CHEMWATCH

Bulletin Board

Contents

JUL. 30, 2021

(click on page numbers for links)

CONTACT US

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

1227 Glen Huntly Rd
Glen Huntly
Victoria 3163 Australia

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

Contents

JUL. 30, 2021

CHEMWATCH
Bulletin Board

Contents

JUL. 30, 2021

ASIA PACIFIC

Prescription drugs, controlled chemicals fuel illicit drug trade in India

2021-07-22

India ranks among countries reporting opioid seizures, and concerns are rising over prescription drugs and their ingredients being increasingly diverted towards recreational use and illicit trade

Prescription drugs and their ingredients--or 'precursors'--are being increasingly diverted for recreational use in India--the largest manufacturer of generic drugs in the world--as per the 2021 World Drug Report of the UN Office on Drugs and Crime (UNODC).

In 2018, India amended its law to regulate the painkiller tramadol after being named a leading supplier in clandestine markets. The entire world's annual seizures of the drug fell from 125 to 32 tons in a single year. But tramadol is only one of India's growing drug problems.

India ranked among the 10 countries reporting the biggest opioid seizures in the world in 2019, the report said--India's opium haul in 2019 was the fourth biggest in the world, and of morphine and heroin the seventh largest.

But the diversion of pharmaceutical drugs and ingredients is a relatively new trend. Can this diversion be controlled without impacting their medical use? We investigate.

Read More

Business Standard, 22 July 2021

https://www.business-standard.com/article/current-affairs/prescription-drugs-controlled-chemicals-are-fuelling-illicit-drug-trade-121072200161_1.html

China children's cosmetics controls could see companies boycott market

2021-07-23

Manufacturers of children's cosmetics opposed to the use of animal testing will probably withdraw their products from the Chinese market if regulations currently out for consultation get the go ahead, industry experts have warned.

In 2018, India amended its law to regulate the painkiller tramadol after being named a leading supplier in clandestine markets.

CHEMWATCH
Bulletin Board
Regulatory Update
JUL. 30, 2021

A draft of the Regulations on the Supervision and Administration of Children's Cosmetics, published by the National Medical Products Administration (NMPA), would mandate that toxicological tests cannot be waived in the case of cosmetics aimed at children.

"These requirements are a step back into animal testing and inhibit innovation with the restrictions on ingredients," Garth Wyllie, technical executive director at Cosmetics New Zealand told Chemical Watch. He said that rather than reformulating, it is more likely companies would withdraw products from the market given the move to essentially require animal tests.

Mette Knudsen, CEO of Knudsen&CRC, added that the draft rules are giving Chinese brands a definite advantage "because most Western brands that are producing cosmetics for children and babies are against animal testing".

Under the draft, only ingredients with a proven safety record can be used in children's cosmetics. Those that are still being monitored or do not have "significant" safety data are not permitted for use, while new ingredients would be banned while they are being evaluated.

Read More

Chemical Watch, 23 July 2021

https://chemicalwatch.com/304023/china-childrens-cosmetics-controls-could-see-companies-boycott-market

AMERICA

Comment period begins on draft NIOSH report on approaches to developing occupational exposure limits or bands for engineered nanomaterials

2021-07-13

On July 13, 2021, the National Institute for Occupational Safety and Health (NIOSH) announced the availability of a draft technical report entitled *Approaches to Developing Occupational Exposure Limits or Bands for Engineered Nanomaterials: User Guide and Technical Report*. 86 Fed. Reg. 36748. NIOSH states that the draft report describes an evidence-based approach to evaluate the scientific information available to derive occupational exposure limits, or bands, for engineered nanomaterials. This

NIOSH seeks comments from individuals, including scientists and representatives from various government agencies, industry, labor, and other stakeholders, and also the public.

draft report contains two main parts: (1) user guide; and (2) full technical report and appendixes. NIOSH seeks comments from individuals, including scientists and representatives from various government agencies, industry, labor, and other stakeholders, and also the public. NIOSH asks that comments note whether there are errors of fact, unsubstantiated claims, evidence of careless experimental work, inclusion of too much information already in the literature, or statements that are inaccurate. NIOSH requests that special emphasis be placed on technical review of the following issues:

- Does the draft document adequately describe the process for gathering and evaluating the information available on occupational exposure limits or bands for engineered nanomaterials?
- Does the draft document adequately describe the development of a framework for categorizing engineered nanomaterials by potential occupational health hazard from inhalation exposure?
- Are the clustering and classification modeling methodologies reasonable for these data?
- Is a revision to current occupational exposure banding guidance needed to incorporate a band F?
- How useful and practical is the approach described in both the user guide and full technical report for deriving categorical occupational exposure limits, and what are the opportunities for improvement?
- Are the current searches and collection of scientific data sufficient, and are there additional opportunities for obtaining data that were not included?
- Would the methods used in the report also be appropriate for a future comprehensive dataset of experimental, toxicological, and physicochemical information for engineered nanomaterials?

Read More

Nano and Other Emerging Chemical Technologies Blog, 13 July 2021

https://nanotech.lawbc.com/2021/07/comment-period-begins-on-draft-niosh-report-on-approaches-to-developing-occupational-exposure-limits-or-bands-for-engineered-nanomaterials/

CHEMWATCH
Bulletin Board
Regulatory Update
JUL. 30, 2021

Notice of proposed rulemaking, warnings for exposures to glyphosate from consumer products new sections 25607.48 and 25607.49

2021-07-20

NOTICE IS HEREBY GIVEN that the Office of Environmental Health Hazard Assessment (OEHHA) proposes to amend certain sections of Article 6 of Title 27 of the California Code of Regulations.[1] OEHHA is proposing to adopt a new safe harbor warning regulation to address the content of warnings for exposure to glyphosate in consumer products.

This proposed rulemaking would add Sections 25607.48 and 25607.49 to the Title 27, Article 6 Clear and Reasonable Warnings regulations. The proposed regulations would provide safe harbor guidance for businesses that cause consumer product exposures to glyphosate that require warning.

PUBLIC PROCEEDINGS

Written Comment Period

Any written comments concerning this proposed regulatory action, regardless of the form or method of transmission, must be received by OEHHA no later than September 7, 2021, the designated close of the 45-day written comment period required under the Administrative Procedure Act. All written comments will be posted on the OEHHA website at the close of the public comment period.

Read More

OEHHA, 20 July 2021

https://oehha.ca.gov/proposition-65/crnr/notice-proposed-rulemaking-warnings-exposures-glyphosate-consumer-products-new

OEHHA is proposing to adopt a new safe harbor warning regulation to address the content of warnings for exposure to glyphosate in consumer products

House passes sweeping PFAS "forever chemical" regulation

2021-07-21

Today the House of Representatives passed the PFAS Action Act of 2021, jumpstarting regulations for per-and polyfluoroalkyl substances (PFAS), the toxic lab-made chemicals that have been posing major health risks to communities across the country for decades. Among its provisions, the legislation would require the EPA to set drinking water standards for PFOA and PFOS, the two most studied PFAS chemicals, and would designate

these as "hazardous substances" under the Superfund program to facilitate the cleanup of toxic sites. The legislation, H.R. 2467, passed in a vote of 241-183.

Studies have found that long-term exposure to PFAS is associated with many health problems, including liver malfunction, birth defects, thyroid disease, weakened immunity and certain cancers. PFAS has been found in the blood of 97 percent of people in the United States and in human breast milk, and more than 200 million people in the country could be drinking PFAS-contaminated water.

Read More

Food and Waterwatch, 21 July 2021

https://www.foodandwaterwatch.org/2021/07/21/house-passes-sweeping-pfas-forever-chemical-regulation/

CPSC sues Amazon to force recall of hazardous products sold on Amazon.com

2021-07-21

The U.S. Consumer Product Safety Commission (CPSC) **announced** on July 14, 2021, that it filed an **administrative complaint** against Amazon.com, "the world's largest retailer, to force Amazon to accept responsibility for recalling potentially hazardous products sold on Amazon.com." CPSC claims that the specified products sold through Amazon's "fulfilled by Amazon" (FBA) program are defective and pose a risk of serious injury or death to consumers and that Amazon is legally responsible to recall them. According to the complaint, the products include "24,000 faulty carbon monoxide detectors that fail to alarm, numerous children's sleepwear garments that are in violation of the flammable fabric safety standard risking burn injuries to children, and nearly 400,000 hair dryers sold without the required immersion protection devices that protect consumers against shock and electrocution."

CPSC filed the complaint under the Consumer Product Safety Act (CPSA). According to the complaint, Amazon acts as a "distributor," as defined by CPSA, of its FBA products by: (a) receiving delivery of FBA consumer products from a merchant with the intent to distribute the product further; (b) holding, storing, sorting, and preparing for shipment FBA products in its warehouses and fulfillment centers; and (c) distributing FBA consumer products into commerce by delivering FBA products directly to consumers or to common carriers for delivery to consumers.

CPSC claims that the specified products sold through Amazon's "fulfilled by Amazon" (FBA) program are defective and pose a risk of serious injury or death to consumers and that Amazon is legally responsible to recall them.

CHEMWATCH
Bulletin Board
Regulatory Update
JUL. 30, 2021

The complaint states that after CPSC notified Amazon about the hazards presented by the specified products, Amazon took "several unilateral actions," including:

- Removing the Amazon Standard Identification Numbers (ASIN) for certain of the specified products; and
- Notifying consumers who purchased certain of the specified products that they could present a hazard. Amazon also offered a refund to these consumers in the form of an Amazon gift card credited to their account.

Read More

Pesticide Law and Policy Blog, 21 July 2021

http://pesticideblog.lawbc.com/entry/cpsc-sues-amazon-to-force-recall-of-hazardous-products-sold-on-amazon.com

EUROPE

Review of standards related to materials in contact with drinking water

2021-07-21

This report presents an inventory of European and international standards related to the hygiene requirements on materials that come into contact with drinking water (DCM). These materials are relevant for Directive (EU) 2020/2184 on the quality of water intended for human consumption. The report is also listing technical committees of CEN and ISO that may deal with standardisation related to materials in contact with drinking water. It provides lists of documentary standards that are directly relevant to the characterisation of those materials, i.e. describing 'analytical methods' or 'migration test methods'. A search was also conducted beyond those applications by looking into product groups of the Construction Products Regulation (CPR) (EU) No 305/2011 and to other standards indirectly relevant to DCM that may contain useful information for the future establishment of the positive lists and accepted methodologies required by Directive (EU) 2020/2184. The inventory will serve as basis for a further gap analysis of analytical and migration methods for drinking water contact materials not yet covered by standards. This shall support in addition the establishment of possible standardisation mandates from the European Commission to CEN, as foreseen in the Directive.

These materials are relevant for Directive (EU) 2020/2184 on the quality of water intended for human consumption.

Read More

European Commission, 21 July 2021

https://publications.jrc.ec.europa.eu/repository/handle/JRC125733

Official start to ban PFAS in Europe

2021-07-19

Germany, the Netherlands, Sweden, Denmark and Norway formally announced the intention to submit a restriction proposal for PFAS to the European Chemicals Agency ECHA by 19 July 2022. A restriction proposal is a first step towards a European ban on PFAS. With a restriction on manufacturing, marketing authorisation and use of PFAS, the countries want to stop the spread of PFAS in the environment and improve the quality of the environment and the health of people in the European Union. Special about this restriction is that it includes more than 6000 substances and many uses and products.

Survey on PFAS and alternatives: call for information

The five countries have published summaries of the information they have gathered about PFAS so far. In addition, they have created a questionnaire in to gather further information to fill knowledge gaps. This survey is primarily aimed at relevant industry and industry associations, but is also aimed at companies that produce or have knowledge of alternatives to PFAS.

The aim of the survey is to ensure that the information about PFAS and alternatives is accurate and representative of the market situation so that we have the best basis for a knowledge-based restriction proposal for next year. Among other things, such information may form the basis for assessing any derogations or special conditions for certain applications of PFAS that are particularly important to society and where alternatives are not available.

Deadline for survey completion is 19 September

In order to make such assessments, the five countries depend on cooperation with the industry and organisations, as they often have the most detailed information required in such assessments.

A restriction proposal is a first step towards a European ban on PFAS.

CHEMWATCH
Bulletin Board
Regulatory Update
JUL. 30, 2021

Read More

RIVM, 19 July 2021

https://www.rivm.nl/en/pfas/official-start-to-ban-pfas-in-europe

INTERNATIONAL

Bottle cap liners test positives for phthalates and PVC

2021-07-19

Toxic Free Food Campaign reports on the use of ortho-phthalates and polyvinyl chloride (PVC) in cap gaskets of bottled beverages from 141 brands; finds 66% of the cap liners made of PVC and gaskets of 50 beverage brands to contain ortho-phthalates; several beverage companies respond by announcing to phase out phthalates.

A report published on July 13, 2021, by *Defend Our Health* and *Ecology Center Healthy Stuff Lab* on behalf of the *Toxic Free Food Campaig*n summarizes the use of phthalates and polyvinyl chloride (PVC) in plastic bottle cap liners. The *Ecology Center Healthy Stuff Lab* acquired 273 bottle cap liners from non-alcoholic glass-bottled beverages and 10 from plastic-bottled beverages sold in 12 US states, Washington DC, and Toronto, Canada between late 2019 and throughout 2020. Subsequently, cap gaskets were analyzed with FTIR (Fourier-transform infrared) spectroscopy for the presence of ortho-phthalates and PVC.

The study found that cap gaskets from more than one-third of the 141 tested brands contained the ortho-phthalates bis(2-ethylhexyl) phthalate (DEHP, CAS 117-81-7), diisononyl phthalate (DINP, CAS 28553-12-0), and diisodecyl phthalate (DIDP, CAS 26761-40-0), all three of which are listed in the *Food Packaging Forum*'s Food Contact Chemicals database (FCCdb) as priority hazardous substances. In addition, "four safer alternatives to ortho-phthalates were identified in use as a plasticizer." Phthalates were most frequently detected in cap gaskets for soda, with 55% of the cap liners containing phthalates, followed by organic products (41%), smaller brands (41%), and kombucha (40%). PVC "was most frequently found in the bottle cap liners from ready-to-drink coffee (100% of brands tested) and tea (84% of brands tested), juices and juice drinks (82% of brands tested), and brands purchased at dollar stores (75% of brands tested)." Cap gaskets from around two-thirds of the tested brands were made of PVC, 19% of polystyrene, 11% of polyethylene vinyl acetate, and 3% of polyethylene. In

In addition, "four safer alternatives to ortho-phthalates were identified in use as a plasticizer.

total, 59 brands used plastics other than PVC to produce their bottle cap liners, and these were tested and found to be free of ortho-phthalates.

Read More

Food Packaging Forum, 19 July 2021

https://www.foodpackagingforum.org/news/bottle-cap-liners-test-positive-for-phthalates-and-pvc

ISO publishes standard evaluating methods for assessing the release of nanomaterials from commercial-containing polymer composites

2021-07-19

The International Organization for Standardization (ISO) has published ISO/TR 22293:2021, "Evaluation of methods for assessing the release of nanomaterials from commercial, nanomaterial-containing polymer composites." ISO states that an understanding of what is released from products containing manufactured nanomaterials "is critical to planning and managing safe development and use of those products." The document aims to provide a guide to the information to be taken into account in determining the methods for identifying and evaluating releases of manufactured nanomaterials from matrices; providing a framework for understanding how these methods and the information they produce can support decision-making; and identifying opportunities for developing standards in this area. According to ISO, the document provides practical support for decisions related to product development and use through early consideration of the potential for release of manufactured nanomaterials and through focus on realistic use scenarios where exposures to the released manufactured nanomaterials might occur. The intended users of the document include:

- Those planning to develop or adapt technical specifications for manufactured nanomaterials used in commercial products;
- Risk managers, product developers, exposure measurement practitioners, and other stakeholders seeking guidance on the availability and utility of methods to measure releases that could occur from uses of specific manufactured nanomaterials in composites;
- Methods and instrumentation developers seeking to identify needs of the risk management community; and

ISO states that an understanding of what is released from products containing manufactured nanomaterials "is critical to planning and managing safe development and use of those products."

CHEMWATCH
Bulletin Board
Regulatory Update
JUL. 30, 2021

- Those planning basic and applied research programs for measurement and modeling to support decisions about sustainably safe uses of manufactured nanomaterials.

Read More

Nano and Other Emerging Chemical Technologies Blog, 19 July 2021

https://nanotech.lawbc.com/2021/07/iso-publishes-standard-evaluating-methods-for-assessing-the-release-of-nanomaterials-from-commercial-nanomaterial-containing-polymer-composites/

Why are some food additives that are banned in Europe still used in the U.S.?

2021-07-22

It might surprise you to learn that certain food additives found in bread, baked goods, and candy on grocery store shelves in the United States aren't allowed in Europe. Likewise, European Union regulations prohibit the use of different drugs and hormones given to farm animals to promote growth or increase milk production that are permitted in the United States.

How can a food additive be considered a cancer risk on one continent yet safe on another? Keep reading to find out how the United States' approach to food safety influences the ingredients in your food, and what you need to know about additives that are prohibited in Europe but still deemed safe by the U.S. Food and Drug Administration (FDA).

When It Comes to Additives, U.S. Regulators Focus on Probability, EU Considers Possibilities

Europe takes a more precautionary approach to evaluating chemicals and additives compared to the United States, says Justin J. Kastner, PhD, associate professor in the department of diagnostic medicine and pathobiology at Kansas State University in Manhattan.

"One key difference is that historically the United States has been more insistent in focusing on the probability or likelihood of hazards or bad things occurring, and the European Union approach has been more precautionary; they give attention to not just probabilities of something going wrong, but also the mere possibility," says Dr. Kastner. That has resulted in the EU banning more additives than the United States, he adds.

How can a food additive be considered a cancer risk on one continent yet safe on another?

