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

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Regulatory Update

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ASIA PACIFIC

Chemical Management changes coming in 2021

2020-11-05

A revamped regime for classifying hazardous substances takes effect in late April 2021, in the interests of safety for all New Zealanders.

The changes will bring our chemical management into line with the rest of the world, support international trade, and facilitate improved regulatory compliance.

We are adopting the seventh revised edition of the Globally Harmonised System (GHS 7), which will implement hazard classifications tailored for New Zealand. These capture physical hazards such as flammability, human health hazards such as skin irritation, and environmental hazards such as how toxic a chemical is in water.

We have led this three-year project, working with the European Chemicals Agency and the Organisation for Economic Co-operation and Development (OECD), and other domestic regulators.

"These changes are for the benefit of all New Zealanders. Chemicals touch every area of our lives, and the world of chemical management is dynamic and fast-moving, so it's important we stay on top of best practice," says the EPA's General Manager of Compliance, Monitoring, and Enforcement, Gayle Holmes.

More than 9,000 hazardous substances are individually approved for use in New Zealand. Their details will be captured in our new database, which has been configured for New Zealand's unique requirements.

The new classification system and database are both on track to take effect on 30 April 2021.

"Now is a good time for importers and manufacturers to start getting familiar with the changes required of them. Although there is a transition period through to 2025 for many requirements, we strongly encourage industry to comply with the various changes sooner rather than later," says Gayle Holmes.

As a starting point, importers and manufacturers should be looking carefully to get their hazard classification, labelling, and safety data sheets to comply with the new classification system.

The new classification system and database are both on track to take effect on 30 April 2021.

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Consumers should start to see the GHS 7 pictograms appearing on product labels, as New Zealand's chemical labelling aligns with the rest of the world.

EPA New Zealand, 5 November 2020

<https://www.epa.govt.nz/news-and-alerts/latest-news/chemical-management-changes-coming-in-2021/>

Improving chemical assessment for a safer environment

2020-11-12

Changes are being made to the Hazardous Substances and New Organisms Act 1996 (HSNO) that will enable us to more quickly assess and reassess chemicals for use in New Zealand.

There are over 9,000 substances with individual approvals, and many thousands of substances with approvals under group standards.

"If approvals are delayed, beneficial chemicals, including safer alternatives to existing ones, take longer to be in use," says the Ministry for the Environment's Director of Waste and Resource Efficiency – Regulatory and Policy, Glenn Wigley.

"Delaying reassessments means safety and environmental controls might not be up to date and fit for purpose."

The Ministry for the Environment (MfE) is responsible for developing the policy behind the changes.

The EPA is the regulator of chemicals used in New Zealand, approving new chemicals and setting controls for them. It also reassesses chemicals already in use to ensure the existing controls are fit for purpose.

"The changes will speed up these processes by enabling us to better use information, assessments and decisions of trusted overseas regulators," says the EPA's General Manager of Regulatory Systems and Operations, Siobhan Quayle.

"This will lead to better protection of people and the environment."

The changes are part of a broader government work programme to improve the hazardous substances system, including the EPA's chemical modernisation programme and increased funding to support the EPA's reassessment programme.

There are over 9,000 substances with individual approvals, and many thousands of substances with approvals under group standards.

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The changes only relate to hazardous substances – there are no changes to the new organisms provisions of the HSNO Act.

The next steps will involve MfE drafting amendments to the HSNO Act, and making changes to the relevant regulations, to be considered by Parliament.

Read the Cabinet paper on proposed amendments to the HSNO Act 1996 - Ministry for the Environment website (PDF, 742KB)

EPA New Zealand, 12 November 2020

<https://www.epa.govt.nz/news-and-alerts/latest-news/improving-chemical-assessment-for-a-safer-environment/>

Six more chemicals prioritised for reassessment

2020-11-04

Insecticides used in ant bait, and chemicals found in timber treatment substances, are among the additions to our priority list for reassessment.

We regulate hazardous chemicals under the Hazardous Substances and New Organisms (HSNO) Act. This includes making decisions on whether to approve the use of new hazardous substances in New Zealand, and reassessing approvals of those already in use.

The Priority Chemicals List contains 43 substances that we believe are most in need of review in New Zealand, drawn from a long-list of 1,200 chemicals we have screened.

The six additions to the Priority Chemicals List are:

azocyclotin, an insecticide used in spider mite control products

chromates, a group of industrial chemicals, found in timber treatment substances

hydramethylnon, an insecticide used for professional and home use ant baits

nonylphenol, a multi-use chemical found in professional and home use pesticides, cleaning products and veterinary medicines

propiconazole, a fungicide used in the production of fruit, cereals, grass seed, and on turf

The Priority Chemicals List contains 43 substances that we believe are most in need of review in New Zealand, drawn from a long-list of 1,200 chemicals we have screened.

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tricresyl phosphate, used as a flame retardant in a variety of products, such as adhesives, lubricants, and surface coatings.

The EPA's spokesperson, Siobhan Quayle, says "All of these chemicals scored highly when we screened them for human health and environmental health harm, and have been added to the Priority Chemicals List on that basis.

"We are updating the Priority Chemicals List to ensure risks to people and the environment continue to be managed effectively. Over time, we will review the rules that apply to each of these chemicals in our reassessment work programme to ensure they are fit for purpose."

More than 150,000 hazardous substances are approved for use in New Zealand. Approvals do not expire; the only way they can be amended or revoked is through a formal reassessment process. Reassessments can be complex, lengthy, and costly – with some costing more than \$1 million.

"We now have a dedicated team focused on progressing these reviews, with several reassessments currently underway including for the log fumigant methyl bromide and the horticultural spray ingredient hydrogen cyanamide," says Siobhan Quayle.

EPA New Zealand, 4 November 2020

<https://www.epa.govt.nz/news-and-alerts/latest-news/six-more-chemicals-prioritised-for-reassessment/>

AMERICA

1,4 Dioxane: Another forever chemical plagues drinking-water utilities

2020-11-08

1,4-Dioxane gets around.

It's on laboratory shelves, a reagent familiar to bench scientists. Some drugmakers use it to purify pharmaceutical ingredients. Filter makers employ it to create tiny pores in membranes. The chemical's commercial heyday was in the second half of the 20th century, when it stabilized chlorinated solvents used for metal degreasing.

Since then, the chemical's reputation has dimmed.

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In toxicity studies, laboratory rodents given 1,4-dioxane in their drinking water developed liver cancer. The US National Toxicology Program classifies the synthetic compound as "reasonably anticipated to be a human carcinogen." Likewise, the US Environmental Protection Agency deems this synthetic chemical a likely carcinogen. In addition, 1,4-dioxane doesn't readily biodegrade in the environment, the EPA says.

Full Article

Chemical and Engineering News, 8 November 2020

<https://cen.acs.org/environment/pollution/14-Dioxane-Another-forever-chemical/98/i43>

New Jersey signs strongest plastic and paper bag ban in US

2020-11-04

On Nov. 4, New Jersey Gov. Phil Murphy (D) signed the strongest single-use bag ban in the nation, effectively prohibiting the use of single-use plastic and paper bags in all stores and food service establishments across the state.

The bill, S864, was introduced into the New Jersey state Senate with five primary sponsors, including Sens. Bob Smith, Linda Greenstein, and Nancy Pinkin, all Democrats. It traveled through several committees before being passed on Sept. 24.

Some of the containers affected by the ban include plastic carryout bags, single-use paper carryout bags, polystyrene foam food service products (commonly known as Styrofoam), as well as the limited usage of plastic drinking straws.

Full Article

The Hill, 4 November 2020

<https://thehill.com/changing-america/sustainability/environment/524531-new-jersey-signs-strongest-plastic-and-paper-bag>

4, New Jersey Gov.

Since then, the chemical's reputation has dimmed.

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Wisconsin officials offer water quality standards for PFAS

2020-11-06

Wisconsin health officials said Friday they've finished drafting new groundwater standards for more than 20 substances, including a dozen types of PFAS chemicals.

The Department of Natural Resources asked the Department of Health Services in April 2019 to begin researching the health impacts of 40 unregulated substances and provide recommendations on how much of each substance should be allowed in groundwater. The DNR plans to use the recommendations as the basis for writing an administrative rule establishing standards that will apply to bottled water, agricultural chemicals, clean-up at contaminated sites and landfills.

DHS officials said they reviewed scientific literature about each substance and came up with recommendations for 22 of the 40 substances, including 16 types of PFAS and six pesticides. The department said it couldn't come up with recommendations for the remaining 18 due to limited information on their effect on human health.

[Full Article](#)

The Journal Times, 6 November 2020

https://journaltimes.com/news/state-and-regional/wisconsin-officials-offer-water-quality-standards-for-pfas/article_428c17b8-836f-50e2-987c-7678c08f371a.html

Biden's EPA expected to pass limits on some "Forever Chemicals"

2020-11-11

The EPA under a future Biden administration is expected to quickly move to set regulations on "forever chemicals" in water and other areas, but not to restrict the entire group of thousands of the substances, attorneys said in recent interviews.

The Environmental Protection Agency is already expected to set national drinking water limits for two of these chemicals, perfluorooctane sulfonate, or PFOS, and perfluorooctanoic acid, or PFOA, said Cynthia AM Stroman, a partner in King & Spalding LLP's Washington, D.C. office.

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President-elect Joe Biden's EPA would be expected to set standards for both of those chemicals and possibly other per- and polyfluoroalkyl substances, or PFAS, that states and federal agencies are finding in drinking water, she said.

The incoming administration also could set waste remediation and other limits for some PFAS, said Lynn Bergeson, managing partner of Bergeson & Campbell P.C., which specializes in chemical policies.

Yet as a centrist, Biden is likely to rely on scientific information and insights into how medical and other high-value industries use some of these chemicals in order to determine a strategy for many of the substances, she said, voicing a perspective shared in interviews with three other chemical policy analysts.

Many Industries Use PFAS

There are thousands of PFAS, of which at least 600 are known to be used in the U.S. by the aerospace, automotive, and various industrial sectors to make products as varied as semiconductor chips, cables, food packaging, and medical stents that keep patients' blood flowing.

But PFAS are an emerging concern across the country because some, such as PFOA and PFOS, have migrated into the soil, water, and air during decades of production and use.

While PFOA and PFOS are no longer made in the U.S., sunlight, weather, and microbes don't break them and similar PFAS down. That means they persist in the environment and can get into water, crops, and farm animals. Exposed people may have weaker immune systems, increased risk of cancer, and other health problems, according to the Centers for Disease Control and Prevention.

[Full Article](#)

Bloomberg Law, 11 November 2020

<https://news.bloomberglaw.com/environment-and-energy/bidens-epa-expected-to-pass-limits-on-some-forever-chemicals>

The EPA under a future Biden administration is expected to quickly move to set regulations on "forever chemicals" in water and other areas, but not to restrict the entire group of thousands of the substances, attorneys said in recent interviews.

Notifying exports ahead of the GB PIC regime entering into force will help to minimise any disruption to trade.

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EUROPE

Advice for GB-based companies intending to export chemicals listed in the PIC Regulation (EU 649/2012) in the period immediately after the end of the Transition Period

2020-11-09

Key points following the UK's withdrawal from the EU:

- Exports of PIC-listed chemicals will be subject to the GB PIC requirements from 1 January 2021. The GB PIC regime is based on the existing EU PIC regime and similar rules will apply.
- HSE continues to be the PIC Designated National Authority (DNA) for Great Britain.
- GB-based exporters will no longer have access to ePIC and will use the replacement GB procedures for submitting export notifications.
- Chemicals subject to the regulation will form the GB PIC list. When the new requirements come into force, the chemicals in the GB PIC list will be the same as those in Annexes I and V of the EU PIC Regulation.
- GB PIC will apply to exports of listed chemicals to the EU countries as well as other countries.
- Under the Northern Ireland Protocol, GB PIC will apply to movements of listed chemicals between GB and NI. A PIC export notification for supply to NI will cover both movement of that chemical to NI and export to any EU country.

Transitional arrangements for exports in early 2021

As part of our planning for the end of the Transition Period (TP), HSE, the PIC Designated National Authority (DNA) is putting in place some interim arrangements to allow GB-based companies to notify exports of PIC chemicals in the immediate period following the end of the TP on 31 December.

Notifying exports ahead of the GB PIC regime entering into force will help to minimise any disruption to trade.

These transitional arrangements will only apply to the first export of the chemical or product in 2021 and where the intended date of export is between:

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- 1 January and 8 February inclusive for chemicals listed in Part 1 of Annex I to the EU PIC Regulation ((EU) 649/2012) and**
- 1 January and 8 March for chemicals listed in Parts 2 and 3 of Annex I to the EU PIC Regulation**

Exports outside of these periods should be notified from 1 January using the new GB PIC procedures. Further information about these will be published on HSE's website.

GB-based companies should not use the EU's ePIC system for notifying exports from GB planned for 2021. These exports will be subject to the GB PIC requirements. Any pending notification procedures involving exporters in Great Britain will be discontinued by ECHA at the end of the transition period.

How to notify exports under the transitional arrangements

If you are intending to export a PIC listed chemical where the intended date of export falls within the transitional arrangements timescales set out above, and you haven't already been contacted by HSE, we advise you to contact us as soon as possible at ukdna@hse.gov.uk to request a GB PIC export notification form and further information.

The GB notification forms are similar to those that are used in ePIC.

Exports should be notified at least 35 days before the intended date of export to ensure that we have enough time to process them and forward them to the importing country. If the chemical you are exporting additionally requires the consent of the importing country, we would advise you to submit the notification as soon as possible to allow enough time for us to seek consent on your behalf.

Please consider sharing this PIC ebulletin with anybody in your networks who does not currently subscribe. They can [sign up here](#) to receive notifications when guidance and updates are published

Health and Safety Executive, 9 November 2020

<https://www.hse.gov.uk/>

On November 2, 2020, the European Commission (EC) requested a scientific opinion from the Scientific Committee on Consumer Safety (SCCS) on the ultraviolet (UV) filter HAA299 (nano) (chemical name "2-(4-(2-(4-Diethylamino-2-hydroxy-benzoyl)-benzoyl)-piperazine-1-carbonyl)-phenyl)-(4-diethylamino-2-hydroxyphenyl)-methanone").

