5 per cent of the purchase cost.

And demand is high: all the homes from the first stage have been sold, and the next stages have been brought forward ahead of schedule.

"Definitely this is what Mirvac will be building as standard within 10 years," Ms Anderson says.

"I would think that this would become a standard offering within the very near future."

It's a similar story at The Cape, where Mr Condon says most of the lots have been sold.

"People told me there would be no demand for energy-efficient homes and now we have 40 lots left and 13,000 people interested," he says.

'This is a massive health and safety issue'

Proposed changes to the 2022 National Construction Code will increase the minimum thermal performance of newly built homes from six stars to seven stars — the first increase to this figure since 2010.

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It's a welcome change, says Trivess Moore, a sustainable housing expert at RMIT, but Australia has a lot of catching up to do.

"They're requiring zero-energy houses for new residential dwellings across the EU," he says.

"The UK is pushing to be there in the next couple of years.

"I would estimate Australia is still somewhere in the region of 5-10 years behind — if these changes go through."

But these changes won't help the millions of Australians who rent, or the hundreds of thousands in public housing.

As the climate warms, Australians living in poorly insulated suburban homes are going to be more vulnerable in the face of catastrophic heatwaves.

In 2009, a record weeks-long heatwave in south-eastern Australia killed 374 people, most of them in Melbourne.

A subsequent study found that increasing the average house energy rating in Melbourne to 5.4 stars would have reduced deaths by 90 per cent.

"Everybody thinks this is about energy bills and greenhouse emissions, but this is a massive health and safety issue," says Rob Murray-Leach, head of policy at the Energy Efficiency Council.

"What we want to be doing is making every home in Australia decent. Doing that across the board is going to do far more than making homes high end."

How do we make every home 'decent'?

Mr Murray-Leach has a few ideas.

First, listing the energy performance rating of a home that's advertised for sale could be made mandatory.

Second, homes that fall below a minimum energy performance standard should not be allowed to be rented.

"This is the same as rules that say homes have to have locks on doors," he says.

Victoria, South Australia and the ACT already have, or are working towards this.

There are also calls for a national retrofit program, similar to the EU's "renovation wave strategy", which aims to improve the energy performance of tens of millions of existing buildings by 2030.

For the moment, however, these retrofits are mostly being done in an ad hoc way by a relatively small proportion of owner-occupiers.

Seeking information, they often find their way to the MEEH Facebook group.

In Brunswick East, Annabelle and Alex remain enthusiastic about their choice to get off gas and go net zero.

But they're also frustrated so few people know this is an option — that they had to go digging for information on Facebook.

"I get targeted advertising from Australian gas networks all the time, but no-one is advertising this," Annabelle says.

Every week, a few hundred members join the MEEH Facebook group.

One by one, the pilot lights are going out.

abc.net, 25 October 2021

https://www.abc.net.au

Okefenokee mine project: What is titanium used for?

2021-10-25

Titanium ranks as the ninth most abundant element on earth, just ahead of hydrogen.

But even though there's a lot of the metal deemed critical for national security, it is found in scattered clusters, something that makes supply undependable.

If you live on the Georgia coast, though, you've probably seen places where titanium is concentrated, maybe without realizing it, while walking on the black sands on Tybee or St. Simons.

"Most of your sands on the beach are made of quartz, which is silicon dioxide," said Kelly Vance, a geology professor at Georgia Southern University. "But if you've been on any of our Georgia beaches, if you look in certain places, you can see little black layers in there, the black layers of sand.

"But if you've been on any of our Georgia beaches, if you look in certain places, you can see little black layers in there, the black layers of sand.

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About 35 miles inland from the southern coast of Georgia, a swath of land now called Trail Ridge was beachfront property more than 2 million years ago. Human sunbathers hadn't evolved yet, but sea turtles like loggerheads had, making it a likely area for laying their eggs.

Alabama-based Twin Pines Minerals wants to mine heavy mineral sands from 8,000 acres along Trail Ridge for titanium, something that has raised concerns among environmentalists because of the proximity to the Okefenokee. Forty conservation organizations have banded together to form the Okefenokee Protection Alliance, which is urging the Georgia Environmental Protection Division to deny Twin Pines the five permits needed to proceed. Their main concern is that mining so close to the edge of the swamp, especially on the ridge, risks disrupting the flow of water in the swamp.

"We have to demonstrate that the public is opposed to this project, and that there's not scientific justification for this to move forward," Christian Hunt of Defenders of Wildlife, an alliance member, said on a webinar Wednesday. The EPD has already received more than 40,000 comments about the mining proposal, though no official permit comment period has opened yet.

Just what the company wants to mine and the uses of the mineral in the ground at Trail Ridge has gotten less attention. When extracted from minerals like ilmenite and rutile that make up the heavy minerals sands, what use does titanium dioxide have?

A black mineral that whitens

Had a skinny latte today, or brushed your teeth? You've probably eaten some titanium. If not, you've probably touched and seen dozens of products containing it.

"Most titanium ore is refined into titanium dioxide to impart a durable white color to paint, paper, rubber, wallboard, and plastic," a US Geological Survey fact sheet on titanium reports.

And by "most," the scientists mean about 95%.

Vance says that titanium dioxide is found in all kinds of everyday materials: paint, plastic, rubber, slick magazine paper or photo grade poster paper. The paint industry began using titanium dioxide after lead proved to be a health and environmental hazard. But food companies use it as well.

"Because titanium is relatively inert, it can also be used as coloring in such products as toothpaste, skim milk, candy, and sunscreen," the USGS reports.

Unlike the black-colored heavy mineral sands, pure titanium dioxide, a powder, is a brilliant white. It can provide an opaque base on which to paint other colors, like on candy-coated chocolates. It's used in toothpaste, skim milk and even sunscreen, according to scientists.

In fact, only about 5 percent of the world's annual production of titanium minerals goes to make titanium metal, according to the USGS.

"Titanium is different than most other metallic elements in that it is mined primarily to satisfy demands for a chemical product – titanium dioxide for pigment – rather than for the metal itself," according to the group's 2017 report. "The high cost of extracting titanium metal from ore curtails broader use of titanium metal and alloys."

Health concerns have prompted the European Union and Australia to phase out titanium dioxide in foods based on uncertainty about its ability to accumulate in the body and damage genetic material in cells.