Read More

Everyday Health, 22 July 2021

https://www.everydayhealth.com/diet-nutrition/why-are-some-food-additives-that-are-banned-in-europe-still-used-in-the-us/

European Commission | Regulation (EU) 2021/1199 amending Annex XVII to Regulation (EC) No 1907/2006 as regards polycyclic-aromatic hydrocarbons (PAHs) in granules or mulches

2021-07-21

Commission Regulation (EU) 2021/1199 of 20 July 2021 amending Annex XVII to Regulation (EC) No 1907/2006 of the European Parliament and of the Council as regards polycyclic-aromatic hydrocarbons (PAHs) in granules or mulches used as infill material in synthetic turf pitches or in loose form on playgrounds or in sport applications (Text with EEA relevance)

C/2021/5260

OJ L 259, 21.7.2021, p. 1–5 (BG, ES, CS, DA, DE, ET, EL, EN, FR, GA, HR, IT, LV, LT, HU, MT, NL, PL, PT, RO, SK, SL, FI, SV)

ELI: http://data.europa.eu/eli/reg/2021/1199/oj

Read More

EUR-Lex, 21 July 2021

https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32021R1199

ECHA Calls for Tenders to Perform Study on Impact of Graphene, Graphene Oxide, and Other 2D Materials

2021-07-21

The European Chemicals Agency (ECHA) has launched a call for tenders to perform a study "Assessment of the potential impact of graphene, graphene oxide and other 2D materials on health, and the environment" as part of the European Union (EU) Observatory for Nanomaterials (EUON). According to the description, the goal of the study is to conduct a systematic literature review of the health and environmental effects of graphene, graphene oxide, and other two-dimensional (2D) materials, based on existing public information. The objective of the requested services is to collect information from existing public sources, including journal publications and EU-funded research projects. The study should also assess what general conclusions can be made regarding the potential health and environmental properties of 2D materials. Finally, the review should examine to what extent existing approaches to health and

Commission Regulation (EU) 2021/1199 of 20 July 2021 amending Annex XVII to Regulation (EC) No 1907/2006 of the European Parliament and of the Council as regards polycyclic-aromatic hydrocarbons (PAHs) in granules or mulches used as infill material in synthetic turf pitches or in loose form on playgrounds or in sport applications (Text with EEA relevance)

•

environmental testing of chemicals are applicable to graphene, graphene oxide, and other 2D materials, and what challenges and pitfalls exist surrounding the testing of these materials. The deadline for expressing interest is **August 13, 2021**.

Read More

Nano and Other Emerging Chemical Technologies Blog, 21 July 2021

https://nanotech.lawbc.com/2021/07/echa-calls-for-tenders-to-perform-study-on-impact-of-graphene-graphene-oxide-and-other-2d-materials/

Pollution

2021-07-30

https://punch.photoshelter.com/image/I0000qtBcWBrKHdw

Isophorone

2021-07-30

Isophorone is a α,β-unsaturated cyclic ketone with the molecular formula $C_9H_{14}O$. It is a colourless to yellowish liquid with a characteristic peppermint-like smell. [1] Isophorone evaporates faster than water but slower than charcoal starter or paint thinner, and it will not mix completely with water. It is a manmade chemical for use commercially, but it has been found to occur naturally in cranberries. Isophorone does not remain in the air very long, but can remain in water for possibly more than 20 days. The length of time that isophorone will remain in soil is not known, but it probably is about the same as the length of time it remains in water. [2]

USES [3]

Isophorone is used mainly as a solvent for concentrated vinyl chloride/acetate-based coating systems for metal cans, other metal paints, nitrocellulose finishes, and printing inks for plastics. In addition, it is used in some herbicide and pesticide formulations and in adhesives for plastics, polyvinylchloride, and polystyrene materials. Isophorone is an intermediate in the synthesis of 3,5-xylenol, 3,3,5-trimethylcyclohexanol, and plant growth retardants.

IN THE ENVIRONMENT [4]

Isophorone is released to the air from inks, paints, and other products containing it. It disappears in air very quickly, half of it disappears in less than 5 hours. It may be present in water from industrial releases. In water, bacteria can break it down over a period of several days to about a month. In soil, it may be broken down by bacteria, filter to groundwater, or evaporate to the air; however, there is not much information on its presence in soil. It does not build up in the food chain.

SOURCES AND ROUTES OF EXPOSURE

Sources of Exposure [4]

- Breathing low levels found in air.
- Drinking water contaminated with isophorone.
- Eating food that contains isophorone.
- Working in the printing, adhesives, and coatings industries where isophorone is used.

Isophorone is a α,β-unsaturated cyclic ketone with the molecular formula C9H14O.

CHEMWATCH
Bulletin Board
Hazard Alert
JUL. 30, 2021

Routes of Exposure [5]

The major routes of exposure to isophorone are:

- inhalation
- ingestion
- skin and/or eye contact

HEALTH EFFECTS [3]

Acute Effects

The only acute effects of isophorone reported in humans are irritation of the skin, eyes, nose, and throat, headache, and dizziness. Exposure to high concentration of isophorone via inhalation in animals causes inactivity and coma. Tests involving acute exposure of rats and guinea pigs have shown isophorone to have moderate toxicity from oral and inhalation exposure.

Chronic Effects

Workers exposed to isophorone over a long-term period experienced dizziness, fatigue, and depression. Animal studies indicate that long-term inhalation of high concentrations of isophorone causes central nervous system effects such as narcosis, staggering, depression, ataxia, lethargy, prostration, and coma. The Reference Dose (RfD) for isophorone is 0.2 milligrams per kilogram body weight per day (mg/kg/d) based on no observed effects in dogs. EPA has determined that there are inadequate data for establishing a Reference Concentration (RfC) for isophorone. In the final listing rule for solvents, EPA calculated a provisional RfC of 0.012 milligrams per cubic metre (mg/m^3) based on body weight effect in rats. The provisional RfC is a value that has had some form of Agency review but is not on IRIS. The California Environmental Protection Agency (CalEPA) has calculated a chronic inhalation reference exposure level (REL) of 2 mg/m^3 for isophorone based on developmental effects in rats. The CalEPA reference exposure level is a concentration at or below which adverse health effects are not likely to occur.

Reproductive/Developmental Effects

No studies were located regarding developmental or reproductive effects in humans. Limited evidence in animal studies suggests that isophorone may cause birth defects such as foetal malformations and growth retardation from inhalation exposure to isophorone during pregnancy.

Cancer Risk

No studies were found concerning the carcinogenicity of isophorone in humans. One study demonstrated an increased incidence of kidney tumours and preputial gland (a male reproductive gland) tumours in male rats exposed to isophorone by gavage. However, the type of kidney tumour observed in male rats is of questionable relevance to humans. EPA considers isophorone to be a possible human carcinogen (cancer-causing agent) and has ranked it in EPA's Group C.

SAFETY [6]

First Aid Measures

- General advice: Immediately remove contaminated clothing. If danger of loss of consciousness, place patient in recovery position and transport accordingly. Apply artificial respiration if necessary. First aid personnel should pay attention to their own safety.
- If inhaled: Remove the affected individual into fresh air and keep the person calm. Assist in breathing if necessary. Immediate medical attention required.
- If on skin: Wash affected areas thoroughly with soap and water. Remove contaminated clothing. Immediate medical attention required.
- If in eyes: In case of contact with the eyes, rinse immediately for at least 15 minutes with plenty of water. Immediate medical attention required.
- If swallowed: Rinse mouth and then drink plenty of water. Do not induce vomiting. Never induce vomiting or give anything by mouth if the victim is unconscious or having convulsions. Immediate medical attention required.
- Note to physician: Treat according to symptoms (decontamination, vital functions), no known specific antidote. Pulmonary oedema prophylaxis. Medical monitoring for at least 24 hours.

Exposure Controls & Personal Protection

Engineering Controls

- Provide local exhaust ventilation to control vapours/mists.
- Eye wash fountains and safety showers must be easily accessible.

CHEMWATCH
Bulletin Board
Hazard Alert
JUL. 30, 2021

Personal Protective Equipment

The following personal protective equipment is recommended when handling isophorone:

- Respiratory protection: Wear a NIOSH-certified (or equivalent) organic vapour/particulate respirator.
- Hand protection: Chemical resistant protective gloves
- Eye protection: Tightly fitting safety goggles (chemical goggles). Wear face shield if splashing hazard exists.
- Body protection: Impermeable protective clothing

REGULATION

United States [3]

- ACGIH: American Conference of Governmental and Industrial Hygienists' has set a threshold limit value ceiling of 28 mg/m^3 for isophorone. This concentration should not be exceeded during any part of the working exposure.
- NIOSH: The National Institute of Occupational Safety and Health has set a recommended exposure limit of 23 mg/m^3 for an 8- or 10-h time-weighted-average exposure and/or ceiling.
- NIOSH: The National Institute of Occupational Safety and Health has set an immediately dangerous to life or health concentration for isophorone of 140 mg/m^3. This recommended exposure limit is set to ensure that a worker can escape from an exposure condition that is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from the environment.
- OSHA: The Occupational Safety and Health Administration has set a permissible exposure limit of 140 mg/m^3 expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effect averaged over a normal 8-h workday or a 40-h workweek.

Australia [7]

Safe Work Australia: Safe Work Australia has established a time weighted average concentration for isophorone of 5ppm and 28mg/m^3 for an 8-hour workday.

REFERENCES

1. http://en.wikipedia.org/wiki/Isophorone
2. http://www.atsdr.cdc.gov/PHS/PHS.asp?id=761&tid=148
3. http://www.epa.gov/airtoxics/hlthef/isophoro.html
4. http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=762&tid=148
5. http://www.cdc.gov/niosh/npg/npgd0355.html
6. http://worldaccount.basf.com/wa/NAFTA/Catalog/ChemicalsNAFTA/doc4/BASF/PRD/30036765/.pdf?title=&asset_type=msds/pdf&language=EN&validArea=US&urn=urn:documentum:ProductBase_EU:09007af880094839.pdf
7. http://www.safeworkaustralia.gov.au/sites/swa/about/Publications/Documents/772/Workplace-exposure-standards-for-airborne-contaminants.docx

Experimental male birth control is magnets that heat up your testicles

2021-07-29

A team of scientists from China's Nantong University just completed animal tests for an interesting new approach to male birth control — but you probably won't enjoy hearing how they got there.

The one-simple-trick involved injecting mice with magnetic nanomaterials, using external magnets to guide the particles into their testicles, and then using another magnetic field to heat their you-know-whats so much that they temporarily stopped producing sperm, according to research published this month in the journal Nano Letters.

Now look, maybe you're wincing a little or crossing your legs as you read this, and we assure you that you can relax. Believe it or not, this approach to male contraception is actually a lot less unpleasant than similar attempts, a new press release on the research claims. Other experiments used higher temperatures to achieve longer-lasting results, but they also risked causing burn injuries or required painful injections directly into the testes themselves — both of which this new experiment avoided.

In the experiment, the researchers found success after heating the little magnets that they'd guided into the mouse testes to just 104 degrees Fahrenheit. That's certainly a noticeable amount of heat, and considerably warmer than your typical body temperature, but it's still seemingly safe. According to the National Institute of Standards and Technologies, your skin will start to experience first degree burns at 118 degrees F, so it's reasonable to suggest that the warmed magnets won't damage anything that they're not supposed to.

On top of that, the treatment worked for months at a time, after which the mice that were injected with the magnetic nanomaterials returned to their usual reproductive health. Initially, the mouse testes shrank a bit and stopped producing new sperm in response to the heat. Seven days after treatment, the mice were firing nothing but blanks. But by day 60, the treated mice were back to fathering litters of around 12 pups per female, just like normal.

That suggests that when it comes to family planning, a treatment like this that could eventually become available for humans would be far from the nuclear option. Because the treatment was designed to be temporary and the biodegradable nanomaterials vanish over time, it seems like opting

Now look, maybe you're wincing a little or crossing your legs as you read this, and we assure you that you can relax.

to take a little heat for a month or two of birth control won't mess with anyone's long-term plans for parenthood.

futurism.com, 29 July 2021

https://www.futurism.com

Breast cancer: Hundreds of chemicals identified as potential risk factors

2021-07-22

Researchers have identified almost 300 chemicals in everything from hair dye to pesticides that can increase levels of breast cancer-contributing hormones.

Of those chemicals, 219 had not been previously identified as potential carcinogens, Ruthann Rudel, director of research for the Silent Spring Institute and co-author of the new study, told EHN. The findings come in a study out this week in Environmental Health Perspectives.

While scientists have known for decades that higher levels of estrogen and progesterone are linked to breast cancer, experts say that safety screening to test U.S. consumer products rarely looks at how chemicals affect the production of those hormones.

"The way that chemicals are tested now, they are really missing breast-related effects," said Rudel. "We have to do a much better job checking for these effects when we test chemicals."

Environmental chemicals and hormone production

Scientists have historically used animal studies to understand whether chemicals pose a threat to humans. Animal studies take time and money, though, leading researchers and regulators to increasingly use high-throughput tests to more quickly screen chemicals for hormone disruption and other potentially disease-inducing effects. With these high-throughput tests, researchers expose cells and other molecules to chemicals to see whether they trigger any changes.

Researchers from the Silent Spring Institute, a non-profit that studies the environmental causes of breast cancer, decided to look through 2018 EPA ToxCast safety data on roughly 1,800 chemicals to see how many caused cells to increase estrogen and progesterone.

"The way that chemicals are tested now, they are really missing breast-related effects," said Rudel.

CHEMWATCH
Bulletin Board
Gossip
JUL. 30, 2021

Laura Vandenberg, associate professor of environmental health sciences at the University of Massachusetts Amherst who was not involved in the study, told EHN that one of the characteristics toxicologists commonly look for is whether a chemical mimics estrogen. To date, though, there has been little focus on whether chemicals could actually cause cells to produce more estrogen or progesterone.

Rudel and a colleague found that 296 chemicals increased one or both of the hormones. Some of the hormone-increasing chemicals include the pesticide atrazine, the fungicide imazalil, and hair dye ingredient 1-4, benzenediamine. Vandenberg said she was disturbed but not shocked to see that so many of these chemicals increase hormone production in cells as "many of these chemicals (like pesticides) were designed to be biologically active."

The Silent Spring researchers then looked through carcinogen and reproductive toxicity databases, like California's Prop 65 list, to see which of these chemicals were already on those lists. The researchers found that roughly a third had been identified as carcinogenic, toxic to development and reproduction, or both. But they also found that many of the chemicals on their list "hadn't been tested or evaluated," for impacts to those systems, Rudel said.

Scientists have known for some time now that estrogen and progesterone contribute to breast cancer because both hormones stimulate breast cell growth, increasing the risk of uncontrolled cell growth and DNA damage. Around 70% of breast cancer cases respond to these hormones, and treatment for this disease commonly involves using drugs that inhibit estrogen.

"What we know is that a woman's own production of estrogen is actually one of the biggest risk factors for breast cancer," Vandenberg said, adding that early puberty and delayed menopause, which give the body more time to produce estrogen, have been linked to higher rates of breast cancer.

Women's health focus

Rudel said that their list of hormone-increasing chemicals provides a good starting point for both toxicity and human exposure research. "There hasn't been a super systematic approach to what chemicals should be studied in breast cancer (epidemiological) studies," she added.

The researchers also found that even for chemicals that had been previously scrutinized, past risk often didn't look at or dismissed mammary gland impacts. For example, although a multi-generational toxicology study showed that exposure to dichlorophenol, a chemical in some pesticides and disinfectants, stiffened and whitened breast tissue in all doses, the authors of that study didn't take those effects into consideration when determining what a safe dose of that chemical is.

And a lot of the animal tests used by regulators only look at a couple of the hundreds of ducts in the mammary gland, which is "treated as sufficient—and it's not," Vandenberg said.

"My worry is that women's health always gets sort of short shrift, and there's a little bit of an attitude of breast cancer as a disease of the old, and therefore, it's not a priority for regulatory agencies," she said, stressing that no one at those agencies had actually said that.

How to limit your chemical exposure

Researchers also don't have a great sense of how we're exposed to many of the chemicals on the list, Rudel added.

Silent Spring has a mobile app, Detox Me, that allows people to scan consumer product barcodes and other features to try to minimize their exposure to toxic chemicals.

ehn.org, 22 July 2021

https://www.ehn.org

The insect apocalypse: 'Our world will grind to a halt without them'

2021-07-25

I have been fascinated by insects all my life. One of my earliest memories is of finding, at the age of five or six, some stripy yellow-and-black caterpillars feeding on weeds in the school playground. I put them in my empty lunchbox, and took them home. Eventually they transformed into handsome magenta and black moths. This seemed like magic to me – and still does. I was hooked.

In pursuit of insects I have travelled the world, from the deserts of Patagonia to the icy peaks of Fjordland in New Zealand and the forested mountains of Bhutan. I have watched clouds of birdwing butterflies sipping minerals from the banks of a river in Borneo, and thousands

In pursuit of insects I have travelled the world, from the deserts of Patagonia to the icy peaks of Fjordland in New Zealand and the forested mountains of Bhutan.

CHEMWATCH
Bulletin Board
Gossip
JUL. 30, 2021

of fireflies flashing in synchrony at night in the swamps of Thailand. At home in my garden in Sussex I have spent countless hours watching grasshoppers court a mate and see off rivals, earwigs tend their young, ants milk honeydew from aphids, and leaf-cutter bees snip leaves to line their nests.

But I am haunted by the knowledge that these creatures are in decline. It is 50 years since I first collected those caterpillars in the school playground, and every year that has passed there have been slightly fewer butterflies, fewer bumblebees – fewer of almost all the myriad little beasts that make the world go round. These fascinating and beautiful creatures are disappearing, ant by ant, bee by bee, day by day. Estimates vary and are imprecise, but it seems likely that insects have declined in abundance by 75% or more since I was five years old. The scientific evidence for this grows stronger every year, as studies are published describing the collapse of monarch butterfly populations in North America, the demise of woodland and grassland insects in Germany, or the seemingly inexorable contraction of the ranges of bumblebees and hoverflies in the UK.