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EC requests scientific opinion on UV-Filter HAA229 (Nano)

2020-11-11

On November 2, 2020, the European Commission (EC) requested a scientific opinion from the Scientific Committee on Consumer Safety (SCCS) on the ultraviolet (UV) filter HAA299 (nano) (chemical name "2-(4-(2-(4-Diethylamino-2 hydroxy-benzoyl)-benzoyl)-piperazine-1-carbonyl)-phenyl)-(4-diethylamino-2-hydroxyphenyl)-methanone"). According to the EC's request, the applicant seeks to assess the safety of HAA299 (nano) for use as a UV filter up to a maximum concentration of 10%. The EC asks SCCS:

In light of the data provided, does SCCS consider HAA299 (nano) safe when used as a UV filter in cosmetic products up to a maximum concentration of 10%;

In view of the previous SCCS opinion on HAA299 (SCCS/1533/14), which did not cover HAA299 composed of nanoparticles, does SCCS consider both non-nano and nano forms of HAA299 safe when used as UV filters in cosmetic products up to a maximum concentration of 10%;

In case SCCS finds HAA299 (nano) not safe, does it still uphold the conclusions of the SCCS/1533/14 opinion with regard to the safe use of HAA299 non-nano form; and

Does SCCS have any further scientific concerns on human health with regard to the use of HAA299 (nano) in cosmetic products.

The deadline for the scientific opinion is nine months.

Full Article

Bergeson & Campbell PC, 11 November 2020

<https://nanotech.lawbc.com/2020/11/ec-requests-scientific-opinion-on-uv-filter-haa299-nano>

This will make it possible to overcome agency constraints and eliminate management duplication.

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INTERNATIONAL**Kazakhstan to establish interagency coordination body for safe chemicals management**

2020-11-08

NUR-SULTAN. KAZINFORM Supported by the United Nations Development Programme interagency coordination body for safe chemicals management will be established in Kazakhstan. Coordinated by the Ministry of Industry and Infrastructural Development of the Republic of Kazakhstan, this body will be a dialogue platform for discussion of current issues in the field of chemical safety, the first of which will be to discuss the implementation of the EAEU Technical Regulations 041-2017 on safety of chemical products. The establishment of an interagency body for safe chemicals management was driven by the need to improve coordination, effective cooperation and information exchange among stakeholders. This will make it possible to overcome agency constraints and eliminate management duplication. A well-organized mechanism of interagency coordination can help increase transparency and cooperation between ministries, clarify competencies of various institutions, and promote an integrated approach to chemicals management that addresses all stages of the chemical life cycle, the official website of UNDP in Kazakhstan reads. The decision to establish a coordination body in the field of safe chemicals management was made at a recent round table on effective intersectoral coordination jointly organized by the Ministry of Industry and Infrastructural Development of the Republic of Kazakhstan and UNDP. «Lack of sufficient awareness of the forthcoming process of implementation of the EAEU Technical Regulation 041-2017 on safety of chemical products among representatives of industry and business in the future may create additional difficulties in supply, procurement and use of chemicals. Since these processes are regulated by many government agencies at the same time, today the issue of creating an interagency body in the field of safety of chemicals management is very relevant,» - noted Gulnar Ilmaliyeva, Head of Chemical and Pharmaceutical Industry Department of Industrial Development and Industrial Safety Committee MIID RK.

Full Article

Kazinform, 8 November 2020

https://www.inform.kz/en/kazakhstan-to-establish-interagency-coordination-body-for-safe-chemicals-management_a3716019

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REACH Update

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REACH change planned to extend chemical safety reports to low tonnage CMRs

2020-11-05

Article 14 amendment envisaged for 2022, Commission says

The European Commission plans to amend REACH to extend the obligation to perform chemical safety assessments to low tonnage carcinogenic, mutagenic and reprotoxic substances (CMRs), and document them in a report – a move intended to harmonise communication of risk management measures in the supply chain.

It follows a review of the requirement for chemical safety assessments (CSAs) and reports (CSRs) for category 1A and 1B CMRs, the conclusions of which were revealed in a Commission staff working document accompanying the recently-published EU chemicals strategy.

Chemical Watch, 5 November 2020

<https://chemicalwatch.com/175123>

Inspectors to check duty to notify mixtures for poison centres

2020-11-09

ECHA/NR/20/38

The Enforcement Forum has agreed to check the compliance of companies that have a duty to notify mixtures to the Poison Centre Notification portal. The Forum and BPRS also agreed to take steps to make their work more transparent.

Helsinki, 5 November 2020 – The Forum decided that its pilot project in 2022 will focus on how companies comply with their duty to notify hazardous mixtures (e.g. detergents, paints, adhesives) to the Poison Centre Notification portal.

Companies must provide information about the mixtures to relevant national bodies. This information is then made available to poison centres so they can give advice to citizens or medical personnel in the event of a poisoning.

The obligation to notify certain hazardous mixtures placed on the market for consumer and professional use applies from 1 January 2021. The Forum will start preparing its pilot project in 2021 and plans to carry out

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inspections from the second half of 2022 until mid-2023. The project report is expected in early 2024.

Further to this, the Forum reviewed the results of the REF-7 project on registration, while the Biocidal Products Regulation Subgroup (BPRS) reviewed the findings of the BEF-1 project on treated articles. The reports for these projects are planned for publication towards the end of 2020.

The Forum and BPRS also discussed ways of improving their transparency and engagement with stakeholders and agreed to organise remote workshops for accredited stakeholder organisations after each of their enforcement projects to discuss the results and recommendations for industry. The Forum and BPRS will also, starting from 2021, publish information about the follow-up of recommendations from their enforcement projects indicating what was done to put them into practice.

During its first remote open session involving representatives of 46 stakeholders and five candidate countries, the Forum and BPRS discussed topics ranging from industry initiatives for fast tracking the supply of disinfectants, streamlining the classification of petroleum substances of unknown or variable composition (UVCBs), controls of online sales of products and enforcement of REACH duties to use animal testing as a last resort.

The BPRS also started preparing its second BPR enforcement project (BEF-2) which will focus on biocidal products. Inspectors will check whether biocidal products fulfil required pre-marketing conditions (necessary authorisation, use of allowed active substances in the products or correct labelling). The details of this scope of the project are yet to be defined. The BPRS will prepare the project in 2021, run the inspections in 2022 and publish the report in 2023.

The Forum for Exchange of Information on Enforcement met remotely on 26-30 October 2020 and the Biocidal Products Regulation Subgroup (BPRS) met remotely on 4-5 November 2020.

ECHA, 9 November 2020

<https://echa.europa.eu/-/inspectors-to-check-duty-to-notify-mixtures-for-poison-centres>

Article 14 amendment envisaged for 2022, Commission says

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Janet's Corner

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Probiotics vs antibiotics

2020-11-20



<https://justkickthecan.files.wordpress.com/2013/04/funny-yhogurt-antibiotic-probiotic-pills.jpg>

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Hazard Alert

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Zinc Oxide

2020-11-20

Zinc oxide is an inorganic compound with the formula ZnO. Synthetic ZnO is primarily used as a white powder that is insoluble in water, or naturally as the mineral zincite. The powder is widely used as an additive in numerous materials and products including plastics, ceramics, glass, cement, rubber (e.g., car tires), lubricants, paints, ointments, adhesives, sealants, pigments, foods (source of Zn nutrient), batteries, ferrites, fire retardants, and first aid tapes. ZnO occurs as white powder known as zinc white or as the mineral zincite. The mineral usually contains manganese and other impurities that confer a yellow to red colour. Crystalline zinc oxide is thermochromic, changing from white to yellow when heated and in air reverting to white on cooling. This colour change is caused by a small loss of oxygen to the environment at high temperatures to form the non-stoichiometric $Zn_{1-x}O$, where at 800 °C, $x = 0.00007$. Zinc oxide is also an amphoteric oxide. It is nearly insoluble in water and alcohol, but it is soluble in (degraded by) most acids, such as hydrochloric acid. [1]

USES [1]

There are many applications for zinc oxide powder. Most applications exploit the reactivity of the oxide as a precursor to other zinc compounds. For material science applications, zinc oxide has high refractive index, high thermal conductivity, binding, antibacterial and UV-protection properties. Consequently, it is added into materials and products including plastics, ceramics, glass, cement, rubber, lubricants, paints, ointments, adhesive, sealants, pigments, foods, batteries, ferrites and fire retardants.

Rubber Industry

About 50% of ZnO use is in the rubber industry. Zinc oxide along with stearic acid is used in the vulcanisation of rubber. In addition, ZnO additive protect rubber from fungi and UV light.

Concrete Industry

Zinc oxide is widely used for concrete manufacturing. Addition of ZnO improves the processing time and the resistance of concrete against water.

Medical Uses

Medical uses of zinc oxide include the production of calamine via a mixture of zinc oxide with about 0.5% iron (III) oxide (Fe₂O₃). Calamine is then used to produce calamine lotion. There are also two minerals,

Zinc oxide is an inorganic compound with the formula ZnO.

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zincite and hemimorphite, which have been historically called calamine. When mixed with eugenol, a ligand, zinc oxide eugenol is formed, which has applications as a restorative and prosthodontics in dentistry. Reflecting the basic properties of ZnO, fine particles of the oxide have deodorising and antibacterial properties and for that reason are added into materials including cotton fabric, rubber, and food packaging. Enhanced antibacterial action of fine particles compared to bulk material is not intrinsic to ZnO and is observed for other materials, such as silver. This property is due to the increased surface area of the fine particles. Zinc oxide is widely used to treat a variety of other skin conditions, in products such as baby powder and barrier creams to treat diaper rashes, calamine cream, anti-dandruff shampoos, and antiseptic ointments. In addition, it is a component in tape (called "zinc oxide tape") used by athletes as a bandage to prevent soft tissue damage during workouts. Zinc oxide can be used in ointments, creams, and lotions to protect against sunburn and other damage to the skin caused by ultraviolet light. When used as an ingredient in sunscreen, zinc oxide sits on the skin's surface and is not absorbed into the skin, and blocks both UVA (320–400 nm) and UVB (280–320 nm) rays of ultraviolet light.

Cigarette Filters

Zinc oxide is a constituent of cigarette filters for removal of selected components from tobacco smoke. A filter consisting of charcoal impregnated with zinc oxide and iron oxide removes significant amounts of HCN and H₂S from tobacco smoke without affecting its flavour.

Food Additive

Zinc oxide is added to many food products, including breakfast cereals, as a source of zinc, a necessary nutrient. Some pre-packaged foods also include trace amounts of ZnO even if it is not intended as a nutrient.

Pigment

Zinc white is used as a pigment in paints and is more opaque than lithopone, but less opaque than titanium dioxide. It is also used in coatings for paper. Chinese white is a special grade of zinc white used in artists' pigments. It is also a main ingredient of mineral makeup.

Coatings

Paints containing zinc oxide powder have long been utilised as anticorrosive coatings for metals. They are especially effective for galvanized iron. Iron is difficult to protect because its reactivity with

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organic coatings leads to brittleness and lack of adhesion. Zinc oxide paints retain their flexibility and adherence on such surfaces for many years. Plastics, such as polyethylene naphthalate (PEN), can be protected by applying zinc oxide coating. The coating reduces the diffusion of oxygen with PEN. Zinc oxide layers can also be used on polycarbonate (PC) in outdoor applications. The coating protects PC from solar radiation and decreases the oxidation rate and photo-yellowing of PC.

Corrosion prevention in nuclear reactors

Zinc oxide depleted in the zinc isotope with the atomic mass 64 is used in corrosion prevention in nuclear pressurised water reactors. The depletion is necessary, because ⁶⁴Zn is transformed into radioactive ⁶⁵Zn under irradiation by the reactor neutrons.

ROUTES OF EXPOSURE [2]

Exposure to zinc oxide can occur through inhalation, ingestion, and eye or skin contact. Exposure to the chemical may occur through the following operations:

- The manufacture and transportation of zinc oxide
- Use as a white pigment in rubber formulations and as a vulcanising agent
- Use in cosmetics, ointments, and electronic devices
- Use as a UV absorber in plastics, ceramics, floor tile, and glass
- Use in seed treatments, food additives, photoconductors, and in colour photography

HEALTH EFFECTS

Zinc oxide dust is primarily a nuisance dust, but exposures to high concentrations can result in respiratory system effects in humans. Volunteers inhaling 600 mg/m³ zinc oxide dust for 10 minutes exhibited persistent rales, decreased vital capacity, coughing, upper respiratory tract irritation and substernal pain. Studies have reported that exposures to concentrations up to 430 mg/m³ zinc oxide resulted in chest pain [ACGIH 1991, p. 1755]. Inhalation of zinc oxide fume can result in metal fume fever. In itself, this is a self-limiting condition characterised by flu-like symptoms, which resolve within 24 to 48 hours. Repeated exposures to zinc oxide by skin contact have resulted in papular-pustular skin eruptions in the axilla, inner thigh, inner arm, scrotum and pubic areas.

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Epidemiologic studies of zinc refinery workers found no correlation between industrial zinc exposures and lung or other types of cancer.

Acute Effects [2]

Acute exposure: Acute exposure to zinc oxide can result in coughing, substernal pain, upper respiratory tract irritation, rales, chills, fever, nausea, and vomiting.

Chronic Effects [2]

Chronic exposure: Chronic exposure to zinc oxide by skin contact may result in papular-pustular skin eruptions in the axilla, inner thigh, inner arm, scrotum and pubic areas.

SAFETY

First Aid Measures [2]

- Eye Contact: Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.
- Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.
- Inhalation: If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
- Ingestion: Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Exposure Control/Personal Protection [1]

- Engineering Controls: Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.
- Personal Protection: Safety glasses, lab coat, dust respirator (Be sure to use an approved/certified respirator or equivalent), gloves.

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REGULATION [3]

United States:

The Occupational Safety and Health Administration (OSHA) has set a Time Weighted Average (TWA) concentration limit for zinc oxide of 15mg/m³.

Australia [4]

Australia Exposure Standards have set a TWA for zinc oxide (fume) of 5mg/m³.

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Chemicals in your living room cause diabetes

2020-11-10

A new UC Riverside study shows flame retardants found in nearly every American home cause mice to give birth to offspring that become diabetic.

These flame retardants, called PBDEs, have been associated with diabetes in adult humans. This study demonstrates that PBDEs cause diabetes in mice only exposed to the chemical through their mothers.

“The mice received PBDEs from their mothers while they were in the womb and as young babies through mother’s milk,” said Elena Kozlova, lead study author, and UC Riverside neuroscience doctoral student. “Remarkably, in adulthood, long after the exposure to the chemicals, the female offspring developed diabetes.”

Results of the study have been published in the journal *Scientific Reports*.

PBDEs are common household chemicals added to furniture, upholstery, and electronics to prevent fires. They get released into the air people breathe at home, in their cars, and in airplanes because their chemical bond to surfaces is weak.

“Even though the most harmful PBDEs have been banned from production and import into the U.S., inadequate recycling of products that contain them has continued to leach PBDEs into water, soil, and air. As a result, researchers continue to find them in human blood, fat, fetal tissues, as well as maternal breast milk in countries worldwide.”

Given their previous association with diabetes in adult men and women, and in pregnant women, Curras-Collazo and her team wanted to understand whether these chemicals could have harmful effects on children of PBDE-exposed mothers. But such experiments can only be done on mice.

Diabetes leads to elevated levels of blood glucose, or blood sugar. After a meal, the pancreas releases insulin, a hormone that helps cells utilize glucose sugar from food. When cells are resistant to insulin, it doesn’t work as intended, and levels of glucose remain high in the blood even when no food has been eaten.