It'll soon be coming out of M&Ms, Skittles and Altoids along with other candies made by Mars Wrigley, the world's largest candy maker.

"We are continuously listening to our consumers and have committed to removing titanium dioxide from our global portfolio by the end of 2023," a Mars/Wrigley spokesperson wrote in an email.

Mythological Titans behind modern tech wonders

The name "titanium" refers to its strength. British clergyman and amateur geologist William Gregor discovered titanium in 1791 in the black magnetic sands of Cornwall. A few years later German chemist Martin Klaproth named it "titanium" after the Greek Titans, a mythical race of giant deities.

The small portion of mined titanium that isn't used in modern manufactured goods is fundamental to modern technology: aircraft frames and engine components and medical devices such as knee replacements.

For those reasons, titanium was among 35 minerals or mineral groups deemed "critical" by the Trump administration in 2017 based on it being essential to the economic and national security of the U.S. and having a supply chain that's vulnerable to disruption.

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Twin Pines Minerals has emphasized the national security aspect of titanium as lawsuits mounted to try to halt its mining plans in Trail Ridge.

"Opponents would have you believe it is nothing more than a pigment used in paint and toothpaste," read a full-page advertisement published in the Charlton County Herald earlier this year. "Well, yes, it is a pigment used for those purposes (and a very effective one), but that statement is a deliberate attempt to obscure the thousands of other beneficial uses of titanium."

China has been implementing a national strategic initiative to buy or control land around the world where rare metals and minerals are located, something that U.S. military and intelligence officials view with worry. Beijing now controls about a third of the world's reserves of ilmenite, the mineral that accounts for about 90% of the world's consumption of titanium minerals.

In 2020 the U.S. relied on multiple nations for imports of titanium dioxides in various forms. More than 100,000 metric tons were sourced from Canada, 38% of the total imported tonnage, according to the USGS. Imports from China were second highest at more than 38,000 metric tons.

The U.S. imports of titanium metal from China were smaller, at 524 metric tons, all from waste and scrap. Along with China and Russia, Japan is also a large supplier of titanium metal.

It's unclear, however, just how the mineral deposits at Trail Ridge would impact U.S. national security or help secure rare resources of titanium metal.

In an interview with The Current, Twin Pines chief executive Steve Ingle says his company extracts the mineral but doesn't process it into titanium metal. That's a multi-step process done mainly in other countries. And, Twin Pines doesn't know if the minerals it extracts will become the ingredients of a fighter jet or a fresh coat of paint.

"We don't dictate how our customers use the raw materials we provide them, and at this point, it's too soon to know who will be purchasing our products," Ingle wrote in an email. "What is important to know is; China is one of the largest producers of titanium. The federal government declared it as an element essential for national security. Common sense would tell us the U.S. government wouldn't take such a position if their intent was to assure we had enough pigment for toothpaste and paint."

What other minerals lay under Georgia's ground?

Titanium dioxide isn't the only target at Trail Ridge. Twin Pines' permit application states it will also extract zircon and staurolite.

So what are staurolite and zircon?

"(Staurolite) is a relatively hard mineral that is a constituent of the mineral mix on the proposed mining site," Ingle wrote. "It is not in abundance on the property but is present in small quantities. It is a low value mineral that is used as an abrasive in sandblasting."

Zirconium is also not as plentiful as titanium at the Georgia site, Ingle said, but its use is also key to making electronics, fiber optics, lenses and firearms.

John Valley, professor of geology at the University of Wisconsin Madison, says small pale pink zircons found in black mineral sands are incredibly helpful to scientists to chronicle time. In the same way that carbon-14 dating gives the ages of relatively recent events, zircon reveals more ancient happenings in rock formations.

A species of fish in Florida picks up zircons and stores them in their sinuses. Valley has studied the age of these "fish head zircons," which are likely the same era as the Trail Ridge sands, about "400 million to 1,000 million years old," he said.

"When a zircon first forms, it has a lead to uranium ratio of zero," Valley said. "And as it gets older, radiogenic lead accumulates, because the uranium is decaying (into lead). And so the lead to uranium ratios get higher. And we can measure this with extreme accuracy and precision. And so this is the basis for determining the age of the earth. It's the gold standard for determining the ages of our ancient events on earth and throughout the solar system."

But when zircon is not revealing the mysteries of the universe, it has some more pedestrian uses.

"Those ceramic kitchen knives are usually zirconium oxide, which is an exceedingly hard mineral," Valley said. "When it's a fine grain ceramic, it makes a very nice knife."

thecurrentga.org, 25 October 2021

https://www.thecurrentga.org

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Here's the physics of why ducklings swim in a row behind their mother

2021-10-20

There's physics to having your ducklings in a row.

By paddling in an orderly line behind their mother, baby ducks can take a ride on the waves in her wake. That boost saves the ducklings energy, researchers report in the Dec. 10 issue of the Journal of Fluid Mechanics.

Earlier measurements of duckling metabolism showed that the youngsters saved energy when swimming behind a leader, but the physics behind that savings wasn't known. Using computer simulations of waterfowl waves, naval architect Zhiming Yuan of the University of Strathclyde in Glasgow, Scotland, and colleagues calculated that a duckling cruising in just the right spot behind its mother gets an assist.

When a duckling swims on its own, it kicks up waves in its wake, using up some energy that would otherwise send it surging ahead. That wave drag resists the duckling's motion. But ducklings in the sweet spot experience 158 percent less wave drag than when swimming alone, the researchers calculated, meaning the duckling gets a push instead.

Like good siblings, the ducklings share with one another. Each duckling in the line passes along waves to those behind, so the whole brood gets a free ride.

Like good siblings, the ducklings share with one another.

But to reap the benefits, the youngsters need to keep up with their mom. If they fall out of position, swimming gets harder. That's fair punishment for ducklings that dawdle.

sciencenews.org, 20 October 2021

https://www.sciencenews.org

Should you mix and match COVID-19 vaccines?

2021-10-22

Many people will now be able to "mix and match" COVID-19 booster shots — that is, get a different COVID-19 vaccine for a booster, the Food and Drug Administration (FDA) announced Wednesday (Oct. 20).

Studies and real-world data have shown that this mix-and-match approach is safe and, in some cases, can even be more effective than not mixing. So should you get a booster vaccine that's different from your original dose?

Live Science talked with a couple of experts, who agreed that mixing vaccines is perfectly safe, but their recommendations differed slightly.