In 1963, two years before I was born, Rachel Carson warned us in her book Silent Spring that we were doing terrible damage to our planet. She would weep to see how much worse it has become. Insect-rich wildlife habitats, such as hay meadows, marshes, heathland and tropical rainforests, have been bulldozed, burned or ploughed to destruction on a vast scale. The problems with pesticides and fertilisers, she highlighted, have become far more acute, with an estimated 3m tonnes of pesticides now going into the global environment every year. Some of these new pesticides are thousands of times more toxic to insects than any that existed in Carson's day. Soils have been degraded, rivers choked with silt and polluted with chemicals. Climate change, a phenomenon unrecognised in her time, is now threatening to further ravage our planet. These changes have all happened in our lifetime, on our watch, and they continue to accelerate.

Few people seem to realise how devastating this is, not only for human wellbeing – we need insects to pollinate our crops, recycle dung, leaves and corpses, keep the soil healthy, control pests, and much more – but for larger animals, such as birds, fish and frogs, which rely on insects for food. Wildflowers rely on them for pollination. As insects become more scarce, our world will slowly grind to a halt, for it cannot function without them.

Increasingly, most of us live in cities, and grow up seeing few insects other than houseflies, mosquitoes and cockroaches, so the majority of us don't much like insects. Many people are terrified of them. They are

often referred to as "creepy crawlies" or "bugs"; unpleasant, scuttling, dirty creatures, living in filth and spreading disease. Few therefore appreciate how vitally important insects are to our own survival, and fewer still how beautiful, clever, fascinating, mysterious and wonderful insects are.

Insects have been around for a very long time. Their ancestors evolved in the primordial ooze of the ocean floors, half a billion years ago. They make up the bulk of known species on our planet – ants alone outnumber humans by a million to one – so if we were to lose many of our insects, overall biodiversity would of course be significantly reduced. Moreover, given their diversity and abundance, it is inevitable that insects are intimately involved in all terrestrial and freshwater food chains and food webs. Caterpillars, aphids, caddisfly larvae and grasshoppers are herbivores, for instance, turning plant material into tasty insect protein that is far more easily digested by larger animals. Others, such as wasps, ground beetles and mantises, occupy the next level in the food chain, as predators of the herbivores. All of them are prey for a multitude of birds, bats, spiders, reptiles, amphibians, small mammals and fish, which would have little or nothing to eat if it weren't for insects. In their turn, the top predators such as sparrowhawks, herons and osprey that prey on the insectivorous starlings, frogs, shrews or salmon would themselves go hungry without insects.

The loss of insect life from the food chain would not just be catastrophic for wildlife. It would also have direct consequences for the human food supply. Most Europeans and North Americans are repulsed by the prospect of eating insects, which is odd, since we happily consume prawns (which are broadly similar, being segmented, and with an external skeleton). Our ancient ancestors would certainly have eaten insects and, globally, eating insects is the norm. Roughly 80% of the world's population regularly consume them, with the practice very common in South America, Africa and Asia, and among the indigenous peoples of Oceania.

A strong argument can be made that humans ought to farm more insects as an alternative to pigs, cows or chickens. Farming insects is more energy efficient and requires less space and water. They are a healthier source of protein, being high in essential amino acids and lower in saturated fats than beef, and we are much less likely to catch a disease from eating insects (think bird flu or Covid-19). So if we wish to feed the 10-12 billion people who are projected to be living on our planet by 2050, then we should be taking the farming of insects seriously as a healthier source of protein and a more sustainable option to conventional livestock.

CHEMWATCH
Bulletin Board
Gossip
JUL. 30, 2021

While western societies may not eat insects, we do regularly consume them at one step removed in the food chain. Freshwater fish such as trout and salmon feed heavily on insects, as do game birds like partridge, pheasant and turkey.

Aside from their role as food, insects perform a plethora of other vital services in ecosystems. For example, 87% of all plant species require animal pollination, most of it delivered by insects. The colourful petals, scent and nectar of flowers evolved to attract pollinators. Without pollination, wild flowers would not set seed, and most would eventually disappear. There would be no cornflowers or poppies, foxgloves or forget-me-nots. But an absence of pollinators would have a far more devastating ecological impact than just the loss of wild flowers. Approximately three-quarters of the crop types we grow also require pollination by insects, and if the bulk of plant species could no longer set seed and died out, then every community on land would be profoundly altered and impoverished, given that plants are the basis of every food chain.

The importance of insects is often justified in terms of the ecosystem services they provide, which can be ascribed a monetary value. Pollination alone is estimated to be worth between $235bn and $577bn a year worldwide (these calculations aren't very accurate, hence the wide difference between the two figures). Financial aspects aside, we could not possibly feed the growing global human population without pollinators. We could produce enough calories to keep us all alive, since wind-pollinated crops such as wheat, barley, rice and maize comprise the bulk of our food, but living exclusively on a diet of bread, rice and porridge would quickly see us succumb to deficiencies of essential vitamins and minerals. Imagine a diet without strawberries, chilli peppers, apples, cucumbers, cherries, blackcurrants, pumpkins, tomatoes, coffee, raspberries, courgettes, runner beans and blueberries, to name just a few. The world already produces fewer fruit and vegetables than would be needed if everybody on the planet were to have a healthy diet. Without pollinators it would be impossible to produce anywhere near the "five a day" fruit and veg we all need.

Insects are also intimately involved in the breakdown of organic matter, such as fallen leaves, timber and animal faeces. This is vitally important work, for it recycles the nutrients, making them available once more for plant growth. Most decomposers are never noticed. For example, your garden soil – and particularly your compost heap, if you have one – almost certainly contains countless millions of springtails (Collembola). These minute, primitive relatives of insects, often less than 1mm long, are named

for their clever trick of firing themselves as high as 100mm into the air to escape predators. This army of minuscule high-jumpers does an important job, nibbling on tiny fragments of organic matter and helping to break them up into even smaller pieces which are then further decomposed by bacteria, releasing the nutrients for plants to use.

Other insects, the undertakers of the natural world, are similarly efficient at disposing of dead bodies. With uncanny speed, flies such as bluebottles and greenbottles locate corpses within minutes of death, laying masses of eggs that hatch within hours into maggots that race to consume the carcass before other insects arrive. Their relatives, the flesh flies, have an edge in this race, as they give birth directly to maggots, skipping the egg stage entirely. Burying and carrion beetles arrive next and consume both the corpse and the developing maggots. Burying beetles drag the corpses of small animals underground, lay their eggs on them, then remain to care for their offspring. This sequence of events is sufficiently predictable even to be used by forensic entomologists to judge the approximate time of death of human corpses when the circumstances of death are suspicious.

On top of all this, burrowing, soil-dwelling insects help to aerate the soil. Ants disperse seeds, carrying them back to their nests to eat, but often losing a few, which can then germinate. Silk moths give us silk, and honeybees give us honey. In total, the ecosystem services provided by insects are estimated to be worth at least $57bn a year in the US alone, although this is a pretty meaningless calculation since, as EO Wilson once said, without insects "the environment would collapse into chaos" and billions would starve.

The American biologist Paul Ehrlich likened the loss of species from an ecological community to randomly popping out rivets from the wing of an aeroplane. Remove one or two and the plane will probably be fine. Remove 10, or 20 or 50, and at some point that we are entirely unable to predict, there will be a catastrophic failure, and the plane will fall from the sky. Insects are the rivets that keep ecosystems functioning.

Despite dire warnings such as this, insects are far less well studied than vertebrates, and we know essentially nothing about the majority of the 1m species that have so far been named: their biology, distribution and abundance are entirely unknown. Often all we have is a "type specimen" on a pin in a museum, with a date and place of capture. There are estimated to be at least another 4m species we have yet to discover. What a cruel irony it is that, while we are still decades away from cataloguing

CHEMWATCH
Bulletin Board
Gossip
JUL. 30, 2021

the staggering insect diversity on our planet, these creatures are fast disappearing.

The figures are stark. In 2015 I was contacted by the Krefeld Society, a group of entomologists who, since the late 1980s, had been trapping flying insects on nature reserves scattered across Germany. They had amassed insects from nearly 17,000 days of trapping across 63 sites and 27 years, a total of 53kg of insects. They sent me their data to ask for my help in preparing it for publication in a scientific journal. In the 27 years from 1989 to 2016 the overall biomass (ie weight) of insects caught in their traps fell by 75%. In midsummer, when in Europe we see the peak of insect activity, the decline was even more marked, at 82%. I thought initially that there must have been some sort of mistake, because this seemed too dramatic a drop to be credible. We knew that wildlife in general was in decline, but for three-quarters of insects to have disappeared so rapidly suggested a pace and scale of decline that had previously not been imagined.

In October 2019 a different group of German scientists published their findings from a study of insect populations in German forests and grasslands over 10 years from 2008 to 2017. The study's results were deeply troubling. Grasslands fared worst, losing on average two-thirds of their arthropod biomass (the insects, spiders, woodlice and more). In woodlands, biomass dropped by 40%.

What about elsewhere? Is there something peculiar going on in Germany? It seems highly unlikely. Perhaps the best-studied insect populations in the world are the UK's butterflies. They are recorded by volunteers as part of the Butterfly Monitoring Scheme, the largest and longest-running scheme of its kind in the world. The trends it reveals are worrying. Butterflies of the "wider countryside" – common species found in farmland, gardens and so on, such as meadow browns and peacocks – fell in abundance by 46% between 1976 and 2017. Meanwhile, habitat specialists, fussier species that tend to be much rarer, such as fritillaries and hairstreaks, fell by 77%, despite concerted conservation efforts directed at many of them

Worldwide, although the bulk of insect species – the flies, beetles, grasshoppers, wasps, mayflies, froghoppers and so on – are not systematically monitored, we often have good data on population trends for birds that depend on insects for food, and these are mostly in decline. For example, populations of insectivorous birds that hunt their prey in the air (ie the flying insects that have decreased so much in biomass in Germany) have fallen by more than any other bird group in North

America, by about 40% between 1966 and 2013. Bank swallows, common nighthawks (nightjars), chimney swifts and barn swallows have all fallen in numbers by more than 70% in the past 20 years.

In England, populations of the spotted flycatcher fell by 93% between 1967 and 2016. Other once-common insectivores have suffered similarly, including the grey partridge (-92%), nightingale (-93%) and cuckoo (-77%). The red-backed shrike, a specialist predator of large insects, went extinct in the UK in the 1990s. Overall, the British Trust for Ornithology estimates that the UK had 44m fewer wild birds in 2012 compared with 1970.

All the evidence above relates to populations of insects and their predators in highly industrialised, developed countries. Information about insect populations in the tropics, where most insects live, is sparse. We can only guess what impacts deforestation of the Amazon, the Congo, or south-east Asian rainforests has had on insect life in those regions. We will never know how many species went extinct before we could discover them.

Halting and reversing insect declines, or indeed tackling any of the other major environmental threats we face, requires action at many levels, from the general public to farmers, food retailers and other businesses, local authorities and policymakers in government. Here in Britain, recent elections and the Brexit debate have seen precious little serious discussion of the environment, despite the compelling evidence that many of the biggest challenges facing humanity in the 21st century relate to our unsustainable overexploitation of our planet's finite resources.

To save them, we need to act, and act now. We can do this in several ways; some simple, others harder to achieve. First, we need to engender a society that values the natural world, both for what it does for us and for its own sake. The obvious place to start is with our children, encouraging environmental awareness from an early age. We need to green our urban areas. Imagine green cities filled with trees, vegetable gardens, ponds and wild flowers squeezed into every available space – in our gardens, city parks, allotments, cemeteries, on road verges, railway cuttings and roundabouts – and all free from pesticides.

We must transform our food system. Growing and transporting food so that we all have something to eat is the most fundamental of human activities. The way we do it has profound impacts on our own welfare, and on the environment, so it is surely worth investing in getting it right. There is an urgent need to overhaul the current system, which is failing us in multiple ways. We could have a vibrant farming sector, employing many

CHEMWATCH
Bulletin Board
Gossip
JUL. 30, 2021

more people, and focused on sustainable production of healthy food, looking after soil health and supporting biodiversity.

Government organisations responsible for wildlife conservation, such as Natural England, should be properly funded, yet have seen huge budget cuts in recent years. Monitoring schemes and research into understanding the causes of insect declines must also be properly government-funded. And the UK should play a leading role in international initiatives to tackle climate change and biodiversity loss, setting an example of best practice for others to follow.

We must improve legal protection for rare insects and habitats. In the UK most insects have no legal protection at present. For example, the last population of the UK's rarest insect, the pine hoverfly, is threatened by private forestry operations, with no legal recourse. Rare insects should be accorded equal weight to rare birds or mammals. Just because they are small does not make them unimportant.

Our planet has coped remarkably well so far with the blizzard of changes we have wrought, but we would be foolish to assume that it will continue to do so. A relatively small proportion of species have gone extinct so far, but almost all wild species now exist in numbers that are a fraction of their former abundance, subsisting in degraded and fragmented habitats and subjected to a multitude of ever-changing human-made problems. We do not understand anywhere near enough to be able to predict how much resilience is left in our depleted ecosystems, or how close we are to tipping points beyond which collapse becomes inevitable. In Paul Ehrlich's "rivets on a plane" analogy, we may be close to the point where the wing falls off.

theguardian.com, 25 July 2021

https://www.theguardian.com

"We have no hope of finding the missing alive," said Frank Hyldmar, CEO of Chempark operator Currenta.

'No hope' for five missing after blast at German chemical plant as investigators probe cause

2021-07-29

Five people still missing a day after a huge explosion at a German chemical park are unlikely to be found alive, the site operator said on Wednesday, urging residents not to touch possibly toxic soot from the blast.

Key points:

- The cause of the blast at Chempark's waste incineration site remains unknown

- Experts are still probing whether soot particles that came down after the blast may be toxic, with a final report not expected for several days

- Four of the missing are Currenta employees, while the fifth works for an external company

Two people were already confirmed dead in the incident on Tuesday, which also injured 31 others.

"We have no hope of finding the missing alive," said Frank Hyldmar, CEO of Chempark operator Currenta.

"Our thoughts are with the families," he added.

The cause of the Tuesday morning blast at Chempark's waste incineration site in Leverkusen remains unknown, he told a press conference.

The explosion, which was heard several kilometres away and rattled the windows of nearby homes, sent a cloud of black smoke into the air.

The blast also triggered a fire in storage tanks for solvents that took firefighters hours to put out.

Police closed several motorways in the area and residents were told to stay indoors and shut their windows over concerns dangerous gases may have been released.

The warning remained in place for most of Tuesday until city authorities said air pollution measurements had shown no abnormalities.

Fears soot particles could be toxic

Experts are still probing whether soot particles that came down after the blast may be toxic, with a final report not expected for several days.

Currenta chief operating officer Hans Gennen told residents not to touch any residue they might come across and to contact the authorities so samples can be taken.

Locals have also been advised not to eat fruit or vegetables from their gardens, and playgrounds in Leverkusen's Buerrig and Opladen neighbourhoods are temporarily closed.

"We will do everything we can to get to the bottom of this terrible event," Mr Hyldmar said.

CHEMWATCH
Bulletin Board
Gossip
JUL. 30, 2021

Four of the missing are Currenta employees, while the fifth works for an external company, he added.

Of the 31 injured, one is in a serious condition.

All those affected worked at the chemical park.

The area where the blast happened, in Leverkusen's Buerrig district, is a short distance away from Chempark's main industrial park that houses numerous chemical companies including Bayer, Lanxess and Evonik Industries.

A report in Der Spiegel magazine said the blast was measured as far as 40 kilometres away.

abc.net.au, 29 July 2021

https://www.abc.net.au

No life will survive the death of the sun—but new life could be born after, new research suggests

2021-07-22

It's a good situation, for now.

As Earth sails through the solar system, the wind is never at our backs; at every turn, torrents of hot, charged particles called solar wind come streaming out of the sun, crashing into our planet at about 1 million mph (1.6 million km/h).

Lucky for us, Earth's magnetic shield deflects and dismantles the harshest of these winds, allowing little more than a warm breeze to penetrate the planet's atmosphere. For our troubles, we even get to see a colorful light show — the auroras borealis and australis, which shimmer in the sky as runaway solar particles dance toward Earth's magnetic poles.

It's a good situation, for now. But new research suggests that our planet's magnetic shield may not always be so strong — and solar wind will only get more and more powerful as our local star approaches its ultimate demise.

In a study published July 21 in the journal Monthly Notices of the Royal Astronomical Society, a team of astronomers calculated how the intensity of the sun's solar wind will evolve over the next 5-billion-or-so years, when our star runs out of hydrogen fuel to burn and balloons into a tremendous red giant. By then, the sun's wind will become so strong that it will erode Earth's magnetic shield down to nothing, the researchers found. From

there, much of the planet's atmosphere will be blown into space — and with it, all remaining protection from harsh stellar radiation.

Any life on Earth that managed to survive that long will be swiftly eradicated, the authors said.

"We know that the solar wind in the past eroded the Martian atmosphere, which, unlike Earth, does not have a large-scale magnetosphere," study co-author Aline Vidotto, an astrophysicist at Trinity College Dublin, Ireland, said in a statement. "What we were not expecting to find is that the solar wind in the future could be as damaging even to those planets that are protected by a magnetic field."

The sun's final breaths

Billions of years from now, our sun (like all stars in the universe) will eventually run out of the hydrogen that fuels the nuclear reactions in its core. Without this fuel, the sun's core will begin to contract under its own gravity, while the star's outer layers begin to expand. Eventually, the sun will become a red giant — an enormous red orb whose radius extends millions of miles beyond its current boundaries.

As the sun's outer atmosphere expands, it will blaze through every planet in its path. Mercury and Venus will almost certainly be obliterated — and Earth may be too, according to NASA.

After a billion-or-so years of expansion, the sun will collapse into a shriveled white dwarf, dimly smoldering for another few billion years before the lights flicker out completely.

If Earth does manage to survive the sun's violent transformation into a red giant, our planet will be left in a solar system that's very different from how it is today. As the sun's core contracts, its gravitational tug on the planets will weaken, causing any planets that don't get gobbled up to drift about twice as far from the sun as they are today, according to NASA. The radiation oozing out of the red giant sun will also be significantly more intense than it is now.

The authors of the new study wanted to know: How intense will that radiation be, and can Earth's magnetosphere survive the onslaught? In their work, the researchers modelled the winds from 11 different types of stars with masses varying from one to seven times the mass of the sun. The researchers found that, as the sun's diameter expands toward the end of its life, the speed and density of solar wind will fluctuate wildly, alternately expanding and contracting the magnetic fields of any nearby planets.

