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ASIA PACIFIC

Korea GHS: Revised standards for classification and labelling of chemical substances and Material Safety Data Sheet published

2020-11-17

On November 12, 2020, Korean Ministry of Employment and Labor (MOEL) published the revised Standards for Classification and Labeling of Chemical Substances and Material Safety Data Sheet^[1] by Public Notice No.2020-130. It will enter into force on January 16, 2021, the same implementation date of the revised Occupational Safety and Health Act^[2] (K-OSHA).

ChemLinked, 17 November 2020

<https://chemical.chemlinked.com/news/chemical-news/korea-ghs-revised-standards-for-classification-and-labeling-of-chemical-substances-and-material-safety-data-sheet-published>

China's proposed labelling measures would post a challenge for international cosmetics firms

2020-11-10

International cosmetics companies selling into China will face challenges relating to efficacy claims, phrasing and filing if they are to comply with stricter guidelines on labelling and packaging under the draft Measures on the Management of Cosmetics Labelling, according to Shanghai-based regulatory compliance company Knudsen & CRC.

If approved, the draft measures will help support the implementation of the country's overarching cosmetic regulation – the Cosmetic Supervision Administration Regulation (CSAR) – which is set to come into force on 1 January.

Full Article

Chemical Watch, 10 November 2020

<https://chemicalwatch.com/177098/chinas-proposed-labelling-measures-would-pose-a-challenge-for-international-cosmetics-firms>

It will enter into force on January 16, 2021, the same implementation date of the revised Occupational Safety and Health Act[2] (K-OSHA).

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AMERICA

Clock ticking on 'forever chemicals'? Biden win spurs revival of plans for federal regulation

2020-11-19

Toxic PFAS chemicals that contaminate water and soil in many areas of New Jersey and across the country stand a better chance of national regulation under the incoming Biden administration than they have done for the past four years, advocates for their control predicted Tuesday.

New Jersey Rep. Frank Pallone, chairman of the House Energy and Commerce Committee, is expected to play a key role in renewing support for the PFAS Action Act, a bill that was passed by the House in January this year but died in the Senate, and will be reintroduced in the new Congress.

PFAS are widespread, and are known as "forever chemicals" because they do not break down in the environment, and accumulate in the human body, scientists say. In 2009 and 2010, the chemicals were found in two-thirds of 33 New Jersey public water systems tested, according to a DEP report issued in 2014.

"Addressing forever chemicals continues to be a top priority for Congressman Pallone," his office said in a statement. "He was pleased to push through the PFAS Action Plan earlier this year in the House but was disappointed when the Senate refused to act. It will remain a priority for the congressman in the upcoming Congress."

Full Article

NJ Spotlight News, 19 November 2020

<https://www.njspotlight.com/2020/11/biden-win-spurs-hopes-pfas-federal-regulation-forever-chemicals-rep-frank-pallone-key/>

Chemicals in cosmetics will transform history

2020-11-19

A toxic chemical ban signed into law in California will change the composition of cosmetics, shampoos, hair straighteners and other personal care products used by consumers across the country, industry officials and activists say.

The ban, signed by Gov. Gavin Newsom at the end of September, covers 24 chemicals, including mercury, formaldehyde and several types of

PFAS are widespread, and are known as "forever chemicals" because they do not break down in the environment, and accumulate in the human body, scientists say.

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per- and polyfluoroalkyl substances, known as PFAS. All the chemicals are carcinogenic or otherwise toxic — and advocates argue they have no place in beauty products.

When the law takes effect in 2025, it will mark the first major action to remove toxic substances from beauty products in almost a century. Federal regulation of cosmetics has not been updated meaningfully since 1938, and only 11 ingredients in personal care products are regulated by the Food and Drug Administration. By contrast, the European Union bans more than 1,600 cosmetic substances and ingredients from cosmetics.

The California law, passed by wide margins in both houses of the legislature, “is a milestone for cosmetic safety in the United States,” said Emily Rusch, executive director of the California Public Interest Research Group, which was heavily involved in shaping the bill.

Full Article

California Health Line 19, 19 November 2020

<https://californiahealthline.org/news/new-california-law-banning-toxic-chemicals-in-cosmetics-will-transform-industry/>

EUROPE

Scientific Committee on Consumer Safety SCCS opinion on copper (nano) and colloidal copper (nano)

2020-10-18

In total, 9 manufacturers notified the European Commission about 36 different products containing nanosized copper (nanoCu). For every copper dispersion, four different files were presented: a notification file, a safety file, a specification file and a file on the toxicity profile. After initial evaluation and a request for additional information, two manufacturers withdrew their products (n=7) from the notification. Therefore, these 7 products were excluded from evaluation, resulting in the final evaluation of 29 nanosized copper products produced by 7 manufacturers. For three different copper nanomaterials, notification files were provided. These were Copper Water nano-Tech 100 ppm, Copper Water nano-Tech 50 ppm, and ECO COPPER NANO-COLOID.

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Full Report

European Commission, 28 October 2020

https://ec.europa.eu/health/sites/health/files/scientific_committees/consumer_safety/docs/sccs_o_245.pdf

Bioplastics no safer than other plastics

2020-10-23

Conventional plastic is made from oil. The production of plastic is not sustainable, and it can contain substances we know are dangerous if ingested.

In recent years, bioplastics have come onto the market as an alternative to conventional plastic. Bioplastic has some apparent advantages: it is usually made from recycled material or plant cellulose, it can be biodegradable - or both.

But a new study shows that it is not non-toxic.

Bioplastics are in fact just as toxic as other plastics, according to an article recently published in *Environment International*.

“Bio-based and biodegradable plastic are not any safer than other plastics,” says Lisa Zimmermann from Goethe Universität in Frankfurt. She is the lead author of the recent article.

Zimmermann points out that products based on cellulose and starch contained the most chemicals. They also triggered stronger toxic reactions under laboratory conditions.

“Three out of four of these plastic products contain substances that we know are dangerous under laboratory conditions, the same as for conventional plastic,” says Martin Wagner, associate professor at the Norwegian University of Science and Technology’s Department of Biology.

Wagner is one of the collaborators for PlastX, a research group at the Institut für sozial-ökologische Forschung (ISOE) in Frankfurt.

This group has just led the work on the largest survey to date of chemicals in bioplastics and plastics made from plant-based materials.

Bioplastics are in fact just as toxic as other plastics, according to an article recently published in *Environment International*.

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Full Article

Norwegian University of Science and Technology, 23 October 2020

https://www.eurekalert.org/pub_releases/2020-10/nuos-bns102320.php

Roadmap on carcinogens 2.0: New ambitions and concrete challenges to boost impact

2020-11-10

On Monday 9 and Tuesday 10 November 2020 the German EU Presidency Conference 'STOP Cancer at Work' was held. During this online conference, the strategy for 2020-2024 was presented. With new ambitions and focus the Roadmap continues its quest to prevent exposure to carcinogens at work.

The core drivers of RoC 1.0 from 2016-2019 provide a profound and confirmed basis. For the next period from 2020-2024 we have established the following four goals:

- **Creating awareness** through Europe among businesses and workers on the risks of exposure to carcinogenic substances and the need for preventive actions.
- **Providing help** to businesses and workers in preventing exposure to carcinogens on the work floor and minimize its effect on the workforce.
- **Mobilising stakeholders** and increasing the involvement of relevant parties to multiply our efforts throughout Europe.
- **Targeting innovation** to bridge the gap between research findings and businesses' needs.

Full Article

Roadmap on Carcinogens, 10 November 2020

<https://roadmaponcarcinogens.eu/roadmap-on-carcinogens-2-0-new-ambitions-and-concrete-challenges-to-boost-impact/>

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Regulatory Update

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INTERNATIONAL

Greenland accedes to UN treaty against mercury pollution

2020-11-18

Greenland has acceded to the UN treaty against mercury pollution, the government said on Wednesday.

"The supply of mercury to our environment must be limited," said Jess Svane, the minister of the environment for Greenland's Home Rule government.

"Accession is an important step in protecting the health of the country's citizens and the environment from manmade emissions and mercury emissions."

The Minamata Convention came into force in 2017. There are currently 128 signatories, including Canada, that ratified the agreement in 2017.

Although mercury is a naturally occurring metal, human-caused releases of mercury into the environment are becoming an increasing concern. The treaty seeks to control anthropogenic activities that put mercury into the ecosystem.

Among other measures in the convention are banning new mercury mines, phasing out the use of mercury in certain products, controlling mercury emissions in water and air and on land, and regulating mercury's use in small scale, and artisanal gold mining, where mercury is used to help extract gold from ore.

Arctic impact

Although a concern worldwide, mercury pollution is becoming an increasing concern in the Arctic, where mercury travels to by ocean currents and the atmosphere, and then shows up in the food chain and the traditional foods relied upon by Indigenous peoples all across the circumpolar North.

Full Article

Eye on the Arctic, 18 November 2020

<https://www.rcinet.ca/eye-on-the-arctic/2020/11/18/greenland-accedes-to-un-treaty-against-mercury-pollution/>

Urban populations continue to grow rapidly, often in dense settlements with limited basic public services or infrastructure.

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Regulating sanitation services as a public good

2020-11-19

This blog is part of a series for World Toilet Day highlighting issues within the WHO-UNICEF State of the World's Sanitation report. The topic of sanitation regulation is also covered in 'Catalysing Citywide Sanitation For All Through Regulating Service Providers' by IWA's Regulation for Citywide Inclusive Sanitation initiative's advisory and taskforce members - Yvonne Magawa (ESAWAS), Diego Polania (CRA), and Gustavo Saltiel (World Bank).

For too long sanitation, specifically on-site sanitation systems such as septic tanks and pit latrines, have been left in the realm of household responsibility.

The scant investments available for urban sanitation gravitate towards sewered infrastructure, reaching small proportions of large urban areas, primarily wealthier populations. Urban populations continue to grow rapidly, often in dense settlements with limited basic public services or infrastructure. Particularly for sanitation, households are forced to make do, covering the costs of basic access for themselves. The very nature of safe sanitation, however, means that the decisions and priorities of individuals are largely decoupled from what would be required to protect public health, the environment, and reach the poorest. Services for safely containing, emptying, transporting and treating human waste, and preventing pits and septic tanks from contaminating groundwater and open drains are needed, but without regulation, investments will not prioritize public health outcomes.

This situation is both unfair to the households and ineffective in achieving a primary purpose of sanitation: protecting public health. Sanitation is fundamentally a public good. Individuals' decisions maximize their own best interest – they do not necessarily serve the best interests of society at large.

Investments in sanitation need to be planned, regulated and financed to align the priorities of individual households with those of service providers. This alignment is required to address the broader social goals of public health protection, cleaner environments, and stronger economies. Among the countries that have made extraordinary gains in a generation, a common factor among them has been strong political leadership that clarified public goals, gave clear mandates to the responsible authorities to achieve those goals, regulated authorities' delivery of services, and mobilized the corresponding investments needed.

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Where utilities manage sewers, generally those utilities have a defined, public service-oriented mandate, performance accountability, and financing strategies. Over two thirds of countries have environmental standards for wastewater treatment.

Full Article

WHO, 19 November 2020

<https://www.who.int/news/item/19-11-2020-regulating-sanitation-services-as-a-public-good>

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REACH Update

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Beauty majors sign joint statement claiming EU animal testing ban is 'being undermined' by ECHA

2020-11-10

Procter & Gamble, Unilever, L'Oréal and Avon are among signatories of an open statement claiming the European Chemicals Agency (ECHA) and its Board of Appeal is undermining the EU animal testing ban on cosmetics - a claim the agency refutes.

[Full Article](#)

Cosmetics Design Europe, 10 November 2020

[HTTPS://WWW.COSMETICSDSIGN-EUROPE.COM/ARTICLE/2020/11/10/HUMANE-INTERNATIONAL-SOCIETY-AND-BEAUTY-BRANDS-CLAIM-ECHA-IS-UNDERMINING-EU-ANIMAL-TESTING-BAN](https://www.cosmeticsdesign-europe.com/article/2020/11/10/humane-international-society-and-beauty-brands-claim-echa-is-undermining-eu-animal-testing-ban)

What do EU citizens think about nanomaterials?

2020-11-16

A recent survey carried out in five selected EU countries shows that citizens demand better labelling of everyday products containing nanomaterials and increased awareness of the risks and benefits of products containing nanomaterials.

Helsinki, 16 November 2020 – A study, commissioned by the EU Observatory for Nanomaterials (EUON), measured and analysed how citizens in Austria, Bulgaria, Finland, France and Poland perceive nanomaterials and their potential risks to our health and the environment.

It found that despite manufactured nanomaterials being a common part of our everyday lives, general awareness about their nature, characteristics and properties is low. However, the level of awareness has increased compared to earlier surveys, and is expected to continue increasing in the future.

The study identified some concerns over the safety of some established and newer applications of traditional and more advanced nanomaterials. The general risk perception of nanomaterials was nevertheless lower than for other modern trends and technologies.

The results confirm that concerns often correlate with a lack of awareness of nanomaterials. People who know more about nanomaterials tend to be less concerned about the safety of using them in everyday products.

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The majority (87 %) of study respondents want to know if the product they are buying contains nanomaterials. This information could be included, for example, on a label or packaging. They indicated that it would be particularly important to have the information on the product label for food and food-related products, medicines, cosmetics, clothing and textiles, toys, and detergents or household products.

The key recommendation of the study is to increase European citizens' awareness of nanomaterials, including their benefits and risks, to ensure the public can make informed choices. This is to be achieved through sharing of information and communicating the benefits and safety aspects of nanomaterials.

The study also recommends expanding the survey to all 27 EU countries. It outlines a need for further research to determine the most appropriate type of labelling for products containing nanomaterials and whether existing labelling requirements would need to be adapted.

If implemented, the recommendations aim to support authorities and regulators to improve the information and communication on nanomaterials. This will enable consumers to better understand how nanomaterials and nanotechnology are used in different products and address important information required by the general public to better understand the benefits and risks of nanomaterials.

[Full Article](#)

ECHA, 16 November 2020

<https://echa.europa.eu/-/what-do-eu-citizens-think-about-nanomaterials->

Procter & Gamble, Unilever, L'Oréal and Avon are among signatories of an open statement claiming the European Chemicals Agency (ECHA) and its Board of Appeal is undermining the EU animal testing ban on cosmetics - a claim the agency refutes.

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Janet's Corner

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Overreacting

2020-11-27



https://www.pinterest.com.au/pin/86061042867473108/?nic_v2=1a1YYTDXG

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Hazard Alert

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Cumene

2020-11-27

Cumene, CASR number: 98-82-8 and molecular formula: C_9H_{12} , is the common name for isopropylbenzene, an organic compound that is based on an aromatic hydrocarbon with an aliphatic substitution. It is a constituent of crude oil and refined fuels. [1] Cumene is a flammable colourless liquid with a sharp, penetrating, aromatic odour and has a boiling point of 152°C [2]

USES [3]

Cumene is used to manufacture other chemicals such as phenol, acetone, acetophenone, and methyl styrene. It is used as a thinner in paints, lacquers, and enamels. It is a component of high-octane motor fuels. Cumene is also used in the manufacture of rubber, iron and steel, and pulp and paper.