The FDA has authorized booster doses for adults who are immunocompromised, who are 65 years or older or have underlying conditions, or those who are at high risk of exposure to COVID-19. People who received two shots of the Pfizer-BioNTech or Moderna vaccine are considered fully vaccinated and may be eligible for a booster at least 6 months from their last dose, whereas all adults who got the single-shot Johnson & Johnson vaccine are eligible to get a booster dose two months after their shot.

PLAY SOUND

Data suggest that in people who received one of the two mRNA vaccines — that is, Pfizer or Moderna — getting a booster of the other mRNA vaccine will likely be equivalent to getting the same one. But in people who originally received the Johnson & Johnson vaccine, getting a Pfizer or Moderna booster may spur a much better immune response than receiving a second Johnson & Johnson shot.

Evidence on mixing

The FDA's announcement to allow mixing and matching follows the early results of an ongoing National Institutes of Health (NIH) study. On Oct. 15, a group of researchers presented the results from the study, which hasn't yet been peer-reviewed and is posted as a preprint to medRxiv, to an FDA panel of experts.

The researchers tested nine different combinations of Johnson & Johnson, Moderna and Pfizer vaccines given to 458 participants and found that mixing was safe and highly effective. Receiving a booster shot greatly increased the circulating number of antibodies including neutralizing antibodies — molecules that bind to the virus and stop it from infecting cells — against SARS-CoV-2, the virus that causes COVID-19.

In people who received a different booster than their original vaccine series, neutralizing-antibody levels increased 6.2- to 76-fold, depending on which vaccine combination they received. Those who received the same vaccine booster as their original vaccine saw their neutralizing-antibody levels increase between 4.2- and 20-fold, again depending on what vaccine they got.

The greatest increase in neutralizing-antibody levels was among those who originally received the single-dose Johnson & Johnson vaccine and

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then a Moderna booster; this group of participants had, on average, a 76-fold increase in antibodies 15 days after receiving their booster compared to before. The lowest increase — but still an increase — was in those who received the Johnson & Johnson vaccine for both their original dose and their booster. (The Moderna booster in this study was given at the same dosage as the original vaccine, but the FDA has authorized half the dosage for the booster shots that will be given to the public).

Average rise in neutralizing antibody levels

	Pfizer-BioNTech Booster	Moderna Booster	Johnson & Johnson Booster
Two doses Pfizer-BioNTech Initially	20x	31.7x	12.5x
Two doses Moderna Initially	11.5x	10.2x	6.2x
One dose Johnson & Johnson Initially	35.1x	75.9x	4.2x

Levels were measured 15 days after booster shots as part of the NIH study.

For those who originally received an mRNA vaccine, there was also a slight advantage — though much less dramatic — in receiving a booster of the other mRNA vaccine.

Those who originally received Pfizer and then boosted with Pfizer had a 20-fold increase, whereas those who boosted with Moderna had a 31.7-fold increase; those who originally received Moderna and then boosted with Moderna had a 10.2-fold increase, whereas those who originally received Moderna and then boosted with Pfizer had an 11.5-fold increase.

"Based on the data that we've seen and everything that we've learned about the experience in other countries, I would probably recommend an mRNA vaccine as a second dose rather than a second J&J vaccine," for those who originally received a J&J vaccine as their first dose, said Dr. Carlos Malvestutto, an infectious-disease physician at The Ohio State University Wexner Medical Center.

But for people who received one of the two mRNA vaccines, it's fine if you get a booster of the same or the opposite one. You'll still "have a good response," Malvestutto told Live Science.

Dr. Eric Cioe-Peña, director of global health at Northwell Health in New York, agreed.

"What is clear from the data is that the best immune response comes from one of the two currently available mRNA vaccines," he told Live Science in an email. So people who received the Johnson & Johnson vaccine (or the AstraZeneca vaccine, which is similar in makeup to the Johnson & Johnson vaccine and has been approved in other countries) will have a stronger immune response if they receive an mRNA booster.

"What is not clear, and probably doesn't make sense, is the switch between the mRNA vaccines," he added. "

There doesn't seem to be a statistically significant difference between how these two vaccines are doing, and they work in remarkably similar fashion."

Still, not everyone is in agreement.

"If we can ensure that there [are] plenty of all three U.S.-approved vaccines, I would personally recommend sticking with your original vaccine," including for those who received the Johnson & Johnson vaccine, Rodney Rohde, a professor at Texas State University and chair of the university's Clinical Laboratory Science program. That's because "they're all looking fine with a boost," and there's more long-term data on the effectiveness of boosting with the same vaccine. Still, "I do think that it's safe to mix and match, and it might come down to what's available," he told Live Science.

Real-world data

This NIH study isn't the only data that point to the safety and possible benefits of mixing and matching vaccines. Countries such as Turkey have been mixing and matching vaccines for some time now, boosting people who received two doses of the China-made Sinovac vaccine with one or two doses of the Pfizer vaccine.

Data from the U.K. and Canada, which have been giving a second dose of Pfizer on top of an original dose of the AstraZeneca COVID-19 vaccine — an adenovirus vaccine that uses the same platform as Johnson & Johnson — have also shown that mixing and matching can be safe and highly effective.

Even before the NIH study results, it was clear from these real-world studies that mixing and matching was safe and prompted a robust immune response. "What we saw was basically the same types of [adverse reactions] that we see with the first and second dose of these vaccines but nothing worse or nothing scary," Malvestutto said. "The evidence shows it is quite safe."

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What's more, some evidence suggests that mixing and matching these vaccines may lead to a broader immune response that may be better able to respond to a future SARS-CoV-2 variant, Malvestutto said. Still, many questions remain about how effective this approach is for other parts of the immune response.

"Immunity is not just about the levels of the antibodies; there are other parts to the story," Malvestutto said. The NIH study focused solely on the levels of antibodies. Another extremely important part of the immune response is what are known as memory cells, which circulate in the body long after neutralizing-antibody levels have depleted and prompt the immune system to make more targeted antibodies once exposed to the pathogen.

We still need data on whether the mix-and-match approach has a better, worse or same effect on producing these memory immune cell responses, Malvestutto said.

In any case, the data suggest that mixing and matching is safe and effective. But the most important message is for people to complete their initial vaccinations, and if they're in high-risk groups, to get their boosters, he said.