Chronically high levels of glucose can cause damage to the eyes, kidneys, heart, and nerves. It can also lead to life-threatening conditions.

PBDEs are common household chemicals added to furniture, upholstery, and electronics to prevent fires.

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“This study is unique because we tested both the mothers and their offspring for all the hallmarks of diabetes exhibited in humans,” Curras-Collazo said. “This kind of testing has not been done before, especially on female offspring.”

The researchers gave PBDEs to the mouse mothers at low levels comparable to average human environmental exposure both during pregnancy and lactation.

All of the babies developed glucose intolerance, high fasting glucose levels, insulin insensitivity, and low blood insulin levels, which are all hallmarks of diabetes. In addition, researchers also found the babies had high levels of endocannabinoids in the liver, which are molecules associated with appetite, metabolism, and obesity.

Though the mothers developed some glucose intolerance, they weren’t as affected as their offspring.

“Our findings indicate that chemicals in the environment, like PBDEs, can be transferred from mother to offspring, and exposure to them during the early developmental period is damaging to health,” Curras-Collazo said.

The research team feels future longitudinal studies in humans are needed to determine the long-term consequences of early-life PBDE exposure.

“We need to know if human babies exposed to PBDEs both before and after birth go on to become diabetic children and adults,” Kozlova said.

In the meantime, Curras-Collazo advises people to limit PBDE exposure by taking steps such as washing hands before eating, vacuuming frequently, and buying furniture and other products that do not contain it. She also hopes expectant mothers are well informed about stealth environmental chemicals that can affect their unborn and developing children, as well as their breast milk.

“We believe the benefits babies get from mothers’ milk far outweigh the risks of passing on the PBDEs to children. We do not recommend curtailing breastfeeding,” she said. “But let’s advocate for protecting breast milk and our bodies from killer couch chemicals.”

neurosciencenews.com, 10 November 2020

<https://www.neurosciencenews.com>

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Denmark to cull all farmed mink to stop coronavirus outbreaks

2020-11-06

Denmark, the world's largest producer of mink, will cull all farmed mink in the country to prevent the spread of coronavirus infection, both between the animals and to their human handlers, Danish authorities announced Wednesday (Nov. 4).

There are currently more than 15 million mink being raised at more than 1,000 farms in Denmark, The New York Times reported; so far, several hundred farms have reported SARS-CoV-2 infections among their mink, including more than 200 farms in Jutland, the mainland part of Denmark, according to the Danish Broadcasting Corporation.

While the virus spread among these mink, it picked up new genetic mutations. That's not unexpected as viruses mutate continually, and new variants often emerge over time, especially when that pathogen hops between different species. New variants of the coronavirus may or may not change how it infects cells or how easily it spreads.

However, Danish authorities expressed concern that, should the mutated virus spread among humans, the COVID-19 vaccines currently in development may not work as well against the new variant. The first cases of minks transmitting the coronavirus to humans emerged from the Netherlands over the summer, according to The Washington Post, and already, 12 people in the Jutland region have caught the newfound virus variant from mink, Danish Prime Minister Mette Frederiksen said at a press conference, according to the Times.

Warnings about the mutated virus came from the State Serum Institute, the Danish government's public health and infectious disease arm. **PLAY SOUND**

"We have a great responsibility towards our own population, but with the mutation that has now been found, we have an even greater responsibility for the rest of the world as well," Frederiksen said at the press conference, according to BBC News.

Research by the State Serum Institute suggests that, in infected people, the mutated virus shows "reduced susceptibility to antibodies," she said, but no details have been shared about how that conclusion was reached. Until those details are published, statements about how the mutated virus

There are currently more than 15 million mink being raised at more than 1,000 farms in Denmark

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interacts with the human immune system cannot be properly evaluated, Stanley Perlman, a microbiologist at the University of Iowa, told the Times.

Denmark has informed the World Health Organization of the mutation and infections.

"We are in touch with them to find more about this event," the WHO told the Times in an email. Again, until scientists study the mutations more closely, they won't know whether the new variant could interfere with the effectiveness of COVID-19 vaccines. Right now, there isn't enough information to determine whether or not the variant presents a significant problem.

"Someone would have to release the [genetic] sequences soon, and the evolutionary biologists will be all over it," Dr. Jonathan Epstein, vice president for science and outreach at the EcoHealth Alliance, a conservation organization, told the Times.

Farmed minks began contracting the novel coronavirus in the Netherlands as early as April, and in June several farm workers reportedly caught the virus from the sick animals, The Washington Post reported. Some infected minks show no overt symptoms, while others can develop nasal discharge, difficulty breathing and even pneumonia, Science Magazine reported. By mid-June, 12 of about 130 Dutch mink farms had cited cases of the virus, but Denmark had not yet reported any outbreaks.

At this point, mink SARS-CoV-2 infections have been reported in several additional countries, including Spain, Sweden and the United States, where thousands of mink were recently culled in Utah. Worldwide, millions of farmed mink have already been culled due to these outbreaks, BBC News reported.

Originally published on Live Science.

[livescience.com](https://www.livescience.com), 6 November 2020

<https://www.livescience.org>

Penicillin allergies may be linked to one immune system gene

2020-11-09

Penicillin, effective against many bacterial infections, is often a first-line antibiotic. Yet it is also one of the most common causes of drug allergies.

Around 10 percent of people say they've had an allergic reaction to penicillin, according to the U.S. Centers for Disease Control and Prevention.

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Around 10 percent of people say they've had an allergic reaction to penicillin, according to the U.S. Centers for Disease Control and Prevention.

Now researchers have found a genetic link to the hypersensitivity, which, while rarely fatal, can cause hives, wheezing, arrhythmias and more.

People who report penicillin allergies can have a genetic variation on an immune system gene that helps the body distinguish between our own cells and harmful bacteria and viruses. That hot spot is on the major histocompatibility complex gene HLA-B, said Kristi Krebs, a pharmacogenomics researcher for the Estonian Genome Center at the University of Tartu. She presented the finding October 26 at the American Society of Human Genetics 2020 virtual meeting. The research was also published online October 1 in the American Journal of Human Genetics.

Several recent studies have connected distinct differences in HLA genes to bad reactions to specific drugs. For example, studies have linked an HLA-B variant to adverse reactions to an HIV/AIDS medication called abacavir, and they've linked a different HLA-B variant to allergic reactions to the gout medicine allopurinol. "So it's understandable that this group of HLA variants can predispose us to higher risk of allergic drug reactions," says Bernardo Sousa-Pinto, a researcher in drug allergies and evidence synthesis at the University of Porto in Portugal, who was not involved in the study.

Bottom of Form

For the penicillin study, the team hunted through more than 600,000 electronic health records that included genetic information for people who self-reported penicillin allergies. The researchers used several genetic search tools, which comb through DNA in search of genetic variations that may be linked to a health problem. Their search turned up a specific spot on chromosome 6, on a variant called HLA-B*55:01.

The group then checked its results against 1.12 million people of European ancestry in the research database of the genetic-testing company 23andMe and found the same link. A check of smaller databases including people with East Asian, Middle Eastern and African ancestries found no similar connection, although those sample sizes were too small to be sure, Krebs said.

It's too soon to tell if additional studies will "lead to better understanding of penicillin allergy and also better prediction," she said.

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Penicillin allergies often begin in childhood, but can wane over time, making the drugs safer to use some years later, Sousa-Pinto says. In this study, self-reported allergies were not confirmed with a test, so there's a chance that some participants were misclassified. This is very common, Sousa-Pinto says. "It would be interesting to replicate this study in ... participants with confirmed penicillin allergy."

The distinction matters, because about 90 percent of patients who claim to be allergic to penicillin can actually safely take the drug (SN: 12/11/16). Yet, Sousa-Pinto says, those people may be given a more-expensive antibiotic that may not work as well. Less-effective antibiotics can make patients more prone to infections with bacteria that are resistant to the drugs. "This ... is something that has a real impact on health care and on health services," he says.

sciencenews.org, 9 November 2020

<https://www.sciencenews.org>

Machine-designed natural product syntheses pass 'Turing test' for chemistry

2020-11-12

By tweaking their organic synthesis software, Chematica, the team behind the program has shown for the first time that a machine is capable of planning multi-step syntheses for complex natural products. Three of the syntheses were experimentally validated in the lab, and a 'Turing test' for chemistry showed that the machine's routes were largely indistinguishable from those designed by humans chemists.

When poring over a long, drawn-out total synthesis for a complex natural product, it's easy to get lost. Many of the reaction steps involved often don't seem as though they're bringing the starting materials closer to the target. But that's a talent of human chemists – being able to strategise many moves ahead and make creative choices, carrying out a sequence of seemingly arbitrary steps until things suddenly come together. When it comes to total synthesis, computer programs can be likened to beginners at chess – to date, they've been programmed to think only one move at a time. While this strategy allows machines to design routes to relatively simple products, they have difficulty designing multi-step syntheses to complex products because they lack the ability to think many moves ahead and think like a human.

When poring over a long, drawn-out total synthesis for a complex natural product, it's easy to get lost.

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'Sometimes as a chemist you complexify a structure – but a computer doesn't see any gain in doing this,' says Bartosz Grzybowski, one of the developers of Chematica. 'But once you go over the hump in complexity, you can get something very simple.' What's also tricky for the computer is that when generating a pathway to a complex product, the chemical space rapidly becomes astronomically large. Each reaction step creates 100 branches which the computer could follow, meaning that for a synthesis consisting of 20 steps, the space will have 10020 options. In an attempt to help the program navigate this space to find useful reactions, the team introduced a new pair of algorithms. 'One algorithm is exploring the space for a diversity of solutions, while the other is trying to finish the synthesis as quickly as possible. They're both talking to one another, so they're updating themselves,' says Grzybowski. Other changes – new reaction rules, quantum mechanical methods and molecular mechanical methods were also included.

While those changes allowed Chematica to find routes to a few natural products, it still couldn't find others – even when it knew all of the individual reactions to plan the synthesis. Going a step further, the team introduced rules based on causal relationships – teaching the program how choices at one point in the synthesis can create the possibility of other choices down the line; for example, complicating a structure to simplify it later. With this improvement, Chematica was able to create original routes for many complex molecules, such as Lamellodysidine A, which the team experimentally validated along with two other natural products.

The team went on to carry out a chemistry Turing test to determine if the routes designed by Chematica could be distinguished by experts from those designed by a human. Combining 20 pathways designed by the program with 20 syntheses taken from the literature, 18 top-level chemists were asked which they thought was designed by a person and which by a machine. 'They couldn't tell,' says Grzybowski. But Grzybowski emphasises that the intention isn't to do away with humans. 'We're not trying to replace chemists – we're trying to give chemists a calculator to do things faster,' says Grzybowski. 'The machine can show you different options – for example, you can say "I want to do something different – don't use the Diels-Alder reaction". So, it gives you more options on timescales that would be very hard for humans to achieve.'

'I think it's a landmark, it's the first time that we're seeing a computer being able to achieve natural product total synthesis,' says Timothy Cernak, an assistant professor studying the interface of chemical synthesis and

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computer science at the University of Michigan. 'And really the centrepiece is this Turing test ... the computer is approaching the ability of a human to navigate relatively complex molecules. There's some alkaloids in here, there's some polycyclic terpenes – these are not the easiest things to make.'

chemistryworld.com, 12 November 2020

<https://www.chemistryworld.com>

Newly discovered reef is taller than a skyscraper

2020-10-30

Scientists have found a towering coral reef off the northern tip of Australia, the first discovery of its kind in 120 years, BBC News reports. At 500 meters tall, the reef surpasses the height of the Empire State Building and the Shanghai World Financial Center. Researchers made their discovery during a 3D mapping exercise of the northern Great Barrier Reef sea floor, part of a yearlong effort to explore the oceans surrounding Australia. With a 1.5-kilometer-wide base, the reef tapers to a point just 40 meters below the ocean's surface, the Schmidt Ocean Institute announced in a press release this week. The massive, blade-like reef is not part of the main body of the Great Barrier Reef and adds to the seven other tall detached reefs in the area. You can check out the full exploratory dive of the newly discovered reef here. ~sscience.org, 30 October 2020

<https://www.sciencemag.org>

Rare squid with 'elbow tentacles baffles scientists in spooky new footage

2020-11-12

It looks like an alien — head dwarfed by enormous flapping fins, body blobbing through dark water, thin blue tentacles streaming behind it in a tangle of neon spaghetti. But despite its otherworldly appearance, the elusive cephalopod known simply as the Bigfin squid (Magnapinnidae) may be more common in Earth's deep oceans than scientists ever knew.

In the 113 years since its discovery, the Bigfin squid has been spotted in the wild only 12 times around the world. Now, a study published Wednesday (Nov. 11) in the journal PLOS ONE, adds five new sightings to the tally, all of them captured thousands of feet below the surface of the Great Australian Bight in South Australia.

At 500 meters tall, the reef surpasses the height of the Empire State Building and the Shanghai World Financial Center.

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Not only do the sightings mark the first time that Bigfin squid have been seen in Australian waters, but it's also the first time that five of them have been caught hanging out together in one place. The resulting footage — captured by underwater cameras trailing behind a large research vessel — provides an unprecedented look at the bizarre cephalopod's anatomy and behavior, lead study author Deborah Osterhage told Live Science.

"I was stunned and excited when I first saw the Bigfin squid in a photo collected by our camera," Osterhage, a marine researcher with the Commonwealth Scientific and Industrial Research Organisation (or CSIRO, Australia's government science agency), said in an email. "I recognized it immediately, with its distinctive large fins and extremely long and slender arms and tentacles."

Scientists identified the first Bigfin squid specimen, which was caught by fishers near Portugal, in 1907. It took more than 80 years before anyone saw one in the wild, swimming 15,535 feet (4,735 meters) underwater off the coast of Brazil in 1988. The squid is distinct, with giant fins jutting off of its body like Dumbo the elephant's ears. These fins are as wide as the squid's upper body (or mantle) is long, Osterhage said, and Bigfins propel themselves through the water by flapping them like wings.

That's nothing new for cephalopods (just ask the adorably named Dumbo octopus), but what really sets the Bigfin squid apart from its other deep-sea cousins are incredibly long, stringy tentacles. Now, researchers have a better idea of just how long and stringy they can get. In the new study, which culminates from more than 40 hours of underwater observations at depths of 3,100 to 7,900 feet (950 to 2400 m) below the surface, the team not only sighted the gaggle of Bigfins swimming through the Bight, but they even measured one of them with more accurate methods than ever before.

"We were able to measure [one specimen] with lasers — a first, as previous measurements are estimates based on nearby objects," Osterhage said. "It measured 5.9 feet (1.8 m) in length. The specimen's mantle was around 6 inches (15 centimeters), with the remaining 5.9 feet [1.8 m] made up of those long arms and tentacles."