SOURCES OF EMISSION & ROUTES OF EXPOSURE [3,4]

Sources of Emission

- Industry sources: The primary sources of cumene are the industries that manufacture it or use it in production. Some of the industries that manufacture it or use it in production are oil refiners, chemical industry, rubber manufacturers, pharmaceutical industry, pulp and paper manufacturing, roofing and paving, plastics manufacturing, manufacturers of paints, varnishes and lacquers. These emissions mainly are to the air, but are also to the soil and water.
- Other possible emitters of cumene are vapours and spilling of petrol, commercial and household painting and paint, varnish and lacquer removal, tobacco smoke, and consumer products containing cumene. These emissions are to the air unless there is a spill.
- Natural sources of cumene include crude petroleum and coal tar. It is also found in the oils of plants, marsh grasses and in some foods.
- Transport sources: Some cumene is found in the exhaust of motor vehicles, jet engines, and outboard motors.
- Consumer products: Some of the consumer products containing cumene are foam plastic insulation, rubber floor and wall coverings, bathmats, vinyl floor tile, wood office desks and furniture (modular) and thinners for paints, lacquers and enamels.

Cumene, CASR number: 98-82-8 and molecular formula: C_9H_{12} , is the common name for isopropylbenzene, an organic compound that is based on an aromatic hydrocarbon with an aliphatic substitution.

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Routes of Exposure

The main routes of exposure to cumene are via the inhalation of contaminated air, or breathing in tobacco smoke. Human exposure occurs mainly by breathing air-containing cumene, from the evaporation of petroleum products. Cumene can also enter the body through the skin. A minor route of exposure is through the ingestion of contaminated food and water.

HEALTH EFFECTS

Acute Effects

Acute inhalation exposure to cumene may cause headaches, dizziness, drowsiness, slight incoordination, and unconsciousness in humans. It has a potent CNS depressant action characterised by a slow induction period and long duration of narcotic effects in animals. Acute inhalation exposure also causes CNS depression in rodents. Cumene is a skin and eye irritant in humans and animals. Tests involving acute exposure of rats, mice, and rabbits, have demonstrated cumene to have moderate acute toxicity by inhalation or dermal exposure and low to moderate acute toxicity by ingestion.

Chronic Effects (Noncancer)

No information is available on chronic exposure to cumene in humans. Inhalation studies in rats have reported increased liver, kidney, and adrenal weights. Increased kidney weight was observed in rats chronically exposed to cumene via gavage (experimentally placing the chemical in the stomach). The Reference Concentration (RfC) for cumene is 0.4 milligrams per cubic metre (mg/m³). The Reference Dose (RfD) for cumene is 0.1 milligrams per kilogram body weight per day (mg/kg/d) based on increased kidney weight in rats.

Cancer Risk

No information is available on the carcinogenic effects of cumene in humans or animals. EPA has classified cumene as a Group D, not classifiable as to human carcinogenicity.

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SAFETY

First Aid Measures

- Eye Contact: Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.
- Skin Contact: After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.
- Serious Skin Contact: Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.
- Inhalation: Allow the victim to rest in a well-ventilated area. Seek immediate medical attention.
- Serious Inhalation: Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.
- Ingestion: Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Exposure Controls and Personal Protection

Engineering Controls

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapours below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the workstation location.

Personal Protective Equipment

The following personal protective equipment is recommended when handling cumene:

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- Splash goggles;
- Lab coat;
- Vapour respirator (be sure to use an approved/certified respirator or equivalent);
- Gloves

Personal Protection in Case of a Large Spill:

- Splash goggles;
- Full suit;
- Vapour respirator;
- Boots;
- Gloves;
- A self-contained breathing apparatus should be used to avoid inhalation of the product.
- Note: Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

REGULATION [3,6]

United States

- NIOSH: TWA 50 ppm (245 mg/m³) [skin]
- OSHA: TWA 50 ppm (245 mg/m³) [skin]

Australia

- Safe Work Australia has set an 8 hour time weighted average (TWA) of 25ppm and a short term exposure limit (STEL) of 75ppm

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5. <http://www.sciencelab.com/msds.php?msdsId=9927504>
6. <http://www.epa.gov/ttn/atw/hlthef/cumene.html>

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Gossip

NOV. 27, 2020

Psilocybin & migraine: First of its kind trial reports promising results

2020-11-22

A first-of-its-kind exploratory study, led by researchers from Yale School of Medicine, has found a single dose of the psychedelic psilocybin can reduce migraine frequency by 50 percent for a least two weeks. The preliminary trial was small, with follow-up work necessary to validate the results, but the promising findings suggest great potential for psychedelics to treat migraines and cluster headaches.

Back in the 1960s, during the height of the first wave of psychedelic science, one of the more compelling research avenues was the potential for drugs such as LSD and psilocybin to treat headaches. Initial studies at the time seemed to suggest psychedelic drugs that activate 5-hydroxytryptamine 2A (5-HT_{2A}) receptors could significantly reduce headache burden in chronic migraine sufferers.

Of course, all this research froze by the early 1970s as psychedelic drugs were criminalized and rendered taboo. It wasn't really until the early years of the 21st century that the research restarted, and most modern psychedelic research has primarily focused on the drugs as adjuncts to psychotherapy, targeting conditions such as depression, addiction and PTSD.

Although official psychedelic investigations were in a state of deep freeze, out in the real world people continued to experiment with these drugs, self-treating for a number of conditions. Several surveys of these real-world applications revealed an abundance of cluster headache and migraine patients experimenting with LSD and psilocybin.

A new study, published in the journal *Neurotherapeutics*, is offering the first double-blind, placebo-controlled, cross-over study on the effects of a moderate psilocybin dose on migraine frequency and severity. The research is only preliminary and small but its results are deeply encouraging.

Ten migraine sufferers were recruited for the trial. Each subject completed two sessions, one with a placebo and one with a moderate psilocybin dose. Headache diaries were used to track headache frequency and severity in the two weeks leading up to, and following, each experimental session.

Of course, all this research froze by the early 1970s as psychedelic drugs were criminalized and rendered taboo.

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“Compared to placebo, a single administration of psilocybin reduced migraine frequency by about half over the two weeks measured,” explains corresponding author on the new study Emmanuelle Schindler, in an email to New Atlas. “In addition, when migraine attacks did occur in those two weeks, pain intensity and functional impairment during attacks were reduced by approximately 30 percent each.”

Perhaps the most intriguing finding from this small study was the lack of any correlation between the subjective strength of the psychedelic experience and the therapeutic effect. Prior trials using psilocybin to treat depression or addiction have suggested the overwhelming magnitude of a psychedelic experience seems to be fundamentally entwined with its therapeutic efficacy. So essentially, the more powerful the experience the better the result.

But unexpectedly, this migraine/psilocybin trial did not detect that association. In fact, those subjects reporting the highest scores on a self-reported altered state of consciousness scale showed some of the smaller reductions in migraine burden.

What this intriguingly suggests is that, in the case of psilocybin for migraine, it may be possible to separate out the drug’s psychotropic effects from its therapeutic effects. This could be achieved either by exploring microdoses and sub-hallucinogenic doses, or even homing in on the mechanism by which the drug is helping prevent migraines and finding a new way to pharmacologically target it.

“This is definitely a finding we’re interested in exploring further,” says Schindler. “If these outcomes are confirmed to be independent, it suggests that the migraine-suppressing effects do not involve the same systems that cause the acute changes in sensation and perception. Psilocybin has some chemical and pharmacological similarities to existing migraine medications that are not psychedelic, so we plan to investigate its therapeutic effect in this context.”

It is important to understand the limitations of these new findings. This is a small exploratory study, designed to uncover potential signals that are worthy of more robust investigation. The two-week follow up, for example, offers no indication as to the long-term efficacy of this kind of therapy. This is something Schindler suggests will be closely studied in future research.

Moving forward, Schindler is cautious not to overstate her team’s findings but she does say the results are exciting. Not only does this research offer signals psychedelic compounds could meaningfully help those suffering

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from debilitating migraines, but the study offers novel insights into the still-unexplained physiological causes of chronic headache disorders.

Lots of questions still need to be resolved before any kind of clinical treatment can come from this research but Schindler and colleagues are already working on the next steps, with longer follow-up periods and greater focus on different dose effects.

“I have a new migraine study starting soon and I’m also currently studying post-concussion headache, which often resembles migraine,” adds Schindler. “I’m not aware of any other groups investigating psilocybin or related compounds in migraine, though cluster headache is currently being studied, not only by my group, but also Swiss and Danish researchers.”

The new study was published in the journal *Neurotherapeutics*.

[newatlas.com](https://www.newatlas.com), 11 November 2020

<https://www.newatlas.com>

Seas are rising faster than ever

2020-11-18

Ask climate scientists how fast the world’s oceans are creeping upward, and many will say 3.2 millimeters per year—a figure enshrined in the last Intergovernmental Panel on Climate Change report, from 2014. But the number, based on satellite measurements taken since the early 1990s, is a long-term average. In fact, the global rate varied so much over that period that it was hard to say whether it was holding steady or accelerating.

It was accelerating, big time. Faster melting of Greenland’s ice has pushed the rate to 4.8 millimeters per year, according to a 10-year average compiled for *Science* by Benjamin Hamlington, an ocean scientist at NASA’s Jet Propulsion Laboratory (JPL) and head of the agency’s sea level change team. “The [Greenland] mass loss has clearly kicked into higher gear,” agrees Felix Landerer, a JPL sea level scientist. With the help of new data, new models of vertical land motion, and—this month—a new radar satellite, oceanographers are sharpening their picture of how fast, and where, the seas are gobbling up the land.

Hamlington and colleagues first reported signs of the speedup in 2018 in the *Proceedings of the National Academy of Sciences*. Since then, they and others have become more confident about the trends. In a 2019 study in *Nature Climate Change*, a group led by Sönke Dangendorf, a physical

In fact, the global rate varied so much over that period that it was hard to say whether it was holding steady or accelerating.

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oceanographer at Old Dominion University, used tide gauge readings that predate satellite records to show seas have risen 20 centimeters since 1900. The team's data show that, after a period of global dam building in the 1950s that held back surface water and slowed sea level rise, it began to accelerate in the late 1960s—not the late 1980s, as many climate scientists assumed, Dangendorf says. "That was surprising," because the main drivers of sea level rise—the thermal expansion of ocean water from global warming, together with melting glaciers and ice sheets—were thought to have kicked in later.

Oceanographers are about to get a sharper view of the trends thanks to the Sentinel-6 Michael Freilich satellite, which NASA and the European Space Agency plan to launch on 21 November from Vandenberg Air Force Base in California. Named after the former head of NASA's earth science program, who died this year, the satellite will work much like its predecessors, using pulses of reflected radar to measure the ocean's height. But its higher resolution measurements will allow it to gauge ocean height within 300 meters of the coastline, far closer than before.

Top of Form

Bottom of Form

The coasts are where sea level rise hits home—and where large local variations can mask the global average. In work published last month in *Scientific Data*, Anny Cazenave, an ocean geophysicist at the International Space Science Institute, and colleagues reanalyzed the satellite record and showed sea level rise at 20% of the coastal sites they surveyed across Europe, Asia, and Africa was significantly different from that of the open ocean. "We have to explain that," she says.

Some of the variation reflects the vertical motion of the land itself, due to the slow bobbing of continental plates that "float" on a viscous mantle. Coastal ocean currents, freshwater from nearby rivers, and weather patterns can also inject variability by causing water to pile up or retreat from the continents, Cazenave says.

But Dangendorf believes currents in the open ocean drive much of this variable sloshing, routing rising water from the open ocean—where there is more water to warm and expand—to the coastlines. One reconstruction of Norwegian sea levels from 1960 to 2015, for example, showed shifting currents were the best explanation for mysterious, and frequent, 20-millimeter swings in height. Dangendorf is now tracing sea level rise in nine coastal regions to their ocean sources, and has found them to be

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typically 500 to 1000 kilometers away; much of the sea level rise in the northern half of the U.S. east coast, for example, comes from waters swept out of the Labrador Sea.

The trends are worrisome. Aimée Slangen, a climate scientist at the Royal Netherlands Institute for Sea Research, and colleagues are integrating recent projections from climate models to predict when sea levels will rise 25 centimeters above 2000 levels, a point when 100-year floods on some coastlines could be a near annual occurrence. In unpublished work, Slangen finds that the threshold will be reached sometime between 2040 and 2060. Efforts to slow climate change won't do much to postpone it given the inertia of ocean warming and ice melt, though they could forestall much greater increases later in the century. And that near-term certainty, though dire, is "quite good for decision-making," Slangen says.

Dangendorf, who joined Old Dominion late last year, is getting a front row seat to the action. The university is in Norfolk, Virginia, a part of the U.S. coast where the crust is sinking about as fast as the oceans are rising. "I watch coastal flooding every week," he says. "I see it from my balcony."

sciencemag.org, 18 November 2020

<https://www.sciencemag.org>

Scientists create diamonds at room temperature in minutes

2020-11-09

Diamonds might be forever, but that doesn't mean they have to take eons to form.

The gemstones are usually created after carbon is crushed and heated far beneath the Earth's surface over billions of years -- which is what makes them so coveted.

Now, scientists in Australia say they have sped up the process into just a matter of minutes -- and at room temperature.

An international team of researchers led by the Australian National University (ANU) and RMIT University in Melbourne, Australia said Wednesday they have created two types of diamond at room temperature by using high pressure equivalent to 640 African elephants balancing on the tip of a ballet shoe.

Now, scientists in Australia say they have sped up the process into just a matter of minutes -- and at room temperature.

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The researchers said they were able to create two types of structurally distinct diamonds -- one similar to those typically worn in jewelery, and another type called Lonsdaleite, which is found naturally at the site of meteorite impacts and is harder than most diamonds.

Synthetic diamonds are not themselves new, and have already been created in labs since the 1940s in a bid to find cheaper, ethical and environmentally friendly stones.

But researchers were excited to create such diamonds at room temperature, especially the harder Lonsdaleite diamond, which has the potential to be used to cut through "ultra-solid" materials on mining sites, they said.

"Creating more of this rare but super useful diamond is the long-term aim of this work," said Xingshuo Huang, an ANU scholar working on the project. "Being able to make two types of diamonds at room temperature was exciting to achieve for the first time in our lab."

Lab grown diamonds are usually created by carbon being subjected to intense heat.

A huge twisting, sliding force

To form the diamonds, researchers applied immense pressure to create a "twisting or sliding force" that they believe caused the carbon atoms to move into place, said Jodie Bradby, a physics professor at ANU.

"Natural diamonds are usually formed over billions of years, about 150 kilometers (about 93 miles) deep in the Earth where there are high pressures and temperatures above 1,000 degrees Celsius (1,832 degrees Fahrenheit)," she said. "The twist in the story is how we apply the pressure."

Dougal McCulloch, physics professor at RMIT who co-lead the research, and his team then used advanced electron microscopy techniques to take slices from the experimental samples to better understand how they were formed.

When the team studied the samples they found veins of both regular and the Lonsdaleite diamonds running through.

"Seeing these little 'rivers' of Lonsdaleite and regular diamond for the first time was just amazing and really helps us understand how they might form," McCulloch said.

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Researchers from The University of Sydney and Oak Ridge National Laboratory, in Tennessee, US were also involved in the research.

edition.cnn.com, 9 November 2020

<https://website>

Covid: chemicals found in everyday products could hinder vaccine

2020-11-17

The successful uptake of any vaccine for Covid-19, a crucial step in returning a sense of normalcy after a year ravaged by the coronavirus pandemic, could be hindered by widespread contamination from a range of chemicals used in everyday products.