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A Syrian seed bank's fight to survive

2021-10-19

The International Center for Agricultural Research in the Dry Areas, known as ICARDA, is housed in a cluster of small buildings on a dusty property in Lebanon's Bekaa Valley, halfway between Beirut and Damascus. Its facilities, surrounded by fields of experimental grain, include a laboratory, nurseries, and a gene bank—a storage facility in which tens of thousands of seeds have been carefully saved and catalogued.

When I first visited, on an autumn afternoon in 2019, staff members in the main building were counting, weighing, and sliding seeds into small packets. The sound was like waves receding on a rocky beach. Ali Shehadeh, a sixty-six-year-old Syrian plant conservationist, was sitting in a nearby office, entering data about the seeds' country of origin into his computer. "There is a problem with the abbreviation of Kosovo," he

ICARDA houses more than a hundred and forty thousand accessions, or samples of seeds and other genetically significant plant material.

said to himself, peering at the screen. "The system isn't recognizing the abbreviation." Eventually, he found the right code: the International Organization for Standardization uses the abbreviation "XK," because Kosovo is a partially recognized state.

ICARDA houses more than a hundred and forty thousand accessions, or samples of seeds and other genetically significant plant material. Over three decades, Shehadeh had collected most of the original seeds himself, hiking through grasslands and forest. He is an expert in pulses—the family of grain that includes chickpeas and lentils—and together with his colleagues, who focus on legumes, cereals, viruses, and pests, he has used untamed versions of domesticated crops to breed varieties capable of withstanding harsh and changing conditions. The goal of this work was to help the world's poorest farmers. But, as climate change has accelerated, ICARDA's seeds have proved useful to plant breeders working on large-scale farms in wealthy countries.

In a recent article, published in Nature, ICARDA's scientists note, dryly, that gene banks are "also vulnerable to natural and human-caused disasters." The organization was originally situated in Aleppo. In 2012, the Syrian civil war, and the prolonged drought that exacerbated it, forced ICARDA to undertake a desperate, chaotic move to Lebanon; the organization's researchers scrambled to save their own lives and preserve decades of work. ICARDA had been keeping backup copies of its seeds in the global "doomsday" seed vault in Svalbard, Norway, since 2008. The Svalbard vault, known for its forbidding modern design, is a kind of seed ark, designed to protect Earth's biodiversity in case of Armageddon; seeds are not supposed to leave it unless something goes very, very wrong. So far, ICARDA has been the only institution to make a withdrawal from Svalbard; after relocating, the organization had to request its own backups so that it could grow new seeds to replace the ones it had lost.

Stacks of cornflower-blue boxes stood outside Shehadeh's office, waiting to be shipped to Svalbard; the rebuilding of the gene bank in Lebanon and its backup in Norway is expected to continue until at least 2030. In the meantime, ICARDA's mission has become more urgent. In the United States and elsewhere, climatic shifts have been pushing farmers to adapt to unpredictable weather, extreme temperatures, and new pests and diseases. The work of breeding grain is as ancient as farming itself, but Shehadeh and his colleagues have been charged with solving a modern problem: finding genes that might help us feed a warming world.

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ICARDA employs forty-five scientists, who work in countries that are hot, dry, and drought-prone, including Lebanon, Ethiopia, Morocco, Turkey, Egypt, and Senegal. Together, they collect, catalogue, and experiment with the world's largest collection of seeds from the Middle East and North Africa. The seeds are multiplied, often through manual pollination, and then sent, free of charge, to plant breeders and researchers around the globe. The seeds are also bred together to create new seed lines for crops that are resistant to drought or particular pests. ICARDA is part of a network of research centers called the Consultative Group for International Agricultural Research (C.G.I.A.R.), which is funded by a mixture of governments, international organizations, and foundations. "No other organization has done more than CGIAR to ensure that families—especially the poorest—have nutritious food to eat," Bill Gates wrote, earlier this year.

In 2020, farmers in forty-three countries planted new crops developed by ICARDA's breeders; the organization is at the center of a vast agricultural web. Before seeds are sent out, therefore, they must be vetted for infectious diseases and pests. Safaa Kumari, ICARDA's plant virologist, serves as the institution's equivalent of airport security, searching for unwelcome travellers. She also diagnoses the crop diseases that farmers face in ICARDA's dryland territory. Many of the viruses that afflict the seeds ICARDA works with are so geographically specific that the relevant antibody tests aren't available commercially. So Kumari manufactures serums for the tests on site, by injecting viruses into white rabbits and collecting the antibodies that their immune systems produce. A single, minuscule vial of serum takes a year to make.

Shehadeh began working at ICARDA in 1985. He became the manager of its gene bank just after the country's civil war began; armed groups carjacked several ICARDA staffers, shooting one in the chest (he survived) and kidnapping a guard (whom they later released miles away). They stole vehicles in several nighttime raids. On the morning of July 4th, workers arrived at ICARDA to find its buildings painted with a warning: "GET OUT." They packed what they could and left, believing that the move would be temporary. Shehadeh had no choice but to leave ICARDA's refrigerated herbarium—with its folders of pressed, catalogued plant specimens—behind.

The scientists moved to ICARDA's administrative offices, in Aleppo City. Two weeks later, rebels captured eastern Aleppo Province. ICARDA's agricultural facility was a prize, not for its seeds but for its cars. Most international staff members left the country with their families—some

went to Morocco, others to Tunisia, and the rest to Lebanon. For local staff, it was more complicated. In October, Kumari, who was at a conference in Addis Ababa, received a call from her mother: rebels had demanded that Kumari's family leave their home, so they had fled in the span of ten minutes, taking next to nothing with them. (They eventually made it to Turkey.) Kumari briefly returned to Aleppo City, spending two nights camped out with her father in the basement of the family's paint factory. She also collected backups of her antibody serums: she had started to spread them among friends' freezers as the war had got worse.

Shehadeh was among a group that remained in Aleppo City. For the next few months, whenever the roads were safe, he drove between Aleppo and the field office. He refuelled ICARDA's generator and collected seed samples to send to plant breeders who couldn't afford delays in their crops' breeding cycles. The journey, which used to take twenty minutes, could now take two days. Shehadeh asked local hotels whether he could use their refrigerators to store seeds, but none of their fridges were large or empty enough; eventually, he found a home for the herbarium in an abandoned apartment where a generator kept the air-conditioning running twenty-four hours a day.