CHEMWATCH
Bulletin Board
Gossip
JUL. 30, 2021

Ultimately, though, in the models each planet's magnetosphere was always "quashed" by the wind's intensity, the authors wrote in their study. The only way for a planet to maintain its magnetic field throughout the entire course of stellar evolution is if that planet has a magnetic field 100 times stronger than Jupiter's is today — or more than 1,000 times stronger than Earth's — according to the researchers.

"This study demonstrates the difficulty of a planet maintaining its protective magnetosphere throughout the entirety of the giant branch phases of stellar evolution," lead study author Dimitri Veras, an astrophysicist at the University of Warwick in the U.K., said in the statement.

Besides being a fun reminder that life on Earth is doomed, this research has implications for the search for extraterrestrial life. Some astronomers think that white dwarf stars could potentially host habitable planets in their orbit, in part because these "dead" stars create no solar winds. So, if life does exist on an Earth-like planet around a white dwarf star, then that life must have evolved after the star's violent red giant phase ended, the researchers wrote.

In other words, it's extremely unlikely that life on any planet can survive the death of its sun — but new life could spring from the ashes of the old once that sun shrivels up and turns off its violent winds. So, the wind may be against us now, but one day it will be gone. Hopefully, for some worlds out there in the universe, that means new life and smooth sailing.

Originally published on Live Science.

livescience.com, 22 July 2021

https://www.livescience.com

'Record-shattering' heat becoming much more likely, says climate study

2021-07-27

"Record-shattering" heatwaves, even worse than the one that recently hit north-west America, are set to become much more likely in future, according to research. The study is a stark new warning on the rapidly escalating risks the climate emergency poses to lives.

The shocking temperature extremes suffered in the Pacific north-west and in Australia 2019-2020 were "exactly what we are talking about", said the scientists. But they said the world had yet to see anything close to the

The study is a stark new warning on the rapidly escalating risks the climate emergency poses to lives.

worst impacts possible, even under the global heating that had already happened.

The research found that highly populated regions in North America, Europe and China were where the record-shattering extremes are most likely to occur. One illustrative heatwave produced by the computer models used in the study showed some locations in mid-northern America having temperatures 18C higher than average.

Preparing for such unprecedented extremes was vital, said the scientists, because they could cause thousands of premature deaths, and measures taken to adapt to date had often been based only on previous heat records.

Scientists already know that heatwaves of the kind mostly seen today will become more common as the climate crisis unfolds. But heatwaves are usually analysed by comparing them with the past, which means the vast majority are only marginally hotter than before. This can give a false sense of a gradual rise in record temperatures.

The new computing modelling study instead looked for the first time at the highest margins by which week-long heatwave records could be broken in future.

It found that heatwaves that smash previous records by roughly 5C would become two to seven times more likely in the next three decades and three to 21 times more likely from 2051–2080, unless carbon emissions are immediately slashed. Such extreme heatwaves are all but impossible without global heating.

The vulnerability of North America, Europe and China was striking, said Erich Fischer, at ETH Zurich in Switzerland, who led the research. "Here we see the largest jumps in record-shattering events. This is really quite worrying," he added.

"Many places have by far not seen anything close to what's possible, even in present-day conditions, because only looking at the past record is really dangerous."

The study also showed that record-shattering events could come in sharp bursts, rather than gradually becoming more frequent. "That is really concerning," Fischer said: "Planning for heatwaves that get 0.1C more intense every two or three years would still be very worrying, but it would be much easier to prepare for."

CHEMWATCH
Bulletin Board
Gossip
JUL. 30, 2021

Prof Michael Mann, at Pennsylvania State University in the US and not part of the new research, said: "This study underscores something that has been apparent in the record weather extremes we've seen this summer: dangerous climate change is here, and it's now simply a matter of how dangerous we are willing to let it get." Mann's own research published in May showed a possible doubling of heat stress in the US by 2100.

But he said: "If anything, this latest study, and our own, are underestimating the potential for deadly heat extremes in the future, in the absence of significant climate action." That is because current climate models do not capture the slow-moving and very persistent nature of the extreme weather phenomena seen in the Pacific north-west heatwave and German floods recently.

The new research, published in the journal Nature Climate Change, concluded: "Record-shattering extremes are [currently] very rare but their expected probability increases rapidly in the coming three decades."

It found the rate of global heating was critical in increasing the risk, rather than simply the global temperature reached. This indicates that sharp cuts in emissions are needed as soon as possible, rather than emissions continuing and being sucked back out of the atmosphere at a later date.

The scientists used a scenario in which carbon emissions are not reduced, which some experts have argued is unrealistic, given that some climate action is being taken. However, global emissions are not yet falling, bar the blip caused by the coronavirus pandemic, and the researchers argue the scenario remains relevant until CO2 emissions are consistently falling.

The researchers said the rare record-shattering events in the past had huge impacts, such as the Russian heatwave of 2010, which killed 55,000 people and wiped out $15bn of crops, and the European heatwave of 2003, which led to 70,000 early deaths.

"With temperature records being smashed in North America and devastating floods in Europe and China just in the last month, it is clear climate change is affecting the planet," said Vikki Thompson, at Bristol University in the UK. "The need to understand what could happen in the future is vital to allow us to adapt."

"The good news is that we can prevent the worst case shown in this study," she said. If emissions start falling immediately and rapidly, the study showed, the risk of record-shattering extremes is cut by about 80%. "With

Cop26 looming, we must hope that policymakers use evidence like this to show the need for global emissions reductions," Thompson said.

theguardian.com, 27 July 2021

https://www.theguardian.com

Durban chemical fireball puts community health risks and hazard planning in the spotlight

2021-07-25

Chemical explosions and accidents are often associated with remote, low-income or heavily industrialised areas. Faraway places such as Bhopal in India, or the Seveso chemical plant in Italy.

But over the past 10 days or so, the sudden, indiscriminate and potentially deadly risks of such accidents were plain to see much closer to home, as dark clouds of toxic fumes passed unchecked through the front doors and windows of thousands of houses in northern Durban – rich homes, poor homes and middle-income homes. Umhlanga, Mount Edgecombe, Cornubia, Blackburn, Waterloo, Sunningdale and Prestondale, to name just a few.

Large volumes of bright blue, contaminated water also poured into a nearby stream and river, eventually flowing out to sea from the Umhlanga Lagoon, forcing the city to ban swimming and the collection of a wide variety of fish, crayfish and other estuarine and marine creatures that were killed by the poisonous waterborne plume.

Notwithstanding evidence that the new United Phosphorus Limited (UPL) pesticide and agrochemical products warehouse in Cornubia appears to have been torched deliberately at the height of the violence and looting spree in KwaZulu-Natal and Gauteng, tough questions will no doubt be posed shortly to the Mumbai-based agrochemical giant; the property managers and landlords who leased the warehouse to them, as well as the regulatory authorities who approved the storage, pollution control and emergency plans.

Questions include whether the new warehouse was ever classified as a Major Hazard Installation and about the apparent absence or failure of measures to prevent large volumes of contaminated water pouring out into the surrounding environment and the sea.

While no people appear to have died as a result of the explosion, the airborne release of a large but as yet undisclosed quantity of poisonous

Umhlanga, Mount Edgecombe, Cornubia, Blackburn, Waterloo, Sunningdale and Prestondale, to name just a few.

CHEMWATCH
Bulletin Board
Gossip
JUL. 30, 2021

chemicals has sparked concern around the potential health impacts for residents whose lungs and bloodstreams were exposed to a toxic cocktail of airborne fumes and tiny particles of chemically contaminated soot.

Earlier this week, the company refused to release a full list of the chemicals stored at its brand-new storage warehouse in the mixed-use (residential, retail and light-industrial) Cornubia development. According to the company, "Releasing the full list of products stored at the warehouse will not make it any clearer to the public what has actually been released into the environment; what they may have actually inhaled, given numerous other fires in the area, or the levels of exposure or risks. It may instead create unnecessary anxiety."

Yet, according to a list of products marketed online by UPL's South Africa division, the company sells a wide variety of agrochemicals, including several that are toxic to people, animals, fish and other life forms.

Glyphosate, for example, is a herbicide that has been classified as a probable human cancer-causing agent by the International Agency for Research on Cancer (IARC), the expert body that provides advice to the World Health Organization. Other chemical formulations marketed by UPL include 2,4-D (classified by the IARC as possibly carcinogenic to humans); while chlorpyrifos has been recommended for further expert evaluation based on three previous studies in the United States that suggested an increased risk of breast cancer in women and another study that showed a significantly increased risk of prostate cancer among chlorpyrifos workers with a family history of this cancer.

There was anger, too, about the failures or lengthy delays by the company, city and national government health and environmental authorities to provide timeous advice to potentially vulnerable groups such as young children, pregnant mothers, the elderly or people with asthma or heart conditions.

On 17 July, almost five days after the fire began, UPL issued a statement on its website, saying that: "Experts have advised that, as a precautionary measure, people should remain inside if they're in the area of a smoke cloud. People are also advised to cover their eyes and nose by wearing an ordinary mask and glasses over their eyes."

On 19 July, with the airborne chemical fumes still spreading into residential areas, the company issued a further bulletin, stating that it had received expert advice that there was "minimal risk of any long-term effects to the health of people exposed to smoke from the warehouse".

However, it added: "As a precaution, residents who are in contact with the smoke cloud are advised to wear double Covid-19-type surgical or soft cotton masks, of which the outer layer is kept slightly moist to trap particles and fumes."

The national Department of Health appears to have said nothing, despite requests for a public statement, while Barbara Creecy, the Minister of Forestry, Fisheries and the Environment, announced on 21 July that she was sending a team of experts to Durban to assess the situation and lend support.

The team would include technical experts familiar with aquatic systems, epidemiology (health risk assessment), enforcement in waste and pollution issues, and marine compliance.

Though Creecy indicated that there was a joint operations team in place that was "working with the team of specialists appointed by UPL to understand the extent of the impacts", there was no indication that the government had appointed its own team of experts at its own cost, to assess or evaluate the situation independently of UPL-appointed consultants.

Rico Euripidou, a health campaigner and epidemiologist with the groundWork environmental watchdog group, was one of several groups to criticise the company and government authorities for their handling of the accident. Alarmed by the delay by authorities to announce precautionary health advice, Euripidou and University of KwaZulu-Natal occupational and environmental health head Prof Rajen Naidoo took the unusual step of issuing an "unofficial public health warning" on 21 July to affected communities.

They suggested that: "As far as is possible, stay indoors as much as you can, with windows closed, particularly if your home is in the direction of the chemical plume. If you, your child or elderly people with chronic chest and heart disease live in the area of the smoke, and it is at all possible to stay with relatives outside the area for the next few days, then it is advisable to do so."

By then, unfortunately, the toxic air horse had long since bolted from its Cornubia stable and had been swirling through countless homes for

CHEMWATCH
Bulletin Board
Gossip
JUL. 30, 2021

several days – while thousands of fish and other creatures were long since dead.

dailymaverick.co.za, 27 July 2021

https://www.dailymaverick.co.za

This butterfly is the first U.S. insect known to go extinct because of people

2021-07-20

It's been roughly 80 years since the Xerces blue butterfly was last spotted flitting about on pastel wings across coastal California sand dunes. But scientists are still learning about the insect.

New research on DNA from a nearly century-old museum specimen shows that the butterfly was a distinct species. That finding means that the Xerces blue butterfly (Glaucopsyche xerces) is the first U.S. insect species that scientists recognized went extinct because of humans, researchers report July 21 in Biology Letters. There are insects that went extinct earlier, like the Rocky Mountain locust (Melanoplus spretus), that scientists have strong suspicions that humans were to blame for the extinction. But for this butterfly, there was no question at the time.

Its rapid disappearance is attributed to the loss of habitat and native plant food as a result of urban development and, possibly, an influx of invasive ants likely spread though the shipment of goods.

The butterfly used to live only on the San Francisco Peninsula. But by the early 1940s, less than a century after its formal scientific description in the 1850s, the gossamer-winged butterfly had vanished. Its rapid disappearance is attributed to the loss of habitat and native plant food as a result of urban development and, possibly, an influx of invasive ants likely spread though the shipment of goods.

But it's long been unclear if the Xerces blue butterfly was its own species, or simply an isolated population of another, more widespread species of blue butterfly, says Corrie Moreau, an entomologist at Cornell University.

To find out, Moreau and colleagues turned to a 93-year-old Xerces specimen housed at Chicago's Field Museum, extracting DNA from a tiny bit of the insect's tissue. Despite the DNA being degraded from age, the team could compare selected Xerces genes with those of other closely related blue butterflies. The researchers also compared the genomes, or genetic instruction books, of the insects' mitochondria — cellular structures involved in energy production that have their own set of DNA.

Using the genes and the "mitogenomes," the researchers crafted an evolutionary tree, showing how all of the butterfly species are related to

each other. The extinct Xerces blue butterfly was genetically distinct, thus warranting classification as a species, the team found.

"We sort of lost a piece of the biodiversity puzzle that made up the tapestry of the San Francisco Bay area when this species was driven to extinction," Moreau says.

Akito Kawahara, a lepidopterist at the Florida Museum of Natural History in Gainesville not involved with the study, thinks the results are "fairly convincing" that the Xerces blue butterfly was its own species.

The butterfly is considered a candidate for resurrection, Moreau says, where extinct species are brought back via cloning or other genetic manipulations (SN: 10/20/17). But she cautions against it. "Maybe we should spend that time and energy and money on ensuring that we protect the blues that are already endangered that we know about," she says.

One of these insects is the endangered El Segundo blue (Euphilotes battoides allyni), native to the Los Angeles area. It and other butterfly populations are increasingly imperiled by numerous threats, such as climate change, land-use changes and pesticide use (SN: 8/17/16).

For Felix Grewe, an evolutionary biologist at the Field Museum, the new finding illustrates why long-term museum collections are so important: Specimens' true utility may not be clear for many years. After all, the genetic techniques used in the study to illuminate the Xerces blue butterfly's true identity didn't exist when the insect went extinct.

"You don't know what technology there [will be] 100 years from now," Grewe says.

sciencenews.org, 20 July 2021

https://www.sciencenews.org

Michelangelo's fingerprint possibly found on butt of wax statue

2021-07-26

A 500-year-old wax sculpture attributed to Michelangelo might hold the famed Renaissance artist's fingerprint, a new analysis finds.

Michelangelo reportedly created the wax sculpture as a study for a larger sculpture he planned for St. Peter's Basilica in the Vatican, according to a statement from BBC Two, which just released the new season of "Secrets of the Museum" featuring the figurine. However, the larger sculpture was never completed, and now the model belongs to the Victoria and Albert Museum, or the V&A, in London.

"It is an exciting prospect that one of Michelangelo's prints could have survived in the wax," Peta Motture, a senior curator at the V&A, said in the statement.

Called "A Slave," the wax figurine had been on display, but curators moved it from an upper-level gallery during the unusually warm spring in 2020 to a cooler storage area when the museum temporarily closed during the COVID-19 pandemic, according to The Times. Five months later, curators checked up on the figurine in storage, and they noticed a never-before-seen fingerprint or thumbprint on the sculpture's derrière.

PLAY SOUND

Perhaps the changing temperatures and humidity levels modified the figurine's wax composition, which made the print more apparent, art scholars told the Times. Given that Michelangelo reportedly created the sculpture, it's possible that the fingerprint is his.

"It is an exciting prospect that one of Michelangelo's prints could have survived in the wax," Peta Motture, a senior curator at the V&A, said in the statement. "Such marks would suggest the physical presence of the creative process of an artist. It is where mind and hand somehow come together."

Michelangelo destroyed many of his wax models before he died, Motture said. In fact, just before his death at age 88 in Rome in 1564, Michelangelo had many of his drawings and papers burned in two bonfires; he had other drawings burned in 1518, according to The New York Times. It's unknown why he ordered his work burned, but renaissance biographer Giorgio Vasari opined that maybe Michelangelo didn't want people to know the supreme effort he put into his work, as he wanted to appear as a genius whose work was perfect. Or, perhaps Michelangelo burned his work to prevent plagiarism, The New York Times reported.

Because so much of Michelangelo's work was destroyed, "a fingerprint would be a direct connection with the artist," Motture said.

That said, many of Michelangelo's masterpieces — including the paintings on the Sistine Chapel and the statues of Pietà and David — are on display for the public.

While in Florence, Italy, Michelangelo made the 7-inch-tall (17.6 centimeters) figurine with the fingerprint, some time between 1516 and 1519. Later, he used the figurine as a model to create the marble statue

"Young Slave," which is unfinished. This larger statue was designed for the tomb of Pope Julius II. But the design for the pope's tomb was later changed, and so now the unfinished statue — which has a few differences from the earlier model — sits at the Accademia gallery in Florence, according to the V&A.

"A Slave" was acquired in 1854 by the Museum of Ornamental Art at Marlborough House, which later became the V&A. In 1924, a member of the public fell and knocked over the figurine, smashing its limbs, The Telegraph reported. The museum carefully pieced it back together, and did a "pretty amazing" repair job, Victoria Oakley, a conservator at the V&A, told The Telegraph. But after the accident, additives that the artist, presumably Michelangelo, imbibed in the wax began to seep out, which created a dark spot on the surface, she said.

To check the claim that the finger or thumb print on the figurine's rear is really Michelangelo's, V&A staff plan to compare it with a fingerprint on a 1530 terracotta statue known as "Two Wrestlers," which is known to have a fingerprint from Michelangelo, the Times reported.

The BBC Two documentary "Secrets Of The Museum" first aired July 20 and will run for the next six weeks.

Originally published on Live Science.

livescience.com, 26 July 2021

https://www.livescience.com

Ignoring climate change will yield 'untold suffering,' panel of 14,000 scientists warns

2021-07-28

Nearly 14,000 scientists have signed a new climate emergency paper, warning that "untold suffering" awaits the human race if we don't start tackling global warming head-on, effective immediately.