Small amounts of per- and polyfluoroalkyl (or PFAS) chemicals are commonly found in the bodies of people in the US, as well as several other countries. These man-made chemicals, used in everything from non-stick pans to waterproof clothes to pizza boxes, have been linked to an elevated risk of liver damage, decreased fertility and even cancer.

But scientists warn some of these chemicals can also cause another little-known but potentially significant defect by reducing the effectiveness of certain administered vaccines. This impediment could cast a shadow over efforts to roll out a Covid-19 vaccine to enough people that restrictions on day-to-day life are eased.

"At this stage we don't know if it will impact a corona vaccination, but it's a risk," said Philippe Grandjean, an adjunct professor of environmental health at the Harvard School of Public Health. "We would have to cross our fingers and hope for the best."

Research led by Grandjean has found that children exposed to PFAS had significantly reduced antibody concentrations after given tetanus and diphtheria vaccinations. A follow-up study of adult healthcare workers found similar results. Meanwhile, a certain type of PFAS, called perfluorobutyrate (or PFBA), accumulates in the lungs and can heighten the severity of illness suffered by people who are infected with Covid-19, separate research by Grandjean, yet to be peer-reviewed, has suggested.

German company BioNTech and the US pharmaceutical giant Pfizer provoked a surge of optimism over an impending Covid vaccine after announcing a contender was 90% effective in preventing people from falling ill with the disease. The scientist behind the vaccine has predicted

This impediment could cast a shadow over efforts to roll out a Covid-19 vaccine to enough people that restrictions on day-to-day life are eased.

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it will “bash the virus over the head” and help lift the pandemic that has crippled much of the world since the beginning of the year.

The Pfizer vaccine is based on messenger RNA genetic material and it's uncertain if PFAS contamination would disrupt its efficacy in patients. But there are several other vaccine contenders that are formulated around the protein spikes of the virus, similar to vaccines for tetanus and diphtheria, and they may well also have poor results in people who have ingested PFAS.

“People with high exposure to PFAS have a non-protective and very low antibody levels after four vaccinations for diphtheria and tetanus,” Grandjean said. “So if a vaccine for Covid is similar, the PFAS will likely inhibit the response from a vaccine. But it is an unknown at this stage.”

The US president-elect, Joe Biden, has promised to crack down on PFAS pollutants by classifying them as hazardous substances. It is estimated more than 200 million Americans eat food and drink water laced with PFAS, known as “forever chemicals” as they linger long in the body, with hotspots found in areas around military bases where the chemicals are used in firefighting foam.

Despite this, only a few states require drinking water to be largely free from PFAS, a situation that a Biden-controlled Environmental Protection Agency will probably intervene in with new federal limits.

Any new regulation of PFAS will now have an added urgency, with a Covid vaccine expected for the vast majority of Americans by mid-2021. “I do worry constantly about exposure for both known and unknown PFAS, and the impacts they are having on both our immune systems and on our health in general,” said David Andrews, a senior scientist at the Environmental Working Group. “PFAS exposure is an urgent public health crisis.”

[theguardian.com](https://www.theguardian.com), 17 November 2020

<https://www.theguardian.com>

Hidden world of bacteria and fungi discovered on Leonardo da Vinci's drawings

2020-11-20

Leonardo da Vinci is famous for his elaborate, nuanced artworks and advanced technological ideas. But new research has revealed another

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level of complexity to his drawings: a hidden world of tiny life-forms on his artwork.

The findings, the researchers said, could help build a microbiome “catalogue” for artwork. Each of the pieces had a unique enough collection of microbes that researchers could have identified it again later purely from a study of its microscopic biology. And the drawings’ microbiomes had enough key elements in common to help researchers spot counterfeits based on differences in their microbiomes, or even authentic drawings that had been stored in different conditions over the centuries. The researchers also showed that da Vinci’s drawings had a significantly different microbiome than expected, with lots of bacteria and human DNA — likely a consequence of centuries of handling by art restorers and other people. Microbes known to make paper degrade over time were also present, showing why those restorers’ efforts had been necessary. The study amounts to a proof-of-concept exercise, showing how microbiomes might, in the future, reveal unexpected histories of certain artworks or help detect forgeries.

Researchers examined the microscopic biological material, living and dead, in seven of the master’s “emblematic” drawings, and found an unexpected diversity of bacteria, fungi and human DNA. Most of that material probably landed on the sketches well after da Vinci’s death 501 years ago, so the DNA (or the bulk of it at least) likely comes from other people who have handled the drawings over the centuries and not the polymath himself. But the newfound biological materials do have a story to tell.

PLAY SOUND

The biggest surprise, the researchers wrote, was the high concentration of bacteria in the drawings, especially as compared with fungi. Past studies have shown that fungi tend to dominate the microbiomes of paper objects such as these drawings, but in this case an unusually high amount of bacteria from humans and insects (likely flies that pooped on the paper at some point) were present.

“Altogether, the insects, the restoration workers and the geographic localization seem to all have left a trace invisible to the eye on the drawings,” the researchers said in a statement. “[But] it is difficult to say if any of these contaminants originate from the time when Leonardo da Vinci was sketching its drawings.”

But the newfound biological materials do have a story to tell.

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Most of that DNA likely came from people who have restored the work starting in the 15th century. The team has not analyzed the genetic material in the level of detail necessary to see who specifically it might have come from.

The researchers used a new tool called Nanopore, a genetic sequencing method that quickly breaks down and analyzes genetic material, to make the detailed study of the different biological materials. The same researchers have studied artistic microbiomes in the past to determine how statues that were recovered from smugglers had been stored while they were in hiding. Going forward, they said, this technique could reveal new details of the histories of even well-studied artworks.

The study was published Friday (Nov. 20) in the journal *Frontiers in Microbiology*.

Originally published on Live Science.

[livescience.com](https://www.livescience.com), 20 November 2020

<https://www.livescience.com>

Antarctica's blue whales return to South Georgia a century after they were nearly wiped out

2020-11-20

The critically-endangered blue whale — the largest animal known to have ever existed — has returned to the waters near the remote island of South Georgia near Antarctica, almost 100 years after the mega-mammal was nearly made extinct by industrial whaling.

Researchers say a recent survey of the waters around the sub-Antarctic island — a center for industrial whaling until it was banned in the 1960s — recorded dozens of blue whales where only a single whale had been seen between 1998 and 2018.

"We've had indications in previous years that there might be more blue whales starting to come back to South Georgia," marine mammal ecologist Susannah Calderan told Live Science. "But we were very favorably surprised by quite how many we did see this year."

Calderan, a research fellow at the Scottish Association for Marine Science (SAMS), is the lead author of a study into the resurgence of blue whales near South Georgia published Thursday (Nov. 19) in the journal *Endangered Species Research*.

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In January and February this year, she was on board the New Zealand research ship *Braveheart* for an expedition into the waters around South Georgia led by whale biologist Jen Jackson of the British Antarctic Survey, a co-author of the new research.

The scientists, she said, were amazed to find numerous blue whales in a region where they were once eradicated — — 38 sightings on the surface over a few weeks, comprising a total of 58 individual whales, along with many acoustic detections by "sonobuoys" equipped to monitor underwater whale songs.

South Georgia is the largest island in a remote South Atlantic archipelago, known as South Georgia and the South Sandwich Islands.

The island is about 2,500 miles (4,000 kilometers) from the coast of Antarctica, but it is situated within the Antarctic convergence — the hydrological boundary between the cold waters around Antarctica and the warmer waters farther north.

It's now only inhabited by people for a few months every summer, but South Georgia had a prominent role in the history of Antarctic exploration.

In the early 20th century, it became a center for industrial whaling — effectively the "Ground Zero" of whaling, first for humpbacks, and later for blue whales.

According to Calderan's study, more than 42,000 blue whales were killed around South Georgia between 1904 and 1971, most of them before the mid-1930s. "In the early 1900s, South Georgia waters thronged with blue whales; within a little over 30 years, they were all but gone," the researchers wrote.

"It was just a matter of luck that they weren't wiped out altogether," Calderan said. "By the end of whaling, it was estimated that blue whale populations were 0.15% of their pre-whaling levels. They couldn't have hung on much longer."

Although populations of blue whales have been increasing in other parts of the Antarctic in recent decades, the majestic ocean dwellers were almost unseen in the waters around South Georgia until the recent expedition, she said.

Whale resurgence

The near-extinction of blue whales around South Georgia in the early 20th century may have resulted in the loss of their "cultural memory" of the

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abundance there of Antarctic krill — tiny swimming crustaceans found in huge swarms in the Southern Ocean and the only food of blue whales. Knowledge of whale feeding grounds may be passed on from mother whales to their calves. “There was a cultural memory, maybe, of animals that used to come to South Georgia that was lost because they were wiped out,” Calderan said. “They couldn’t pass on the knowledge of the feeding grounds because there weren’t any of them left.”

But the evidence of the recent survey suggested at least some blue whales have rediscovered South Georgia’s abundance of krill.

“I think we may well be seeing evidence of site fidelity to certain feeding areas, which would be an explanation for why [blue whale] numbers started recovering in the wider Antarctic, but has taken longer to recover at South Georgia,” Calderan said.

The increase in blue whales around South Georgia comes after BAS research indicating the population of humpback whales in the region has also increased — like blue whales, humpbacks were all but driven to extinction by industrial whaling.

“It’s a good sign,” Calderan said. “This was an area that was particularly hard hit by whaling, and it is really encouraging that we’re starting to see whales there again.”

Originally published on Live Science.

[livescience.com](https://www.livescience.com), 20 November 2020

<https://www.livescience.com>

No place is safe: Tiny bit of plastic pollute the snow, streams on iconic Mount Everest

2020-11-23

Scientists have found microplastics hidden in the snow and streams on the famous climber’s mecca, Mount Everest, adding to the concerning body of evidence that no place on the planet is free from these microscopic pollutants.

New analysis of 19 snow and stream water samples collected from the world’s highest mountain—standing at 29,029 feet and located at the China-Nepal border— showed the presence of microplastics in every snow sample from five locations, and in three out of eight stream water samples from six locations. The concentrations of microplastics ranged from three

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to 119 microplastics per liter of snow and zero to two microplastics per liter of stream water.

The research, funded by the National Geographic Society and Rolex and published today in the journal *One Earth*, is the first to document the presence of microplastics in snow and stream water on Mount Everest, the iconic peak famously first summited by Edmund Hillary and Tenzing Norgay in 1953 and which was recently cleared of 24,000 pounds of trash.

“Mount Everest is somewhere that I considered quite pristine and remote. But actually, it’s been called the highest junkyard on Earth in the last few years,” Imogen Napper, lead author and marine scientist at the University of Plymouth, told EHN. “And knowing that waste is on Mount Everest isn’t surprising, but no one had ever looked at microplastics on Everest before—the scary thing is we found microplastic in every single snow sample that we took.”

The most common polymers detected were polyester, acrylic, and nylon fibers, suggesting that the plastic pollution originated from clothing and hiking gear like ropes and tents. The next steps in the research, Napper said, would be to more precisely pinpoint the origins of these fibers, and maybe inspire innovation in industry and design to create better products.

While Napper and her team did not examine potential effects these fibers could have on the mountain ecosystem, previous studies have shown that microplastics in ice can increase albedo levels which could amplify ice melt, and in water can transport toxics— such as PCBs or pesticides, which bind to the plastics— to marine life.

Napper’s analysis adds to an unfortunate trend—scientists are realizing that there is likely no place on Earth free of microplastic pollution.

Matthew Rillig, an ecologist who studies microplastics in terrestrial ecosystems at the Free University of Berlin who was not associated with the new research, told EHN he was not surprised. “There have been a few papers over the years that show that microplastic is basically raining down from the atmosphere,” he said. “So I don’t know where you’d have to go to get away from that.”

Rillig doubts that there is any place on Earth that is microplastic free, let alone a place that consistently gets hundreds of hikers a year. Regardless, he said, it’s good to keep conducting as many of these measurements as we can as he hopes scientists will be able to assess how these

The concentrations of microplastics ranged from three to 119 microplastics per liter of snow and zero to two microplastics per liter of stream water.

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microplastics are affecting the ecosystems, and how concentrations of these materials might change in the future.

The research was limited in that they took a small number of samples—a product of the logistical challenges in collecting materials in a place like Mount Everest. The inaccessibility of the site makes it a physical strain on the researchers, Napper said.

Even with a team of 34 scientists conducting research on the mountainside for nearly two months, there was a limit to how much they could carry and take. All the snow and water samples were flown off the mountain by helicopter. They arrived at Napper's lab at the University of Plymouth shortly after, where she conducted microscopy analysis—"unfortunately, the closest I got to Everest was actually my lab in the University of Plymouth," she said, "though I was quite excited, waiting for the parcels to be delivered."

Napper said she hopes that finding plastic at the top landmasses on Earth spurs scientists and the public alike to take the issue of microplastic pollution more seriously. "This research is not the end of the story, it's very much the first page of a chapter. And hopefully, it will lead to more work on how and why we need to protect our planet."

ehn.org, 23 November 2020

<https://www.ehn.org>

One year on: Insects still in peril as world struggles with global pandemic

2020-11-11

In the middle of the COVID-19 pandemic, in the heart of a what was increasingly a global lockdown, the rains finally came to East Africa. They came after several years of drought and less-than-stellar rainy seasons. And with these rains, came the insects, says Dino Joseph Martins, the executive director of the Mpala Research Center.

"There's been this beautiful flash of butterflies and everybody's with their families or at home, or trying to entertain their kids that are not in school, and looking at things in the garden or going on walks," Martins said in August.

Martins, an entomologist and butterfly aficionado, has become so "inundated" by questions from curious insect onlookers in lockdown that

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he's considering "quitting social media" just to have some time to breathe again.

"I think there has been a much broader appreciation of nature [during the pandemic] and it's because of the loneliness of lockdown, the isolation," says Martins. "This has been such a blow for so many people." But, according to the scientist, the pandemic has also unexpectedly awakened many people to the marvels of the natural world and our interconnectedness with it.

It's a happy anecdote in a year that has seen not only wrenching global change due to the pandemic, but also reams of new research on the potential decline of insects around the world, often dubbed more dramatically as the "insect apocalypse" by the media.

New data fills out increasingly complex global picture

A year after publishing Mongabay's June 2019 series *The Great Insect Dying*, I reached out again to some of my scientific sources to see how they viewed new findings across the previous twelve months. None of the seven researchers I spoke with expressed a major shift in their well informed views, which ranged from concern over regional declines, to a wider belief that global insect diversity and abundance may be gravely in trouble.

"My views on the decline haven't changed drastically but they've become more nuanced; I can see that different systems around the world are responding differently," says Martins, who adds that the last year has shown him that some insect species are remarkably resilient. Still, the entomologist increasingly worries about places like the Amazon which are being devastated—and could be completely transformed — by human-caused fires and climate change.

As for standout studies, a number of the researchers pointed to a meta-study published in *Science* that looked at insect surveys covering 1,676 sites around the world. It found that land-based insect species, including all pollinators, were dropping by around 9% per decade, an alarming statistic, but one not quite as high as some other research has reported, especially in Europe.