During this period, Shehadeh's youngest son, Amr, who was working for the Syrian Arab Red Crescent—the country's version of the Red Cross—was kidnapped by ISIS fighters; they kept him blindfolded in the hallway of a children's hospital for forty-one days before letting him go. In 2014, ICARDA's veterinarian was kidnapped; he is still missing. Finally, in 2015, ICARDA lost control of its field office completely. By then, eighty per cent of its collection was safely backed up at Svalbard. Shehadeh moved to Lebanon, where his wife and daughter joined him. Today, all he and his colleagues know of their old gene bank is what they hear from local farmers: sometimes, the lights are on.

As Shehadeh was leaving Syria, Mike Pumphrey—a wheat breeder and geneticist who, at that time, was carrying out research at Kansas State University—was receiving increasingly urgent calls from wheat farmers. A pest called the Hessian fly had reëmerged in eastern Washington State, and the severity and regularity of its outbreaks were getting worse. In the past, wheat in Washington State had grown more by the time the flies were ready to attack. Now, warmer springs were allowing the flies to start breeding earlier in the year.

In 2015, Roger Koller, a third-generation farmer, lost a third of his spring wheat to the Hessian fly. "That was economically devastating," he told

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me. "When you walk your field and discover the damage, it's a hopeless feeling." In 2017, Jason Scrupps, a fourth-generation wheat farmer, lost ninety per cent of his spring wheat crop. The next year, Bruce Petty, a fifth-generation farmer, suffered a similar loss. At first, the wheat had seemed healthy, but, a few weeks in, "it was spindly," Petty said. "It kind of got to a certain stage of growth and it just stopped. And you could dig around and the roots weren't right—they were trying to send another shoot out sideways." He likened the Hessian fly to "a scary ghost story that somebody tells you around a campfire. Something you always heard about, but thought, Oh, that'll never happen; we don't have those anymore. Well, we do have 'em!"

"The Hessian-fly-research community is pretty small," Pumphrey said. "Which is crazy, considering how important it is around many regions of the world." By Pumphrey's count, there are only five people in the United States focussed on managing long-term Hessian-fly infestations, which could cause billions of dollars of damage worldwide each year. "I would like to say there's more internationally, but really, it's just ICARDA," he said.

ICARDA's approach to problems such as Hessian-fly infestations hinges on so-called wild relatives—plant species that bear close resemblances to domesticated crops, but, being rougher around the edges, lack their taste, good looks, and consistency. These undomesticated strains appear at harvest time, when farmers select their tamer, more pampered kin for replanting. But, because the wild relatives have survived with little or no help from people, they are hardy and persistent, and so can serve as lifelines when crops begin to fail.

In 2016, Pumphrey learned that one of his colleagues, Ming-Shun Chen, an entomologist at the U.S.D.A.'s Agricultural Research Service, happened to have a few of ICARDA's seeds for a wild relative of wheat called Aegilops tauschii on hand. Chen had used them in a previous experiment; an ICARDA entomologist named Mustapha El Bouhssini had sent them to Chen from Syria, before the facility in the Aleppo countryside had been lost. The seeds had travelled in a cardboard box for more than three months before arriving with what Pumphrey called "passport information." It showed that they had been collected in Gilan Province, in northern Iran, before U.S. sanctions led ICARDA to suspend its activities there.

Pumphrey and Chen planted the seeds and waited for them to grow, alongside a few varieties of commercial wheat. At the right time, Chen unleashed some Hessian flies. Of the varieties planted, only A. tauschii

survived. This is because, Pumphrey explained, it responds to a fly attack in part through "programmed cell death": receptors recognize the attack and shut down the targeted cells.

The next step was to cross A. tauschii with commercial wheat varieties—intricate, manual work. Wheat tends to self-fertilize, so a stalk of commercial wheat must be grown until its flowers are fully developed; a breeder, armed with a loupe, tweezers, and forceps, then carefully removes its dozens of tiny male parts just before the plant is mature enough to pollinate. The now all-female stalk is then put into an exclusion bag, which keeps all other pollen out, together with a father plant—in this case, A. tauschii. The breeder then gently flicks the father plant, so that it sheds its pollen onto the mother.

The plants produced from such a union will be infertile. So, their embryos must be removed and placed in a tissue culture—a petri dish containing salts, sugars, and hormones—that will trick around five per cent of the embryos into developing. These, too, will be sterile; they lack stable pairs of chromosomes and can't pollinate themselves. Scientists expose them to a chemical called colchicine, which is derived from the crocus flower; this causes the embryos' chromosomes to double rather than divide normally. About a third of the plants that grow from these will be fertile hybrids.

Wild-relative hybridization is crucial to the continued success of large-scale agriculture. Many of the crops grown around the world, Pumphrey told me, have just a single gene protecting them from any given pest or pathogen. Along with Sam Prather, a Ph.D. student in his lab, Pumphrey has recently confirmed that a single gene is the main source of resistance to the Hessian fly in almost all of the commercial wheat grown in the Pacific Northwest. Such protection is "likely to break down," Pumphrey said. "History tells us that Hessian-fly resistance doesn't last if there's just one gene protecting a specific variety." Wild relatives, which have evolved to prioritize defense, often have layers of resistance to multiple threats; A. tauschii, for example, is also resistant to the mites that spread wheat streak mosaic virus, an infection that currently threatens crop yields in the United States. And yet, wild relatives are not invulnerable: many of the species in ICARDA's collection are endangered or extinct.

"Most people don't know enough about where their food comes from, or how fragile those systems can be," Pumphrey told me. In a separate project, he and his collaborators are using seeds from ICARDA and other C.G.I.A.R. seed banks to breed drought- and heat-resistant wheat varieties. He hopes to begin distributing seeds for the A. tauschii hybrid wheat,

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in partnership with the nonprofit Washington State Crop Improvement Association, in the next three years.

When crops fail in Kansas and Washington, farmers are likely to have insurance, savings, and, possibly, government help. When they fail in poorer countries, it's a different story. Two-thirds of the world's poor are subsistence farmers; after a single crop failure, such a farmer may have to sell his livestock, take his daughters out of school, or send his children to find work in a city. "Where you have one crop failing, you probably have many," Filippo Bassi, the Italian scientist who leads ICARDA's Durum Wheat Breeding Program, told me. "These effects are happening on the scale of a whole village." Crop failures in one country can have ripple effects: in 2008, a drought in Australia—then one of the world's largest wheat exporters—contributed to a doubling of global wheat prices, pushing an estimated hundred million people into poverty.