Think, an upper body as long as a U.S. dollar bill, trailing tentacles as long as U.S. tennis champ Serena Williams. And that may even be on the small side; according to Osterhage, previous studies have estimated that Bigfin squid can grow to 22 feet (7 m) long. **PLAY SOUND**

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Stranger still may be how the squids hold those tentacles. Unlike most cephalopods, whose tentacles hang below their bodies, the Bigfin squid's appendages jut out at perpendicular angles to their mantles before bending and curling away, making each tentacle look like an "elbow," Osterhage said.

During one of the team's sightings, a Bigfin surprised the researchers by raising one long arm above its body and holding it there — a baffling behavior never before seen in squids, the researchers wrote. The posture could have something to do with filter feeding, they speculated, but the truth is nobody knows for sure. Finding the answer to that (and many other outstanding questions about the oddball squid) will require many more encounters in the wild.

"There is much to learn about the Bigfin squid — basic questions such as what it feeds upon, how it reproduces, etc., are still unknown," Osterhage said. "But one exciting thing about our paper is that all five specimens were found clustered in close spatial and temporal proximity of each other, which has never been seen before."

Why they were clustered together is yet another question without an answer, but this behavior is often associated with survival or mating opportunities, Osterhage said. Future sightings will help determine the squid's specific needs, she added — but for now, maybe it's safest just to say that aliens of a feather (or tentacle) stick together.

Originally published on Live Science.

[livescience.com](https://www.livescience.com), 12 November 2020

<https://www.livescience.com>

Injection of long-acting drug prevents HIV in women

2020-11-09

A single shot of a long-lasting antiviral agent every 2 months is 89% more effective at preventing HIV infections in women compared with a daily pill, The New York Times reports. In a randomized, double-blind trial, scientists compared the injected drug, called cabotegravir, with an approved pill marketed as Truvada in 3223 women across seven countries in sub-Saharan Africa. During the trial, which evaluated a vaccinelike strategy known as pre-exposure prophylaxis (PrEP), 34 participants taking Truvada became infected with HIV, whereas just four receiving injections contracted the virus, the researchers report today in a press release. Two of the participants from the latter group had stopped receiving injections

In a randomized, double-blind trial, scientists compared the injected drug, called cabotegravir, with an approved pill marketed as Truvada in 3223 women across seven countries in sub-Saharan Africa.

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every 2 months. After an interim review of data on cabotegravir's efficacy and safety, advisers recommended the study investigators end the trial early and release their results. Cabotegravir was previously shown to prevent HIV infections only in cisgender men and transgender women who have sex with men; participants in the new trial were cisgender women. People often struggle to adhere to a daily pill regimen, which undermines its effectiveness, and one shot of cabotegravir every 8 weeks could provide patients with more freedom and flexibility, public health experts say. ~ssceincenews.org, 12 November 2020

<https://www.sciencemag.org>

STEVE may even be less like typical auroras than scientists thought

2020-11-11

The atmospheric light show nicknamed STEVE may be even weirder than skywatchers thought.

STEVE, short for Strong Thermal Emission Velocity Enhancement, is a sky glow that appears south of the northern lights (SN: 3/15/18). STEVE's main feature is a mauve band of light formed by a stream of plasma flowing westward through the atmosphere — a different phenomenon from the one that gives rise to auroras (SN: 4/30/19). But STEVE's purple arc is often accompanied by a "picket fence" of vertical green stripes. That fence looks similar enough to the shimmering green curtains seen in the aurora borealis that scientists thought at least this part of STEVE could be a type of aurora.

Recently, studies of the picket fence's color have cast doubt on its origins. Auroras form when electrons from the magnetic bubble, or magnetosphere, surrounding Earth cascade into the atmosphere (SN: 2/7/20). Those electrons make nitrogen in the air glow blue and oxygen glow green. While STEVE's green picket fence also contains glowing oxygen, a dearth of nitrogen emission hints that the fence is not the same kind of light show as an aurora.

Now, researchers and citizen scientists have identified an even more unusual aspect of STEVE's picket fence: small green streaks that stick out like feet from the bottom of some of its vertical stripes. The structure of these horizontal streaks cannot be formed by the electron showers responsible for auroras, researchers report in the December AGU Advances.

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"It's really weird, and nobody really knows what's going on just yet," says Joshua Semeter, an engineer at Boston University. But the new observations suggest these horizontal streaks — and perhaps the similarly colored fence — arise from some STEVE-specific process.

Semeter and colleagues examined horizontal streaks below picket fences in high-resolution images of STEVE taken by citizen scientists. The analysis suggested that the streaks in these images were not actually lines extended across the sky, but only appeared that way due to motion blur, as spherical blobs of glowing gas moved through the atmosphere.

These green blobs might arise from turbulence in the torrent of plasma that creates STEVE's purple band, Semeter says. Positively charged atoms in the plasma may rush through the atmosphere largely unimpeded, forming a smooth purple arc. Meanwhile, electrons in the plasma are far lighter and more liable to get tripped up by Earth's magnetic field lines — giving those particles a much bumpier ride through the air. As a result, those high-energy electrons may get tangled up in small vortices on the edge of the plasma stream, below the purple streak. There, the particles could excite pockets of oxygen to glow green.

For now, this is just a theory for what might be occurring. Computer simulations of plasma flowing through the atmosphere could test whether the idea is correct.

Whatever is going on with STEVE's horizontal green features, "there's some tantalizing evidence" that they're related to the vertical picket fence, Semeter says. "We found events where these little feet appear before or at the same time as the green column above it." And some horizontal and vertical streaks looked connected. "It appears that the green emission is actually expanding upward along the magnetic field line," Semeter says. If so, that could explain why STEVE's picket fence doesn't have quite the same color as typical auroras.

While these observations do hint that the fence may arise from STEVE-specific particle interactions, it's hard to be sure based only on photographs from the ground, says Toshi Nishimura, a space physicist at Boston University who was not involved in the work.

Future satellite observations could confirm whether electrons from the magnetosphere are pouring into the atmosphere in the region of a STEVE

That fence looks similar enough to the shimmering green curtains seen in the aurora borealis that scientists thought at least this part of STEVE could be a type of aurora.

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picket fence, he says. If satellites don't see such electron showers, that will bolster the idea that the fence is different from normal auroras.

sciencenews.org, 11 November 2020

<https://www.sciencenews.org>

Rare wolf spider presumed extinct turns up on British military base

2020-11-07

A 2-inch-long (5 centimeters) spider thought to be extinct in Great Britain is actually alive and thriving on a British military base.

A program manager at the Surrey Wildlife Trust rediscovered the great fox-spider (*Alopecosa fabrilis*) on an undeveloped portion of a military installation in Surrey, England, after a two-year search. The last time the spider was seen before this in Britain was in 1993, or 27 years ago.

"It's a gorgeous spider, if you're into that kind of thing," the program manager Mike Waite told *The Guardian*.

Nocturnal hunter

The great fox-spider is a wolf spider, a family of arachnids that hunts down its prey rather than building webs. The spider is nocturnal, which makes it an elusive quarry for spider enthusiasts. According to *The Guardian*, Waite used aerial photography of the military installation to find bare patches where the spiders like to hunt. His search in these sandy spots paid off after many fruitless nights.

"As soon as my torch fell on it I knew what it was. I was elated," Waite said. "With coronavirus, there have been lots of ups and downs this year, and I also turned 60, so it was a good celebration of that." **PLAY SOUND**

Waite found several male spiders, one female and possibly some immature spiderlings, though the latter were difficult to identify conclusively.

The adult spiders have gray-and-brown furry bodies. They can spin silk, but instead of making webs, they use that silk to line the burrows that they dig in order to hibernate over the winter. Great fox-spiders are critically endangered, but they are also found on the European mainland, particularly on coastal sand dunes in Holland and Denmark, according to *The Guardian*. Waite wonders whether the spiders are also quietly surviving on Britain's coastlines.

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"It makes me think how hard have we looked for it on our coasts? Have we been looking hard enough?" he told *The Guardian*.

Conserving space for wildlife

The Surrey Wildlife Trust manages thousands of acres of undeveloped land in the Surrey area to protect wildlife. Ministry of Defence sites are also prime real estate for animals, because they're left relatively undisturbed other than the military training exercises that occur there. For security reasons, the researchers are keeping confidential the identity of the site where they found the great fox-spiders, but it consists of scrubby heartland that also provides a home for native birds, snakes, lizards and butterflies.

"Many people are unaware of the size and diversity of the Defence estate and its tremendous wildlife richness," Rich Lowey, the head of technical services at the Defense Infrastructure Organization, said in a statement. "It has generally been protected from agricultural intensification and urban development, so it now provides a vital sanctuary for many of the country's most rare and endangered species and habitats."

Waite now plans to continue his survey for the spiders in order to estimate the size of their population.

Originally published on Live Science.

livescience.com, 7 November 2020

<https://www.livescience.com>

Protecting the brain from infection may start with a gut reaction

2020-11-11

Some immune defenses of the brain may have their roots in the gut.

A new study in mice finds that immune cells are first trained in the gut to recognize and launch attacks on pathogens, and then migrate to the brain's surface to protect it, researchers report online November 4 in *Nature*. These cells were also found in surgically removed parts of human brains.

Every minute, around 750 milliliters of blood flow through the brain, giving bacteria, viruses or other blood-borne pathogens an opportunity to infect the organ. For the most part, the invaders are kept out by three

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membrane layers, called the meninges, which wrap around the brain and spinal cord and act as a physical barrier. If a pathogen does manage to breach that barrier, the researchers say, the immune cells trained in the gut are ready to attack by producing a battalion of antibodies.

The most common route for a pathogen to end up in the bloodstream is from the gut. "So, it makes perfect sense for these [immune cells] to be educated, trained and selected to recognize things that are present in the gut," says Menna Clatworthy, an immunologist at the University of Cambridge.

Bottom of Form

Clatworthy's team found antibody-producing plasma cells in the leathery meninges, which lie between the brain and skull, in both mice and humans. These immune cells produced a class of antibodies called immunoglobulin A, or IgA.

These cells and antibodies are mainly found in the inner lining of the gut and lungs, so the scientists wondered if the cells on the brain had any link to the gut. It turned out that there was: Germ-free mice, which had no microbes in their guts, didn't have any plasma cells in their meninges either. However, when bacteria from the poop of other mice and humans were transplanted into the mice's intestines, their gut microbiomes were restored, and the plasma cells then appeared in the meninges.

"This was a powerful demonstration of how important the gut could be at determining what is found in the meninges," Clatworthy says.

Researchers captured microscope images of an attack in the meninges of mice that was led by plasma cells that had likely been trained in the guts. When the team implanted a pathogenic fungus, commonly found in the intestine, into the mice's bloodstream, the fungus attempted to enter the brain through the walls of blood vessels in the meninges. However, plasma cells in the membranes formed a mesh made of IgA antibodies around the pathogen, blocking its entry. The plasma cells are found along the blood vessels, Clatworthy says, where they can quickly launch an attack on pathogens.

"To my knowledge, this is the first time anyone has shown the presence of plasma cells in the meninges. The study has rewritten the paradigm of what we know about these plasma cells and how they play a critical role in keeping our brain healthy," says Matthew Hepworth, an immunologist at the University of Manchester in England who was not involved with the

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study. More research is needed to classify how many of the plasma cells in the meninges come from the gut, he says.

The finding adds to growing evidence that gut microbes can play a role in brain diseases. A previous study, for instance, suggested that in mice, boosting a specific gut bacterium could help fight amyotrophic lateral sclerosis, or ALS, a fatal neurological disease that results in paralysis (SN: 7/22/19). And while the new study found the plasma cells in the brains of healthy mice, previous research has found other gut-trained cells in the brains of mice with multiple sclerosis, an autoimmune disease of the brain and the spinal cord.

For now, the researchers want to understand what cues plasma cells follow in the guts to know it is time for them to embark on a journey to the brain.

[sciencenews.org](https://www.sciencenews.org), 11 November 2020

<https://www.sciencenews.org>

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Botched restoration leaves Spanish statue looking like a confused potato head

2020-11-13

Is it ... a statue that's melted in the heat? Forky from "Toy Story 4"? A clay figure crafted by a preschooler? President Donald Trump?

In yet another extraordinary restoration-gone-awry, a 20th-century Spanish statue of a smiling woman next to a flock of livestock has turned into a slightly confused-looking lump with large holes for eyes, a button nose and a grimacing mouth.

The once-elegant statue, first unveiled in 1923, is sculpted on the front of a bank in the northern city of Palencia, according to The Art Newspaper. Now, people have likened the restored statue to a "potato" and President Donald Trump, according to The Art Newspaper.

"It looks like the head of a cartoon character," Antonio Guzmán Capel, an artist who first pointed out the botched restoration, said in a Facebook post. "I'm sure whoever did it got paid for it," Capel said. "But the bigger crime was committed by the person who commissioned it and then tried to carry on as though nothing was wrong."

This statue is just one in a long line of botched restoration efforts in Spain. In 2012, an 81-year-old church member repainted a 19th-century fresco of Jesus that ended up looking like a monkey and earned the nickname "Monkey Christ," according to NPR.

In 2018, an amateur restorer painted a 15th-century Spanish wooden statue of the Virgin Mary, Saint Anne and the infant Jesus in neon colors, according to NPR. Early this year, a furniture restorer turned a copy of a famous "immaculate conception" painting of the Virgin Mary by 17th-century Spanish artist Bartolomé Esteban Murillo into a smudged, unrecognizable mess, Live Science previously reported.

Conservation experts continue to call for stricter regulations to restorations. This is "NOT professional restoration," Spain's Professional Association of Restorers and Conservators wrote on Twitter.

"Restoring is not repairing, serious interventions must follow criteria, which are internationally approved, as well as those applied by the IPCE [the Spanish Cultural Heritage Institute], and other accredited entities that

"But the bigger crime was committed by the person who commissioned it and then tried to carry on as though nothing was wrong."

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exist in Spain," the Valencia-based conservator Illanos Argudo, wrote on Twitter, The Art Newspaper reported.

livescience.com, 13 November 2020

<https://www.livescience.com>

A butterfly's brilliant blue wings lead to less toxic paint

2020-11-13

The vibrant blue hues of morpho butterflies' wings have long captivated not only lepidopterists but also chemists. The latter's interest stems from the intricate nanoscale protein structures that are layered within the wings: their shapes act like prisms, reflecting a stunning cerulean color. Materials scientists hope to eventually harness these structures' properties to make products such as paint and cosmetics—without dyes and pigments that can be harmful to human health and the environment.