On a more positive note, the study found that water-based insect populations have been rising on average, perhaps due to conservation efforts to clean up waterbodies. However, water loving species represent

It found that land-based insect species, including all pollinators, were dropping by around 9% per decade, an alarming statistic, but one not quite as high as some other research has reported, especially in Europe.

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only around one tenth of the world's insects — meaning that the majority of insect fauna still appears to be at risk.

Tyson Wepprich, a postdoctoral research associate at Oregon State University, calls this a “benchmark paper.” Still, he adds “there is so much variation between sites and insect groups, [and] there's no way that a meta-analysis like this could describe what is happening globally.”

Meanwhile, over the past year in Europe — where the alarm over deep insect declines was first sounded — new studies continue shining a light on extensive and startling losses. For example, a study in Germany late last year solidified insect decline there, finding massive declines in both grasslands and forests. Meanwhile, research in Switzerland found that food for insects has plummeted in the country. That hits insect predators too: another Swiss study found that orb-web spiders population density has crashed (140 times lower than Europe's 1970-80s average). Research in the U.S. shows a more complex picture, with overall abundance potentially more stable, but ongoing declines among pollinators and other species.

One glaring research gap, highlighted in Mongabay's June, 2019 survey, has yet to be closed by global research conducted since then: almost no new studies cover the tropics. Insect abundance and diversity is highest in the tropics — indeed, insects there help make tropical rainforests the most diverse ecosystems on our planet. But tropical diversity is also at grave risk due to escalating deforestation, and agribusiness, mining and infrastructure expansion.

“I'm still disappointed that the tropics..., and Africa in particular, are very poorly represented,” says Martins.

Numerous sources pointed to one paper out of Costa Rica as one of a few, but one of the best, studies on insect abundance carried out in the tropics recently; it's findings weren't heartening. Scientists found that 40% of 64 once-common caterpillar genera had declined over the past 22 years in La Selva, a 1,600-hectare (4,000-acre) forest patch surrounded by agriculture. The study also discovered that the parasitoids that depend on these caterpillars were also in decline.

Another study, this time in the Brazilian Amazon, found that dung beetle populations fell by more than 60% during severe droughts in El Niño years, and by 20% due to forest burning, mostly caused by humans. Dung beetles provide key ecological services, processing waste and dispersing seeds and soil nutrients. Record annual fires are an increasingly common

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and escalating crisis in the Amazon rainforest, which in the past rarely burned.

Daniel Janzen, a professor with the University of Pennsylvania, who has studied insects in Costa Rica since the 1960s adds to the alarming tropical picture. Janzen has been outspoken as a witness to a long-term insect decline in Costa Rica's Guanacaste Conservation Area; especially alarming because the losses — as in other parts of the world — are occurring inside a protected area.

“This has not changed,” he says referring to losses over the last year. He notes that taxonomists collecting caterpillars during the last rainy season found that species richness had dropped by 60-80% over what was found just 10-20 year prior.

Insect biomass decline “remains obvious, and levels remain low as they have been for the past 5-10 years,” Janzen says.

Declines driven by deepening systemic problems

In identifying the sources of declines, researchers pointed to the same drivers as last year: climate change, habitat destruction, pesticides and human overpopulation — with habitat loss the most cited in temperate regions, and climate change of highest concern among those working in the tropics.

“Obviously,” says Janzen, “if you nuke a [forest] area for palm oil, beef, soy, peanuts, rice, [or] urban sprawl, the insect diversity and biomass will crash... A sugar cane field contains not 1% of what was there before. Same for a soccer field.”

But that doesn't mean pristine or protected habitats are immune, either.

The “overall depressant is obviously the combination of climate change impacts (no research is needed to know that) and millions of tiny small site point source perturbations [occurring] simultaneously,” Janzen wrote via email. “It is shooting someone with a BB gun 1,000 times while they are on a COVID respirator. They will not do well.”

In this analogy, of course, smaller, but innumerable — often intense — human impacts are the BB gun, while all-encompassing global climate change is COVID-19. Bradford Lister, a biologist at Rensselaer Polytechnic Institute, says research demonstrating the impact of a rapidly warming planet on insect abundance has only been “strengthened” in recent years;

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he pointed to a number of studies showing how heat can harm insect sperm.

Global warming may not only be impacting insects in the tropics, Lister adds, citing a study published this year in *Science* which found that climate change may be contributing to bee declines in the U.S. and Europe.

Seesawing media coverage, and new U.S. science

While the past year saw increasing coverage of insect decline, including a cover story in *National Geographic*, it also saw a number of scientists raising concerns about the apocalyptic nature of some of that reporting.

“The issue is not a simple one: generalizations about the state of all insect populations globally are a distraction and can hinder public and political action,” says Manu Saunders, a professor at the University of New England in Australia. Saunders was the lead author on a paper in *Bioscience* that criticized some of the over-the-top coverage of what has been popularly dubbed the “insect apocalypse,” reportage that she believes promoted “an exaggerated and unlikely narrative.”

Saunders adds: “I am very concerned about the continuing threats insects, and all biodiversity, face. Insects generally are at risk from multiple threats that are directly and indirectly a result of human activities,” but “there is no silver bullet. If we want effective evidence-based action to reduce extinction risk, we need to do a lot more than just quantify species declines or argue about global trends and predictions based on limited data.”

Other coverage, in other media outlets, however, swung the other way: even claiming that declines simply aren’t happening. One such story, published in the libertarian magazine, *Reason*, declared: *The Insect Apocalypse Has Been Cancelled*.

The article, which was somewhat more serious than the title, was based on a recent study finding that overall populations of U.S. insects were generally stable across 68 sites, though the research also found some species to be decreasing. The scientists theorized that widespread declines may not be occurring in the U.S. as in Europe, because of lower human population density. They called their study “reassuring,” but others caution as to how such research is perceived.

“I am concerned with how new studies of insect trends are framing their findings as ‘disproving’ the insect apocalypse narrative,” Oregon State

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University’s Wepprich wrote via email, pointing to how the U.S. study was presented by the University of Georgia in a press release and reported by *Reason* and other media. “We should probably just agree to stop using apocalyptic terms to describe our findings, whether positive or negative!” he urged.

Recent research published on U.S. insects presents a more nuanced, but still worrying picture. Wepprich himself published a study last year that found butterflies in Ohio to be declining by about 2% per year — a pretty massive decline. Another study, published this year, found that 94% of wild bee interactions with native plants have been lost in New England. Another paper found that grasshopper abundance had fallen by 30% in a protected Kansas grassland over 20 years. While insects in the U.S. might be faring better than in Europe overall, many vital pollinators and other vulnerable species are struggling, or vanishing at alarming rates.

Martins says that the differing media responses and seemingly conflicting scientific findings to the crisis aren’t unexpected, given the massive diversity of insect species, their varying lifestyles, habitats and the complexity of impacts. While some insects being in serious trouble comes as no surprise in our increasingly fragmented, pesticide saturated and warmer world, the scientist suggests that other species may be able to take advantage of local conditions and thrive.

“Insects are very good at adapting and there are definitely a lot of opportunists who are winning in the climate change casino, as I call it, that we’ve built. A good example are the desert locusts who have appeared in East Africa [this year] for the first time in a long time.”

But overall, he said, the trend is one of loss.

“There is no new diversity that we’ve created through our impact on the world that is actually able to replace or even match a fraction of the diversity that we’re losing.”

The future of insects

Clearly, the intensifying focus over the last year on insect loss — all the new research and attempts to measure if, where, or how big the declines may be — is useful to defining a biodiversity crisis that until recently flew largely beneath the radar. But Janzen says we don’t need more research. We know insects are in trouble, he asserts, just as all biodiversity is, and we know what’s causing it (i.e. climate change, habitat destruction, pesticides, etc.). What is needed is action.

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“Vastly more important [than more research] is that we put everything into working to ensure that the insatiable human animal does not eat the final dregs of what is left of once massive tropical biodiversity, and more so, is willing to welcome [that diversity] as a productive and useful portion of the human global garden,” says Janzen. “Real insect conservation would mean conserving large whole ecosystems both from the point source attacks, AND the overall blanket of climate change and six billion more people on the planet than there should be.”

There is some political movement, some hope, if largely regional to date. Hans de Kroon, a professor at Radboud University Nijmegen in the Netherlands, attributes the science and reporting on insect decline on the continent for helping to catalyze the European Green New Deal, which was supported by the EU Parliament in January, Poland withstanding.

On the other hand, most sources say they have seen no evidence of growing awareness — or of action — among leaders or the public. Saunders noted that in Australia, the massive, climate-change driven biome-devastating fires last year have led to some discussion over wildlife recovery efforts, but none of those talks are focused on insects.

Since June 2019 the world has changed irrevocably. The COVID-19 pandemic has already led to the deaths of more than a million people, further exposed deep cracks in the global economy, and tested the limits and adaptability of governments everywhere, some proving wiser and more resilient than others. Whether or not the novel coronavirus, likely kickstarted by deforestation and the wildlife trade in China, will ignite a real conversation about our ever-destructive relationship with nature, and lead to a global conservation effort, remains to be seen.

“If you ask me, one of the things that has changed over the past year, is I’m not

as pessimistic... as we’re learning from the greater lessons coming out of the pandemic that nature is incredibly resilient,” concludes Martins. “She a tough old lady she will make it if we just give her a chance.”

news.mongabay.com, 11 November 2020

<https://www.news.mongabay.com>

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Arthritis drug can reduce mortality rate in Covid-19 patients by 71%: Study

2020-11-15

With almost a year since the coronavirus (Covid-19) disease was declared a pandemic, the viral disease continues to wreak havoc across the world. There is still very less we know about the disease and the researchers are working day and night to gather more and more information about the viral disease and its cure.

In a major win against the Covid-19 researchers have identified that an Arthritis drug can help in reducing the mortality rate in elderly people by 71%. As per the findings, a daily pill of baricitinib along with standard care can reduce the deaths by 71% in Covid-19 patients with moderate or severe infection.

The drug is marketed under the name Olumiant and is available for rheumatoid arthritis for only three years now.

The latest findings can be encouraging for medics as they are hoping the arthritis drug could help save most vulnerable to coronavirus that are elderly people.

The research is led by the researchers in Karolinska Institute in Sweden.

As many as 53,945,763 people have been infected by the Covid-19 across the world. Most of the fresh cases were reported from the United States and Europe. While 1,311,427 others have succumbed to the disease.

Meanwhile, on vaccine front, US-based pharmaceutical company recently announced that the vaccine, it is developing in joint cooperation with Germany’s BioNTech is 90% effective in preventing infections in the ongoing Phase 3 trials.

The findings were based on an interim analysis conducted after 94 participants contracted the illness. The trial will continue until 164 cases have occurred. The preliminary results pave the way for the companies to seek an emergency-use authorization from regulators if further research shows the shot is also safe.

hindustantimes.com, 15 November 2020

<https://www.hindustantimes.com>

This marks the first time Japan has set a date for becoming carbon neutral—it is the same date set by the European Union.

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Japan's prime minister declares 2050 goal for carbon neutrality in Japan

2020-11-11

Japan's Prime Minister announced on October 26 that Japan has set a goal to become carbon neutral by 2050, according to CNN.

Yoshihide Suga, who took office in September, stated his administration will put "maximum effort" into making Japan more environmentally friendly.

This marks the first time Japan has set a date for becoming carbon neutral—it is the same date set by the European Union.

"We need to change our thinking to the view that taking assertive measures against climate change will lead to changes in industrial structure and the economy that will bring about great growth," said Suga.

Japan is the fifth biggest emitter of carbon dioxide in the world, with a total of 1.36 billion tons of greenhouse gases emitted in 2018.

eponline.com, 11 November 2020

<https://www.eponline.com>

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Guttural toads shrank by a third after just 100 years on two islands

2020-11-19

On two islands in the Indian Ocean, the toads just aren't what they used to be. Less than a century after their introduction by humans, the islands' toads have shrunk in size by about a third.

The finding, reported online November 18 in *Biology Letters*, potentially illustrates that "island dwarfism," where animals evolve to be much smaller after settling on an island, can occur over very short timescales.

"When you imagine insular dwarfism, you imagine this happening over thousands or millions of years," says James Baxter-Gilbert, an invasion biologist at Stellenbosch University in South Africa. "But this [research] has the potential to show it happening in four orders of magnitude shorter timeframe, which is super exciting."

Guttural toads (*Sclerophrys gutturalis*) are native to much of the eastern half of sub-Saharan Africa. Humans brought the toads to Mauritius — an island east of Madagascar, roughly 2,000 kilometers from mainland Africa — in 1922 to devour cane beetles. Just five years later, toads from Mauritius were brought to the nearby island of Réunion to control mosquito populations.

Bottom of Form

Baxter-Gilbert was fascinated by how those deliberate introductions might have influenced the toads' evolution and biology. Thanks to previous work on the toads' genetics, it was clear that the island toads' likely progenitors were from Durban, South Africa.

"We know the [genetic] blueprint that they came with," he says. "We can kind of see how they have changed from that original blueprint."

From June 2019 to March 2020, Baxter-Gilbert and colleagues caught nearly 500 toads from Mauritius, Réunion and Durban. The team noted the sex of each toad and measured body length plus different dimensions of the jaw, legs and feet.

Island toads were quite a bit smaller than the roughly 7-centimeter-long toads in Durban. Female toads measured on average about 34 percent shorter on Mauritius and 26 percent shorter on Réunion. Male Mauritius toads were about 22 percent shorter, while male Réunion toads were about the same size as their mainland counterparts. Both sexes of island

Island toads were quite a bit smaller than the roughly 7-centimeter-long toads in Durban.

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toads had legs and feet that not only were shorter than Durban toads', but also disproportionately stumpy for their already reduced body size.

Both the fossil record and recent natural history are full of examples of island dwarfs, ranging from Ice Age mammoths to hippos on the island of Crete to dinosaurs (SN: 11/10/04). Such shrinking may be the result of less available food on an island, making smaller bodies more advantageous. The reduction could also be an evolutionary response to a lack of predators.

"In the case of [dwarf] elephants, they have the luxury to evolve miniature size when no lions and tigers are on the hunt for their calves," says Alexandra van der Geer, a paleontologist at the Naturalis Biodiversity Center in Leiden, Netherlands, who was not involved with this research. "Why would this not apply to frogs?" she says. On the mainland, being larger may be more useful in dissuading the toads' predators, she says. Those predators can include snakes and birds.

The new study's findings provide a fresh look at some of the early stages of this downsizing and how quickly it occurs. Major body size changes to other island dwarfs might have also occurred soon after the animals arrived on islands, and just persisted over millennia, Baxter-Gilbert says.

The island toads' short legs may have arisen because there's little pressure on tiny islands to move into new territory quickly to beat competing toads to an area of rich resources, unlike what cane toads invading Australia are experiencing. Those dinner plate-sized toads are evolving into forms that can travel efficiently over long distances across Australia's giant landmass (SN: 10/14/14).

"If you're a toad on an island and there's nowhere to disperse to, then you don't need to invest energy into getting these long gangly legs that let you jump straight for days on end, because there's nowhere to go," Baxter-Gilbert says.

Baxter-Gilbert acknowledges that the shrinking may not be due to natural selection and could instead be a consequence of the toads having the developmental flexibility to respond to a quirk of their island environment. Another possibility is the toads are smaller due to a dietary deficiency, or maybe the climate isn't quite right for the toads to reach full size.