The new paper, published July 28 in the journal BioScience and led by researchers from Oregon State University, is an update of a 2019 paper that declared a global "climate emergency" and evaluated Earth's vital signs based on 31 variables — including greenhouse gas emissions, surface temperature changes, glacial ice mass loss, Amazon rainforest loss, plus various social factors like global gross domestic product (GDP) and fossil fuel subsidies.

CHEMWATCH
Bulletin Board
Gossip
JUL. 30, 2021

Greenhouse gas emissions are at an all-time high, while glacial ice thickness is at its lowest point in 71 years of record keeping, the report found.

Unsurprisingly, the authors of the new paper find that Earth's vitals have only deteriorated over the last two years, with 18 of the report's 31 categories showing new all-time record highs or lows, the authors wrote. Greenhouse gas emissions are at an all-time high, while glacial ice thickness is at its lowest point in 71 years of record keeping, the report found. The world is richer than it's ever been (measured by global GDP), while the sky is more polluted than ever (measured by carbon dioxide, methane and nitrous oxide concentrations in the atmosphere).

"The updated planetary vital signs we present reflect the consequences of unrelent¬ing business as usual," the authors wrote in the study. "A major lesson from COVID-19 is that even colossally decreased transportation and con-sumption are not nearly enough and that, instead, transformational system changes are required, and they must rise above politics."

While the report includes some positive trends — like record increases in the use of solar and wind energy, and institutions divesting money from the fossil fuel industry — it paints a generally bleak picture of the future, accentuated by ongoing surges in climate-related disasters like floods, hurricanes, wildfires and heat waves, the authors wrote. The planet may also be about to pass (or has already passed) critical natural tipping points — such as the Amazon rainforest becoming a carbon source rather than a carbon sink — from which it will be hard to recover, the team added.

This all boils down to one conclusion: The future habitability of our planet depends on immediate, large-scale action, the authors wrote.

To accomplish this task, the team suggests a three-pronged near-term policy approach: 1) Implement a "significant" global carbon price to reduce emissions; 2) phase out and eventually ban fossil fuels; and 3) restore and protect key carbon-rich ecosystems, like forests and wetlands, to preserve the planet's largest carbon sinks and protect biodiversity.

"Implementing these three policies soon will help ensure the long-term sustainability of human civiliza¬tion and give future generations the opportunity to thrive," the authors wrote. "The speed of change is essential, and new climate policies should be part of COVID-19 recovery plans."

The researchers plan to release another planetary "check-in" in the coming years. Hopefully, that future report will show more signs of positive change as more nations take the severity of climate change seriously. Or, perhaps it will reflect the collapse of society. Time — and political action — will tell.

Originally published on Live Science.

livescience.com, 28 July 2021

https://www.livescience.com

Can we stop Earth from heating up?

2021-07-21

In 2021, Earth reached a bleak milestone: The concentration of carbon dioxide (CO2) in the atmosphere hit 150% of its value in preindustrial times, according to the U.K. Met Office. To prevent the worst effects of climate change, the world needs to decrease net emissions of carbon dioxide to zero by 2050.

But even if we were to achieve this goal, it wouldn't put a sudden brake on the temperature rise, because it takes time to see the effects of CO2 reductions on global temperatures; the negative impacts of global warming will continue for decades. But is there anything else we can do to reduce temperatures more quickly?

A research group at Harvard University thinks it might be possible to achieve a temporary reduction in global temperatures by tweaking the composition of Earth's upper atmosphere. Researchers were hoping to test some of that technology — and the viability of their theory — this summer, in what they call the Stratospheric Controlled Perturbation Experiment (SCoPEx). Although the work has been put on hold, the team is still hoping the experiment will go ahead in the not-too-distant future.

But is there anything else we can do to reduce temperatures more quickly?

The ultimate source of Earth's heat is the sun, which bathes the daytime side of the planet in a constant flow of infrared radiation. About 30% of this is reflected back into space by the atmosphere, while the rest warms the planet during the day and is radiated back into space at night. In the delicate balance that prevailed in preindustrial times, the incoming heat was exactly offset by the amount lost to space, ensuring average global temperatures remained constant.

PLAY SOUND

The problem today is that CO2 emissions disrupt this balance by absorbing some of the heat that should be radiated back into space, trapping it inside the atmosphere. The more carbon dioxide there is in the atmosphere, the more the temperature rises. In the long term, humans must reduce the amount of carbon dioxide in the atmosphere to prevent the worst effects of climate change. But other processes can produce short-term reductions in global temperature.

Volcanic eruptions, for instance, blast clouds of dust particles high up into the stratosphere, an upper layer of the atmosphere, forming a protective shield that prevents some of the sun's heat from reaching Earth's surface.

The 1991 eruption of Mount Pinatubo in the Philippines, for example, caused the average temperature in the Northern Hemisphere to drop by about 1 degree Fahrenheit (more than half a degree Celsius) over the following 15 months. The SCoPEx team wants to take a page from such eruptions by injecting particles into the upper atmosphere in order to lower temperatures.

The basic idea — called stratospheric aerosol injection, or SAI — is simple. A high-flying aircraft or helium balloon would dispense batches of microscopic particles called aerosols into the stratosphere at altitudes of 12.4 miles (20 kilometers) or more — much higher than planes usually fly. The aerosols would remain suspended in the air, too tiny to be visible as clouds from the ground but opaque enough to reflect a fraction of the sun's energy back into space.

In simulations, SAI appears to be a viable concept. A2018 Intergovernmental Panel on Climate Change (IPCC) report found that a fleet of high-flying aircraft could deposit sufficient aerosols to offset current levels of global warming. But the aerosols would have to be replenished every few years, and the method tackles only one of the symptoms of climate change rather than addressing its root cause, the greenhouse effect. At best, it's a stopgap measure, countering rising temperatures while countries simultaneously reduce carbon dioxide levels.

So far, the research into SAI has been theoretical, supplemented by a limited amount of real-world data from volcanic eruptions. SCoPEx wants to make real-world measurements under carefully controlled conditions, allowing better calibration of the computer models. "If we are to provide decision-makers with useful information about whether this could work, we need to ground-truth our models," the project's principal investigator, Frank Keutsch, in the Department of Chemistry and Chemical Biology at Harvard University, told the Boston Globe.

Volcanoes mainly eject sulfur-based compounds. But these compounds not only cool the atmosphere but also damage Earth's protective ozone layer, which shields us from harmful UV radiation. So the SCoPEx team is focusing on a less harmful aerosol, calcium carbonate — chalk dust, in other words — which researchers hope will produce the desired cooling effect without harming the ozone layer.

Proposed experiment

The team wants to deploy a large, uncrewed helium balloon that would be similar to a standard weather balloon except that it would be fitted with

CHEMWATCH
Bulletin Board
Curiosities
JUL. 30, 2021

propellers to allow the team on the ground to maneuver it in a controlled way. With assistance from the Swedish Space Corporation, scientists were planning to launch the balloon near Kiruna, Sweden.

On its first flight, which is tentatively planned for next year, the balloon would not release anything into the stratosphere. Instead, it would ascend to an altitude of 12.4 miles, where the team would test the maneuvering system and check that all the scientific instruments and communications function correctly.

If the test run were to be successful, a second flight would perform a controlled release of 2.2 to 4.4 pounds (1 to 2 kilograms) of calcium carbonate at the same altitude. The balloon would be moving steadily in a straight line during the release, so the aerosol particles would form a narrow plume around 0.6 miles (1 km) in length. The balloon would then turn back through the plume, observing how the particles disperse over time and the extent to which they reflect sunlight, according to the SCoPEx website.

As valuable as the SCoPEx test flight would be for our understanding of SAI, it's important to see the project in perspective. "The goal is not to change the climate or even to see if you can reflect any sunlight," one of the project scientists, David Keith, a professor of Applied Physics at Harvard, previously told HowStuffWorks. "The goal is simply to improve our models of the way aerosols form in the stratosphere."

At least another decade of research will be needed before a large-scale aerosol release, Keith said. The release "might involve injecting around 1.5 million tons [1.4 million metric tons] into the stratosphere per year," he said. "Roughly a hundred aircraft would need to continuously fly payloads up to about 12 miles [20 km] altitude."

The controversy

SAI remains highly controversial, however. One concern is that humans created the climate crisis in the first place by pumping greenhouse gases into the atmosphere, so how can people be sure that pumping aerosols into it will make things better? Although computer modeling suggests SAI is safe, there's still the possibility that it might have unforeseen side effects. There is the possibility that it could disrupt weather patterns, harm crops by reducing the amount of sunlight they receive, and — if sulfide aerosols are used — damage the ozone layer.

Indeed, some scientists are wary of following the SAI route.

"That we might actually try to control the entire climate is a pretty terrifying idea," Douglas MacMartin, a senior research associate and senior lecturer in mechanical and aerospace engineering at Cornell University and a research professor in computing and mathematical sciences at the California Institute of Technology, told Smithsonian magazine. And the IPCC, in a 2018 discussion of what the panel referred to as solar radiation modification (SRM), concluded that "the combined uncertainties, including technological maturity, physical understanding, potential impacts, and challenges of governance, constrain the ability to implement SRM in the near future."

Because of these concerns, the SCoPEx team put off their helium balloon's maiden voyage "until a more thorough societal engagement process can be conducted to address issues related to solar geoengineering research in Sweden."

But Keith argued that the real danger lies in some maverick organizations implementing SAI without the kind of scientific data SCoPEX wants to get. The second big objection to SAI research is that governments and corporations that are already reluctant to reduce carbon dioxide emissions will latch onto SAI as proof that such reductions are unnecessary.

That situation could negate any potential benefits of SAI..Even if the SCoPEx mission is successful and SAI is fully implemented, it will only supplement, not replace, carbon dioxide reduction. Lizzie Burns, managing director of Harvard's Solar Geoengineering Research Program, offered a vivid analogy: "It's like a painkiller. If you need surgery and you take pain medication, it doesn't mean you no longer need surgery.

livescience.com, 21 July 2021

https://www.livescience.com

Can masturbating impact the immune system?

2021-07-28

Masturbation is a normal, healthy activity — yet myths about it still abound. That is partly because this activity is, even today, highly stigmatized in many societies around the world, perhaps because it can be pursued outside of heteronormative, monogamous relationships.

Meanwhile, studies suggest that the pleasure of masturbation can bring various health benefits, including stress relief, improvements in mood, and pain relief, including the relief of menstrual cramps.

There is also some anecdotal evidence that links masturbation with either increased or decreased immunity.

CHEMWATCH
Bulletin Board
Curiosities
JUL. 30, 2021

There is also some anecdotal evidence that links masturbation with either increased or decreased immunity. What does the research say about this, and is there enough evidence one way or the other? We investigate.

Can male masturbation boost immunity?

The studies that look at the potential impact of masturbation on the immune system are few and far between. Moreover, they are affected by the gender data gap, so there is almost no information about the alleged effect as far as female bodies are concerned.

One study from 2004 — published in the journal NeuroimmunomodulationTrusted Source — asked 11 male volunteers to masturbate until orgasm. The researchers drew blood from these participants as they were masturbating, as well as during a control set-up, when no sexual activity was involved.

They then measured the presence of various markers of immune system activity in the blood — leukocytes, lymphocytes, lipopolysaccharide-induced interleukin 6, and tumor necrosis factor alpha — during control conditions, as well as before orgasm, and at 5 and 45 minutes after the volunteers achieved orgasm through masturbation.

The study found that masturbation temporarily increased the activity of some components of the immune system, namely leukocytes, and in particular natural killer cells, which fight cancer tumor cells and cells infected by viruses.

Throughout the years, many media outlets have cited this study to support the idea that masturbation could help improve the immune response — yet health experts warn that the findings should be taken with more than a pinch of salt.

"First, a sample of 11 individuals is not good enough" to prove that masturbation benefits immune function, Dr. Jagdish Khubchandani, a professor of public health at New Mexico State University, told Medical News Today.

"Second, there are no repeat trials on these individuals," he cautioned.

"Third, they are healthy volunteers, which could cause bias and [a] lack of generalizability — e.g., to different age groups and people with disease histories. Fourth, it is not easy to [determine] if masturbation causes [a] spike in immunoprotective molecules or [if this is due to] the accompanying reduction in stress."

– Dr. Jagdish Khubchandani

"Finally," Dr. Khubchandani emphasized, "the bigger concern is about the transient rise in immune markers that could not guarantee long-term immunity enhancement or protection from diseases."

While the authors of the initial study conducted a "follow-up," this research did not include the original participants, nor did it focus on masturbation, specifically. The new study, published in European UrologyTrusted Source in 2016, included self-reported data from 31,925 male participants who answered questionnaires about ejaculation frequency over a period of 18 years.

The research aimed to confirm whether there was a correlation between the frequency of ejaculation and the risk of prostate cancer. It did, indeed, find a "beneficial association" between more frequent ejaculation and a lower risk of prostate cancer.

However, as the study authors acknowledged, there were limitations, including the fact that self-reported data can be inaccurate and incomplete and that "The literature exploring the role of sexual activity in the etiology of [prostate cancer] is inconsistent."

Sex-based differences

If research into the effects of masturbation on the immunity of male bodies is limited and inconsistent, research into these possible effects on female bodies is even more lacking.

Only one study, published in The Journal of Sexual MedicineTrusted Sourcein 2014, appears to have looked at whether and how sexual activity, including masturbation, in females might influence their immune response.

This research analyzed data from two cohorts that included both male and female participants. It specifically focused on the link between parameters of depression and sexual activity, and how their interaction might influence immunity.

The study concluded that in female participants with high levels of depression, partnered sexual activity resulted in lower markers of immunity. However, the frequency of masturbation was not associated with immunity markers.

CHEMWATCH
Bulletin Board
Curiosities
JUL. 30, 2021

Many questions remain unanswered, including those about the potential relationship between depression, various forms of sexual activity, and immunity in females.

Why might masturbation influence immunity?

According to the limited data provided by the studies on male masturbation, the act of self-pleasuring appears to boost immune cell activity.

Dr. Jerry Bailey, who specializes in men's health and holistic health practices, explained to MNT that "The increase in arousal state and release of hormones during and after orgasm boosts immune cells and hormones."

"This effect," he claimed, "can last up to 24 hours post-orgasm. However, the greatest of benefits are within 60 minutes of orgasm."

Are any of these possible benefits enough to help prevent viral infections? Health experts emphasize that, as appealing as the idea might be, masturbation does not have a strong enough influence on the immune system to help it keep pathogens at bay.

"Masturbation is not for long-term or sustained immunity development," Dr. Khubchandani stressed.

He did, however, acknowledge that masturbating can bring some other benefits, such as "help[ing] with good sleep, stress relief, [and] mood elevation."

medicalnewstoday.com, 28 July 2021

https://www.medicalnewstoday.com

Should rivers have the same rights as people?

2021-07-25

The Magpie River winds majestically through the forests of Quebec for nearly 200 miles. Its thundering ribbon of blue is cherished by kayakers, white-water rafters and the indigenous Innu people of Ekuanitshit. Earlier this year, in a first for Canada, the river was granted legal personhood by local authorities, and given nine rights, including the right to flow, the right to be safe from pollution – and the right to sue.

Uapukun Mestokosho, a member of the Innu community who campaigned for the recognition of the Magpie's rights said spending time on the river was "a form of healing" for indigenous people who could

The Magpie is one of a growing number of rivers to be recognised as a living entity across the world.

revive their traditional land-based practices that had been abandoned during the violence of the colonial era. "People are suffering a lot, with intergenerational traumas linked to the past," Mestokosho told CBC. As well as this benefit for people, she said that her ancestors had always protected the Magpie, known as the Muteshekau-shipu, in the past, and a recognition of its rights would help protect it for future generations.

The Magpie is one of a growing number of rivers to be recognised as a living entity across the world. The burgeoning rights-of-nature movement is pushing local, national and international authorities to recognise natural features – from lakes to mountains – in law, giving them either legal personhood or an independent right to flourish.

Giving rivers the status of people – or more – in courts of law is enlivening environmentalism around the world. Ecuador started the movement when it enshrined rights of nature in its constitution in 2008. Countries such as Bolivia, Mexico and Colombia have created comparable legal mechanisms to protect nature, while New Zealand, Australia and Bangladesh have acted to protect rivers. In the United States, residents of Toledo drew up a bill of rights for Lake Erie. But can legal rights for nature protect it in reality? Who decides when a river can sue? Does it diminish the power of nature to squeeze it into the western legal system? Or do nature's rights challenge the very foundations of capitalism?

Western legal thinkers began probing the prevalent Enlightenment assumption that natural objects were simply property to be exploited in 1972 when a young professor of legal philosophy, Christopher Stone, argued that the environment should be considered as a subject and given legal personhood – as granted to corporations, for instance – with human guardians able to seek legal redress if a natural feature is damaged or destroyed. Today's movement was ignited in 2017 when an act of parliament in New Zealand granted the whole Whanganui River rights as an independent entity, considering it an indivisible whole from source to sea. This was part of the treaty settlement between the government and the Māori people. Guardians were appointed to act and speak on behalf of the river and enforce its rights.

But what is a river? Most would say not its banks but its flowing water. Unfortunately, the "elephant in the room," says Dr Erin O'Donnell of the University of Melbourne and author of a book on rights for rivers, is the fact that none of the rivers legally recognised as living beings or legal persons actually have any rights to the water that flows within their banks.

CHEMWATCH
Bulletin Board
Curiosities
JUL. 30, 2021

"There is increasingly an attempt to give rivers a right to flow and so the Magpie River in Canada has got the right to flow, but how you enforce that right is very unclear," says O'Donnell. "And if that's not actually embedded within water law, which it isn't yet, then it's probably not worth the paper it's written on."

In New Zealand, the Whanganui treaty did not address this key issue, with a water company continuing to divert 80% of the river's flow for hydropower until its licence expires in 2039. If this fact makes rights for rivers appear to be symbolism without legal teeth, O'Donnell and others argue that the concept still possesses real transformative power. In Canada, David Boyd, a professor of law and the UN Special Rapporteur on Human Rights and Environment, has said that legal personhood could succeed where decades of environmental laws have failed, kickstarting a cultural shift away from conceiving of nature as a "warehouse of commodities for human use".