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Figuring out how to affordably apply this "structural color" concept to a wide range of products has been tricky. But now chemists at a Berkeley, Calif.-based start-up called Cypris Materials say they are closing in on a way to do so. Without using dyes or pigments, they say, they have developed colorants that can produce hues in the ultraviolet, visible and near-infrared regions of the electromagnetic spectrum—and that can be used in applications from automotive paints to printer inks and nail polish. "They've made progress in a field that desperately needs innovation, and it looks like they've made the jump from the laboratory to the real world. That's super impressive," says John Warner, a distinguished research fellow at the company Zymergen and a pioneer of green chemistry, who was not involved in Cypris Materials' work.

Traditional pigments and dyes have been used for centuries to add color to fabric and paints and for other everyday applications. They impart various hues through the way they absorb or reflect light. Red dye in a shirt, for example, contains molecular components called chromophores, which absorb the wavelengths of light in all colors except for red—so red is what we see. But some of the chemicals involved, such as azo dyes, contain materials linked to cancer and other harmful effects. Many countries have banned them.

Structural color, however, comes from microscopic structures whose varying shapes reflect or refract light in different ways. The tiny scales on a morpho butterfly's wings, for example, are covered with minuscule

"They've made progress in a field that desperately needs innovation, and it looks like they've made the jump from the laboratory to the real world..."

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ridges that have cross-ribs—a little like the profile of a fir tree. These formations refract specific light wavelengths to produce a brilliant blue. Other structures create similar effects: for example, helically arranged cellulose microfibers make marble berries glisten with a shiny, metallic shade of blue. Scientists are still studying the finer details of the ways structural color manifests in nature. But they already know that the sizes and volumes of the features in a structure and the material itself are what principally determine how light bounces off that structure—and what color results.

Cypris Materials creates structure-based colorants using what are known as self-assembling block copolymers. They are long chains of molecules that in this case stitch together two different types of commonly used plastics, such as polyacrylates or polyesters. When formulated into a paint or ink and applied to a surface, these copolymers arrange themselves into neatly ordered layered structures that refract light. To grasp how this works, imagine gummy worms that are half yellow and half green, with each color representing a different plastic. If a big bagful of these worms were arranged so that each gummy's yellow and green parts only touched the same colored halves of other gummies, they would form a multilayered structure. Cypris's copolymers do this on their own when put into a solution, with the length of the polymer chain determining the wavelength of light reflected. Short copolymer chains refract shorter wavelengths of light: ultraviolet, blues and greens. Longer chains refract longer wavelengths in the orange, red and near-infrared parts of the spectrum.

Self-assembling copolymers are not new, but the company says it has made two key advancements: its materials self-assemble under everyday environmental conditions, such as when paint is applied, and can create the longer chains that reflect long wavelengths of light. "Being able to get it out into the redder colors—no one has been able to do that" with structural color, says Robert Grubbs, a Nobel Prize-winning chemistry professor at the California Institute of Technology and a co-founder of the company who works in an advisory role. "They've come a lot further than I thought was going to be possible."

The new colorants come in a powdered form that Cypris Materials says can be incorporated into manufacturing processes—added to paint in an automotive spray gun, for example, or mixed into nail polish. The colorants also act like binders, chemicals that are added to hold pigments and dyes in solution while the paint dries on a surface. "We're simplifying paint," says the company's co-founder and acting CEO Ryan Pearson. Traditionally,

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"people need to add in pigment. They also need to add in extra additives just to stabilize the paint. Not only are we removing the need for pigments and dyes, we're taking out the need for all of the stuff around it to stabilize it."

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Other chemicals frequently added to paints to help stabilize the pigments include surfactants. It remains to be seen if the new colorants will render those chemicals unnecessary, but "if they're able to replace surfactants or formulate without the use of alkylphenols [chemicals widely used in paints to prevent separation], that would certainly be a positive development in our view," says Teresa McGrath, chief research officer at the Healthy Building Network, a nonprofit organization that promotes the use of sustainable and less toxic materials and is not linked to Cypris Materials.

The new method contrasts with other applications of structural color, such as those used to create films that can be applied to windows to improve insulation and save energy. That technique involves creating and combining many layers of film to achieve a structure that reflects infrared light. But those films can only be applied to certain surfaces, making the new structural color technology potentially more versatile.

The start-up's colorants still have hurdles to overcome and possible limitations. For example, they may not be able to compete pricewise with some pigments, such as titanium dioxide. The company also still needs to do a full analysis of its copolymers and manufacturing processes to confirm that its colorants are indeed safer and more environmentally friendly than traditional dyes and pigments. "It's not going to be perfect," Warner says. But "the enemy of the excellent is the perfect. Science works by these kinds of steps forward."

scientificamerican.com, 13 November 2020

<https://www.scientificamerican.com>

Why some environmentalists are pushing for an end to plastic tampon applicators

2020-11-08

During her annual cleanups along the shores of Lake Ontario, Rochelle Byrne has come across hundreds of plastic tampon applicators.

"When I started finding those on beaches, I was a little bit confused," she said.

"It's because people flush them down the toilet."

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Unlike litter such as coffee cups, plastic bags or cigarette butts, tampon applicators aren't items that are usually discarded on the shoreline. So Byrne did some research to find out why they were ending up there.

"It's because people flush them down the toilet."

Although they're not listed as one of the items in the upcoming Canadian ban on single-use plastics, tampon applicators are frequently found in shoreline cleanups and don't easily degrade.

Since 2014, when Byrne began organizing cleanups, she estimates they've found over 1,500 tampon applicators along Lake Ontario. They're so common that her non-profit, A Greener Future, began a petition a few years ago asking leading tampon brand Tampax to stop making plastic applicators. It now has nearly 150,000 signatures.

"It comes down to understanding the implications of single-use plastic," Byrne said. "And that it doesn't go away for a very long time."

But why are tampon applicators ending up on our shores in the first place?

'Things that come out of your toilet'

Tampon applicators are nowhere near as abundant as other shoreline litter — for example, the Great Canadian Shoreline Cleanup found more than 680,000 cigarette butts and 74,000 food wrappers last year.

Still, between 3,000 and 3,500 tampons and applicators are found on the country's beaches annually, said Kate Le Souef, manager of the Great Canadian Shoreline Cleanup. She estimates that applicators alone make up 80 per cent of that number.

Today in Canada, many tampons are sold with an applicator, which helps the user insert the tampon. Some applicators are made of cardboard but many are now plastic, and come in different colours, depending on the design and brand.

While tampon applicators are only used for a few seconds, plastic takes a long time to degrade.

"Because they're hard plastic, they float," Le Souef said. "[They] last a long time in the water."

These applicators are often found on shorelines along with condoms and needles, items that usually originate in the same place — the toilet.

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Applicators, condoms and needles aren't supposed to be flushed, but if they are, they're meant to be filtered out at sewage treatment plants.

The fact that they're ending up on beaches is "an indicator that there's sewage being discharged in the area," said Mark Mattson, the Lake Ontario Waterkeeper and president of Swim Drink Fish, a group that monitors the water in Lake Ontario.

Untreated sewage shouldn't generally be released into Canadian waters. However, Mattson said that it does happen in certain circumstances.

In cities with older sewage systems, the same pipes take both sewage and rainwater to the treatment plant. These combined sewer overflows are used in cities like Toronto and Vancouver. But if there's a big rainstorm, the sewers get too full — and it's all released into waterways without being treated.

"If you go down to any of the marinas after a rain," Mattson said, "you'll see condoms floating around, tampon applicators and needles."

The prevalence of plastic applicators

Though plastic applicators did not meet the criteria to be included as one of the six single-use plastic items in next year's ban, Byrne said that A Greener Future's Tampax petition is a way to raise awareness about the problem of plastic applicators.

"People don't know that they're even a problem," she said.

But not everyone has shown support for the petition against plastic applicators.

"A lot of people aren't happy with the alternatives on the market now, and don't want to make that change," Byrne said.

She added that anyone used to plastic applicators may find it difficult to switch. Alternatives such as tampons with cardboard applicators — or no applicator at all — can be less comfortable and not as easy to use.

On their websites, tampon companies say not to flush their products. Instead, applicators are supposed to be disposed of in the garbage, so they'll eventually end up in a landfill. Since they're considered medical waste, plastic applicators can't be recycled.

Other alternatives, such as menstrual cups, can be reused and produce significantly less waste.

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If people still choose to use tampons with applicators, Byrne wants them to understand the ramifications of disposing of them in the toilet.

"I think it comes down to just the convenience of flushing," Byrne said. Another factor, she explained, may be that it's an easy way to make signs of a tampon disappear.

"If people are at someone else's house or out at a restaurant and there isn't a way to dispose of the applicator discreetly, it's probably easier to flush it down the toilet so it's gone."

Flushing applicators helps 'hide periods'

The idea of keeping menstruation discreet may be at the root of this plastic problem, said Sharra Vostral, a professor at Purdue University who's studied the history of menstrual pads and the author of two books on the subject.

"We're operating under this assumption that we need to hide periods," she said. Vostral described how pads and tampons are designed to be as discreet as possible to help people "pass" as if they're not menstruating. Flushing these products has helped hide periods for decades.

"I think it's like, out of sight, out of mind, get rid of it," Vostral said. She described how some of the early Kotex instructions in the 1920s and '30s would tell consumers to take apart the used pad and flush it down the toilet, one piece at a time. This practice, of course, could cause major plumbing issues.

"I think it does have a lot to do with embarrassment," she said. "We're taught to not tell people. We're taught that it is disgusting."

Tampon applicators, Vostral explained, have their own history of discretion. When modern tampons came into common use in the 1930s, there were worries about women using their fingers to insert a tampon, which led to the development of the applicator.

"There [were] concerns that women might find [tampons] pleasurable," Vostral said, "and that they really should not be touching themselves."

The applicator was also supposed to make the overall process of using a tampon less dirty.

"[Marketers] always use these words like 'dainty' or 'hygienic,'" she said. "That was the argument: that it was a mess, and you don't need to touch the mess."

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Talking about a taboo

These ways of thinking about menstruation may be at the root of why so many tampon applicators end up in the sewage system. Challenging those attitudes, Vostral said, is the first step toward change.

"I don't think it's realistic to say everyone's going to jump up and embrace their periods," she said. "But just making it neutral instead of stigmatized is a big shift."

It may be easy to overlook the issue of plastic applicators on our shores, Byrne said, because "it's a bit of a taboo topic." That's part of her motivation to make others understand what happens when plastic is flushed.

So far, Tampax hasn't responded to the petition asking them to stop making plastic applicators. But Byrne hopes more awareness about the problem will lead to less plastic along the shoreline.

"It all comes down to education," she said, "and figuring out why these problems are happening."

cbc.ca, 6 November 2020

<https://www.bcb.ca>

A blue-green glow adds to platypuses' long list of bizarre features

2020-11-06

Between the electricity-sensing bill, venomous heel spurs and egg laying, the platypus was already one of the strangest mammals alive today (SN: 5/8/08). Now, researchers have found that this Australian oddity has another unexpected feature: It fluoresces under ultraviolet light.

Platypuses' dense, waterproof fur absorbs ultraviolet light and emits a blue-green glow, mammalogist Paula Spaeth Anich and colleagues discovered somewhat serendipitously. A chance sighting of a fluorescent flying squirrel in the wild had led the researchers to the mammal collection at the Field Museum in Chicago. After examining the museum's preserved squirrel skins and finding that fluorescence occurred in at least three flying squirrel species, the team decided to examine pelts from marsupials too, as those were the only mammals previously known to possess fluorescent fur. And it just so happened that the drawer of monotremes — an early branch of mammals that, today, is represented only by platypuses

And they were incredibly, vividly fluorescent green and blue."

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(*Ornithorhynchus anatinus*) and echidnas — was the next one over from marsupials.

“We were curious,” says Anich, of Northland College in Ashland, Wis. “So, we pulled the monotreme drawer, and we shined our [ultraviolet] light on the platypuses. And they were incredibly, vividly fluorescent green and blue.”

To make sure the glow wasn’t something unusual about the Field Museum’s pelts, the team also examined a platypus specimen at the University of Nebraska State Museum in Lincoln. Sure enough, it also glowed, the researchers report online October 15 in *Mammalia*.

Bottom of Form

Anich is confident that the glow isn’t an artifact of preservation, because several of the examined squirrel species and the echidna pelts didn’t fluoresce. It’s also likely that the living animals glow like their pelts, she says, as that’s been the case for all other known fluorescent mammals.

“I’m curious to know myself now,” says Josh Griffiths, a wildlife ecologist with the environmental consulting company Cesar in Parkville, Australia, who has been working with platypuses for over a decade. “Next time I’m out trapping, I’ll take a UV light with me and test it out.”

What, if any, purpose this fluorescence may have remains a mystery. Anich’s hunch is that it helps camouflage the mostly nocturnal platypuses from nighttime predators that have UV vision, since, by absorbing some of the UV light, platypuses reflect less of it.

Griffiths isn’t convinced. “Maybe up in northern Queensland, they get chomped by a crocodile every now and then,” he says. “But essentially, they just don’t have any predators.” Instead, he thinks that the glow could be helping the usually solitary animals spot one another or communicate when they do meet up. Something similar is thought to occur in some nocturnal frogs (SN: 4/3/17).

In fact, all known cases of fluorescence in mammals occur in species that are active at night or the low light of dawn and dusk, so Anich thinks the glow has something to do with darkness. “We don’t know as much about the nocturnal world,” she notes, so it’s possible there are lots of other fluorescent mammals awaiting discovery (SN: 2/27/20).

It may even be that the ancestor of all mammals glowed this way. To see this feature in “all three of the major branches” of mammals — placental

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mammals, marsupials and monotremes — “is really indicative that it is an ancestral trait,” Anich says, and she’d like to see further research explore that possibility.

Evolutionary and ecological significance aside, Griffiths is excited to see if these findings can help biologists who study these shy, elusive animals. “Platypuses are just bloody difficult to study in the wild,” he explains, so perhaps fluorescence will allow researchers to detect these creatures more reliably.

Even if not, the glowing fur certainly adds to platypuses’ reputation for bizarreness. “It’s another weird thing about this weird creature,” he says.

sciencenews.org, 6 November 2020

<https://www.sciencenews.org>

What happens when psychedelics make you see God

2020-11-09

Doctors gave Clark Martin a year to live after they found he had stage 4 kidney cancer in 1990.

“I’m still here,” he says now.

If the statement doesn’t carry the triumphant tone one might expect of a person who has survived decades longer than medical science predicted, that’s because the years of treatments, and the constant threat of death, dulled and depressed him for a long time. “It was exhausting,” he says, “and it was no way to live.”

In 2010, almost 20 years into his battle with cancer, Martin read about a strange research program. Participants wouldn’t take a magic pill that might shrink their tumors in a novel way. No. They’d be getting drug-drugs: Brain scientists wanted to see how hallucinogens that alter thinking patterns and sensory perceptions might affect afflicted people’s mental health. “I had always been interested in psychedelics but never had taken any,” says Martin, a retired clinical psychologist. “I was terrified that I would mess up.”