He wants to raise some island toads on the African mainland with their Durban counterparts in a "common garden" experiment. This could help determine if diet, temperature or some other environmental condition on

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the two islands, rather than rapid evolution, could be behind the toads' diminutive size.

sciencenews.org, 19 November 2020

<https://www.sciencenews.org>

China set to bring back first rocks from the Moon in more than 40 years

2020-11-19

On Earth, deep time is an open book. By measuring trace radioactive compounds in rocks that decay with metronomic regularity, dating experts have learned when oceans opened, volcanoes erupted, and mass extinctions struck. But the story is muddled elsewhere in the Solar System because records are sparse. Scientists estimate ages on the Moon and the rocky planets from the number of craters that pock their surfaces. They have fixed dates from just nine places, all on the Moon: the six Apollo and three Soviet Luna sites from which samples were returned to laboratories on Earth.

China's Chang'e-5 mission, set to launch on 24 November, aims to make it 10, by returning the first Moon rocks since the last Luna mission in 1976. Getting a firm date from another location will improve the shaky crater counting scheme, says Kentaro Terada, a cosmochemist at Osaka University. It will also sharpen the picture of the Moon's history. A fresh sample date "is the most important and exciting new finding [that will come] from the Chang'e-5 samples," Terada says. Getting it will require a tour-de-force, round-trip space flight that has not been attempted for more than 40 years.

Chang'e-5's target is Mons Rümker, a 70-kilometer-wide volcanic mound on the Moon's near side, which may have erupted as recently as about 1.3 billion years ago. It is "the youngest mare basalt on the Moon," says Xiao Long, a planetary geoscientist at the China University of Geosciences, referring to the dark lava also seen in the Moon's maria, or seas. Brett Denevi, a planetary geologist at Johns Hopkins University's Applied Physics Laboratory and science chair of a NASA lunar analysis group, says China has picked a spot where it can have a big scientific impact. "Understanding the age of those samples and all of the Solar System-wide implications that flow from that result will be a big leap forward for planetary science," she says.

Top of Form

Getting it will require a tour-de-force, round-trip space flight that has not been attempted for more than 40 years.

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Bottom of Form

The crater counting method for determining age relies on the notion that surfaces scarred with fewer craters are younger than those that have accumulated more. Regions dated with Apollo and Luna samples have helped calibrate the method. But except for one young outlier, all of those dates cluster between 3.2 billion and 3.9 billion years, leaving the method unanchored, and highly uncertain, for surfaces younger than 3 billion years old, Terada says. “Chang’e-5 samples will provide another data point,” he says.

Getting a firm date for Mons Rümker will also shed light on how lunar volcanism changed over time. Evidence suggests numerous eruptions in the first billion years of the Moon’s existence blanketed the surface with volcanic basalts, forming the dark maria, before tapering off about 3 billion years ago. If Mons Rümker material proves to be just 1.3 billion years old, it will raise questions about how the interior of a small planetary body remained hot enough to erupt so long after formation, says Romain Tartese, a planetary scientist at the University of Manchester.

Retrieving the samples will require a complex deep-space ballet. After launch from the Wenchang launch center in southern China, Chang’e-5 will arrive at the Moon about 3 days later, where an orbiter will release a lander. Over the course of 14 days, the lander’s robotic arm will scoop up surface samples and a drill will retrieve cores down to 2 meters. Scientists are hoping for 2 kilograms of material. (NASA’s Apollo program brought back more than 380 kilograms; three Soviet robotic Luna missions returned 301 grams.) An ascent vehicle will ferry the samples to the orbiter, where they will be packed into a re-entry capsule for return to Earth and a touchdown in the grasslands of Inner Mongolia. Xiao says international investigators will have access to the samples, but U.S. scientists may not because of limits on cooperation with China set by the U.S. Congress.

Chang’e-5 is the latest in a set of increasingly ambitious Moon missions from the China National Space Administration, all named after Chang’e, a Chinese Moon goddess. A pair of orbiters, launched in 2007 and 2010, focused on mapping and remote observations. The lander-rover Chang’e-3 mission, in 2013, carried the first ground-penetrating radar to the lunar surface. In 2019, Chang’e-4, another lander-rover, was the first spacecraft to soft-land on the far side of the Moon. Three more Chang’e missions and a robotic scientific research station are planned by 2035.

Results from Chang’e-4, still trundling along after having traveled nearly 600 meters, are raising questions for later missions. The craft landed in

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the South Pole–Aitken basin, the Moon’s largest, deepest, and oldest impact crater, at perhaps 4 billion years. Scientists have calculated that the impacting body likely burrowed 70 kilometers into the Moon and churned material from the mantle up to the surface. In a study published in 2019 in *Nature*, one group of Chinese scientists said the rover’s instruments had detected mantle minerals, but other groups, including Xiao’s, have challenged that interpretation. Patrick Pinet, a planetary geophysicist at France’s Astrophysics and Planetology Research Institute, says researchers are debating why such an enormous impact apparently did not exhume mantle material—or whether the mantle composition is somehow unexpected.

Zou Yongliao, a geochemist at the Chinese Academy of Sciences’s National Space Science Center, says China is making the South Pole the focus of its near-term lunar plans. And although the target site has not been revealed for Chang’e-6, another sample return mission, planetary scientists are rooting for South Pole–Aitken. A basin sample would provide clues to the mantle puzzle. It would also anchor the older end of the crater-counting curve, says Carolyn van der Bogert, a planetary geologist at the University of Münster, and “illuminate the early history of the Moon.”

[sciencemag.org](https://www.sciencemag.org), 19 November 2020

<https://www.sciencemag.org>

Bug bites: Edible insect production ramps up quickly in Madagascar

2020-11-19

Two years ago, the villagers of Ambodifohara on the Masoala Peninsula in northeastern Madagascar knew nothing about sakondry, a small hopping insect, except that it was tasty. Locals would collect it when they came across it, and that was that. A chance forest snack. Fast-forward to late 2020, and the insect is now a staple. “We eat sakondry regularly, almost every day during high season,” says BeNoel Razafindrapaoly, a resident.

This change of status is the outcome of the Sakondry program, which Cortni Borgerson, an anthropologist at Montclair State University in New Jersey, developed in collaboration with the IUCN Save Our Species initiative. The idea was to see whether farming the insect, and therefore increasing its consumption, could halt biodiversity loss and reduce malnutrition.

Fast-forward to late 2020, and the insect is now a staple.

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“When you ask people why they are hunting [lemurs], the number one reason is: ‘it’s there and it’s easy to catch,’” Borgerson says. “If you just tell people not to hunt something, you increase food insecurity.”

To get people to stop hunting lemurs, Borgerson says they needed to find a replacement that fills the same cultural role as lemur meat. “Sakondry does just that. Both sakondry and lemurs are wild ‘natural’ foods, which are fatty, clean, cheap, peak in availability during seasons of low food security, and are traditionally eaten and tied to local identity.”

Borgerson says that the idea of farming sakondry (*Zanna tenebrosa*) came from the villagers themselves. “When we asked what meats were available in the diet and what they preferred, one of the foods that came up regularly was sakondry. We just had to figure out a way to increase its availability,” she says.

The program encouraged villagers in six communities to cultivate sakondry’s host plant, a native bean called tsidimy (*Phaseolus lunatus*), to attract the insect. The residents of Ambodifohara now cultivate tsidimy on about 2 hectares (5 acres) of land. Each community managed to raise more than 90,000 harvest-size sakondry this year. That added about 450,000 kilocalories and 35,000 grams of protein to their diets, enough to both replace the meat and exceed the nutritional value of hunted lemurs, according to Borgerson.

The program took a steep learning curve: little was known about the insect’s life cycle, so Borgerson and her team first had to learn to distinguish males from females and adults from juveniles, and to spot laying females, all essential for sustainable harvesting. Growing tsidimy has also presented challenges. “In the village, chickens eat tsidimy seedlings. Children also play with them and destroy them. In the forest, snails eat the young plants,” says Razafindrapaoly, Sakondry’s project manager.

Hiccups aside, cultivating the bean and rearing the insects has been straightforward, which explains why virtually every household in the village has taken part. Importantly, the most active hunters halved their annual hunting totals, saving between 25 and 50 lemurs per community each year, according to Borgerson. They have also become the most enthusiastic sakondryfarmers. “With sakondry, we gave people something that was easier than the original activity,” Borgerson says, referring to hunting.

Jeanne Mathilde Randriamanetsy, another villager, says that “people are no longer inclined to hunt wild animals. They’re increasingly concerned about

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protecting the environment.” As the gateway to Masoala National Park, Ambodifohara welcomes a few thousand tourists every year, so people are very aware of the economic potential of their forests. Until the pandemic halted tourism, locals had even started selling sakondry kebabs to visitors. They are exploring opportunities to sell the insects in Maroantsetra, the largest town in the region, four hours away by motorized canoe.

Borgerson cautions, however, that “it’s not as simple as ‘eat insects stop eating lemurs’ because robust food systems depend on diversity. Sakondry is just one part of creating the sustainable food system that is needed to end lemur hunting.”

Despite its delectable bacon-like flavor when fried, sakondry also tends not to be a straight meat replacement. “We eat it like snacks, we don’t eat it with rice,” says Razafindrapaoly, referring to Madagascar’s ubiquitous staple grain. Randriamanetsy agrees. “Sakondry doesn’t quite replace meat. Meat is tastier.”

The popularity of the insect as food is undeniable, however, and three more neighboring communities have already started planting tsidimy too. Thanks to the farming model piloted by the Sakondry program, Borgerson reckons that remote communities could now have an established insect population within three months, a boon anytime, but especially during disrupted food supply chains caused by the COVID-19 pandemic.

She is now planning to roll out the Sakondry program in appropriate locations across Madagascar. “It would be ideal for areas with the highest biodiversity combined with the lowest food security,” she says. She is currently researching how to adapt what is working in the rainforests of the northeast to the kaleidoscope of habitats in Madagascar. There are many *Zanna* species in the country, so she is trying to identify the best host plants and ecosystems to replicate their farming model. “Our hope is that if we can remove some of the barriers such as lack of seed stock or lack of knowledge of production, then it becomes a viable option.”

Borgerson is setting up supply chains to provide the initial tsidimy seed stock for new communities. As for the knowledge gap, she has devised an unusual manual: a deck of playing cards. The Malagasy are enthusiastic card players, and having lived in Madagascar for the best part of 15 years, Borgerson knew that any other paper support would end up being used for alternative purposes, whereas cards would be cherished and shared. The decks, which include everything from how to care for tsidimy seedlings (the No. 9 card) to sakondry’s nutritional composition (the No. 4

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card), illustrations of the female (Queen), male (King) and eggs (Ace), will be ready in December this year.

The Sakondry program is not the only initiative in Madagascar looking at the role of insects in conservation. In Antananarivo, Madagascar's capital, Valala Farms rears crickets and grinds them into a powder for use as a nutritional supplement for vulnerable populations. The farm is about to expand significantly: it has just broken ground on a new 3,000-square-meter (32,000-square-foot) facility, a significant upgrade from its existing 100-square-meter (1,100-square-foot) premises.

One important byproduct of cricket farming is frass, or cricket manure, a powerful fertilizer. Although frass is available commercially in North America as a garden fertilizer, it has never been used in Madagascar before. Valala Farms is therefore running trials to test its efficacy on many types of crops (vegetable, fruit trees, ornamental plants, etc.) as well as in reforestation.

Madagascar has lost as much as 90% of its original forest cover, yet restoration of native forests has a poor track record. "Compared to South America, restoration has yet to be demonstrated successfully at scale in Madagascar," says Chris Birkinshaw, a researcher at Missouri Botanical Garden (MBG) who is overseeing restoration trials at four locations in Madagascar. "In some sites, one of the issues is the critically poor nutrient composition of the soil and when we tried to plant native tree species, they did very badly. Frass is just one of these experiments to see whether it can do better."

Early results are encouraging: six native tree species planted on plots with frass grew between two and eight times as well as the same species with no frass, and the results were best on the plots with the least added frass. "This begs the question of how low we could go. Frass is a bulky item, hence why we're particularly interested in how it could be used in low concentrations," Birkinshaw says. The trial has only been running for six months, however, and Birkinshaw says the 12-month results will give a more comprehensive picture.

Back in the food department, farmed insects could help solve the same protein problem that the semi-wild sakondry addressed. Pound for pound, insects require less land, water and feed than other meats. They also produce fewer greenhouse gases. In a country where protein is in short supply, this makes insect farming an attractive, sustainable option. Brian Fisher, an entomologist at the California Academy of Sciences and one of Valala Farms' founders, says the farm has been contacted by a number of

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conservation organizations in Madagascar interested in setting up cricket farms in their areas of operation to help curb consumption of bushmeat like lemurs and turtles and to stem deforestation for agricultural land.

Fisher, who's collaborated with Borgerson, is keen, but says he wants to do things right. First, native insect species would have to be found for each region to ensure farming is sustainable. Valala Farms' highland cricket could not withstand the harsh heat of the south without air-conditioning, which would make farming prohibitively expensive. Second, Antananarivo's crickets feed on corn. This was necessary to standardize production, but it's not sustainable. Fisher says there needs to be a feed source for the insects that is free and does not compete with human food supplies. That is: waste, most likely agricultural.

"We should approach things differently," Fisher says. "You go into an area, figure out what waste is available and then you choose the insect that will thrive on that. Sometimes it will be a beetle, sometimes a fly larvae, sometimes a cricket, and then you tailor how you use the insect: if it's a fly larvae you use it for animal feed [chickens, pigs, aquaculture], if it's a beetle or a cricket, you use it for food."

Fisher acknowledges that this approach will take much longer—it might take two years to find a suitable solution for each region of Madagascar—but he is sanguine about the approach. "There are so many exciting potential sources of waste that we know something will work."

[news.mongabay.com](https://www.news.mongabay.com), 19 November 2020

<https://www.news.mongabay.com>

The next Covid dilemma: How to make buildings breathe better

2020-11-09

CLAMBERING AROUND THE ceiling of a big-box store, Jeff Siegel, a mechanical engineer at the University of Toronto, had no idea that he was looking at the post-pandemic future of air-conditioning systems. Siegel studies indoor air quality, and he and his colleagues were testing the air in the store—he wouldn't say which one. This is the possibly grim future part: While they were up there, they found that one of the six HVAC units (that's heating, ventilation, and air-conditioning) was installed exactly upside down. Like, 180 degrees from spec. "The door that was used to access the filter couldn't be fully opened, and the filter couldn't be replaced," Siegel says.

"The best HVAC in the world performs poorly when it's not well maintained, and the usual standard is 'not well maintained,'" Siegel says.

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When the team went back six months later to test again, “the filter was entirely plugged with dust and other stuff. There was literally no way to change it without a Sawzall to cut the frame,” Siegel says. At the time, Siegel knew what that meant. The air inside the store would be that much crummier. It was, in a way, just like a thousand other HVAC mistakes Siegel has seen: dampers that are supposed to admit outside air into a building rusted open or shut, badly installed filters letting air pass around their edges, forced-air fans running barely 18 percent of the time. In theory, HVAC heats and air-conditions. In practice, it doesn’t always ventilate or filter.