In Australia, that shift is underway with regards to the Yarra, believes O'Donnell. The Yarra was recognised as a living, integrated entity as its traditional owners, the Wurundjeri people, had always known it, in a state act of parliament in 2017. Unlike Lake Erie and other locations in North America, the Yarra has not been made a legal person. "The upside of having legal personality is that you do have extra legal powers, so a river that is a legal person can go to court. The downside is that you immediately focus people's attention on those rights and powers and expect the river to start using them," says O'Donnell. "One of the first questions that I get asked almost every time I speak publicly about the issue of rivers having rights is, 'Can we sue the river when it floods?'" As soon as Lake Erie was granted rights in the United States, farmers – concerned that measures to stop fertilisers running into the lake would threaten their businesses – challenged it in court.

Having the Yarra recognised as a living entity sounds like a weaker step than legal personhood, but it still has "the most transformative potential in terms of the way that people relate to the river," argues O'Donnell. Until very recently, the river was a resource to exploit: a source of water, a stormwater drain and a sewer. "When we see the river as a living being, is that when we start to say, hang on, what do we want for the river? That's the genuine conversational shift I'm seeing with the Yarra away from this western resource extraction model to seeking a partnership with the river in its own management."

Some rights-of-nature sceptics argue that it simply can't fit into western law, which upholds capitalism, property rights and extracting profit from the Earth's resources. After Ecuador incorporated rights of nature into its constitution, in 2011 a provincial court ruled in favour of the Vilcabamba River against damaging road construction. The river won in court but the developer didn't actually take the action required to remediate the pollution. Ecuador's courts have since held more than three dozen lawsuits in the name of nature. Many have been successful but verdicts have not always been enforced on the ground.

In India, a state high court tried to give the Ganges and Yamuna River legal personhood in 2017, but the decision was appealed to the supreme court. Campaigners are still waiting for the verdict while the rivers continue to be polluted and exploited.

Rights of nature are being asserted most powerfully in post-colonial countries where indigenous people strive to protect traditional lands. But some indigenous campaigners view legal personhood and "rights" for nature as western constructs. "The use of rights doesn't quite fit into the teachings of many indigenous people," says Michelle Bender of the Earth Law Center, an influential co-operative based in the United States. "Nature is the source of life, it's already an entity to be respected and so some people say we don't need this recognition of rights. To be clear, the rights of nature movement is learning from an indigenous worldview rather than the other way around. The use of rights of nature can help to reorient the law around indigenous relationships and responsibilities to nature."

Europe lags behind other continents where indigenous people have challenged western concepts of owning and exploiting nature. In Britain, nature's rights briefly emerged in 2018 when Frome town council, run by community-minded independent councillors, proposed to pass a bylaw recognising the rights of their stretch of the River Frome and water-meadows to remain pollution-free. Belatedly, in 2020, central government said that the council could not pass its bylaw because they judged it duplicated existing environmental protections.

Mumta Ito, the founder of Nature's Rights and a former environmental lawyer based in Scotland, says it is not possible to make local laws in Britain as municipalities can in North America. "Then you get the backlash, the voices that say it doesn't work," she says. "Of course it doesn't work. How can one part of the River Frome have rights when the stretch flowing through the next county doesn't? All you can achieve with these local-level laws is raise awareness."

CHEMWATCH
Bulletin Board
Curiosities
JUL. 30, 2021

Ito argues that we can't simply drop the rights of nature into the current legal system, but require much more fundamental change. Ultimately the law must recognise that nature's rights come first, followed by human rights and then corporate rights because without living systems such as clean water, air and fertile soils there is no human life. "We are an intrinsic part of nature and our human right to life emanates from the rights of nature. All human rights exist because of nature. It's irrational to say we have rights to life or property rights if nature's rights are not achieved. But we have an economic system that undermines the natural system that we come from."

Such radical legal changes would probably require us to uproot established western concepts of property rights, individualism and ceaseless economic growth. "Where do we start?" says Ito. "We should start with common sense. People becoming connected with nature is really going to help. All of us have experienced how good we feel being in the forest or by the sea. It's hard to get people to care about something if they don't make the connection."

Rather than battling at a local level in Britain, Ito is examining how the EU could recognise rights of nature. Ito says EU commissioners and legislators are paying attention. "At least they are willing to hear what we've got to say."

Other rights of nature advocates are also setting their sights higher. Rivers cross state and national borders and most are boundary-less, ultimately flowing into the sea. Protecting oceans looks a particularly daunting task, but Michelle Bender argues that it may be easier to assert nature's rights here because no one owns the high seas. Rights of nature don't conflict with property rights so oceans could more easily be recognised as an independent legal entity. "The ocean would own herself and decisions would be made considering her wellbeing and impact on all life, rather than just the piecemeal approach that's currently used," says Bender. There could be a seat for the ocean at the UN or a council of ocean guardians who are legally responsible for representing the ocean's needs. They could set standards for a "healthy" ocean.

In some respects, new rights of nature laws resemble the "net zero" emissions targets set by governments, councils and corporations: worthy aspirations yet to translate into decisive action and change in real life. There is also a chicken-and-egg element to this debate: can law change popular consciousness or is it doomed to fail if it doesn't simply prop up existing values?

Campaigners believe the law can and does change the way we think. For Ito, her ambitious pursuit of rights for nature is not nearly as frustrating as her years as an environmental lawyer seeking to defend nature using inadequate existing structures. "At least on this I'll be able to look my grandchildren in the eye and say I did what I could," she says. "The changes in the legal system deeply affect the psyche. If the law says I'm in relationship with the ocean and the river then it won't be long before people start behaving as if we are interconnected with the other life forms on the planet."

theguardian.com, 25 July 2021

https://www.theguardian.com

How intricate Venus's-flower-baskets manipulate the flow of seawater

2021-07-21

A Venus's-flower-basket isn't all show. This stunning deep-sea sponge can also alter the flow of seawater in surprising ways.

A lacy, barrel-shaped chamber forms the sponge's glassy skeleton. Flow simulations reveal how this intricate structure alters the way water moves around and through the sponge, helping it endure unforgiving ocean currents and perhaps feed and reproduce, researchers report online July 21 in Nature.

Previous studies have found that the gridlike construction of a Venus's-flower-basket (Euplectella aspergillum) is strong and flexible. "But no one has ever tried to see if these beautiful structures have fluid-dynamic properties," says mechanical engineer Giacomo Falcucci of Tor Vergata University of Rome.

Harnessing supercomputers, Falcucci and colleagues simulated how water flows around and through the sponge's body, with and without different skeletal components such as the sponge's myriad pores. If the sponge were a solid cylinder, water flowing past would form a turbulent wake immediately downstream that could jostle the creature, Falcucci says. Instead water flows through and around the highly porous Venus's-flower-basket and forms a gentle zone of water that flanks the sponge and displaces turbulence downstream, the team found. That way, the sponge's body endures less stress.

Previous studies have found that the gridlike construction of a Venus's-flower-basket (Euplectella aspergillum) is strong and flexible.

CHEMWATCH
Bulletin Board
Curiosities
JUL. 30, 2021

Ridges that spiral around the outside of the sponge's skeleton also somehow cause water to slow and swirl inside the structure, the simulations showed. As a result, food and reproductive cells that drift into the sponge would become trapped for up to twice as long as in the same sponge without ridges. That lingering could help the filter feeders catch more plankton. And because Venus's-flower-baskets can reproduce sexually, it could also enhance the chances that free-floating sperm encounter eggs, the researchers say.

It's amazing that such beauty could be so functional, Falcucci says. The sponge's flow-altering abilities, he says, might help inspire taller, more wind-resistant skyscrapers.

sciencenews.org, 21 July 2021

https://www.sciencenews.org

4 bizarre Stephen Hawking theories that turned out to be right (and 6 we're not sure about)

2021-07-23

Stephen Hawking was one of the greatest theoretical physicists of the modern age. Best known for his appearances in popular media and his lifelong battle against debilitating illness, his true impact on posterity comes from his brilliant five-decade career in science. Beginning with his doctoral thesis in 1966, his groundbreaking work continued nonstop right up to his final paper in 2018, completed just days before his death at the age of 76.

Hawking worked at the intellectual cutting edge of physics, and his theories often seemed bizarrely far-out at the time he formulated them. Yet they're slowly being accepted into the scientific mainstream, with new supporting evidence coming in all the time. From his mind-blowing views of black holes to his explanation for the universe's humble beginnings, here are some of his theories that were vindicated … and some that are still up in the air.

The Big Bang wins

Hawking got off to a flying start with his doctoral thesis, written at a critical time when there was heated debate between two rival cosmological theories: the Big Bang and the Steady State. Both theories accepted that the universe is expanding, but in the first it expands from an ultra-compact, super-dense state at a finite time in the past, while the second

Hawking worked at the intellectual cutting edge of physics, and his theories often seemed bizarrely far-out at the time he formulated them.

assumes the universe has been expanding forever, with new matter constantly being created to maintain a constant density. In his thesis, Hawking showed that the Steady State theory is mathematically self-contradictory. He argued instead that the universe began as an infinitely small, infinitely dense point called a singularity. Today, Hawking's description is almost universally accepted among scientists.

Black holes are real

More than anything else, Hawking's name is associated with black holes — another kind of singularity, formed when a star undergoes complete collapse under its own gravity. These mathematical curiosities arose from Einstein's theory of general relativity, and they had been debated for decades when Hawking turned his attention to them in the early 1970s.

PLAY SOUND

According to an article in Nature, his stroke of genius was to combine Einstein's equations with those of quantum mechanics, turning what had previously been a theoretical abstraction into something that looked like it might actually exist in the universe. The final proof that Hawking was correct came in 2019, when the Event Horizon Telescope obtained a direct image of the supermassive black hole lurking in the center of giant galaxy Messier 87.

Hawking radiation

Black holes got their name because their gravity is so strong that photons, or particles of light, shouldn't be able to escape from them. But in his early work on the subject, Hawking argued that the truth is more subtle than this monochrome picture.

By applying quantum theory — specifically, the idea that pairs of "virtual photons" can spontaneously be created out of nothing — he realized that some of these photons would appear to be radiated from the black hole. Now referred to as Hawking radiation, the theory was recently confirmed in a laboratory experiment at the Technion-Israel Institute of Technology, Israel. In place of a real black hole, the researchers used an acoustic analog — a "sonic black hole" from which sound waves cannot escape. They detected the equivalent of Hawking radiation exactly in accordance with the physicist's predictions.

Black hole area theorem

CHEMWATCH
Bulletin Board
Curiosities
JUL. 30, 2021

In classical physics, entropy, or the disorder of a system that can only ever increase with time, never decreases. Together with Jacob Bekenstein, Hawking proposed that the entropy of a black hole is measured by the surface area of its surrounding event horizon.

The recent discovery of gravitational waves emitted by merging pairs of black holes shows that Hawking was right again. As Hawking told the BBC after the first such event in 2016, "the observed properties of the system are consistent with predictions about black holes that I made in 1970 ... the area of the final black hole is greater than the sum of the areas of the initial black holes." More recent observations have provided further confirmation of Hawking's "area theorem."

So the world is gradually catching up with Stephen Hawking's amazing predictions. But there are still quite a few that have yet to be proven one way or the other:

The information paradox

The existence of Hawking radiation creates a serious problem for theoreticians. It seems to be the only process in physics that deletes information from the universe.

The basic properties of the material that went into making the black hole appear to be lost forever; the radiation that comes out tells us nothing about them. This is the so-called information paradox that scientists have been trying to solve for decades. Hawking's own take on the mystery, which was published in 2016, is that the information isn't truly lost. It's stored in a cloud of zero-energy particles surrounding the black hole, which he dubbed "soft hair." But Hawking's hairy black hole theorem is only one of several hypotheses that have been put forward, and to date no one knows the true answer.

Primordial black holes

Black holes are created from the gravitational collapse of pre-existing matter such as stars. But it's also possible that some were created spontaneously in the very early universe, soon after the Big Bang.

Hawking was the first person to explore the theory behind such primordial black holes in depth. It turns out they could have virtually any mass whatsoever, from very light to very heavy — though the really tiny ones would have "evaporated" into nothing by now due to Hawking radiation. One intriguing possibility considered by Hawking is that primordial black holes might make up the mysterious dark matter that astronomers believe

permeates the universe. However, as LiveScience previously reported, current observational evidence indicates that this is unlikely. Either way, we currently don't have observational tools to detect primordial black holes or to say whether they make up dark matter.

The multiverse

One of the topics Hawking tinkered with toward the end of his life was the multiverse theory — the idea that our universe, with its beginning in the Big Bang, is just one of an infinite number of coexisting bubble universes.

Hawking wasn't happy with the suggestion, made by some scientists, that any ludicrous situation you can imagine must be happening right now somewhere in that infinite ensemble. So, in his very last paper in 2018, Hawking sought, in his own words, to "try to tame the multiverse." He proposed a novel mathematical framework that, while not dispensing with the multiverse altogether, rendered it finite rather than infinite. But as with any speculation concerning parallel universes, we have no idea if his ideas are right. And it seems unlikely that scientists will be able to test his idea any time soon.

Chronology protection conjecture

Surprising as it may sound, the laws of physics — as we understand them today — don't prohibit time travel. The solutions to Einstein's equations of general relativity include "closed time-like curves," which would effectively allow you to travel back into your own past. Hawking was bothered by this, because he felt that backward travel in time raised logical paradoxes that simply shouldn't be possible.

So he suggested that some currently unknown law of physics prevents closed timelike curves from occurring — his so-called "chronology protection conjecture." But "conjecture" is just science-speak for "guess," and we really don't know whether time travel is possible or not.

No creator

One of the questions cosmologists get asked most often is "what happened before the Big Bang?" Hawking's own view was that the question is meaningless. To all intents and purposes, time itself — as well as the universe and everything in it — began at the Big Bang.

"For me, this means that there is no possibility of a creator," he said, and as LiveScience previously reported, "because there is no time for a creator to have existed in." That's an opinion many people will disagree with, but

CHEMWATCH
Bulletin Board
Curiosities
JUL. 30, 2021

one that Hawking expressed on numerous occasions throughout his life. It almost certainly falls in the "will never be resolved one way or the other" category.

Doomsday prophecies

In his later years, Hawking made a series of bleak prophecies concerning the future of humanity that he may or may not have been totally serious about, BBC reported

These range from the suggestion that the elusive Higgs boson, or "God particle," might trigger a vacuum bubble that would gobble up the universe to hostile alien invasions and artificial intelligence (AI) takeovers. Although Stephen Hawking was right about so many things, we'll just have to hope he was wrong about these.

Originally published on Live Science.

livescience.com, 23 July 2021

https://www.livescience.com

Microplastics: The 'big little problem' plaguing oceans

2021-07-26

Microplastics are everywhere.

"It's in our water, it's in the ocean, it's in the animals, in the air, even in space," Ana Zivanovic-Nenadovic, North Carolina Coastal Federation assistant director of policy, said recently during a virtual forum on microplastics.

Since the mass production of plastics began in the mid-20th century, plastic has permeated our lives, she explained July 15 to the 202 from 29 different counties logged on for the North Carolina Coastal Microplastics Forum, organized by the federation.

The online forum included presentations from researchers, educators and environmental group representatives who explained the different types of microplastic pollution, the risks microplastics pose to the natural environment and human health, and current policies.

"This forum is the first step in our effort to inform the public and galvanize support for the change that will hopefully lead to solutions to microplastics," Zivanovic-Nenadovic said.

"This forum is the first step in our effort to inform the public and galvanize support for the change that will hopefully lead to solutions to microplastics," Zivanovic-Nenadovic said.

Bonnie Monteleone, executive director of the nonprofit Plastic Ocean Project Inc. and a plastic marine researcher, said she found in her research that around 3.86 metric tons of microplastics, or pieces measuring less than 5 millimeters, are in the North Atlantic.

The ocean is turning into "plastic soup," Monteleone said.

Plastic is the newest member of the food web "because plastics break up, not down. They're breaking up into smaller and smaller particles, making them more bioavailable for all the organisms in the ocean. So I like to call it the 'big small problem,'" she said. "As the particles get smaller, we start to see less and less of them and scientists are really concerned to where these smaller particles are going."

One place these microplastics are being found is in our seafood.

Dr. Susanne Brander, a member of the faculty at Oregon State University since 2017 and previously faculty at University of North Carolina Wilmington, explained that microplastics are transferred through food webs and then are ingested directly by organisms, "but they are also trophically transferred, meaning that they are ingested by smaller organisms that are then fed upon as prey items by forage fish or larger predators. The ultimate result is that these items can end up in seafood on our dinner plates."

According to an analysis, globally, about 26% of a fish species are found to ingest microplastics, which is roughly the same in the U.S. Microplastics affect the fish's ability to survive and to reproduce, and that can have population level impacts.

"So we should think about this from a human health perspective but also from a fish health perspective. And in the end, that's going to influence how many fish there are out there to catch."

Dr. Marielis Zambrano with North Carolina State University department of forest biomaterials said that these microplastics being found in the ocean — and in our seafood — are from synthetic textiles, tires, city dust, road markings, marine coatings, personal care products and plastic pellets, or nurdles.

Microplastics are synthetic solid particles that don't dissolve in water and are less than 5 mm in size. It's estimated that a minimum of 5.25 trillion plastic particles weighing 270,000 tons are floating in the world's oceans, she explained.

CHEMWATCH
Bulletin Board
Curiosities
JUL. 30, 2021

The average person ingests more than 5,800 particles a year of synthetic debris, found in everything including seafood, beer, tap water and sea salt. Microplastics are even found in human stool samples, meaning we are eating microplastics, Zambrano said.

Found in 99.7% of all samples taken from the ocean surface, microfibers are a primary source of microplastics. These microfibers get into the environment through the home laundry process. The effluent is processed in wastewater treatment plants but some of the particles are too small to filter out before being discharged. Microfibers are also in the air from carpet, clothing and other materials.

Dr. Marielis Zambrano with N.C. State University explains how microfibers get to the environment during her presentation.

Dr. Richard Venditti, the Elis-Signe Olsson professor in Paper Science and Engineering in the Forest Biomaterials Department at N.C. State University, said a study at the university found that cotton and rayon, both based on natural materials, degrade in about 35 days in lake water in a simulation.