With someone else guiding him, though, the experience seemed less risky. Those someones—scientists in the psychiatry department of Johns Hopkins University—are part of the burgeoning field of psychedelic studies. Recently invigorated by a more permissive regulatory environment, the sector investigates if, how, and why reality-bending

The mysterious encounters take many forms.

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substances might help human brains. So far, research from all over the world suggests the drugs can break old mental patterns and help fight addiction, alleviate depression, shrink existential fears, and improve relationships.

Additionally, investigators have been surprised by another consistent finding: When people have spiritual experiences while tripping, they're even more likely to kick bad habits and be happier or more satisfied with their lives in the long term. The mysterious encounters take many forms. Sometimes people feel they're in the presence of God, or of a more nebulous entity like Ultimate Reality—a higher power that reveals the truth of the universe—or they just feel a novel connectedness to everything from now back to the big bang and beyond. Because of the link between the mystical and the medical, scientists like those at Johns Hopkins are probing why people have transcendent tendencies at all, how that might help our brains, and what it means for how we perceive the world.

Martin signed up for the trial and prepared for it in a series of counseling sessions with William Richards, a clinical psychologist at Johns Hopkins School of Medicine. On game day, Martin sat on a couch in a campus medical office that had been transformed into a calming living room, with a statue of the Buddha, airy paintings, and yellow-light table lamps. Still, things did not begin smoothly. After he took his psilocybin—the hallucinatory compound in magic mushrooms—from a chalice, he reclined, put a mask over his eyes, and listened to classical music, as the researchers watched and guided his experience. But when the chemicals started to kick in, he panicked. "The things in the room no longer looked familiar," Martin says, recalling what happened after he took off his mask. "Voices no longer made sense." He sat straight up, wanting to run outside so he could look at something that would make reality snap back into place.

Seeing his distress, Richards put his arm around Martin's shoulder. Richards didn't speak or try to soothe Martin. He just acted as a steadying presence, tethering Martin to the known world, even as he began to enter a brand-new one.

The psilocybin soon worked its way fully into his physiology. And Martin found himself in a cathedral. Or rather a sort of gymnasium with stained-glass windows, which felt to him like a cathedral, because it seemed like a sanctuary.

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"In my mind I said, 'Well, if there's ever going to be an opportunity to talk, this is it,'" he recalls.

And so he invited God to chat.

When Richards supervised Martin's trip, he and Johns Hopkins colleague Roland Griffiths were on an uphill climb to establish their field's significance in the treatment of mental illness and addiction. Their foundational work, including Richards' 2015 book *Sacred Knowledge: Psychedelics and Religious Experiences*, has since inspired a new generation of scientists and led to the establishment in 2019 of the university's Center for Psychedelic and Consciousness Research. The group employs about 30 people, from senior investigators to college kids, with Griffiths as director.

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It's a workplace that embraces rather than shuns the cliché parts of psychedelic culture, says research coordinator and former grad student Ian Geithner. On his office wall, for instance, hangs a tapestry of a mushroom and a big, all-seeing eye. A knee-high lava lamp lights the room. When Griffiths first saw the fixture, Geithner worried he'd think, "Unprofessional," but he just pointed at it and said, "I haven't seen one of those in ages!"

Griffiths and Richards' work continues a line of official scientific inquiry that began in 1962 with a project called the Good Friday Experiment, conducted by doctor and Harvard Divinity student Walter Pahnke. He brought volunteers from his theology classes to a basement chapel where they would ingest either psilocybin or a placebo and hear the Good Friday service being piped in from above them. Afterward they wrote their accounts, and Pahnke scored their descriptions according to how well they fit the classical characteristics of a mystical experience. Developed by Princeton philosopher Walter Stace in 1960, that list of effects includes feeling unity with the universe, in touch with something holy, and as though the episode is hyperauthentic—more real than reality. About 40 percent of the Good Friday participants fit all the criteria "very well." A few years later, Richards, then working at the Maryland Psychiatric Research Center, co-authored a paper with Pahnke titled "Implications of LSD and Experimental Mysticism."

In the mid-1960s, though, new US regulations made producing and selling psychedelics illegal—whether for recreational or clinical use. Once

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these drugs became a synecdoche for the hippie counterculture, and some researchers (including ones at the CIA) did less-than-ethical work, the stigma stuck. Studying these substances depended on getting the go-ahead from the FDA and the Drug Enforcement Administration. The change essentially shut down most work like Pahnke's; the powers that be were tightfisted with both permission and research money for topics that might be seen as sketchy. Griffiths, who had been building up his street cred in psychopharmacology, instead rose to prominence studying people's relationships to alcohol, cigarettes, and sedatives. Only after he'd established himself as a legit substance-use investigator did he submit a safe research plan to the authorities.

After a decades-long dry spell, in 2000, Griffiths and Richards—who had since moved to Johns Hopkins—were the first of many to get a green light and funds to resume rigorous psilocybin studies. They began their project, funded by the National Institute of Drug Abuse, where Pahnke had left off: with mystical experiences and their effects on the mindsets of healthy volunteers. They wanted to know what would happen to the moods and psychologies of stable-brained people who ingested psilocybin, and what those changes had to do with any spiritual strangeness that might occur while they were under the influence. The men noted in their work that many cultures have centuries-old histories of using hallucinogens, a legacy and tradition researchers are now beginning to respect rather than dismiss for its nonmodern non-Westernness.

Their first endeavor was essentially a more rigorous, updated version of the Good Friday Experiment. In a double-blind study, the scientists gave 36 volunteers psilocybin in one session and a placebo during the next—or vice versa. When stimulated by the chemical, 61 percent of the subjects had a "complete mystical experience" that satisfied all of the criteria. One participant later told of a conversation with God—who had appeared as golden streams of light—assuring them that everything that exists is perfect, even if their limited corporeal self couldn't fully understand that. More than a year later, two-thirds of participants ranked their trip in the top five most spiritually significant moments in their lives.

Following this toe-dip back into mysticism, the Johns Hopkins group continued to investigate the links among psychedelics, spiritual episodes, and quality of life. In a follow-on from 2011, the majority of participants had complete mystical experiences, which produced "positive changes in attitudes, mood, and behavior" that stuck around long after the compounds were metabolized. In a study the same year that looked into personality traits, people who had had a mystical experience scored

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much higher for openness after the trip than they had before. The transformation was larger than adults—cemented in their ways—normally make over decades of natural maturation.

Next the scientists investigated whether psychedelics—which seemed to so alter psychology and perspective—might help curb addiction, as some decades-old and not-so-meticulous studies had suggested. In 2014 the team did a small trial with smokers. After two or three doses of psilocybin, along with cognitive behavioral therapy, 80 percent of the subjects quit for at least six months, the investigators found. Varenicline, the best smoking-cessation drug on the market at the time, had just around a 35 percent success rate, while cognitive behavioral therapy on its own typically led fewer than 30 percent of smokers to stop. Something else also stood out: If someone had a mystical experience while tripping, they were even more likely to succeed.

Regulation and stigma had also hampered early research into psychedelics' effects on anxiety and depression in cancer patients, so the Johns Hopkins team picked that back up too. Here their work, including the study in which Clark Martin participated, found the same spiritual uptick. The substances appeared to perhaps kick-start new patterns in the brain: less sad and scared ones, with shifted perspective and priorities.

As his own trip progressed, Martin—at last flying comfortably high—was ready to find out what the drugs might be able to do for him. With the psilocybin coursing through his system, he stayed in his mental cathedral and waited for an answer from the God he'd reached out to.

And waited.

None came.

The silence did not disturb Martin, though. And soon another vision appeared. There he was: living on a bubble. Its surface was thick, yet fragile like a balloon, but it was the size of a planet. Other people were here too, living within different parts of its membrane.

It's tempting to view this as a metaphor, the way a dream interpreter might read into your nighttime interludes. But to Martin the images weren't abstractions. They weren't to be parsed. Meaning wasn't the point. "I didn't get hung up with them or try to make sense of them," he says of his Earth balloon, his gymnasium sanctuary, his absent God. He just experienced them.

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That was new for Martin, who had navigated his life only with logic and rationality. This trip, though, was just about being alive and alert to every interaction, feeling whatever feelings he had, sensing whatever sensations arose. To use the hip lingo of mindfulness, he was Present.

After the session ended, so did his depression.

Martin didn't hear from any deities, but plenty of other trippers have. Scientists want to understand how their perceptions compare to godly encounters sober people have, in terms of quality, authenticity, and lasting effect. Alan Davis, an Ohio State professor of social work who collaborated on mental health and substance abuse studies as a postdoc in Griffiths' lab and is still affiliated with it, believes the mystical aspect of trips is a factor in their success. "It seems to be a big piece of the puzzle," he says.

To gather a wide variety of accounts—from a larger number of mind-altered and sober subjects than they could accommodate in the lab—Davis and his Johns Hopkins colleagues created an internet-based survey to find out about people's "God encounter experiences." The survey asked individuals about their most memorable rendezvous with a supreme figure, either when sober or when they had taken a psychedelic. More than 4,000 responded. They published the results in 2019.

The sober group was more likely than the other one to label the being God. The psychedelic users instead tended to call it Ultimate Reality. But both sets generally agreed that whatever they'd encountered was "conscious, benevolent, intelligent, sacred, eternal, and all-knowing." And the majority said the experience left them with more purpose and meaning, greater satisfaction with their lives, and a decreased fear of death.

Perhaps the most striking result, though, involved people from both groups who hadn't subscribed to the idea of a higher power to start with. After their hangout with an omniscient entity, more than two-thirds became believers. (If you've ever tried to change an atheist's mind, you know how big a feat that is.)

The shift means, essentially, that they thought the experience revealed something true about the world. As the paper put it, "The majority of both groups endorsed that that which was encountered existed, at least in part, in some other reality and that it continued to exist after the encounter."

One participant, a data architect in his 40s who wished to remain anonymous because his substance use occurred outside a clinical setting,

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has had plenty of mystical encounters, but he views these chemical creations as internal. "Psychedelics allow you to explore your own mind," he says. For instance, when he met Jesus Christ while under the influence of ayahuasca, he believed he was simply meeting "the construct of Christ that exists in my own mind."

Whether or not such occurrences reveal something about the actual nature of the universe doesn't necessarily change the clinical outcomes. "If someone did have a God-encounter experience," Davis says, "and because of this they say, 'I now know that God exists,' people get rubbed the wrong way: 'You can't possibly know that. You can't prove that to be true.' As a scientist, I agree with that."

However, if it's not real, he adds, "That doesn't make the experience any less valuable. The clinician part of me is like, 'Does it matter if it's true?'"

Whether the mystical experiences are real or imagined, or both, the positive changes they produce in people stick around, and scientists are closing in on some potential chemical reasons why psychedelics so often leave folks feeling misty-eyed and spiritual.

Johns Hopkins' Roland Griffiths and colleague Frederick Barrett, a cognitive neuroscientist, laid out the basics in a 2017 paper called "Classic Hallucinogens and Mystical Experiences: Phenomenology and Neural Correlates." To start, certain psychedelics stick to serotonin receptors called 5-HT_{2A} in the central nervous system, producing classic trippy effects in ways neuroscientists don't totally understand yet. But the substances seem to most affect a framework in the brain called the default mode network, which typically lights up when you're pointing your attention inside yourself and not toward the outside world—like when you're daydreaming. When you pop or sip or chomp on a hallucinogen, this grid calms down, and its connections and oscillations change. Since in its sober state, it's all about self-contemplation, Griffiths and Barrett suspect that disrupting it results in the opposite: the "dissolution of the self," or the loss of your sense of being a lone individual. That could also explain the feeling of connectedness to everything outside who you are.

Changes in this network also remove your sense of space and time. Voila: mystical experience.

Is that really...it?

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Not quite, according to Bar-Ilan University's Ido Hartogsohn, a scholar of science, technology, and society. He postulates that psychedelic encounters with the seemingly divine feel so significant—so real—because the drugs also enhance the meaning people impose on experiences. Consider that if you had a simple nighttime dream in which you met God, you'd be more likely to wake up, shake your head, and tell the story as a funny anecdote than you'd be to ditch your atheism. Hartogsohn's work is more philosophical than neurological, but the people wielding the fMRI machines could devise ways to investigate his ideas.

And perhaps they will. Because no one really knows for sure yet why these drugs make people mystical, what that mysticality really means, or exactly why any of it changes people's personalities for the better, boosts them out of mood disorders, or rids them of addictions. Those questions merit answers. The science's consistent results have helped erode the stigma surrounding hallucinogens and taken them beyond the province of hippies, military experiments, and fringe academics. After approvals and research funding resumed in the late 1990s, that work largely happened through drug-focused nonprofit organizations like the Multidisciplinary Association for Psychedelic Studies and the Heffter Research Institute. Now universities have membership cards too. In April 2019, Imperial College London spun up the Centre for Psychedelic Research. Johns Hopkins opened its center the same year. Clinical trials are ongoing or have been approved at the University of Chicago, Yale, New York University, the University of Arizona, and the University of California, San Francisco, among others.

Whatever you make of them, psychedelic treatments hold promise that keeps pushing the research forward. Davis thinks often of a young woman in a Johns Hopkins study who had struggled for a decade with severe depression and social anxiety. She thought about suicide often. But after her treatment with psilocybin, things changed. For example, Davis says, "The look in her eye that she had gone a whole week without thinking of ending her life. It doesn't get better than seeing hope in somebody."

Davis believes psychedelics do something deeper than traditional pharmaceuticals or therapies. "Whether that's because of the mystical experiences or the insight, something is happening at a level that is not just about reducing symptoms," he says.

That's what ensued for Clark Martin. Instead of focusing on cosmic connectedness, he thought about how to forge better interpersonal links with people here on the ground—especially his daughter and his

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father, who was struggling with Alzheimer's. Martin recalls his intuitive experience of his surroundings, both illusory and physical, and how much the mere presence of psychologist Richards meant to him. He wanted to find a way to be there for others.

"It wasn't about being smarter or reading more stuff," he says. "It was having a visceral experience of the alternative"—living a moment emotionally, listening, and just being there—"and understanding it was possible. I don't think any amount of smarts and education would do the same."

No, it took someone placing a magic-mushroom compound in a chalice—for science—and passing it to a man who'd been almost-dying for far too long.

popsci.com, 9 November 2020

<https://www.popsci.com>

Study finds psychedelic DMT may be a powerful nootropic

2020-11-09

Researchers with the Complutense University of Madrid have found that DMT, the psychedelic compound found in an Amazonian tea called ayahuasca, promotes the formation of new neurons in the brain, a process called neurogenesis. That's only one of the potential benefits identified by the new study, hinting at 'great therapeutic potential,' according to one of the researchers.

Dimethyltryptamine, more commonly called DMT, remains illegal in many countries, but has grown in popularity among spiritual and brain-enhancing communities for its alleged ability to boost cognition and promote mental wellbeing — at least based on some anecdotal claims.