But now that scientists around the world largely agree that the pandemic virus SARS-CoV-2—like a lot of other respiratory viruses—transmits most easily indoors, in crowded and poorly ventilated spaces, that occasional, multipronged failure signifies a much more serious problem. As the number of people infected with Covid-19 in the US breaks records, and cooped-up kids and suffering business owners agitate for a life slightly more normal, the once boring ventilation and filter systems in the guts of homes, schools, offices, and factories have become a focus of debate. People know that if they want to go back inside those buildings—even while masked and 6 feet away from each other—something has to vent potentially virus-infused air. That means a renewed interest in HVAC, and possibly a new future for an often-overlooked field of science. Maybe. “The best HVAC in the world performs poorly when it’s not well maintained, and the usual standard is ‘not well maintained,’” Siegel says. “What we’re seeing now in the pandemic is that people want HVAC to help us, and it’s like, wait a second—you’ve systematically underinvested and not done the kinds of things you should do to have a well-functioning system.”

On the other hand, that might mean a new future for ventilation is emerging, and along with it a new way of seeing the future of building design and engineering—because trying to Covid-proof a home or office might make it better in all sorts of other ways, too.

SARS-CoV-2 is a respiratory coronavirus that almost certainly has among its modes of transmission the ability to move almost like a vapor, in invisible bubbles of snot and spit or dessicated protein that waft on air currents, emitted by people showing no symptoms of illness. Transmission is most common indoors, where the air doesn’t exchange as often as it does outside. So one of the biggest ideas for decreasing transmission but still letting people go back to school and work safely—not to mention places like restaurants, theaters, and bookstores—is ventilation: getting potentially infectious viral particles in the air out, and clean air in. “Those

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of us in this field have been arguing for decades that we need to pay attention to the indoor environment, and we’re thrilled people are recognizing it’s important. But how to get from here to there will take an infusion of investment,” says Shelly Miller, a mechanical engineer at the University of Colorado Boulder who studies indoor air. “We view outside air and water as shared goods. This is something everybody shares. I don’t really see why it would be any different from the air in a building, because lots of people share the air in the building. We just haven’t looked at it that way.”

The basics of the technology are already there, deployed in specialized environments like hospitals. It’s really the idea of equivalent air changes, or clean air delivery that is the sum of the outdoor air delivered to spaces to dilute contaminants and particulates, filtered air, and disinfected air, says William Bahnfleth, an architectural engineer at Penn State and chair of the Epidemic Task Force of the American Society of Heating, Refrigeration, and Air-conditioning Engineers, or ASHRAE, a standards-setting organization for the field. He and everyone else who works on indoor air has suddenly become very popular as the coronavirus’s airborne ways have become clearer. Everyone wants to shore up their buildings’ defenses.

One way to do that is to increase a metric called the air exchange rate—how often new air from outside replaces old air inside. A basic approach: Open lots of windows. But that only works if they’re there—and if the air outside isn’t even worse, like during a wildfire. A second angle is cleaning the air that’s already inside with a high-grade filter, either built into the central air system or with a stand-alone unit—mounted on a wall or in a portable air purifier anyone can buy (or even make). High-efficiency particulate air (HEPA) filters are probably too expensive and require too much energy to expect their use in typical HVAC systems, Bahnfleth says; that’s why so much advice now focuses on filters with a “minimum-efficiency reporting value” (MERV) of 13. They’re plenty good enough for Covid-capturing.

That makes it sound easy, and it isn’t. Even if your home has central air—and many don’t—the system probably doesn’t replace the air once per hour, much less six times, as some of the new virus-oriented recommendations call for in other indoor spaces. Moving more air calls for bigger fans that run more often. And bigger filters can create something called pressure drop inside a system, slowing down the air throughout. It takes bigger fans to overcome that, too. And the main point of an HVAC system is making all that air comfortable, raising or lowering its

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temperature. All those things increase costs and the amount of energy the system uses.

A third option is some kind of device, either in the ducts or in rooms, that actually removes microorganisms. Ultraviolet light can blow apart viruses' genetic material, and at a wavelength of 254 nanometers—that's so-called UV-C—it can kill germs. Even shorter wavelength "far UV-C" can kill coronaviruses. But nobody's exactly sure about the best dosages and placement to deal with airborne viral particles. Bipolar ionizing filters and hydroxyl generators put chemically reactive or electrically charged particles into the air, but careful, rigorous studies of their effectiveness don't exist yet.

None of that has stopped all those options from becoming very popular. "It's a total Wild West of a marketplace for technologies that purport to clean the air or kill coronavirus. People are flocking to them because they're really low cost, but don't introduce additional pressure drop like a filter might. So you don't have to retune or redesign the HVAC system," says Brent Stephens, an architectural engineer and indoor air quality researcher at the Illinois Institute of Technology. "But a lot of that stuff is not well tested and not well regulated for effectiveness."

Another approach, maybe even more expensive, might be to rethink—or more accurately, re-rethink—how people design buildings overall. Arguably, the history of architecture is the history of finding new ways to deal with uncomfortable climates. The shotgun houses of the American south were designed for front-to-back airflow in humid summers; the high ceilings people favored closer to the equator let hotter air rise out of the living space while the lower, closer confines of northern buildings keep that heat in. Thicker walls and interior courtyards are cooling, while fireplaces in every room provide local control over heat when fuel is expensive.

That history has a semi-secret undercurrent. Buildings, especially in the modern era (and the modernist tradition) have been designed with health in mind. At least as early as the 1860s, a physician lectured on the dangers of "man's own breath" and a lack of ventilation as being somehow responsible for the spread of disease. The foundational story of public health—the London physician John Snow tracing a cholera outbreak to public water pumps—is a story of geography and urban planning. And a newer thread of research traces the large-windowed, airy, smooth style of early modernism to hospitals built to help people recover from tuberculosis and the Spanish flu of 1918—airborne diseases that

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prefigured Covid-19. By the early 1920s, scientists understood that people who lived in high-quality housing had lower rates of respiratory and gastrointestinal diseases than those who lived in tenements, a conclusion that led to more spacious and well-ventilated housing, but also to racially motivated "slum clearance" under the guise of the sanitation.

In the 1920s and 1930s, "modernism developed in the context of the flu and health concerns, and with the ambition to be a modernizing, socially beneficial force," says Daniel Barber, an architectural and environmental historian at the University of Pennsylvania and author of *Modern Architecture and Climate: Design Before Air Conditioning*. "The capacity for a building to render a space more healthy than the neo-Baroque structure next to it, for example, was one of the selling points and reasons that modernism is appealing to its client base."

Then, around the middle of the 20th century, came air conditioning. "HVAC was available, and mechanical systems could manage the climate of a building so the architect didn't have to worry about it," Barber says. In a way, that was liberating—the climate no longer had the power to literally shape the building, and architects could do crazy postmodern stuff. They'd let the engineers take responsibility for all the machinery to keep the inside of the building warm or cool. "The culture of architecture today doesn't even think about air-conditioning. It's just not a factor. It's a given," Barber says.

The result: nearly-airtight buildings filled with synthetic materials, with windows that sometimes don't open, and high levels of recirculated, often unfiltered air. Even that's not consistent, because building codes tend to ask for just minimum adherence to standards. So some buildings are better than others, and some legitimately make people sick. Add that to the general inability of US cities to build enough housing—forcing people to live in crowded conditions—and you have a country of petri dishes with bad air, even before Covid-19 and increasingly stringent (and necessary) energy efficiency requirements. "We treat our water so we don't get sick. We process our waste so it doesn't transmit disease. And then we basically stopped, and haven't done much for the health of our urban society—where we spend 90 percent of our time indoors," Miller says. "We focused a lot on outdoor pollution because in the 1950s we realized outdoor air pollution kills people. We started to control emissions and put controls on cars and power plants and industry. But we've left the indoor environment to the purview of the owner or renter or occupant and said, 'That's your personal domain, do what you want.'"

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Fixing all that will require more than just new air purifiers. Like so many other problems revealed by the Covid-19 pandemic, the way people think about air in buildings needs fundamental changes. Even seemingly straightforward retrofits of existing HVAC systems won't be easy. Like, here's some HVAC nerdiness: In most standard air-conditioning systems, the rack designed to hold a filter is just 2 inches deep. But a MERV-13 filter, the one folks like Bahnfleth are recommending to capture viral particles, really has to be 4 inches thick to maintain its performance. Or you can use a 2-inch one manufactured to enhance its filtering abilities with an electrostatic charge. "But it wears off," Bahnfleth says. "You have to change them pretty often if you're going to keep them operating at that level." That gets back to the kinds of problems Siegel has seen with maintenance. And refitting for 4-inch-thick filters means increasing overall pressure drop, which means spending money to amp up the whole system.

Covid-related changes to ventilation systems will be complicated, perhaps, and almost certainly expensive, but they might not require new technology. They might need more power, and that'd be a bummer, because buildings are the biggest users of power in the US and are responsible for as much as 40 percent of greenhouse gas emissions, the cause of global climate change. Some officials, like in New York City, are already trying to put more stringent emission and energy efficiency standards on some commercial buildings. The global "passive house" movement advocates heavier insulation and other innovations to moderate indoor climate and air quality with less power—very much like the old pre-air-conditioning ideas, actually, but with fancier materials. "You build a house that's very well insulated, very tight, very good windows, and you hardly ever need to heat or cool it, but you're always bringing in outside air, filtering it, using a heat exchanger," says Miller. (That's a device that lets air at different temperatures trade heat without mixing—on a cold winter day, outside air pulled into the house gets warmed by indoor air exhausting out, saving the energy of heating it from scratch. It works vice versa too.) "The only issue they need to address is how to exhaust the kitchen emissions when you're cooking."

These kinds of systems-level changes might do much more than help deal with Covid-19. Before the pandemic, indoor air quality researchers were worried about all kinds of other issues. Airborne diseases like influenza were on their minds, of course, but so were even more insidious problems. Particle pollution and allergens can increase childhood asthma rates. Most people understand that carbon monoxide, a byproduct of incomplete combustion and sometimes faulty stoves and heaters, is dangerous

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enough to have warning alarms for. But even the carbon dioxide that all of us humans give off when we breathe can accumulate indoors, and if levels of it get too high it may actually slow us down cognitively. And it isn't the only gas in our poorly ventilated living and work spaces—human bodies give off all kinds of weird stuff, and not all of it's just the usual vaguely humorous, odorous gas. "Very few studies show an impact of CO₂ by itself. Many studies show no impact of CO₂ by itself," Siegel says. "But many studies across the board show an impact of reduced ventilation."

For now, though, the standards that end up in municipal codes for ventilation often come straight, or nearly straight, from recommendations made by groups like ASHRAE. And those, says Bahnfleth, are still sort of de minimis rather than extreme. The suggested rules for homes and offices don't even have the same philosophy as the suggestions for health care facilities, where you can imagine people really care about things like viruses. Home and office standards measure ventilation rates per person and per square foot, and they're more focused on the perception of air quality, on bad smells. Hospital standards focus on complete air exchanges and filtration of an entire room or building, and health care facilities may build in the equivalent of as many as 20 changes per hour in high-risk areas like operating rooms. "This air change concept really hasn't penetrated the current design standards for residential and commercial buildings, and it'll be interesting to see if that's the way to go," Bahnfleth says. "I would like to believe the experience we're having with Covid-19 is going to create the motivation to improve standards for non-health-care buildings to provide better health care control. But how far we'll go with that, I don't know."

The technology, then, isn't as tricky as the sociology and the politics. Legend says John Snow was able to remove the handle of a cholera-contaminated pump in London, rendering the pump unusable and arresting the epidemic; he might've had a much harder time if he'd tried to go into the homes of everyone with indoor plumbing to confiscate their water faucets.

More pragmatically, no one knows who'd pay for any of these changes. Landlords? A government fund? The incentives among government, building owners, and renters to make any of these changes aren't exactly in alignment. The people who might spend the money aren't necessarily the ones who'd accrue the direct benefits. It might be true that better ventilation and filtration could improve cognitive outcomes and affect, increase productivity, reduce absenteeism from illness—but those things are all good for the people who work in the office and rent the

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space, not the people who own the skyscraper and have to install a more powerful, more energy-efficient, more magical HVAC system. New rules that mandate those systems are great for the people who build, sell, and maintain them, and maybe not so great for the people who might be forced to buy them.

That said, the pitch is compelling: New systems to bring fresh air into buildings where people spend most of their time could beat back not only this pandemic, but maybe the next one too—while making people generally healthier and also fighting global warming. That's the change that's in the air.

wired.com, 9 November 2020

<https://www.wired.com>

Beyond the impossible: Lab-grown meat is better for the planet if you'll eat it

2020-11-18

Winston Churchill foresaw the biggest food innovation of the 21st century back in 1931: "We shall escape the absurdity of growing a whole chicken in order to eat the breast or wing, by growing these parts separately under a suitable medium."

Today that prospect nears, but is still so new it doesn't have a widely agreed-upon name: cultured meat, clean meat, lab-grown meat, cultivated meat or, by its detractors, test tube meat.

All those terms denote meat grown from animal cells, rather than from a living, sentient animal. I'll call it cultured meat, but regardless of name, it may start arriving at small scale in 2022 from companies such as Mosa Meat, Memphis Meats, Aleph Farms, and Meatable. It will be positioned as a more sustainable, environmentally friendly option for meat eaters. But who it will appeal to and at what price remains a different story.

More food, fewer resources

Meat production's footprint on natural resources is an accepted issue. The Food and Agriculture Organization of the United Nations says the livestock sector "is increasing pressure on ecosystems and natural resources" and "in some cases its impact on ecosystems is out of proportion with the economic significance of the sector." The FAO also estimates that 26% of the earth's land that isn't covered in ice is used for livestock grazing, and

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that 33% of all crop lands are used to grow crops to feed to livestock that are fed to people in a sort of nutritional bucket brigade.

Cultured meat doesn't require grazing land or tons of feed. Instead it's grown in bioreactors like those already used to produce pharmaceuticals and ethanol. A few animal cells are chosen for the type of meat desired, and placed on a biological scaffold to grow into the right shape and structure in a bioreactor that turbocharges cell growth from a speck to a serving.

In many ways, the process is old news: "We already grow animal cells at scale," says Ryan Bethencourt, co-founder of venture capital firm IndieBio, an early investor in cultured meat startup Memphis Meats. "All the big pharma companies essentially have big protein factories" for the development of biologic drugs, he says. The first cultured meat hamburger was unveiled (and eaten) in 2013.

But if the basic technology for growing cultured meat is relatively clear, how much energy will be required at scale is less so.

"Cultured meat production will likely require more industrial energy than do livestock to produce equivalent quantities of meat," says Alison Van Eenennaam, a cooperative extension specialist in the Department of Animal Science at the University of California, Davis, in a presentation to the 2019 Range Beef Cow Symposium.

A paper from Arizona State University, which is cited by both clean meat doubters and backers, suggests cultured meat "could require smaller quantities of agricultural inputs and land than livestock," but at a potentially higher energy demand. The reason? It doesn't use animals whose bodies provide temperature regulation, waste elimination and other functions that will have to be replaced by industrial equivalents. But the Good Food Institute, a leading connector of cultured meat innovators and investors, says that clean energy will develop alongside the cultured meat sector to "reduce the life cycle emissions of a clean meat facility by 40% to 80%."