On a warm, windy afternoon in Lebanon, Bassi took me to see experimental wheat varieties growing in small, separate rectangles in ICARDA's fields. The wheat rustled loudly in the breeze; Bassi knelt to show me the black-blistered stem of one of the plants, which was infected with a rust disease. (The Food and Agriculture Organization estimates that a third of the world's wheat is vulnerable to rusts.) Standing in the field, I could easily imagine the rust's spores spreading on the wind—and yet, as Bassi indicated, varieties of wheat infected with rust were growing beside wheat that was disease free. We walked to the far edge of the field, past varieties of wheat with short spikes, long spikes, gold spikes, black spikes. From a distance, the field's rectangles blended into a single expanse, wind rippling across its surface.

Bassi is trying to perfect a strain of wheat that can withstand temperatures of a hundred degrees Fahrenheit. (Typically, wheat suffers heat stress once temperatures reach seventy-seven degrees.) In 2017, when he introduced a version of it to farmers living on the banks of the Senegal River, he encountered an unanticipated problem: the local birds, delighted with his invention, ate the entire crop. Then he noticed that a single patch of wheat had survived. The spikes on its kernel were particularly short, and the birds couldn't grasp the seeds with their beaks. Bassi crossed that wheat with varieties which had other good qualities; five years and many variations later, the new wheat was almost ready to be sent out.

Later that afternoon, I met Kumari, the ICARDA plant virologist, in her laboratory. Her assistant brought us a tray of coffee, dates, and almond-rosewater biscuits. Kumari has discovered varieties of broad, or, faba,

beans—a staple crop in many countries—that are resistant to the fast-spreading faba bean necrotic yellows virus, which is being carried by intrepid aphids from Syria to Ethiopia. Kumari had cultivated the resistant seeds in the course of ten years, during her time in Aleppo; she managed to take some of them to Lebanon with her. (In 2020, partly for this work, she was named one of the BBC's "100 Women of 2020.") Various faba-bean varieties crossed with the resistant seeds are now being tested in Egypt and Tunisia.

As late afternoon light shone through the laboratory's windows, Kumari recounted her journey from Aleppo to Tunis, and then to Lebanon, for me. She spoke forcefully, her voice rising until she was almost shouting. "By the way, I have the bag," she said, of the small suitcase that she had with her at the conference when her family fled their home. "I still have my suitcase with me, because I feel that when I look at it I remember my story." Lebanon, too, is now in the midst of an economic and political catastrophe; since October, 2019, its currency has lost ninety per cent of its value, and the cost of food has risen more than fivefold. The World Bank estimates that Lebanon's economic crisis may be one of the three worst worldwide in the last hundred and seventy years; following the 2020 Beirut explosion, the country's government resigned, and it took more than a year to form a new one. Hospitals are now battling both COVID and food poisoning. (Extended power outages mean limited refrigeration.) Meanwhile, across the border, in Syria, ISIS has repeatedly been burning fields to the ground. In recent months, Syrians have queued for up to six hours for bread.

It was early fall in the Bekaa Valley, and glowing orange persimmons ripened on dusty trees. Sitting in his office, Shehadeh recalled the shock of losing the Aleppo seed bank. "It was just destroyed," he said. "I spent more than twenty-seven years of my life working in Syrian agriculture." ICARDA is important to many countries, Shehadeh said, but he was also conscious of how much it mattered to Syria and Syrians. Suddenly, all that was gone.

While we spoke, a DHL van pulled into the driveway outside, and a small crowd of staffers gathered around it. We walked out into the sun, and Shehadeh lit a cigarette. We watched as the blue boxes bound for Svalbard were loaded inside. More seeds for the doomsday vault; more backups being reëstablished. The doors thumped shut. "Yalla, bye!" Shehadeh yelled, Arabic slang for "see ya!" As the van disappeared around the corner,

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I asked Shehadeh how he felt. "Released," he said. With the rest of the staff, we walked back inside.

newyorker.com, 19 October 2021

https://www.newyorker.com

Salmon need trees

2021-10-20

A new study stands as a striking reminder that logging watersheds has an outsized impact on salmon and trout.

Led by Kyle Wilson at Simon Fraser University in British Columbia, the study looked at the successes and failures of five species of salmonids in the Keogh River (called Giyuxw by the local Kwakiutl First Nation) on northern Vancouver Island. For steelhead trout, the salmonid Wilson and his colleagues had the most data for, the problems the fish faced in the BC river hit the population just as hard as the challenges they faced out at sea. Wilson suspects the same holds true for other species with similar life cycles.

"Most people point to marine impacts as the biggest thing affecting salmon survival. This counters that," Wilson says.

Chinook, coho, and steelhead populations in the Salish Sea have declined by up to 90 percent over the past 40 years. The Committee on the Status of Endangered Wildlife in Canada deemed several populations of steelhead as endangered in 2020. Unpicking exactly how and why fish are crashing has proved hard. Whatever happens to the fish out at sea has been seen as something of a black box, so much recent research has focused on marine survival. Those efforts point to multiple culprits for declining salmon numbers, including climate change, overfishing, reductions in the salmons' food, and rebounding populations of seals and Steller sea lions that gorge on the fish. Wilson's research, however, highlights the need to keep our eyes on terra firma.

Logging has long been known to have big impacts on the well-being of fish. Watershed logging was improved after the 1990s "War in the Woods" in British Columbia—salmon streams are better protected under regulations now—but remains a concern. Reducing shade over rivers can boost water temperature, which can be good or bad for spawning fish. Removing roots loosens soils and causes turbidity. Fewer logs may fall into streams, reducing the number of pools and turns that salmon like. A recent study by David Reid, completed when he was a postdoctoral researcher at

"Most people point to marine impacts as the biggest thing affecting salmon survival. This counters that," Wilson says.

the University of British Columbia, found the full impacts of logging can take a surprisingly long time to kick in. "It might take decades," he says.

Wilson's paper aims to weigh up riverine against marine survival. "It's nice to see these components linked together," says Reid.

Wilson and his colleagues looked at the numbers of baby fish in the river traveling out to sea, and the number of adults returning to the river to spawn. The populations of steelhead, cutthroat, and Dolly Varden salmonids dropped dramatically over the study period from 1976 to 2015: steelhead adults declined by about 80 percent and juveniles by about 90 percent. Only pink salmon, which spend most of their life in the ocean, stayed steady; coho declined moderately.