Research into the compound is still slim, relatively speaking, but has expanded with the new study out of Spain. The researchers spent four years studying the compound both in vivo and in vitro, finding that mice treated with the psychedelic experience 'greater cognitive capacity.'

The researchers explain in their study:

Our results demonstrate that DMT administration activates the main adult neurogenic niche, the subgranular zone of the dentate gyrus of the hippocampus, promoting newly generated neurons in the granular zone.

That's only one of the potential benefits identified by the new study, hinting at 'great therapeutic potential,' according to one of the researchers.

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Moreover, these mice performed better, compared to control non-treated animals, in memory tests, which suggest a functional relevance for the DMT-induced new production of neurons in the hippocampus.

The researchers note that it is difficult to form new neurons when some die from disease or as we age. DMT is called a promising future approach to solving this problem, one that may not even include the profound — or sometimes terrifying — hallucinations that users report.

According to the study, researchers altered the receptor that DMT binds to, reducing the hallucinogenic effect as a result. This may make the compound more tolerable for future patients suffering from neurodegenerative and psychiatric illnesses.

The study states:

One of the main limitations that arise when designing a possible drug from the results obtained is to achieve the desired neurogenic effect without causing the patient hallucinogenic effects secondary to treatment with DMT, through the activation of 5-HT_{2A} receptors. The results here obtained indicate that the observed effects of DMT are mediated by the activation of the 5HT_{2A}. In this regard, it has been shown that the stimulation of the 5HT_{2A} by different agonists enhances neurogenesis in the hippocampus.

Of course, additional research into this psychedelic and others like it are necessary to get a complete picture of the drug and its potential benefits and risks in humans.

[slashgear.com](https://www.slashgear.com), 9 November 2020

<https://www.slashgear.com>

Is NZ's vanishing nature worsening kids' asthma rates?

2020-11-10

Scientists are investigating whether the loss of green spaces is linked to asthma among Kiwi kids, in a new study that could have global implications.

A team of researchers from Massey and Otago universities are taking a deeper look at the connection, following earlier work that followed tens of thousands of children.

New Zealand has amongst the highest rates of asthma and allergy in the world, with Māori and Pasifika disproportionately affected.

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Because scientists don't yet have a clear understanding of what triggers asthma development, there's still no cure in sight for sufferers.

Studying a group of 50,000 children, the research team previously discovered that children exposed to more green space were less likely to develop asthma - and that effect was even stronger in places with plenty of native trees and plants about.

"We followed these children for 18 years and looked at where they are living at different stages of their lives, and then we used satellite data to look at how green the neighbourhoods were that they grew up in - and how diverse those green spaces were," Massey's Professor Jeroen Douwes said.

"We found an inverse relationship with green spaces and asthma - children who grew up in areas that were greener had a lesser likelihood of developing it.

"When we started digging a little bit deeper, we found having a more diverse green space was more protective.

"So, just having an area near your house that's green - it could be grass or trees - may give you some protection. But the biggest factor we found was being exposed to multiple sources of green space."

Douwes said the overall reduction in asthma risk that came with this likely buffer was 15 per cent.

"To put that into perspective, globally, there's about 300 million people who suffer from asthma. If you reduce that by 15 per cent, we're talking quite a substantial proportion."

The explanation could potentially be found in kids' gut microbiota, given the growing evidence that the mix of microorganisms living within us play critical roles in maintaining our health.

Their next project will investigate whether changes in gut microorganisms over time are associated with loss of biodiversity, or less access to green spaces.

They'll also compare samples from asthmatic and non-asthmatic kids here, and also in Ecuador, Brazil and Uganda, to see whether there are differences in human microbiota.

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“The exciting bit for me is, if we can replicate those earlier findings, and we do find out what actually confers protection, then we can start applying it to the general population,” he said.

“There are various options here - and one is working with city councils to start making more high-quality green spaces that are more available to people, which would have a number of other benefits as well.”

The three-year, \$3m study is among 134 new research projects awarded more than \$84m under this year’s Marsden Fund, administered by Royal Society Te Apārangi.

“New Zealanders are world leaders in many research areas and the Marsden Fund plays a critical role in ensuring that we continue to have expertise available in these fields,” Marsden Fund Council chair Professor David Bilkey said.

“Furthermore, Marsden Fund support enhances connectivity between researchers, both nationally and internationally whilst also facilitating the engagement between researchers and their communities.”

[nzherald.co.nz](https://www.nzherald.co.nz), 10 November 2020

<https://www.nzherald.co.nz>

A new portable device can reveal a chili pepper’s heat

2020-11-10

Just how hot is your chili pepper? A new chili-shaped device could quickly signal whether adding the pepper to a meal might set your mouth ablaze.

Called the Chilica-pod, the device detects capsaicin, a chemical compound that helps give peppers their sometimes painful kick. In general, the more capsaicin a pepper has, the hotter it tastes. The Chilica-pod is sensitive, capable of detecting extremely low levels of the fiery molecule, researchers report in the Oct. 23 ACS Applied Nano Materials.

The device could someday be used to test cooked meals or fresh peppers, says analytical chemist Warakorn Limbut of Prince of Songkla University in Hat Yai, Thailand. People with a capsaicin allergy could use the gadget to avoid the compound, or farmers could test harvested peppers to better indicate their spiciness, he says.

A pepper’s relative spiciness typically is conveyed in Scoville heat units — an imperfect measurement determined by a panel of human taste testers. Other more precise methods for determining spiciness are time-intensive

.The Chilica-pod is sensitive, capable of detecting extremely low levels of the fiery molecule, researchers report in the Oct. 23 ACS Applied Nano Materials.

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and involve expensive equipment, making the methods unsuitable for a quick answer.

Enter the portable, smartphone-compatible Chilica-pod. Built by Limbut and colleagues, the instrument’s sensor is composed of stacks of graphene sheets. When a drop of a chili pepper and ethanol solution is added to the sensor, the capsaicin from the pepper triggers the movement of electrons among the graphene atoms. The more capsaicin the solution has, the stronger the electrical current through the sheets.

The Chilica-pod registers that electrical activity and, once its “stem” is plugged into a smartphone, sends the information to an app for analysis. The device can detect capsaicin levels as low as 0.37 micromoles per liter of solution, equivalent to the amount in a pepper with no heat, one test showed.

Limbut’s team used the Chilica-pod to individually measure six dried chili peppers from a local market. The peppers’ capsaicin concentrations ranged from 7.5 to 90 micromoles per liter of solution, the team found. When translated to Scoville heat units, that range corresponds to the spice of peppers like serrano or cayenne — mild varieties compared to the blazing hot Carolina reaper, one of the world’s hottest peppers (SN: 4/9/18).

Paul Bosland, a plant geneticist and chili breeder at New Mexico State University in Las Cruces who wasn’t involved in the study, notes that capsaicin is just one of at least 24 related compounds that give peppers heat. “I would hope that [the device] could read them all,” he says.

[sciencenews.org](https://www.sciencenews.org), 10 November 2020

<https://www.sciencenews.org>

What are cytokines?

2020-11-07

Cytokines are molecules that allow your cells to talk to each other, and are crucial for healthy immune system function. Too many cytokines, however, can have a negative effect and result in what’s known as a “cytokine storm.”

These small signaling molecules are produced by many different immune cells, such as neutrophils (some of the first cells to travel to an infection site), mast cells (responsible for allergic reactions), macrophages, B-cells and T-cells, according to a 2014 review published in the journal *Frontiers in Immunology*.

Too many cytokines, however, can have a negative effect and result in what’s known as a “cytokine storm.”

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Cytokines radiate out from cells “kind of like a Wi-Fi signal,” said Joyce Wu, an immunobiologist at the University of Arizona in Tucson. They then bind to specific receptors on both immune and non-immune cells, and may signal the cell to adjust how it grows or behaves. Nearly every organ of the body contains cells with cytokine receptors.

Chemokines are cytokines that act like a beacon directing immune cells where to go. In this way, chemokines help immune cells find and destroy whatever harmful invader has entered the body.

While cytokines typically come from immune cells, they can also come from non-immune cells, said Mandy Ford, an immunologist at Emory University in Atlanta, Georgia. Endothelial cells, which are the cells lining the inside of blood vessels, and epithelial cells, which are the cells covering the surface of organs, skin and other tissue, can also send cytokines around the body. **PLAY SOUND**

How do cytokines work?

When a pathogen, or harmful invader enters the body, immune cells, cytokines and organs respond by working together like an orchestra, Ford said. The first immune cell to notice the pathogen is like the conductor. That cell directs all the other cells by creating and sending out messages (cytokines) to the rest of the organs or cells in the body (the orchestra members), which then respond as directed.

“The initiation of cytokine secretion tells the rest of the immune cells, and also non-immune cells in the body that there is a pathogen present, and an immune response should be occurring,” Ford said.

One of the immune responses cytokines may elicit is inflammation. Cytokines help inflame tissue by directing the cell walls of blood vessels to become more porous by reducing cell-to-cell contact, Ford said. Blood vessels will then leak blood into the surrounding tissue, allowing immune cells to travel via the leaked fluid to the damaged area, and start the healing process.

While cytokine production mainly occurs when the body is infected by a pathogen, cytokine-induced inflammatory responses also happen when tissues are physically damaged, such as if you tripped and cut your knee on the sidewalk.

Are cytokines part of the innate or adaptive immune system?

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Our immune system can be divided into two categories: the innate immune system and the adaptive immune system. The innate immune system refers to the immunity that you’re born with, which targets general health threats, while adaptive immunity refers to acquired immunity, which targets more specific pathogens.

Cytokines are “at the crossroads of bridging the communication between the innate and adaptive immune responses,” Ford said. That’s because the amount and type of cytokines that cells secrete differ depending on the type of pathogen, and those differences help the immune system appropriately tailor its response to be innate or adaptive. Certain cytokines can stimulate either the innate immune system, adaptive one, or a mix of both depending on the infection.

Cytokines can also direct brain cells to release chemicals that tell your body that you’re sick, prompting you to rest and avoid activities that could further expose you to pathogens. “Tiredness, lethargy, malaise and just that kind of achy feeling is the impact of cytokines on our bodies,” Ford said.

Without cytokines, the innate immune system wouldn’t know when to activate because there would be no indication of a threat. Once activated, innate immune cells don’t secrete cytokines intended for any specific receptors at first, Ford said. Rather, secreted cytokines will target the entire body, causing fever, achy joints and fatigue, according to a 2007 study published in the journal *International Anesthesiology Clinics*. The adaptive immune system will eventually secrete specific cytokines that target and activate T-cells in order to fine-tune the immune response toward the specific introduced pathogen, reported a 2010 study from *The Journal of Allergy and Clinical Immunology*.

Cytokines signal the adaptive immune system to activate when the innate immune system fails to subdue an infection. While the innate immune system is good at warding off general health threats, it may fail to destroy foreign pathogens. Cytokines direct the adaptive immune system to produce pathogen-specific antigens that quickly identify the pathogen so the immune system can destroy it.

The cytokine response is slow, and for good reason, Wu said. A 2020 editorial published in the journal *JAMA Internal Medicine* describes how a rapid immune response in which loads of cytokines are released would cause hyperinflammation, which can lead to shock and organ damage. The slow initial response of the innate immune system prevents the release of too many cytokines at one time, avoiding collateral damage to the body,

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according to a 2007 study published in the journal *Nature Public Health Emergency Collection*. The fine-tuned T-cell response can then attack the infection without causing excess harm to the body.

When are cytokines a bad thing?

Cytokines help your body fight off and kill infections, but too many cytokines overwhelm the body and create what is known as a “cytokine storm.” It’s a “simple analogy to a weather-type storm where it’s too much of a good thing,” Ford said.

A cytokine storm may occur when too many pathogens enter the body at once, or if the body secretes the wrong type of cytokine early in the immune response, in which case the excessive cytokines can’t accurately direct the immune system to clear out the pathogen. Because nearly every organ has cytokine receptors, almost every part of the body is susceptible to the negative effects of a cytokine storm.

A normal release of cytokines causes blood vessel walls to become leakier in order to promote healing of damaged tissue via inflammation, but too many cytokines may cause blood vessels to become overly porous and result in low blood pressure. That, in turn, depletes organs of oxygen and could eventually cause death, Ford said.

Patients with sepsis or uncontrolled bacterial infections typically experience a cytokine storm, and it’s also a symptom of some diseases, such as COVID-19, as described in the *JAMA Internal Medicine* editorial. A cytokine storm is essentially an uncontrolled immune response that leads to reduced oxygen in the blood, fluid build-up in the lungs, difficulty breathing, and many of the other symptoms observed in COVID-19 illnesses, Ford said.

Whether induced by COVID-19 or not, cytokine storms can also cause neurological issues. The brain is naturally protected from harmful chemicals thanks to the blood-brain barrier. But cytokines are much smaller than cells, so they can slip through the brain’s protective membrane. Cytokine storms have been known to cause symptoms such as headache, migraine, decreased appetite, increased need for sleep and overwhelming fatigue, according to a 2009 review published in the journal *Psychiatry*.

Treating COVID-19 cytokine storms

Some research suggests that cytokine storms are a major reason for illness and death among COVID-19 patients, according to the *JAMA Internal*

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Medicine editorial. A 2020 study published in the journal *Clinical Infectious Diseases* found the cytokine inhibiting drug tocilizumab has been shown to reduce mortality in COVID-19 patients on ventilators by 45%.

Cytokine levels can also influence the care COVID-19 patients receive. The presence and amount of certain cytokines can predict the survivability of COVID-19 cases, reported a recent study published in *Nature Medicine*. This can help doctors create an effective treatment protocol depending on cytokine severity. Although the mechanisms underpinning the severity of COVID-19 are still poorly understood, a recent review published in the journal *Cardiorenal Medicine* found that properly timed anti-inflammatory strategies may help reduce the severity of cytokine storms and can improve a patient’s health when infected.

[livescience.com](https://www.livescience.com), 7 November 2020

<https://www.livescience.com>

The 15-minute city—no cars required—is urban planning’s new utopia

2020-11-12

The Minimes barracks in Paris don’t look like the future of cities. A staid brick-and-limestone complex established in 1925 along a backstreet in the Marais district, it’s the sort of structure you pass without a second glance in a place as photogenic as Paris.

A closer look at its courtyard, however, reveals a striking transformation. The barracks’ former parking lot has become a public garden planted with saplings. The surrounding buildings have been converted to 70 unusually attractive public housing apartments, at a cost of €12.3 million (\$14.5 million). Elsewhere in the revamped complex are offices, a day-care facility, artisan workshops, a clinic, and a cafe staffed by people with autism.