Even if substantial energy is needed to produce clean meat, there could still be large environmental rewards. A 2018 paper by Hanna Tuomisto of University of Helsinki calculates a potentially large reduction in greenhouse gases with cultured meat compared to raising cows and sheep for meat.

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Traditional animal meat advocates counter that their production typically uses non-arable land as well as feed that isn't considered edible by humans. But the Good Food Institute claims that most of the crops that animals eat end up as 1.1 billion pounds of manure, exuding vast amounts of methane that the Environmental Defense Fund says is 84 times more potent than carbon dioxide.

Some of this may be settled over the next five years at University of California, Davis, one of the nation's foremost animal agriculture institutes that in September received a landmark \$3.5 million grant from the National Science Foundation to explore cultured meat. It will assess its nutrition, taste and texture, less expensive paths to scale, and life cycle analysis.

Far from the vast feedlots and poultry sheds are the oceans, where over 50% of stocks are being fished at full exploitation level and over 33% are being overfished, according to the most recent estimate by the UN FAO.

Shiok Meats in Singapore is focused on creating cultured shrimp meat due to its popularity in that region, while San Diego startup BlueNalu is planning production facilities about the size of a Target store that it believes can produce enough cultured seafood to meet the demand of a metro area with 10 million residents. San Francisco Bay Area startup Finless Foods is developing cultured bluefin tuna meat, an alt-seafood holy grail.

Whether cultured meat tech is creating fish or franks, the process revolves around five common aspects, creating a level of synergy that doesn't currently exist between land and water-based animal processors today.

Feeding more people who want more meat

The World Health Organization reports "a strong relationship between the level of income and the consumption of animal protein" as the world's population grows and urbanizes. This puts intense pressure on animals like the cow, which can be seen as an amazing machine for turning a lot of food into a little food.

Cultured meat advocates estimate it takes as much as 20 pounds of plant-based feed to create one pound of beef, though the cattle industry argues that number is a vast mischaracterization because it fails to credit the pounds of other outputs like leather, bone, manure and organs that the feed also underlies. Still, even the Beef Cattle Clearinghouse industry group estimates that a pound of red meat from a cow requires nearly 5

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pounds of corn feed. South Dakota State University estimates that only about 500 pounds of meat are derived from a 1,200 pound steer.

Viewed another way, Good Food Institute estimates that for every 25 to 30 calories fed to a cow, just one edible calorie of food energy is produced, resulting in a conversion rate of 3 to 4%.

"Feeding animal cells is far more efficient than feeding the whole animal because you're just growing the tissue that will end up being consumed," says Liz Specht, associate director of science and technology at the Good Food Institute. "There is still a conversion step, but the pragmatist in me looks at plant-based and cultured meat and sees both as orders of magnitude improvement over the conventional system."

Will it work in the grocery aisle?

The idea of cultured meat is still too new to accurately predict its eventual price, and using the plant-based meat sector popularized by Beyond Meat and Impossible Foods as a model is likely flawed, since they differ vastly in ingredients, process and era of market entry.

Traditional meat from slaughtered animals enjoys a centuries-long head start over cultured meat, as well as the perception of being natural, normal and necessary. It has had its cost driven down by scale, decades of industrial experience and, often, indirect government subsidies in the form of predator control programs, artificially low fees to graze animals on public lands, and a host of assistance programs that can cover unexpected costs incurred by businesses raising animals for meat.

Clean meat is also new tech, and will cost like it for years. Even established plant-based meats from Beyond and Impossible still cost more than their slaughtered competition. Cultured meat must achieve price parity or run the risk that its promised big picture benefits be hobbled by small market share.

"Cost is the hurdle," says Karl O'Donovan, global R&D director of food development company Kerry. "There's a great story here about sustainability and animal husbandry, but everything comes down to the cost. People will be willing to pay a premium, but there's a limit."

There's also the issue of getting buy-in from the general public. "Even if we solve all our technical hurdles and we start using these technologies for space exploration and vegans, I think there's still going to be a large portion of our population that will not participate," says Denneal Jamison-

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McClung, director of the University of California, Davis biotechnology program.

Cultured meat's biggest ace in the hole is that it is more sustainable -- an important proposition to Gen Z consumers -- but it's also still meat. Regardless of demographic wokeness trends, the USDA expects US meat consumption to increase between 2016 and 2025. Plant-based meats alone may not be able to flatten that curve amidst a vast number of consumers that still expect animal muscle at the center of their plate.

Is it food or is it tech?

If cultured meat succeeds, its story will be one for marketing textbooks, having walked a fine line between boasting about technology but not so much that it invokes an "ick" factor of sterility or banks too much on people being motivated by sustainability rather than their pocketbooks and palates.

"Even if you're thrilled about being able to get your bioreactor up and running, you need to really understand whether the guy down the street who doesn't know what you know about stem cells even wants to eat that," says UC Davis' Jamison-McClung.

"The cultured meat fraternity has come at it from a science perspective, as opposed to food being created using science and technology," says TC Chaterjee, CEO of food development company Griffith Foods. "And from the consumer's point of view, there is a difference."

Cultured meat isn't targeted at the vegan and vegetarian markets, since those people tend to have no interest in eating meat in the first place, says Kris Wadrop, General Manager of Biotechnology at Centre for Process Innovation in the UK. "The challenge is around the carnivores and flexitarians and whether they would shift or switch," he adds.

Another issue: Without a widely accepted name, these products could become branded as a "frankenmeat," says Kerry's O'Donovan. "If the major players could come up with a consumer-friendly name and all stick to it, it would be a huge help," he adds.

But CPI's Kris Wadrop argues "the name is already there: Beef. Chicken. Pork. They aren't trying to mimic them, they're actually recreating those products." Cultured meat fits neatly as a premium version of a traditional food, he adds, not unlike organic, free-range or GMO-free products.

Meat in the age of COVID-19

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Another name for cultured meat is "clean meat," a term that few of its advocates could have predicted the increased appeal of before 2020.

Meat from slaughter may look less appetizing as coronavirus-era consumers are increasingly aware it's largely the result of an antibiotic victory over the conditions in which it's produced. For many of us it's become second nature to reach for a bottle of disinfectant after handling raw meat.

The pandemic has also reminded us that slaughtered meat is the product of America's grisliest place to work. Cultured meat would be a 180-degree turn away from those perceptions and, if anything, risks coming across as almost too clean to people who are charmed by the illusion that their food comes from rustic ranches tended by homespun families in Pendleton shirts.

What's next for cultured meat

It reasons that cultured meat will find its first audience among consumers who are open to new things, favor innovation in the abstract, and want to be seen with the Tesla of food on their plate. The next wave might be reflected in a recent Gallup survey of people eating less meat that found that most were doing so for their own health, followed by concern about the environment, food safety, and then animal welfare.

In a major 2017 report on future products of biotechnology, the National Academies of Sciences, Engineering and Medicine identified cultured meat as "having high growth potential." While there are few products to compare it to and many challenges to widespread regulation and adoption, there are also well-established approaches to assessing its risk on the market.

Bottom of Form

Cultured meat will have to pass through the same fine sieve as all "next big things": Can it sustain investor and early adopter belief that it's truly a better option long enough to get to the point that it is? We've seen this happen in electronic technology many times, but food isn't a phone -- it comes with consumer traditions and lizard-brain reactions that don't always make sense.

"Most consumers really want to know three things: Does it taste good, is it safe to eat, and can I afford to buy it," says UC Davis' Jamison-McClung. "I prefer to take a really big tent approach and say that global nutrition and

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food security needs are so immense that there's probably room for the new things. There's definitely tension, but that makes it exciting."

But cultured meat could follow the same path as many other innovations.

"I don't see anything that would keep this technology from doing what technology always does," says Bethencourt, the investor. "Faster, cheaper, better."

cnet.com, 18 November 2020

<https://www.cnet.com>

Study offers "indisputable" link between Alzheimer's and gut microbiome

2020-11-15

Research into the relationship between the brain and the bacteria in our bellies is uncovering links to an increasing number of neurological conditions, with Alzheimer's among them. A new study is throwing further weight behind the theory that an imbalance in the gut microbiome may be related to the onset of the disease, showing how shifts in bacterial diversity are associated with inflammation and heightened numbers of amyloid plaques in the brain, one of the hallmarks of the condition.

The community of bacteria that lives in our gut has become the focus of much medical research of late, with scientists uncovering evidence that it can play a role in depression, autism, multiple sclerosis and heart disease, to name just a few examples. Likewise, connections have begun to emerge between the gut microbiome and Alzheimer's disease, with one 2017 study revealing decreases in microbiome diversity among those diagnosed with the condition.

Last year, Chinese authorities even approved a novel drug designed to treat the disease by modulating a person's gut microbiome that became the first Alzheimer's drug to reach the market in almost 20 years. Another recent study found that fecal transplants in mice can affect age-related cognitive decline by altering the gut microbiome.

The international team of scientists behind the new study claim that it has confirmed this correlation. Study author Giovanni Frisoni from the University Hospitals of Geneva has been investigating these links for several years and previously uncovered evidence of reduced microbiome diversity among Alzheimer's patients, and suspects that one of the flow-on effects of this, inflammation, may also have an important part to play.

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"Furthermore, we have also discovered an association between an inflammatory phenomenon detected in the blood, certain intestinal bacteria and Alzheimer's disease; hence the hypothesis that we wanted to test here: could inflammation in the blood be a mediator between the microbiota and the brain?" says Frisoni.

In search of answers to this question, the researchers used PET imaging to measure amyloid plaque buildup and inflammation markers in the blood of a cohort of 89 people, all between the ages of 65 and 85 and some with Alzheimer's or related conditions and some without.

The team was on the lookout for a couple of markers in particular. Lipopolysaccharides are endotoxins found in the membrane of pro-inflammatory bacteria and have also been spotted in amyloid plaques and vessels in the brains of Alzheimer's sufferers. Some short-chain fatty acids produced by the gut microbiota, meanwhile, can have a protective anti-inflammatory effect.

"Our results are indisputable: certain bacterial products of the intestinal microbiota are correlated with the quantity of amyloid plaques in the brain," explains Moira Marizzoni first author of the study. "Indeed, high blood levels of lipopolysaccharides and certain short-chain fatty acids (acetate and valerate) were associated with both large amyloid deposits in the brain. Conversely, high levels of another short-chain fatty acid, butyrate, were associated with less amyloid pathology."

While the scientists describe this as proof of the correlation between an altered composition of gut bacteria and the amyloid plaques associated with Alzheimer's, understanding whether it contributes to the disease or is simply a consequence of it is the great unknown. Nonetheless, the more we understand these relationships the more we can uncover potential new pathways for treatment, with the authors of the new study already floating some ideas, such as a bacterial cocktail that boosts "good" bacteria numbers.

"However, we shouldn't be too quick to rejoice," says Frisoni. "Indeed, we must first identify the strains of the cocktail. Then, a neuroprotective effect could only be effective at a very early stage of the disease, with a view to prevention rather than therapy. However, early diagnosis is still one of the main challenges in the management of neurodegenerative diseases, as protocols must be developed to identify high-risk individuals and treat them well before the appearance of detectable symptoms."

Likewise, connections have begun to emerge between the gut microbiome and Alzheimer's disease, with one 2017 study revealing decreases in microbiome diversity among those diagnosed with the condition.

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The research was published in the Journal of Alzheimer's Disease.

newatlas.com, 15 November 2020

<https://www.newatlas.com>

Planets with many neighbors may be the best places to look for life

2020-11-16

If you're looking for life beyond the solar system, there's strength in numbers.

A new study suggests that systems with multiple planets tend to have rounder orbits than those with just one, indicating a calmer family history. Only child systems and planets with more erratic paths hint at past planetary sibling clashes violent enough to knock orbits askew, or even lead to banishment. A long-lasting abundance of sibling planets might therefore have protected Earth from destructive chaos, and may be part of what made life on Earth possible, says astronomer Uffe Gr e J rgensen of the Niels Bohr Institute in Copenhagen.

"Is there something other than the Earth's size and position around the star that is necessary in order for life to develop?" J rgensen says. "Is it required that there are many planets?"

Most of the 4,000-plus exoplanets discovered to date have elongated, or eccentric, orbits. That marks a striking difference from the neat, circular orbits of the planets in our solar system. Rather than being an oddity, those round orbits are actually perfectly normal — for a system with so many planets packed together, J rgensen and his Niels Bohr colleague Nanna Bach-M ller report in a paper published online October 30 in the Monthly Notices of the Royal Astronomical Society.

Bottom of Form

Bach-M ller and J rgensen analyzed the eccentric paths of 1,171 exoplanets orbiting 895 different stars. The duo found a tight correlation between number of planets and orbit shape. The more planets a system has, the more circular their orbits, no matter where you look or what kind of star they orbit.

Earlier, smaller studies also saw a correlation between number of planets and orbit shapes, says astrophysicist Diego Turrini of the Italian National

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Astrophysics Institute in Rome. Those earlier studies used only a few hundred planets.

"This is a very important confirmation," Turrini says. "It is providing us an idea of ... how likely it is there will be no fight in the family, no destructive events, and your planetary system will remain as it formed ... long enough to produce life."

Systems with as many planets as ours are exceedingly rare, though. Only one known system comes close: the TRAPPIST-1 system, with seven roughly Earth-sized worlds (SN: 2/22/17). Astronomers have found no planetary systems so far, other than ours, with eight or more planets. Extrapolating out to the number of stars expected to have planets in the galaxy, J rgensen estimates that about 1 percent of planetary systems have as many planets as we do.

"It's not unique, but the solar system belongs to a rare type of planetary system," he says.

That could help explain why life seems to be rare in the galaxy, J rgensen suggests. Exoplanet studies indicate that there are billions of worlds the same size as Earth, whose orbits would make them good places for liquid water. But just being in the so-called "habitable zone" is not enough to make a planet habitable (SN: 10/4/19).

"If there are so many planets where we could in principle live, why are we not teeming with UFOs all the time?" J rgensen says. "Why do we not get into traffic jams with UFOs?"

The answer might lie in the different histories of planetary systems with eccentric and circular orbits. Theories of solar system formation predict that most planets are born in a disk of gas and dust that encircles a young star. That means young planets should have circular orbits, and all orbit in the same plane as the disk.

"You want the planets to not come too close to each other, otherwise their interactions might destabilize the system," says Turrini. "The more planets you have the more delicate the equilibrium is."

Planets that end up on elliptical orbits may have gotten there via violent encounters with neighboring planets, whether direct collisions that break both planets apart or near-misses that toss the planets about (SN: 2/27/15). Some of those encounters may have ejected planets from their planetary systems altogether, possibly explaining why planets with eccentric orbits have fewer siblings (SN: 3/20/15).

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Earth's survival may therefore have depended on its neighbors playing nice for billions of years (SN: 5/25/05). It doesn't need to have escaped violence altogether, either, Jørgensen says. One popular theory holds that Jupiter and Saturn shifted in their orbits billions of years ago, a reshuffling that knocked the orbits of distant comets askew and send them careening into the inner solar system. Several lines of evidence suggest comets could have brought water to the early Earth (SN: 5/6/15).

"It's not the Earth that is important," Jørgensen says. "It's the whole configuration of the planetary system that's important for life to originate on an earthlike planet."

sciencenews.org, 16 November 2020

<https://www.sciencenews.org>

Should researchers shelves plans to deliberately infect people with the coronavirus?