The team then crunched those numbers against a host of forces that influence fish survival. For their time in the river, that included air temperatures, rainfall, and how much area had been logged any time over the previous 15 years. At sea, they looked at factors including seal numbers, ocean temperature, and climate factors like the North Pacific Gyre Oscillation index that can affect nutrient levels.

From their calculations, the researchers found the vast majority of problems at sea were associated with species interactions: being eaten by predators, or competing with each other for resources. In rivers, the vast majority of the impact was from logging.

"The logging footprint explained a ton of the baby salmon productivity," says Wilson. If all other factors, like temperature, had stayed constant over the study period, logging would have driven the number of baby steelhead born per mother fish down 97 percent, he says. It was 98 percent for coho, and 99 percent for cutthroat.

Looking across all stages of the fish's life cycle is important, says Jacques White, a biological oceanographer and executive director of Long Live the Kings in Seattle, Washington, a nonprofit that aims to restore wild salmon. The organization and its partners have just completed a US $23-million five-year project looking at the issues affecting marine survival of salmon in the Salish Sea, which highlighted predators and food availability as major factors, along with pollutants in some estuaries. "What I really want to do next is take a hard look at climate change and how it's going to affect salmon onshore, near shore and offshore," says White. The relative impacts are often different for different species across different watersheds, he notes.

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In June 2021, the Canadian government announced a CAN $647-million Pacific Salmon Strategy Initiative. "The first big push was a bunch of commercial fishery closures," says Wilson. Forestry management, he says, needs to be emphasized, too.

One problem in Canada, Wilson says, is that the Province of British Columbia regulates things like watershed activity, while the federal Department of Fisheries and Oceans regulates things that happen at sea: "These two agencies are very happy blaming each other for what they can't control."

hakaimagazine.com, 20 October 2021

https://www.hakaimagazine.com

Tuskless elephants became common as an evolutionary response to poachers

2021-10-21

When ivory poachers target elephants, the hunters can affect more than just animal numbers. In Mozambique, past hunting pressure led to an increase of naturally tuskless elephants in one park, a study finds.

During the Mozambican Civil War, which lasted from 1977 to 1992, armies hunted elephants and other wildlife for food and ivory (SN: 5/5/19). This caused the number of large herbivores to drop more than 90 percent in the country's Gorongosa National Park.

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Now, video footage and photographic records show that as elephant numbers plummeted, the proportion of tuskless female African savanna elephants (Loxodonta africana) rose from about 18 percent to 51 percent.

Decades of poaching appear to have made tusklessness more advantageous from an evolution standpoint in Gorongosa, encouraging the proliferation of tuskless females with mutations in two tooth genes, researchers report in the Oct. 22 Science.

The rapid culling of tusked individuals changed the makeup of traits in the elephant population in only two decades, leaving behind more tuskless individuals, say evolutionary biologist Shane Campbell-Staton of Princeton University and colleagues. The tuskless trait is heritable, and the evolutionary change in the population may stick around for several generations at least, even as poaching eases.

The team also analyzed the genetic instruction books of 18 tusked and tuskless females, zeroing in on two genes rife with mutations in tuskless females. In humans, the disruption of one of those genes can cause tooth brittleness and the absence of a pair of upper incisors that are the "anatomical equivalent of tusks," Campbell-Staton says. Abnormalities in the other gene's protein product can cause malformations of the tooth root and tooth loss.

Poaching "changing the course of evolution" in Gorongosa's elephants, Campbell-Staton says, can have reverberating effects through the ecosystem given elephants' dramatic impact on their surroundings.

"[Tusks are] not just ornamental. They serve a purpose," he says, detailing how elephants use tusks to dig for water and strip tree bark for food. "If an elephant doesn't have the tool to do those things, then what happens?"

sciencenews.org, 21 October 2021

https://www.sciencenews.org

When did Constantinople become Istanbul?

2021-10-24

Istanbul is a rare place. It's the only city to straddle Europe and the Middle East; the Turkish metropolis is simultaneously an Asian and a European city. This geography helps explain why it was once the capital of the Eastern Roman Empire, also known as the Byzantine Empire, when the city was called Constantinople, and then later why it became the power base of the Ottoman sultans, whose influence stretched into Africa and the Arab world.

But exactly when did Constantinople change its name to Istanbul?

The answer, surprisingly, isn't when the former Roman city was captured by Ottoman forces in 1453. Variations of "Constantinople" continued to be used by the Turkish-speaking conquerors long after they took control of the city. "It's a fact that the Ottomans called Istanbul 'Kostantiniyye,' among other names, in thousands of their official documents," said Christoph Herzog, chair of Turkish studies at the University of Bamberg in Germany. Live Science Video in 30 seconds

PLAY SOUND

The city already had many names before being called Constantinople. It was first known as Bazantion (also spelled Byzantion) by the Greeks who

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founded it in 657 B.C., which later evolved into the Latin name Byzantium. It's also been called New Rome and Augusta Antonina, in honor of a Roman emperor's son — not to mention its nicknames such as "Queen of Cities" or simply "The City." Then the Roman Emperor Constantine the Great — who is famous for being the first Roman emperor to convert to Christianity — named it Constantinople after himself around the year 330. That name stuck until the Ottomans showed up.

The Ottomans didn't officially change the name of Constantinople when they took over in the 15th century, but the conquest did mark a seismic change in geopolitics, as Constantinople's center of gravity shifted eastward and away from Europe.

"I think the strategic and symbolic importance of Istanbul was recognized even then, as can be seen by the fact that it was made into the Ottoman Empire's new capital," Herzog told Live Science. People elsewhere in the empire began to use the word "Istanpolin," which means "to the city" in Turkish (adapted from the Greek phrase "to The City" or "eis tan polin") to colloquially describe the new seat of Ottoman imperial power. Progressively, Istanpolin became used more, but the official name remained Constantinople.

As the centuries marched on, the vernacular changed little by little, and so Istanpolin eventually graduated to become Istanbul.

Following its defeat in World War I, the sultanate of the Ottoman Empire was abolished in 1922, and the Republic of Turkey was born in 1923, according to Britannica. Shortly thereafter, in 1930, the Turkish postal service decided that some clarification was in order, and it opted to make Istanbul the city's official name. Other institutions soon followed suit. That same year, the U.S. State Department and other governments around the world began using Istanbul in their official communications.