The green, mixed-use, community-friendly approach extends to the streets beyond. Five minutes down the road, the vast Place de la Bastille has been renovated as part of a city-funded €30 million revamp of seven major squares. No longer a roaring island of traffic, it’s now dedicated mainly to pedestrians, with rows of trees where asphalt once lay. A stream of bikes runs through the square along a freshly repaved, protected “coronapiste”—one of the bike freeways introduced to make cycling across Greater Paris easier during the coronavirus pandemic. City Hall has since announced that the lanes will be permanent, backed by €300 million

“The 15-minute city represents the possibility of a decentralized city,” says Carlos Moreno, a scientific director and professor specializing in complex systems and innovation at University of Paris 1.

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in ongoing funding from the region and top-ups from municipalities and the French government.

Taken together, the new trees and cycleways, community facilities and social housing, homes and workplaces all reflect a potentially transformative vision for urban planners: the 15-minute city. “The 15-minute city represents the possibility of a decentralized city,” says Carlos Moreno, a scientific director and professor specializing in complex systems and innovation at University of Paris 1. “At its heart is the concept of mixing urban social functions to create a vibrant vicinity”—replicated, like fractals, across an entire urban expanse.

Named Paris Mayor Anne Hidalgo’s special envoy for smart cities, Moreno has become a kind of deputy philosopher at City Hall as it endeavors to turn the French capital into what he calls a “city of proximities.” His 15-minute concept was developed primarily to reduce urban carbon emissions, reimagining our towns not as divided into discrete zones for living, working, and entertainment, but as mosaics of neighborhoods in which almost all residents’ needs can be met within 15 minutes of their homes on foot, by bike, or on public transit. As workplaces, stores, and homes are brought into closer proximity, street space previously dedicated to cars is freed up, eliminating pollution and making way for gardens, bike lanes, and sports and leisure facilities. All of this allows residents to bring their daily activities out of their homes (which in Paris tend to be small) and into welcoming, safe streets and squares.

Similar ideas have been around for a long time, including in Paris itself. Walkable neighborhoods and villages were the norm long before automobiles and zoning codes spread out and divided up cities in the 20th century. Yet the 15-minute city represents a major departure from the recent past, and in a growing number of other cities it’s become a powerful brand for planners and politicians desperate to sell residents on a carbon-lite existence. Leaders in Barcelona, Detroit, London, Melbourne, Milan, and Portland, Ore., are all working toward similar visions. They’ve been further emboldened by the pandemic, with global mayors touting the model in a July report from the C40 Cities Climate Leadership Group as central to their recovery road maps.

With climate change, Covid-19, and political upheaval all challenging the ideals of globalism, the hope is to refashion cities as places primarily for people to walk, bike, and linger in, rather than commute to. The 15-minute city calls for a return to a more local and somewhat slower way of life, where commuting time is instead invested in richer relationships with

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what’s nearby. “These crises show us the possibility for rediscovering proximity,” Moreno says. “Because we now have the possibility to stay closer to home, people have rediscovered useful time—another pace for living.”

It’s a utopian vision in an era of deep social distress—but one that might, if carried out piecemeal, without an eye to equality, exacerbate existing inequities. Skeptics also wonder whether a city that’s no longer organized around getting to work is really a city at all.

Dreams of breaking down the segmented urban planning that dominated the 20th century—with industry on the outskirts, residential areas ringing the city, commerce in the core, and auto networks connecting long distances—of course aren’t new. Urban thinkers have been advocating for the preservation or return of walkable, socially mixed neighborhoods at least since the 1961 publication of Jane Jacobs’s paean to Manhattan’s Greenwich Village in *The Death and Life of Great American Cities*.

This advocacy has slowly filtered into mainstream planning orthodoxy. Copenhagen pedestrianized its main shopping street in 1962, the first of many densely built European cities to take this approach in their downtown cores. In the U.S., the so-called New Urbanism of the 1980s and ‘90s created a planning template (first fully realized in Seaside, Fla.) that saw a preference for row houses and apartments over detached houses, as well as for walkable, tree-lined streets and a careful dispersal of schools, stores, and parks to reduce the need to drive. Since the turn of the millennium, rising concerns over air pollution and climate change have led to further innovations, such as the congestion charge London introduced in 2003 for cars driving into the center and massive expansions of public transit networks in cities from Moscow to Medellín.

The 15-minute city concept draws all these trends into an intuitive rubric that ordinary residents can test against their own experiences. It’s also served as a response to pressures wrought by property speculation and rising tourism, which have pushed up rents and driven residents and businesses out of some long-standing communities. The 15-minute city seeks to protect the vitality that made diverse, locally oriented neighborhoods attractive in the first place.

Paris has been moving in this direction for some time. Under the mayorship of the Socialist Party’s Hidalgo, who was first elected in March 2014, the city introduced bans on the most polluting motor vehicles, transformed busy roads flanking the Seine into a linear park, and, in a bid to maintain socially mixed communities, expanded the city’s network

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of public housing into wealthier areas. It wasn't until 2020, however, that Hidalgo grouped these efforts together under the umbrella of the 15-minute city, plucking the term from the academic realm and giving it new political urgency.

During her reelection campaign, she teamed with the concept's originator, Moreno, a former robotics specialist who'd realized that his primary interest was the environment in which robots functioned. Hidalgo had already laid much of the political groundwork for Moreno's blueprint in her first term; now she could link all those bike paths and car lane closures with a vision that matched the vibrancy and convenience of a metropolis with the ease and greenery of a village.

Since winning reelection in June, she's doubled down, appointing a Commissioner for the 15-Minute City, Carine Rolland. A Socialist Party councillor who'd previously served in a culture-oriented role in the 18th arrondissement, Rolland also became Paris's culture commissioner. "It's true that Paris is already a 15-minute city to an extent," she says, "but not at the same level in all neighborhoods and not to all sections of the public." There's much to be done in the working-class districts on Paris's eastern edge and in many quarters close to the Boulevard Périphérique beltway, for example. In areas like these, social housing towers frequently predominate, and grocery stores and community facilities such as sports centers and clinics are sparse. This has particularly acute consequences for older people and those with limited mobility, Rolland points out.

Closer to Paris's heart, she says, are areas "characterized by what we call 'mono-activity'—a single commercial activity occupying a whole street." These are notably around the eastern section of the city's inner ring of boulevards, which are dominated by offices and small shops, leaving streets that are lively on workdays to become quiet and uninviting on evenings and weekends.

Rolland's job as 15-minute-city commissioner entails coordinating related efforts by different departments. In September, for example, 10 Parisian school grounds reopened as green "oasis yards," bringing the total to 41 since the initiative began in 2018. Each has been planted with trees and remodeled with soft, rain-absorbent surfaces that will help battle the summer heat. The yards are left available after school for use as public gardens or sports grounds, and they open onto revamped "school streets" where cars are banned or severely limited and where trees and benches have been added. Transformations like these, Rolland explains, involve

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bringing together departments responsible for education, sports, roads, and parks, as well as local business and community organizations.

Paris is far from alone in attempting this sort of transformation. London's new "Mini-Hollands" import Dutch planning ideas that seek to reduce or block car access to neighborhood shopping hubs. Barcelona has been turning 400-by-400-meter chunks of road in areas dominated by apartment towers into mostly car-free "superblocks." Madrid has declared plans to copy that approach, in keeping with its goal to be a "city of 15 minutes" as it recovers from the pandemic. Milan has said the same, with hopes to turn Covid-19 bike lanes and sidewalks permanent as its economy restabilizes. But turning the 15-minute city into a truly global movement will require a big battle over a core urban tension: the primacy of the car.

It's one thing to turn a Paris or a Barcelona—cities that were almost completely shaped before the automobile was invented—into a neighborhood-centric utopia. Transforming them is rather like giving a supermodel a makeover. The challenge is far greater in the kinds of younger, sprawling cities found in North America or Australia, where cars remain the dominant form of transit.

Some are trying. Since 2017, Melbourne has been working on a long-term planning blueprint centered on the "20-minute neighbourhood." But while the city's aspirations are similar to Paris's, the issues involved in implementing them could scarcely be more different, especially in areas beyond the already densifying core and inner suburbs. "Some middle suburbs are well-served by public transport and are starting to experience densification, but others aren't on the bandwagon," explains Roz Hansen, an urbanist who oversaw the preparation of Melbourne's blueprint. "Meanwhile, the outer suburbs are still at very low densities, partly because of poor public-transport connections."

The city has tried to improve transportation and job options in the outer suburbs, which are marked by single-family homes. Some of the middle suburbs have hosted pilot projects where new mixed commercial-residential developments are being encouraged and streets are being remodeled to increase cycling space and improve walkability. But to create and connect true 20-minute neighborhoods, investment in public transit will be key. "The bureaucrats kept thinking, 'Oh, this is also about getting in your car for a 20-minute trip,' but it's got nothing to do with the car," Hansen says. "The 20-minute neighborhood is about active modes of transport and increasing an area's catchment of accessibility. If you're

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walking, 1 to 2 kilometers [1.2 miles] is your catchment. If you're cycling, it could be up to 5 to 7 kilometers. With public transport, it can be 10 to 15 kilometers."

U.S. cities holding similarly optimistic blueprints are also struggling to strike a balance between vision and reality. In 2016, Detroit Mayor Mike Duggan laid out a plan to turn high-density corridors outside the central business district in his sprawling, 140-square-mile city into 20-minute neighborhoods. Its leading edge thus far is a \$17 million pedestrian upgrade in the Livernois-McNichols area, 9 miles northeast of downtown. The project concluded in early 2020 with an emphasis on narrower streets, wider sidewalks for cafe seating, and new lighting. Residents and business owners have been largely pleased with the improvements; a walk to the supermarket is now a much more pleasant ambition.

But that basic urban function is out of reach for the vast majority of the city. An estimated 30,000 citizens lack access to a full-service grocery store, according to a 2017 report by the Detroit Food Policy Council. Katy Trudeau, the city's deputy director of planning and development, says it wasn't long ago that many people had to travel to the suburbs for shopping and other errands. That's improved overall, and nine other districts have been targeted for upgrades along the lines of the one in Livernois-McNichols. Yet chronic fiscal problems and large swaths of blighted structures left vacant as the city's population declined have made rapid transformation implausible.

So far, most of Detroit's achievements under the 20-minute rubric have been modest, including moves toward a comprehensive transportation plan and ongoing investments in lighting and resurfacing. Trudeau also points to a new \$50 million public-private affordable housing fund, which seeks to help low-income residents stay in place as property values rise in redeveloping neighborhoods. "These things might seem really basic in Paris, but here we've suffered so much in the form of population loss and financial uncertainty in the form of bankruptcy," she says. "We have to balance these concentrated strategies with citywide strategies that help everyone with their quality of life." The 20-minute label has served mainly as useful shorthand to communicate the city's goals with residents and investors. Trudeau hopes initiatives such as the housing fund will ensure that it includes a diverse cross section of the population.

Fifteen Minutes in Three Cities

Detroit's plans were partly inspired by Portland, Ore., which is celebrated in urbanist circles as a model of U.S. city planning. Portland has the highest

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rate of bike commuting of any major American metro, a tight boundary that defines how much it can sprawl, and forward-thinking policies aimed at spurring dense, lower-cost housing production. "We're often mixed up with Paris," jokes Chris Warner, director of the Portland Bureau of Transportation (PBOT).

Yet even there, it will take years to achieve the level of compactness that makes for a "complete neighborhood," as the city's 2013 plan phrased its goal. About three-quarters of Portland's residential land is occupied primarily by single-family homes, and more than half of its population commutes by car. A recent Brookings Institution report that studied local travel behaviors found that among six U.S. metropolitan areas, Portland had the shortest average trip distance for people traveling to work, shopping, and errands. But that distance was still 6.2 miles, hardly a 15-minute walk or bike ride to the dentist or laundromat. To combat this, PBOT is spending most of its \$150 million capital-improvement budget on bike and walking infrastructure inside complete neighborhoods, and on transit to connect them.

Adie Tomer, a fellow at Brookings' Metropolitan Policy Program and co-author of the report, says the 15-minute concept falls flat in America because "people in the U.S. already live in a 15-minute city, it's just that they're covering vast distances in a car." Planners concerned with urban livability and rising carbon emissions might do well to focus on distance rather than time, he says. He suggests that the "3-mile city" might resonate better.

However the concept is cast, Art Pearce, PBOT's manager of policy planning and projects, sees signs that Portlanders are keeping their travel closer to home as the pandemic changes the way they relate to their surroundings. "We're seeing a lot of people adjusting their behaviors to focus more on their communities," he says. "That produces an opportunity to strengthen those ties as people return to a more normal life."

One thing would-be 15-minute cities everywhere will have to reckon with is social equity—and affordable housing in particular, as Detroit's Trudeau points out. Many neighborhood services rely on lower-income workers who often make long commutes, and a 15-minute city isn't really one if only the well-off can stay put. To that end, Paris aspires to have 30% of its housing stock in the public domain by 2030, and it's been increasing the share even in richer districts despite resistance from well-heeled neighbors. "It is completely part of Anne Hidalgo's program to resist real

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estate pressure, to maintain public housing, and to diversify the housing offer for the middle class," says Rolland, the 15-minute-city commissioner.

Such measures can, to a degree, counterbalance Paris's trends toward high rents and social polarization. But in a city where property prices rose even during the pandemic, they're unlikely to prevail completely. And other goals of the 15-minute city, such as greening and pedestrianizing the heart of Paris, risk alienating lower-income suburban commuters. This accusation was leveled against Hidalgo's administration in 2016, after it introduced changes to the Seine's lower quayside that eliminated a key route for car commuters. Valérie Pécresse, president of the regional council for Île-de-France, which encompasses Paris's suburbs, accused Hidalgo of acting in an "egotistical manner" by pushing through road closures, noting that "some people don't have any solution other than driving into Paris for work, because they don't have the means to live there." Others have pointed out a related concern: that, by prioritizing local infrastructure, governments will overlook badly needed regional investments, such as in transit systems for more distant commuters.

Moreno recognizes that large segments of the population might never enjoy the slower-paced, localized life he envisions. "Of course we need to adapt this concept for different realities," he says. "Not all people have the possibility of having jobs within 15 minutes." But he emphasizes that many people's circumstances could be profoundly changed—something he believes we're already seeing because of the pandemic's canceled commutes. In his view, centralized corporate offices are a thing of the past; telework and constellations of coworking hubs are the future.

The 15-minute city could also be seen as what writer Dan Hill identified as a form of "post-traumatic urbanism"—a way to recover from the onslaughts of such things as property speculation, overtourism, and now the pandemic. Already it's become clear in Paris, Rolland says, that the city needs a more localized medical network, "so people don't feel they have to go straight to the emergency room."

Following the unending traumas of 2020, there's an appealing nostalgia to a renewed emphasis on neighborhoods, even if it addresses only some of the city's modern challenges. This, too, Moreno acknowledges, pointing yet again to his idea's recuperative possibilities above all. "The 15-minute city is a journey, a guideline, a possibility for transforming the paradigm

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for how we live over the next many decades," he says. "Before, people were losing useful time. With the 15-minute city, we want them to regain it."

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