2020-11-20

In the early days of the COVID-19 pandemic, tens of thousands of young volunteers offered to risk their health by letting scientists intentionally infect them with the pandemic coronavirus, hoping to speed the hunt for a vaccine or treatment. Several research groups announced plans to run these so-called human challenge trials, even as some scientists questioned whether they could be conducted ethically.

Now, with the recent news that conventional human trials have produced at least two very promising vaccines, scientists are debating whether planned challenge trials are still needed. In the United States, one nascent effort appears to be on hold. In the United Kingdom, however, researchers say they are moving ahead. "There are still many strong arguments for pursuing" human challenge trials, says Christopher Chiu, an immunologist at Imperial College in London and lead researcher for the proposed U.K. trial.

In traditional human trials, researchers give volunteers either a vaccine or a placebo, then wait months or longer for enough cases to emerge to gather statistically rigorous results. Challenge trials can move faster by first vaccinating volunteers and then intentionally exposing them to SARS-CoV-2 in a controlled setting. Researchers would then closely monitor the volunteers for days or weeks.

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But challenge trials are also rife with ethical concerns. For example, because no reliable treatments for severe COVID-19 have emerged, people who volunteer to test a vaccine could be putting their lives on the line if they get sick.

Medical authorities around the world have adopted a cautious approach. Even 1 year after the outbreak began, no such trial is underway. Meanwhile, 11 vaccines have entered the final phase of conventional human testing, with promising results already emerging: Pfizer and BioNTech announced on 18 November that their vaccine is 95% effective, and Moderna announced similar preliminary results 2 days earlier.

Proponents say challenge experiments could still advance science and save lives. They could be used to compare the effectiveness of different vaccines, for instance, and help quickly screen the most promising second-generation candidates from the dozens now in the works. Challenge studies could also help answer unknowns, such as what immunological markers indicate someone is protected from the virus, and whether vaccines block infection entirely or simply prevent people from getting sick. That's important, because if a vaccinated person can still transmit the virus, people who aren't vaccinated would be at risk.

It's hard to use large-scale field trials to figure out whether a vaccinated person still sheds the virus, says Marc Lipsitch, a Harvard University epidemiologist who has advocated for COVID-19 challenge trials. "It's almost prohibitively expensive because in a 30,000-person trial you have to test 30,000 people a week for a long period of time," he says.

The initiative Chiu heads, the Human Challenge Consortium, is the closest to starting. Backed by £33 million from the U.K. government, Chiu is preparing to submit the test plan to government regulators in late November. If approved, scientists could infect the first young adult volunteers in January 2021. The preliminary studies, involving up to 100 volunteers ages 18 to 30, would determine the lowest viral dose needed to cause an infection. Once researchers have a standard dose, they could move forward with head-to-head comparisons of different vaccine candidates. Although the experiment won't replace large-scale traditional efficacy trials, it could highlight which vaccines warrant further investment, Chiu says.

Chiu is comfortable with intentionally infecting people with SARS-CoV-2 because there is growing evidence that young adults have a low risk of serious illness. He consulted with researchers at King's College London who help manage an app tracking COVID-19 symptoms for more than 4

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million people. Among 650 young adults with confirmed cases, nine in 10 had no symptoms after 3 weeks, whereas the symptoms of a few “outliers” resolved after a few months, Chiu says.

In the United States, however, the recent vaccine results have put a damper on enthusiasm for human challenge trials. A month ago, virologist Matthew Memoli put the final touches on plans for a challenge trial at the National Institute of Allergy and Infectious Diseases (NIAID), where he heads the Clinical Studies Unit at the Laboratory of Infectious Diseases. Now, he says, “That program is in limbo.”

After the first news of the vaccine success, Memoli heard NIAID Director Anthony Fauci and the head of the National Institutes of Health, Francis Collins, make remarks at an online meeting with the Bill & Melinda Gates Foundation that suggested the challenge experiment might not be necessary. Collins confirmed the exchange through a spokesperson.

That’s welcome news to some, who fear that challenge trials present risks of serious complications and warn that the long-term impacts of SARS-CoV-2 infections are uncertain. Wilbur Chen, an infectious disease expert at the University of Maryland, Baltimore, who has conducted challenge experiments to study intestinal diseases including cholera, says such trials are far riskier for COVID-19. Antibiotics could effectively treat his volunteers if they got sick, Chen says, but “I don’t think there’s a good rescue therapy right now” for COVID-19. He co-wrote a recent article in the Proceedings of the National Academy of Sciences arguing that challenge experiments would be unethical at this point.

Others, however, say the apparent success of some vaccines could strengthen the case for using challenge trials to test other vaccines. Once viable vaccines are available, it’s harder to justify continuing to use a placebo in traditional trials involving thousands of people, says Rutgers University, New Brunswick, bioethicist Nir Eyal, who earlier joined Lipsitch in supporting the use of challenge trials. “Are you going to hope that tens of thousands of people will altruistically be willing to forgo access to a proven vaccine? ... Are you going to block their access to the vaccine?” he asks. Challenge trials offer a way to speed testing of other vaccines, which the world may end up needing.

Seema Shah, a bioethicist at Northwestern University who has written about challenge trials, thinks such trials could still be useful, but there is less urgency now. And she would like to see more ways to ensure participants’ safety, such as finding biological markers for people at greater risk of getting sick. “I think I would feel more comfortable waiting a bit to

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see how those things developed and whether the risk could be minimized further,” she says.

Lipsitch agrees that “the immediate need is not great” for human challenge trials. But, he adds, researchers “need to keep preparing in case we have reason to start doing them.”

[sciencenews.org](https://www.sciencenews.org), 20 November 2020

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Everest summits may become easier due to climate change

2020-11-20

Mountaineers Reinhold Messner and Peter Habeler first proved that humans could climb to the top of Mount Everest without using supplemental oxygen in 1978. But as of 2019, only 208 individuals have ever achieved this feat—2.1 percent of the more than 10,000 people to reach earth’s tallest peak. Only one, Ang Rita Sherpa, a Nepali climber known as the Snow Leopard, has pulled it off in winter.

But these exclusive clubs might soon have more members, thanks to climate change.

As the world becomes hotter, the air pressure around Mount Everest is increasing, according to a new study published in the journal *iScience*. As air molecules heat up, they gain more energy and move around faster, creating more pressure and density and bringing the oxygen molecules closer together. Meaning: the higher the air pressure, the more oxygen there is to breathe there, even at Everest’s 29,029-foot summit. The findings are part of a 2019 National Geographic expedition that studied climate impacts on the Himalayas.

With an average global temperature two degrees Celsius (or 3.6 degrees Fahrenheit) warmer than that of preindustrial times—the marker when many climate scientists project we’ll see more dangerous climate-change impacts—air pressure is expected to increase a person’s maximum oxygen uptake by up to 4.9 percent at the top of Everest, according to the study. “It’s like being lower in the atmosphere,” says the study’s lead author, Tom Matthews, a climate scientist at Loughborough University in the United Kingdom.

Summitting Everest without supplemental oxygen is incredibly risky. “We always like to joke that you’re taking ten steps per breath when you’re

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using oxygen," says Peter Athans, a world-renowned high-altitude climber who was involved in the National Geographic expedition. "When you're not using oxygen, it's more like ten breaths per step."

Even the simplest tasks can be exhausting at that elevation, says Sandra Elvin, who coordinated the 2019 trip. Climbers become hypersensitive to headaches, are more susceptible to frostbite and hypothermia, and have greater difficulty making decisions.

All of these risks are only amplified during the winter. Not only is the air pressure lower (on average it's 5 percent lower at the summit during the winter compared to its highest point during summer monsoon season), but freezing temperatures and high winds from the jet stream that engulf the mountain can make the climb nearly impossible.

That's why most people who reach the summit without supplemental oxygen (nearly 82 percent, according to the study) do so in the pre-monsoon month of May, the most popular time of year on Everest, a result of the higher air pressure and warmer, less windy conditions. October, after the summer rains subside, has historically been the next most successful time to make such an attempt. Soon, however, climbers may be able to tackle this challenge in the wintertime as well.

As the study found, some of the most dramatic increases in air pressure are expected during this harsh season. If temperatures rise to the 3.6 degrees Fahrenheit mark, breathing in this extra oxygen during the winter could feel equivalent to shaving off nearly 118 meters—387 feet—from your climb. "You can pick a day that makes it feel like you're climbing in spring," Matthews says. "It doesn't have to be a difficult winter ascent in terms of oxygen availability."

New climbers forgoing extra oxygen—both in the winter and the spring—would be joining a subset of climbers who each have their own philosophy on oxygen-less climbs. "You need motivation, you need something special, you need to do it for yourself," says Spanish alpinist Alex Txikon, who last year attempted to summit Everest during the winter without supplemental oxygen before being beaten back by bad storms. But, he admonishes, climbers shouldn't try to break records for the sake of it. "It's not something you do to become famous," he says. "The first rule is not to destroy your career, your life, just because of the ego."

In addition to increased oxygen, the shifting seasons in a warmer world are further opening up opportunities to summit Everest. When Athans first started climbing in the early 1980s, the winter season began in October.

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These days, he says, the monsoon season is extending and the traditional fall season is now starting later. "We've frequently seen in recent years that late November and December can be excellent times to climb," he says. During the two-month-long National Geographic expedition, Matthews helped install the world's highest weather station on Mount Everest; sitting at 27,650 feet, it will provide precise forecasts that can be of help to those planing an ascent.

There is the chance that better forecasts and seemingly more favorable conditions could spur riskier behavior on the mountain, according to Matthews. Having more specific weather information from the station high on Everest could create a sense of safety that might cause climbers to miscalculate other critical details, like the amount of time the ascent might take or how much bad weather they can endure. Still, Matthews says, "It's the world's best climbers that are at the absolute forefront of their profession, that are trying to do this in the first place, and I think really what this does is it helps fine-tune those preparations."

Panuru Sherpa, cofounder and executive director of Xtreme Climbers Treks and Expeditions, says he has noticed a change in Everest's air pressure and oxygen content in his 30 years of climbing (and 15 summits). But according to him, these factors alone aren't enough to make the mountain easier to overcome; climate change is also bringing with it new difficulties: Glaciers are shifting and shrinking. More crevasses are appearing higher up the mountain. The notorious Khumbu Icefall could become more treacherous to pass. And more rock is becoming exposed, making it harder to scramble up as snowpack dwindles. Climate change, says Panuru, has definitely made it "more challenging and more dangerous to climb Everest."

Most experts agree. The final stretch to the summit might be a bit easier these days, says Athans, while the bottom half of the mountain could become trickier to navigate. But he says that's just "the challenge of mountaineering—being able to adapt to your environment, to be able to deal with whatever it throws at you."

outsideonline.com, 20 November 2020

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A vast web of clumps and strands of the stuff served as the scaffolding on which the cosmos developed.

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To explain away dark matter, gravity would have to be really weird, cosmologists say

2020-11-20

Dark matter, the invisible stuff whose gravity is thought to hold galaxies together, may be the least satisfying concept in physics. But if you want to get rid of it, a new study finds, you'll need to replace it with something even more bizarre: a force of gravity that, at some distances, pulls massive objects together and, at other distances, pushes them apart. The analysis underscores how hard it is to explain away dark matter.

Concocting such a theory of gravity "is so complicated that it seems very unlikely that anyone could come up with a scenario that would work," says Scott Dodelson, a theoretical physicist at Carnegie Mellon University, who wasn't involved in the new work. Still, some theorists say it may be possible to pass the test.

According to cosmologists' prevailing theory, dark matter pervades pretty much every galaxy, providing the extra gravity that keeps stars from swirling out into space, given the speeds at which astronomers see the galaxies rotating. A vast web of clumps and strands of the stuff served as the scaffolding on which the cosmos developed. Yet, after decades of trying, physicists haven't spotted particles of dark matter floating around, and many would happily dismiss the idea—if it didn't work so well.

Top of Form

Bottom of Form

Some scientists have tried to kick the dark matter habit. In 1983, Israeli physicist Mordehai Milgrom found he could account for the high speeds of stars swirling around the peripheries of galaxies by modifying Isaac Newton's famous second law of motion: force equals mass times acceleration. That insight suggested the need for dark matter could be obviated by changing the law of gravity, at least on the scale of individual galaxies. But theorists labored for decades to turn the idea into a coherent theory of gravity akin to Albert Einstein's general theory of relativity, and to do so, they had to add new fields, cousins of the usual gravitational field.

But to do away with dark matter, theorists would also need explain away its effects on much larger, cosmological scales. And that is much harder, argues Kris Pardo, a cosmologist at NASA's Jet Propulsion Laboratory, and David Spergel, a cosmologist at Princeton University. To make their case,

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they compare the distribution of ordinary matter in the early universe as revealed by measurements of the afterglow of the big bang—the cosmic microwave background (CMB)—with the distribution of the galaxies today.

The evolution of the universe is a tale of two fluids: dark matter, which doesn't interact with light, and ordinary matter, which does. The big bang left ripples in the dark matter, which under its own gravity began to coalesce into the denser spots. Ordinary matter—then, a hot soup of free-flying protons and electrons—also began to fall into the dark matter clumps. However, those charged particles themselves generated radiation that pushed them back out, creating sound waves known as a baryon acoustic oscillations. The waves continued to spread until the universe cooled enough to form neutral atoms, 380,000 years after the big bang, when the CMB was born. The sound wave left its imprint on the CMB and, faintly, in the distribution of the galaxies.

Or could that evolution be explained with only ordinary matter interacting through modified gravity? To explore that possibility, Pardo and Spergel derived a mathematical function that describes how gravity would have had to work to get from the distribution of ordinary matter revealed by the CMB to the current distribution of the galaxies. They found something striking: That function must swing between positive and negative values, meaning gravity would be attractive at some length scales and repulsive at others, Pardo and Spergel report this week in *Physical Review Letters*. "And that's superweird," Pardo says.

The strange behavior is required to explain how the larger baryon acoustic oscillation faded over cosmic time while the smaller galaxies emerged, Pardo says. Just as Milgrom did with individual galaxies, the new work shows how, without dark matter, gravity would have to change to explain the universe's large-scale structure, Dodelson says. But that change would have to be radical, he says. "They're demonstrating that to do that you have to jump through these 13 hoops," he says.

However, theorists already seem prepared to jump through those hoops. In a paper posted in June to the preprint server arXiv, theoretical cosmologists Constantinos Skordis and Tom Złosnik of the Czech Academy of Sciences present a dark matter-less theory of modified gravity they say jibes with CMB data. To do that, researchers add to a theory like general relativity an additional, tunable field called a scalar field. It has energy, and through Einstein's equivalence of mass and energy, it can behave like a

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form of mass. Set things up just right and at large spatial scales, the scalar field interacts only with itself and acts like dark matter.

The team hasn't explicitly shown that the theory, which isn't meant to be a fundamental theory of gravity, passes Pardo's and Spergel's particular test. But because it's designed to mimic dark matter, it ought to, Skordis says. "We engineered it to have that behavior."

Skordis's and Złosnik's paper is "very exciting," Pardo says. But he notes that in some sense it merely replaces one mysterious thing—dark matter—with another—a carefully tuned scalar field. Given the complications, Pardo says, "dark matter is kind of the easier explanation."

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