So, it's hard to say exactly when Constantinople became Istanbul because by the time it was made official, people had already been using Istanbul and variations of that name for centuries. It's impossible to put a date on when the transition came to pass in popular speech because language evolves so gradually.

Traces of Istanbul's storied history of many names remain alive in the cultural makeup of the city today, Herzog said. "As the capital of an empire spanning three continents for centuries, there were lots of groups of people residing there."

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Flamingoes dye their sun-faded feathers to stay pretty in pink

2021-10-26

Greater flamingos apparently aren't fans of a sun-faded look for their neck feathers.

Scientists have known that the leggy birds touch up their color by smearing their necks with a serum they produce glands near their tails. But greater flamingos (Phoenicopterus roseus) aren't simply enhancing color that's already there; they're also fighting the sun's bleaching effect on it, researchers report in the October Ecology and Evolution. Feathers with a thicker coating of this serum held their color better than those with less, analysis shows.

Flamingos' feathers help the birds fly, keep their bodies dry and attract mates. The feathers get their red color from carotenoids, molecules responsible for many natural pigments, found in the birds' steady diet of brine shrimp and algae.

When flamingos preen, they care for their feathers a bit like how we care for our hair, cleaning out accumulated dirt and parasites. And like some of us, they add color. To apply their DIY feather dye, flamingos rub their cheeks on a gland above their tail called the uropygial gland, which generates a color-carrying serum. The birds then rub their serum-coated cheeks on their feathers and sway their necks to make sure the dye sticks. All that effort, paired with some slick dance moves, is aimed at attracting potential mates.

But the sun's ultraviolet radiation can break down carotenoids. That got Maria Cecilia Chiale, a biologist at Universidad Nacional de La Plata in Argentina, wondering if flamingos lose their color without constant reapplication of the serum. If so, that might help explain their instinct to constantly "touch up" their plumage.

Chiale and her collaborators collected dozens of neck feathers from flamingos in France that had died in a cold snap (SN: 10/16/14). The team scanned the feathers and used Adobe Photoshop to analyze their color, and then placed half of them on a roof, exposed to sunlight. The other half

Feathers with a thicker coating of this serum held their color better than those with less, analysis shows.

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were kept in darkness. Forty days later, new scans to analyze the feathers' color intensity showed that the exposed feathers were sun-faded and paler than those kept in the dark.

Before the exposure experiment, Chiale had extracted carotenoids from both the surface and interior of each feather. After exposure, she found that feathers with a greater concentration of carotenoids had kept more color. That suggests that the birds had applied more serum to those feathers, letting them withstand fading better than those with a thinner coating.

Flamingos actively work to maintain their blushed necks throughout their lengthy display season as they prepare to mate, the research suggests; otherwise, they'd have pale feathers.

"Preening behaviors … have great social importance for flamingos because they live in large flocks and have synchronized behavior," says Henrique Delfino, an ecologist at Universidade Federal do Rio Grande do Sul in Brazil who was not involved in the study. "Initially, the behavior was for [waterproofing], but since it reinforces the color signal of the feathers … it helps in the social communication of flamingos." Without flashy feathers to advertise their health, flamingos probably struggle to find a partner.

All that preening to prevent feather fade doesn't continue forever, though. Once they've snagged a mate and successfully hatched a chick, Chiale says, flamingos put the dye away, at least until the next year's mating season. The concentration of carotenoids in the serum drops dramatically, and the flamingos apply it far less frequently.

"They don't need to have makeup on while they're raising the kids," she says. They need that energy to take care of their chicks.

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https://www.sciencenews.org

Green tea discovery upends ideas about its health benefits

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Green tea has long been known to have health benefits. In particular, it contains catechins called ECG and EGCG that are said to prolong life.

As a result, the catechins in green tea that researchers fed to nematodes led to longer life and greater fitness.

These two substances belong to the group of polyphenols. They are considered antioxidants, which means they counteract or prevent oxidative stress in the body caused by aggressive free radicals of oxygen.

Until now, researchers have assumed that the catechins neutralize these free radicals and thus prevent damage to cells or DNA. One source of oxygen free radicals is metabolism; for example, when the mitochondria—the powerhouses of the cell—are working to produce energy.

In the new study in the journal Aging, the researchers show that these polyphenols from green tea initially increase oxidative stress in the short term, but that this has the subsequent effect of increasing the defensive capabilities of the cells and the organism. As a result, the catechins in green tea that researchers fed to nematodes led to longer life and greater fitness.

"That means green tea polyphenols, or catechins, aren't in fact antioxidants, but rather pro-oxidants that improve the organism's ability to defend itself, similar to a vaccination," says study leader Michael Ristow, professor of energy metabolism at the health sciences and technology department at ETH Zurich.

However, this increase in defensive capability manifests not through the immune system, but rather by activating genes that produce certain enzymes such as superoxide dismutase (SOD) and catalase (CTL). It is these enzymes that inactivate the free radicals in the nematode; they are essentially endogenous antioxidants.

Ristow isn't surprised to see this kind of mechanism at work. His research group showed back in 2009 that the reason sport promotes health is because sporting activities increase oxidative stress in the short term, thus improving the body's defenses.

Consuming fewer calories has the same effect, as has been shown several times in animals. Mice fed a reduced-calorie diet live longer than those fed a normal, high-calorie diet. "So it made sense to me that the catechins in green tea would work in a similar way," Ristow explains.

He goes on to say that the findings from this study translate well to humans. The basic biochemical processes by which organisms neutralize oxygen free radicals are conserved in evolutionary history and are present in everything from unicellular yeast to humans.

Ristow himself drinks green tea every day, a practice he recommends. But he advises against taking green tea extracts or concentrates. "At a certain

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concentration, it becomes toxic," he says. High-dose catechins inhibit mitochondria to such an extent that cell death ensues, which can be particularly dangerous in the liver. Anyone consuming these polyphenols in excessive doses risks damaging their organs.

While the most catechins are to be found in Japanese varieties of green tea, other green teas also contain sufficient amounts of these polyphenols. Black tea, on the other hand, contains a much lower level of catechins, since these are largely destroyed by the fermentation process.

"That's why green tea is preferable to black tea," Ristow says.

Additional coauthors are from the University of Jena and ETH Zurich.

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