"In stark contracts, polyester and many other plastics are completely inert to biological activity and persist in the lake water for a very long time," which is a challenge, he said.

The microfiber problem has no unique solution but there are some possible ways to help, such as filters on washing machines, a sustainable coating on fabrics, using natural or plant-based fibers, or new methods to spin fibers that are durable, though all of these are not without problems.

Haw Riverkeeper Emily Sutton reiterated that microplastics are a huge public health concern and noted the high percentage of microfibers they find while testing because wastewater treatment plants aren't able to remove all those before being discharged. Haw River, a tributary of Cape Fear River, is in the central part of the state.

Plastic, which is getting into our bodies through drinking water, has even been found in breast milk, she added. There's also concern about the chemical compounds these plastics are made of, as well as about PFAS and other chemicals. "Those compounds are also being soaked up by these plastic particles" that are making it into our bodies.

Dr. Scott Coffin, a research scientist at the California State Water Resources Control Board, said that while wastewater treatment plants are effective at removing microplastics — between 88 and 99% of plastics — what is removed is then turned into sludge.

The sludge, which contains a high level of nutrients, is often transformed into biosolids and used as fertilizer in agricultural fields across the country. For North Carolina, 25-50% of sludge is applied as biosolid to agriculture, according to a map Coffin included in his presentation. With the increase in plastic production, there's an increase in microplastic concentrations in biosolids, he said.

While it's known that plants can uptake and accumulate microplastics through their roots and be distributed through their shoots, it's unknown that plastic particles can make their way into the actual fruits and vegetables that we eat, Coffin explained. "However, we do know that with increasing plastic concentrations in soils, we see decreasing plant production of fruits and vegetables, with above a certain threshold, a complete inability of the plant to create tomatoes in this one study."

Coffin added that plastic does often contain hazardous chemicals, some of which are intentionally added.

There's at least 3,300 known chemical additives, 98 are hazardous, and 15 are endocrine disrupting. Bodies create estrogen naturally but when exposed to higher levels, it can cause things like diabetes, intellectual disabilities and cancer.

"Why do we care so much about endocrine disruptors? Exposure to just one class of endocrine disruptors of flame retardants results in more intellectual disabilities than pesticides, mercury and lead combined with an estimated 750,000 to 1.75 million total intellectual disabilities in the United States between 2001 and 2016," Coffin said. While the human health effects of microplastics are largely uncertain, he said, evidence is rapidly evolving.

Coffin said humans are exposed to microplastics through tap water. Researchers found in 2017 that 94% of samples in the United States had detectable levels of microplastics, prompting California to pass a bill for its Water Board to define microplastics and develop standardized testing.

When it comes to bottled and tap water, in general, higher concentrations are found in bottled water than tap water. "This is not surprising, as the bottle itself seems to be the source of these particles. Just unscrewing a lid from a plastic water bottle releases on the order of 14 to 2,400, plastic particles."

CHEMWATCH
Bulletin Board
Curiosities
JUL. 30, 2021

A recent study also found that polypropylene feeding bottles for infants releases about 16 million particles per liter. This results in the estimated daily exposure of 14,000 to 4.5 million particles per day to infants.

"This is just an exposure, and we don't know how much risk this could cause," he said, adding that looking across all exposure routes, air is likely the greatest exposure pathway, with a much higher concentration indoors than outdoors.

Microplastics don't go away once we're exposed to them. "It's estimated that we're walking around with between 525 and 9.3 million plastic particles. We know that these particles can be transferred to the next generation with four out of six placentas containing microplastics in a 2021 study."

Associate professor at Wake Forest University School of Law, Sarah Morath said in terms of plastic pollution, there are regulatory instruments like bans, such as the 2015 ban on microbeads in beauty products like body wash and toothpaste, economic instruments such as a tax or fee designed to encourage individuals and businesses to alter their behavior, and persuasive instruments, like an education campaign or Plastic Free July which where individuals voluntarily commit to eliminating their use of single-use plastics for a month.

Legislation that has been enacted or is currently being considered at the federal level includes the Save our Seas Act, which tend to get a lot of bipartisan report because they invoke nonregulatory methods, and Break Free from Plastic Pollution Act, reintroduced in March, with mechanisms to address plastic pollution, including putting the onus on the producer to collect and dispose of the product, Morath said. Other acts include the RECYCLE Act that focuses on improving residential recycling programs and RECOVER Act, focused on building recycling infrastructure, both introduced this year.

Zivanovic–Nenadovic told Coastal Review after the forum that this is the federation's first step in directly addressing the microplastics pollution.

"I hope that the audience was able to gain knowledge about the impacts, magnitude and ubiquity of microplastics. It took decades to get to the point we are in and it will take a determined effort to start to turn the clock back on this problem. We hope to have excited the audience and motivated it to help us as we go forward," she said. "The audience was able to learn about how pervasive the microplastics are in our environment. The presenters share information about microplastics in our food, in

drinking water, elaborated on sampling methods and offered possible policy and regulatory solutions, and examples that exist in other states."

coastalreview.org, 26 July 2021

https://www.coastalreview.org

Why does gravity pull us down and not up?

2021-07-28

Gravity is the reason things with mass or energy are attracted to each other. It is why apples fall toward the ground and planets orbit stars.

Magnets attract some types of metals, but they can also push other magnets away. So how come you feel only the pull of gravity?

In 1915, Albert Einstein figured out the answer when he published his theory of general relativity. The reason gravity pulls you toward the ground is that all objects with mass, like our Earth, actually bend and curve the fabric of the universe, called space-time. That curvature is what you feel as gravity.PLAY SOUND

What is space-time?

Before getting into the complicated world of gravity, you need to understand space-time.

Space-time is exactly what it sounds like: the three dimensions of space — length, width and height — combined with the fourth dimension — time. Using some very brilliant math, Einstein was the first person to realize that the laws of physics work in a universe where space and time are merged together.

What this means is that space and time are connected — if you move really fast through space, time slows down for you compared to someone who is moving slowly. This is why astronauts — who are moving very fast in space — age a tiny bit more slowly than people on Earth.

Remember, gravity is the idea that objects in the universe are attracted to each other because space-time is bent and curved. When Einstein came up with general relativity, he showed that all stuff in the universe can curve space-time — in physics terms that stuff is mass and energy.

Since your brain usually thinks about the world in three dimensions, it is really hard to think about the four dimensions of space-time as a single idea. So to make it easier to visualize, imagine the surface of a trampoline.

So how come you feel only the pull of gravity?

CHEMWATCH
Bulletin Board
Curiosities
JUL. 30, 2021

If there is nothing on it, it is flat. But if you stand on the trampoline, it stretches around your feet and creates a valley with you at the center. If there is a ball on the trampoline, it would roll toward your feet.

This is a two-dimensional example of how space-time works. Your mass stretched the trampoline, creating what is called a gravity well that the ball rolls into. This is very similar to how the gravity of a heavy object — like the Earth — pulls things like you and me toward it.

To make things even weirder, since space and time are connected, time is also stretched by heavy objects!

The heavier you are, the steeper the sides of the trampoline well. That is why really massive things in the universe — like the Sun or black holes — have stronger gravity than Earth.

So why does gravity pull you down and not push you away?

Imagine someone went under the trampoline and pushed up. The ball would roll away! This would be a gravity hill, not a gravity well. As far as scientists know, matter — or stuff — always makes gravity wells and not gravity hills. Scientists can imagine things made of exotic matter or energy that would cause gravity to push you off into space, but so far, no one has found anything that could cause gravity to push you away from Earth.

Matter makes gravity wells, not gravity hills

Remember, gravity is the idea that objects in the universe are attracted to each other because space-time is bent and curved. When Einstein came up with general relativity, he showed that all stuff in the universe can curve space-time — in physics terms that stuff is mass and energy.

Since your brain usually thinks about the world in three dimensions, it is really hard to think about the four dimensions of space-time as a single idea. So to make it easier to visualize, imagine the surface of a trampoline. If there is nothing on it, it is flat. But if you stand on the trampoline, it stretches around your feet and creates a valley with you at the center. If there is a ball on the trampoline, it would roll toward your feet.

This is a two-dimensional example of how space-time works. Your mass stretched the trampoline, creating what is called a gravity well that the ball rolls into. This is very similar to how the gravity of a heavy object — like the Earth — pulls things like you and me toward it.

To make things even weirder, since space and time are connected, time is also stretched by heavy objects!

The heavier you are, the steeper the sides of the trampoline well. That is why really massive things in the universe — like the Sun or black holes — have stronger gravity than Earth.

So why does gravity pull you down and not push you away?

Imagine someone went under the trampoline and pushed up. The ball would roll away! This would be a gravity hill, not a gravity well. As far as scientists know, matter — or stuff — always makes gravity wells and not gravity hills. Scientists can imagine things made of exotic matter or energy that would cause gravity to push you off into space, but so far, no one has found anything that could cause gravity to push you away from Earth.

This article is republished from The Conversation under a Creative Commons license. Read the original article.

livescience.com, 28 July 2021

https://www.livescience.com

Nerve damage in cornea could be sign of 'long COVID,' study hints

2021-07-27

Nerve damage and a buildup of immune cells in the cornea may be a sign of "long COVID," a long-term syndrome that emerges in some people after COVID-19 infection, a new study suggests.

These preliminary results will need to be verified in a larger group of people with long COVID, or COVID-19 long-haulers, as they're known, an expert told Live Science. But the findings do hint at something scientists already suspected: Some symptoms of long COVID emerge due to peripheral nerve damage, she said.

COVID-19 long-haulers experience a wide range of symptoms, and a large proportion report neurological problems, including headache, numbness in the body, loss of smell and "brain fog," or trouble thinking and concentrating, Live Science previously reported. This constellation of symptoms hints that long COVID may partly arise from damage to nerve cells in the body, said senior author Dr. Rayaz Malik, a professor of medicine and consultant physician at Weill Cornell Medicine-Qatar in Doha.

PLAY SOUND

Some symptoms of long COVID emerge due to peripheral nerve damage, she said.

CHEMWATCH
Bulletin Board
Curiosities
JUL. 30, 2021

Specifically, preliminary evidence suggests that long COVID may involve damage to small nerve fibers — thin wires that branch off of specific nerve cells in the body and relay sensory information about pain, temperature and itchiness, among other sensations to the central nervous system. Small-fiber nerve cells also help control involuntary bodily functions, such as heart rate and bowel movements; therefore, damage to these cells can cause a wide array of symptoms.

Malik and his colleagues study small-fiber nerve loss in people with diabetes and neurodegenerative diseases like multiple sclerosis; they noticed that people with long COVID appear to share similar symptoms with these patients, so they decided to investigate the potential link.

Using a technique called corneal confocal microscopy (CCM), the team took snapshots of nerve cells in the cornea, the transparent layer of the eye that covers the pupil and iris. The team used the non-invasive procedure to count the total number of small-fiber nerve cells in the cornea, while also assessing the length and degree of branching of those fibers. In their work with other conditions, the team has found that, when you find damage in the small-fiber nerves of the cornea, that often indicates that there's similar damage elsewhere in the body. "This is like a very good barometer, almost, of nerve damage elsewhere," Malik explained.

According to the new study, published Monday (July 26) in the British Journal of Ophthalmology, people who develop neurological symptoms after a COVID-19 infection show significant small-fiber nerve loss in the cornea, compared with COVID-19 survivors without lingering neurological symptoms. What's more, the degree of nerve-fiber damage correlated with the participants' symptom severity, meaning greater nerve damage was linked to more pronounced symptoms.

The small study included 40 people who had recovered from COVID-19 between one and six months prior to their assessment; out of the full group, 29 people had recovered from COVID-19 at least three months prior. In addition to getting the corneal scan, each participant completed a survey that included questions about any neurological symptoms of long COVID.

They also filled out questionnaires about neuropathic pain, which can include numbing, prickling and burning sensations in the body, as well as muscle weakness, according to UC Davis Health. Another questionnaire helped the researchers to pinpoint the location and severity of the participants' muscle pain; it also helped flag additional symptoms like fatigue and bowel issues, the authors noted.

Of the 40 participants, 22 showed lingering neurological symptoms — including headache, dizziness and numbness — four weeks after recovering from their initial COVID-19 infections. And 13 out of the 29 who had been recovered for at least three months reported having neurological symptoms at week 12 post-infection. "It's very clear, if you look at the graphs ... people who've got the neurological symptoms definitely have a reduction" in small-fiber nerves, while the other participants don't, Malik said.

The study authors also assessed 30 healthy individuals with no history of COVID-19 infection for comparison. They found that, compared with these 30 control participants, all the COVID-19 survivors harbored a large number of immune cells on their corneas; more specifically, immune cells called dendritic cells that help inform the immune system of foreign invaders appeared in unusually high quantities.

The people with lingering neurological symptoms showed a roughly fivefold increase in these dendritic cells, compared with the healthy controls; those without neurological symptoms showed about a twofold increase.

"So there's clearly something, there's an immune process that is still ongoing," even after the initial COVID-19 infection clears, Malik said. "So maybe there is an immune trigger that is switched on and it takes time for it to kind of settle down," he said. And in the meantime, this runaway immune response damages nerve cells.

The new study cannot prove that an immune response caused the observed nerve damage. However, the idea does align with existing evidence that most neurological damage from COVID-19 is caused by inflammation, not by the virus infecting nerve cells directly, according to a 2020 commentary in the journal Pain.

"It's not the infection, per se, it's the immune response it provokes," said Dr. Anne Louise Oaklander, an associate professor of neurology at Harvard Medical School and assistant in pathology at the Massachusetts General Hospital, who was not involved in the new study. "Infection revs up your immune cells to start firing, to fight the enemy, and there's going to be collateral damage," she said. In this case, small-fiber nerve cells may fall victim to friendly fire.

Oaklander added that she was "excited" about the new study, as it provides evidence of small-fiber nerve damage in long COVID patients. The data are helpful to biomedical researchers, like Oaklander, who are trying to

CHEMWATCH
Bulletin Board
Curiosities
JUL. 30, 2021

understand the causes of long COVID and how to treat the syndrome. However, for now, she said the research doesn't necessarily provide any solutions for patients.

In their paper, Malik and his colleagues suggest that corneal confocal microscopy could be used as a diagnostic tool to help identify people with long COVID — particularly those with neurological symptoms. However, currently, the technique is primarily used for research and is not widely available in clinical settings, Oaklander said.

The gold standard for assessing small-fiber nerve damage involves taking a small skin biopsy from a patient's leg and measuring the nerve endings within, she said. Doctors can screen for symptoms of nerve damage with written surveys and neurological exams, but they currently require a skin biopsy to confirm their diagnoses. For this reason, it would be helpful if future studies of long COVID patients included these skin biopsies, along with the standard questionnaires used to screen for small-fiber sensory neuropathies, Oaklander suggested. ("Neuropathy" refers to damage to the nerves that run through the body outside the brain and spinal cord.)

For now, Malik said his group plans to follow up with their initial group of 40 participants, to see how their corneal nerves and long COVID symptoms change through time. In addition, they plan to replicate their study in larger groups of patients to validate the results.

"People might say, 'Well, 40 patients isn't enough.' We agree; you need larger studies," Malik said. Assuming the results can be confirmed in larger cohorts, eventually, this line of research may provide helpful hints as to how doctors can treat long COVID, he added. Treatments for post-infectious neuropathies do exist, it's just a question of whether they'd work for long COVID patients with post-infectious small-fiber neuropathy, and if so, how they can best be applied, Oaklander said.

Originally published on Live Science.

livescience.com, 27 July 2021

https://www.livescience.com

If confirmed, tubes in 890-million-year-old rock may be the oldest animal fossils

2021-07-28

Pale, wormlike tubes in 890-million-year old rock may be ancient sea sponges, a new study concludes. If confirmed, that controversial claim

Early in Earth's history, the ocean mostly lacked oxygen

would push back the origin of the earliest sponges by about 350 million years and make the tiny squiggles the oldest known fossils of animals, by far.

Crucially, these fossils would imply that animals emerged in environmental conditions previously thought unworkable for animal life, geologist Elizabeth Turner reports July 28 in Nature.

Early in Earth's history, the ocean mostly lacked oxygen. It wasn't until a large pulse of the gas to the atmosphere about 800 million to 540 million years ago, known as the Neoproterozoic Oxidation Event, brought atmospheric oxygen levels to within 10 to 50 percent of modern levels, boosting the amount of oxygen in surface ocean waters (SN: 12/11/19). "But sponges are different from other animals," says Turner, of Laurentian University in Sudbury, Canada. "Some sponges in the modern world and in the rock record are known to be tolerant of comparatively low oxygen relative to modern ocean levels."

Until now, the earliest, unambiguous fossils of sponges date to about 540 million years ago to the beginning of the Cambrian Period, when an extreme burst in the evolution of animal diversity took place (SN: 7/29/13). Some other animals are known from just a bit earlier, but go too much further back in time and identities become less clear (SN: 3/9/15). Based on genetic data and their relative simplicity, sponges are generally thought to have been the earliest form of animal life.

Bottom of Form

But some scientists aren't convinced that the newly described tubes are sponge fossils. "Organisms from anywhere on the tree of life can make wiggly, little [branching and rejoining] structures," says Jonathan Antcliffe, a paleobiologist at the University of Lausanne in Switzerland. The fossils lack features such as mineralized skeletal parts called spicules that would identify the creatures as sponges, he says.

What's more, the finding "doesn't fit with everything we know about the whole [ocean] ecosystem" in regards to nutrient, biomineral and oxygen availability before the Cambrian Period, Antcliffe says. "Everything we know about the Earth's oceans in this interval of time tells us that animals originated around 540 [to] 550 million years ago. It's a legion of evidence, and to overturn such an enormously strong paradigm, you need more than 'might be a sponge.'"

CHEMWATCH
Bulletin Board
Curiosities
JUL. 30, 2021

Turner first found the network of tubes in 1992 in rocks from the ancient Little Dal cyanobacteria reef in Canada's Mackenzie Mountains. "I found this thing that was totally out of place," she says. "It was much more complex in terms of its structure than anything that could be made by cyanobacteria."

She would have reported the curious squiggles then, but without much else to tie them to sponges besides a general resemblance, Turner moved on. But after more recent research showed that sponges could be preserved in rock similarly to the Little Dal's pallid wiggles, she returned to her find.

Turner argues that many modern sponges don't have spicules and that the newly described fossils may be similar. And she suggests that sponges predating the Neoproterozoic Oxidation Event may have scraped out an existence in "oxygen oases" along microbial reefs, living in holes and reef flanks and not competing with cyanobacteria for space.

It's possible that early sponges emerged much earlier than the rest of animal life and remained in a kind of "evolutionary stasis" in low-oxygen conditions, she says, with the evolution of later, more complex animals having to wait until the gas became more abundant.

Scientists have known about odd types of fossils in the Little Dal reef for a while, says James Schiffbauer, a paleobiologist at the University of Missouri in Columbia who wasn't involved in the research. And "we've expected from molecular clocks that sponges should be present earlier in the Neoproterozoic [Era]," he adds, referring to genetic analyses that estimate that sponges evolved well before the Cambrian Period. "It has just been a matter of finding them if they were indeed preserved."

Future research could help confirm the fossils' identity. Turner plans to work more with the ancient tubes, adding that more answers may come from looking in the right places. "We need to be looking for similar material with a really open mind in rocks of similar age, and we need to be looking for more complex animal evidence in them as well," rather than just simpler organisms like microbes.

sciencenews.org, 28 July 2021

https://www.sciencenews.org

However, the virus itself does hold clues to its own origin.

Will we ever find COVID-19's 'Patient Zero?'

2021-07-28

Chinese officials have rejected a World Health Organization proposal to investigate the origins of the novel coronavirus that causes COVID-19, raising new questions about whether the world will ever learn when, where and how the coronavirus (SARS-CoV-2) made the leap into humans.

China objected to the WHO plan last week because this phase of the investigation left open the possibility that the virus escaped as the result of a laboratory accident, NPR reported. Without Chinese cooperation, scientists will face frustrating gaps in the data that may keep them from identifying the moment the pandemic began. However, the virus itself does hold clues to its own origin. In the coronavirus's genetic blueprint is a history of where it came from and how long it took to cause the outbreak that led to a global catastrophe.

Even if scientists never identify a Patient Zero — the first person who fell victim and sparked a chain of infections leading to the pandemic — they may be able to determine what animals facilitated the leap and what human activities made it possible, experts told Live Science.PLAY SOUND

Defining Patient Zero

In your typical pandemic fiction, a disease outbreak begins with a single, dramatic moment: A vial of infected blood breaks, a sickly monkey escapes a lab, an alien satellite falls from the sky.

And it is sometimes possible to find a singular source for an epidemic or pandemic in the real world. Recently, epidemiologists traced the source of a devastating 2014 Ebola outbreak in Guinea, Liberia and Sierra Leone to the infection and death of a 2-year-old named Emile Ouamouno.

But this work is extremely challenging and potentially stigmatizing. For example, for many years, a single Québécois flight attendant was blamed for spreading HIV to North America. In a 2016 study in the journal Nature, however, researchers showed that the flight attendant, who died of AIDS in 1984, was just one of thousands who had become infected with the then-unknown virus. Ironically, the man was blamed for so much spread partly because he was one of the most helpful early patients to epidemiologists, providing information on his sexual contacts that other patients couldn't always recall.

Delving further into HIV's history, any notion of a "Patient Zero" becomes foggy: The virus leapt from West African primates into humans at least

CHEMWATCH
Bulletin Board
Curiosities
JUL. 30, 2021

three times, and the major strain responsible for most infections probably emerged sometime around 1910 or 1920.

Even for diseases in the modern era, finding early cases doesn't always translate to understanding how the disease jumped from animal to human. No one knows exactly how Emile Ouamouno caught Ebola, and scientists still haven't discovered the animal reservoir for the disease, though bats are a prime suspect.

Likewise, discovering how a new virus jumped from animals to humans doesn't always require discovering a Patient Zero. SARS-CoV-1, the close relative of the current pandemic coronavirus, emerged in November 2002 with a single patient, a farmer from Guangdong who died in the hospital. But that farmer was just one of several early cases that emerged in five separate cities. Further studies revealed that SARS-CoV-1 was closely related to a virus found in horseshoe bats, which then infected animals sold in wildlife markets, particularly civet cats. A 2003 Center for Disease Control and Prevention study found that 13% of people in the wildlife trade in the region had antibodies against SARS-1 compared with 1% to 3% of the general population, suggesting that the virus or a closely related one had been bouncing from animals and humans asymptomatically or with minimal symptoms before the major outbreak occurred. Among those who traded in civet cats — the likely bridge species between bats and humans — the likelihood of previous infection was 72%.

Ultimately, researchers found a virus in bats that was 97% identical to human SARS-1, and then a virus in civets and raccoon dogs that was 99.8% identical to the virus that infected humans, said Stephen Goldstein, a postdoctoral scholar in evolutionary virology at the University of Utah. Thus, researchers clinched the chain of animal-to-human transmission of SARS-1 without ever learning exactly when and where the virus made the leap.

A murky beginning

SARS-CoV-2 may be particularly tricky to trace because of its inconsistency in producing disease. Somewhere between 30% and 40% of infected people are asymptomatic, and many others experience mild or moderate symptoms of COVID-19 that can be easily mistaken for a head cold or a case of the flu. Wuhan, where the first cases emerged, was in the midst of a bad flu season in fall 2019, so early cases could have been misdiagnosed.

To work within these limits, scientists are trying to rewind the history of the virus from its genetic blueprint. This can't reveal the exact moment of the first animal-to-human transmission, but it can get tantalizingly close.

"For trying to determine when HIV first arrived in the United States, our uncertainty is on the order of years or sometimes even a decade," said Joel Wertheim, an evolutionary biologist at the University of California, San Diego, who is doing this research. "For SARS-CoV-2, our uncertainty is on the order of weeks."

Wertheim and other researchers in his field depend on a powerful tool in viral evolution: a molecular clock. This "clock" is based on a constant pile-up of mutations that occurs each time the coronavirus reproduces. Most of these mutations have no effect on the function of the virus, Wertheim said, but because they occur at a predictable rate, scientists can use them to determine when certain events in the virus's history took place. Those events can include when the infection that kicked off the pandemic first occurred.

This isn't the same as the first human infection with SARS-CoV-2, Wertheim cautioned. Most people who caught the earliest variants of the virus didn't pass it on, so there could have been dozens of infection chains that fizzled out.

There are parallels in human evolution. Around 200,000 years ago in Africa lived a Homo sapien woman known as Mitochondrial Eve, because the maternal genetics of every human alive today can be traced to her. But Mitochondrial Eve wasn't the only woman around back then — she was just the one whose genetic lineage survived.

"You can think of the genetic ancestor of all of SARS-CoV-2 like that," Wertheim told Live Science. "It is the virus from which all circulating SARS-CoV-2 descends, but that doesn't mean that there may not have been other [SARS-CoV-2] viruses around at the time, potentially very closely related, that just went extinct."

Wertheim and his colleagues used the molecular clock of SARS-CoV-2 to try to figure out how much time could have passed between the first appearance of the virus in humans and the infection that sparked the pandemic.

"What we were really interested in in our study was trying to put an upper limit on how long the virus could have been in humans and still given rise to the genetic [common] ancestor," he said.

CHEMWATCH
Bulletin Board
Curiosities
JUL. 30, 2021

In a paper published in Science in April, Wertheim and his team reported that the earliest possible emergence of the coronavirus was October 2019, but the most likely timing was mid-November 2019. Based on the genetic changes in the virus, very few people would have been infected in mid-November, Wertheim said, suggesting that reports of early hospitalizations in Wuhan may indeed have been due to influenza, not COVID-19.

"It would have had to have been at very, very low levels in order to persist without giving rise to this genetic ancestor," Wertheim said.

Wuhan's local health authority reported the first cluster of mysterious pneumonia in the city on December 31, 2019. The WHO later determined that the first case that could be confidently identified as COVID-19 was a man who became ill on Dec. 1, 2019.

Wertheim and his colleagues are now delving deeper into the coronavirus genetics to try to understand whether the virus leapt from animals to humans just once to spark the pandemic, or whether it made multiple incursions leading to multiple infection chains. SARS-1 was genetically diverse early on, Wertheim said, suggesting a multiple-introduction scenario. SARS-CoV-2 was less diverse, which may mean the introduction happened just once, he said. But both scenarios are still possible with the data currently available.

The animal-human connection

Unfortunately, much of the evidence of the early pandemic is now gone, or at least hidden. During the SARS-1 outbreak, the live-animal markets were not initially shut down, Goldstein told Live Science. When scientists went into the markets months later, infected animals were still present, and animal-to-animal transmission was ongoing. In contrast, soon after the SARS-CoV-2 virus began spreading among humans, wet markets were shut down, and Chinese officials initially denied any live animals were sold at the market at the center of the first superspreader event, the Huanan Seafood Market. Researchers later showed that seven vendors were selling live mammals, birds and reptiles at that market, they reported in June in the journal Scientific Reports.

If the Chinese government tested any of the animals present in the markets when they were shut down, they're not talking.

"They haven't announced that they tested any of those animals that were in the markets in November and December 2019," Goldstein said.

Similarly, the government has refused to release early viral samples from Wuhan that might reveal more about the genetics of the first human cases and has taken a database containing early viral sequences offline.

This makes uncovering the animal-human link for SARS-CoV-2 difficult. What's clear right now is that the virus probably originated in bats. The closest known relative so far is a bat virus called RaTG13, with which SARS-CoV-2 shares 96% of its genome. Researchers discovered the virus in Yunnan province, China, in 2013, and published about its close ties to SARS-CoV-2 in March 2020. Researchers are still looking for closer relatives, but it's slow going, Goldstein said, particularly given pandemic-related travel restrictions and China's reluctance to invite in international research teams.

"You've got to find the right bats and it's like a needle in a haystack," Goldstein said.

However, comparing the bat viruses to the human virus can be illuminating. Bats are a lot like humans, said William Haseltine, the president of ACCESS Health International and a former professor at Harvard Medical School, where he studied HIV and the human genome. Like humans, bats have long life spans, travel over long distances and then cluster together in close contact. This pattern of behavior may partly explain why coronaviruses that evolve in bats tend to find fertile ground in humans.

"A bat has a chance to be infected many times in its lifetime, so these viruses have got to survive in a long-lived mammal that has many defenses against them," Haseltine said.

The proteins in SARS-CoV-2 can reveal just how the virus's evolution allowed it to break free of bats and eventually infect humans. The genes alone can't explain this step, said Ingo Ebersberger, a bioinformatician at Goethe University Frankfurt, because most of the mutations in the genome don't change the virus's function. It's the proteins that are the workhorses, as genes give instructions for making proteins and proteins carry out biological functions. In a study not yet peer-reviewed but posted Feb. 5.on the preprint server bioRxiv, Ebersberger and his colleagues studied the proteins of SARS-CoV-2 and found that most of the genetic changes between RaTG13, SARS-1 and closely related viruses translated to exactly nothing on the protein side.

"SARS-CoV-2 is not special," Ebersberger told Live Science.

CHEMWATCH
Bulletin Board
Curiosities
JUL. 30, 2021

In the end, the only major functional change that made SARS-CoV-2 stand out was that the virus has something called a furin cleavage site. This is a tiny sequence of four amino acids that massively improves the coronavirus's ability to fuse to the ACE2 receptors on the surface of human cells. This tiny insertion helps the spike protein on the virus to unfurl, all the better to expose its binding sites to the ACE2 receptors, which then unlock the cell for the virus's invasion.

RaTG13 doesn't have a furin cleavage site, but other coronaviruses, including some that circulate in bats, mice, camels and cats, do.

"This is something we think evolutionarily can happen very quickly," Ebersberger said. The change requires only a tiny mutation, he said, and every sick animal produces millions or billions of viral particles, each of which has a chance at accidentally acquiring that crucial mutation.

Continued change

The acquisition of the furin cleavage site has led some to argue that the origins of COVID-19 lie not in natural animal viruses, but in deliberate manipulation in a laboratory. The researchers contacted by Live Science for this story dismissed this as evidence for such an origin, however. The original version of SARS-CoV-2 actually had a wimpy version of the furin cleavage site and was not particularly transmissible compared with what was to come, Wertheim said.

"Anyone who says they've never seen a more perfectly adapted human virus, well, they clearly hadn't met the delta variant," Wertheim said.

In January 2020, well before the word "variant" exploded into everyone's consciousness, SARS-CoV-2 acquired a spike protein mutation called D614G that made it perhaps 20% more transmissible. Coronavirus strains with this mutation quickly took over the world. And in the spike protein, evolution has marched on. The alpha variant of coronavirus was 50% more transmissible than the variants with D614G alone, according to Yale Medicine, and the delta variant is around 50% more transmissible than alpha.

The spot on the coronavirus' genome that encodes for the furin cleavage site is also evidence for a natural origin, Goldstein said. The mutation is a string of 12 nucleotides dropped right in the middle of a codon, or three-nucleotide sequence, that codes for the amino acid serine. By a stroke of evolutionary good luck for the virus, the sequence still works for coding for proteins: All amino acids are coded for by three-nucleotide codons,

and because 12 is a multiple of three, the overall rhythm of the sequence remains undisturbed. But the position of the mutation smack dab in the middle of the codon for another amino acid looks far more like an accident of nature than something engineered deliberately.

"It's a totally bizarre thing that nobody would ever do," Goldstein said.

Finally, Goldstein said, the amino acid sequence in the SARS-CoV-2 furin cleavage site is not one that anyone had experimented with before and is not one that anyone would have predicted would work particularly well. Some researchers have experimented with artificially inserting a different furin cleavage from feline coronaviruses into harmless virus fragments in the lab. If someone were trying to make an animal virus transmissible in humans on purpose, Goldstein said, you'd expect them to use that proven sequence rather than a new, poorly placed string of amino acids that doesn't work that well out of the gate.

None of these structural studies can prove that SARS-CoV-2 wasn't a natural virus that was present in laboratory samples, though. The question of whether the virus could have leaked from the Wuhan Institute of Virology, a lab where studies of bat coronaviruses took place, has become a political sticking point that might sink any chance of discovering the origin of SARS-CoV-2. The Chinese government has categorically denied that the virus came from the lab, while obfuscating raw data that could prove whether it did or didn't. In recent statements, government officials have tried to steer the conversation away from China entirely, despite no evidence that the virus initially emerged elsewhere. (Indeed, Wertheim's work on early transmission dynamics suggests that the virus needed a densely populated city like Wuhan to take off; simulations mimicking rural population density led to an emerging virus that couldn't find enough hosts and went extinct.)

"In the next stage of origin studies led by the WHO, we should take a global vision and conduct research in different countries and multiple places instead of focusing on one area only," foreign ministry spokesperson Zhao Lijian said on June 16.

Scientists interested in COVID-19's origins have a different take. Both Wertheim and Goldstein said they think a lab leak is unlikely, but that the search for the virus's origins needs to focus on the animal supply chain in and around Wuhan. This search can be stigmatizing, too, Ebersberger said, as many of the news stories circulating about the markets led to the implication that Chinese people eat wild animals indiscriminately. Many wild animals are consumed as delicacies in Chinese cuisine, but much of

CHEMWATCH
Bulletin Board
Curiosities
JUL. 30, 2021

the international chatter around these culinary traditions ignored regional differences and the rarity of these items in people's diets. Bats aren't commonly part of the menu in central China, where Wuhan is located, and bats were not present at the Huanan Seafood market. Many animals sold at these markets aren't sold as meat, either, but as pets or for fur. One possible species that could have carried the virus from bats to humans is the raccoon dog (Nyctereutes procyonoides), which is mostly farmed for fur. The meat from raccoon dogs killed for fur then ends up in the luxury food market, Goldstein said.

Still, disparate species are held close together during both shipping and in stalls at live animal markets, creating prime conditions for viruses to mix, mingle and evolve. It wouldn't be the first time that close quarters between people, wild animals and domestic animals caused trouble. For example, the H1N1 strain of flu, also known as swine flu, is a genetic mix of influenza viruses from pigs, people and birds. Were he advising the WHO, Goldstein said, he'd recommend that scientists test the blood of people working in the animal trade for SARS-CoV-2 antibodies to see if they are more exposed than the general population.

"You can start with the farmers, you can go with the people who transport these animals from farms to cities, you can look at the people who sell these animals in the market," Goldstein said. "If these people have higher antibody positivity rate than the general population, that would be indirect but very strong evidence that this virus was present in animals that were part of the human food chain."

Originally published on Live Science.

livescience.com, 28 July 2021

https://www.livescience.com

CHEMWATCH

Bulletin Board

Technical Notes

JUL. 30, 2021

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

CHEMICAL EFFECTS

Interaction of copper with titanium dioxide nanoparticles induced hematological and biochemical effects in Clarias gariepinus

Luteolin mitigates potassium dichromate-induced nephrotoxicity, cardiotoxicity and genotoxicity through modulation of Kim-1/Nrf2 signaling pathways

Development of QSAR models for evaluating pesticide toxicity against Skeletonema costatum

Transcriptome analysis to elucidate the toxicity mechanisms of fenvalerate, sulfide gatifloxacin, and ridomil on the hepatopancreas of Procambarus clarkii

ENVIRONMENTAL RESEARCH

Mutagenicity, health risk, and disease burden of exposure to organic micropollutants in water from a drinking water treatment plant in the Yangtze River Delta, China

Environmental and Health Risks of Pesticide Use in Ethiopia

How can vegetation protect us from air pollution? A critical review on green spaces' mitigation abilities for air-borne particles from a public health perspective - with implications for urban planning

OCCUPATIONAL

Occupational contact dermatitis in painters and varnishers: data from the Information Network of Departments of Dermatology (IVDK), 2000 to 2019

Urinary bisphenol levels in plastic industry workers

PHARAMACEUTICAL/TOXICOLOGY

Exposome of attention deficit hyperactivity disorder in Taiwanese children: exploring risks of endocrine-disrupting chemicals