https://bit.ly/2ZUALnH

Behind the dead-water phenomenon

What makes ships mysteriously slow down or even stop as they travel, even though their engines are working properly?

This was first observed in 1893 and was described experimentally in 1904 without all the secrets of this "dead water" being understood. An interdisciplinary team from the CNRS and the University of Poitiers has explained this phenomenon for the first time: the speed changes in ships trapped in dead water are due to waves that act like an undulating conveyor belt on which the boats move back and forth. This work was published in *PNAS* on July 6, 2020.

In 1893, the Norwegian explorer Fridtjof Nansen experienced a strange phenomenon when he was travelling north of Siberia: his ship was slowed by a mysterious force and he could barely manoeuvre, let alone pick up normal speed. In 1904, the Swedish physicist and oceanographer Vagn Walfrid Ekman showed in a laboratory that waves formed under the surface at the interface between the salt water and freshwater layers that form the upper portion of this area of the Arctic Ocean interact with the ship, generating drag.

This phenomenon, called dead water, is seen in all seas and oceans where waters of different densities (because of salinity or temperature) mix. It denotes two drag phenomena observed by scientists. The first, Nansen wave-making drag, causes a constant, abnormally low speed. The second, Ekman wave-making drag, is characterized by speed oscillations in the trapped boat. The cause of this was unknown. Physicists, fluid mechanics experts, and mathematicians at the CNRS' Institut Pprime and the Laboratoire de Mathématiques et Applications (CNRS/Université de Poitiers) have attempted to solve this mystery. They used a mathematical classification of different internal waves and analysis of experimental images at the sub-pixel scale, a first.

This work showed that these speed variations are due to the generation of specific waves that act as an undulating conveyor belt on which the ship moves back and forth. The scientists have also reconciled the observations of both Nansen and Ekman. They have shown that the Ekman oscillating regime is only temporary: the ship ends up escaping and reaches the constant Nansen speed.

This work is part of a major project[1] investigating why, during the Battle of Actium (31 BC), Cleopatra's large ships lost when they faced Octavian's weaker vessels. Might the Bay of Actium, which has all the characteristics of a fjord, have trapped the Queen of Egypt's fleet in dead water? So now we have another hypothesis to explain this resounding defeat, that in antiquity was attributed to remoras, 'suckerfish' attached to their hulls, as the legend goes.

Contact Alexiane Agullo for a video: alexiane.agullo@cnrs.fr

Notes

1 This work was financed by the interdisciplinary call for tenders 80|Prime 2019 (OFHYS project) and by the CNRS' Mission for Interdisciplinarity.

https://bit.ly/3eesikA

Scientists scoff at Indian agency's plan to have COVID-19 vaccine ready for use next month

Two Indian companies have received the green light to start human trials of their candidate vaccines.

By Sanjay Kumar

NEW DELHI—The apparent speed at which an Indian government agency aims to test and approve a homegrown COVID-19 vaccine has created an uproar among scientists both in India, which is increasingly overwhelmed by the new coronavirus, and abroad. A letter leaked on Twitter on Friday suggests the first vaccines could be rolled out by 15 August, which would leave far too little time for proper testing, critics say. The Indian Academy of Sciences calls the timeline “unreasonable and without precedent.”

Six Indian companies are developing vaccines against COVID-19. Last week, the Indian government gave two of them, Bharat Biotech and Zydus Cadila, permission to start phase I and II human clinical trials of their most advanced vaccines, named covaxin and ZyCov-D respectively.

For covaxin, Bharat Biotech has joined with the National Institute of Virology, which is part of the Indian Council of Medical Research (ICMR). (The company is separately developing COVID-19 vaccine candidates in collaboration with Thomas Jefferson University in Philadelphia and the University of Wisconsin, Madison.)

ICMR Director-General Balram Bhargava revealed the extremely tight deadline in a letter to hospitals designated to be involved in the Covaxin studies. "It is envisaged to launch the vaccine for public health use latest by 15 August 2020 after completion of all clinical trials," Bhargava wrote. He asked the hospitals to fast-track all approvals for the vaccine and be ready to enroll participants "no later than 7 July 2020," adding that "noncompliance will be viewed very seriously."

But it's absurd to think studies could show a vaccine to be safe and effective in less than 2 months, many scientists say. "In my knowledge, such an accelerated development pathway has never ever been done for any kind of vaccine," says Anant Bhan, an independent ethics and policy researcher and past president of the International Association of Bioethics. "This seems really, really rushed." The timeline "carries potential risks and provides inadequate attention to required safety procedures," Bhan adds.

"Clinical trials cannot be rushed," concurs Indian virologist and veteran vaccine researcher Thekkekara Jacob John, formerly of the Christian Medical College in Vellore. Even when expedited, phase I and phase II trials will take a minimum of 5 months, he says. The duration of a phase III trial would depend on several factors, including the number of subjects enrolled and decisions by a data safety monitoring board, but would probably add at least another 6 months, Jacob John says. "ICMR's intentions may be good but the processes have been vitiated and the risk is it can derail the vaccine," he says.

Critics believe the target date is political: 15 August is India's Independence Day, when Prime Minister Narendra Modi traditionally climbs the ramparts of the Red Fort in Delhi to give a long speech touting his government's achievements and make major announcements.

In a statement on Saturday, ICMR said Bhargava's letter was "meant to cut unnecessary red tape, without bypassing any necessary process, and speed up recruitment of participants."

"Faced with the unprecedented nature of the COVID-19 pandemic, and the consequent dislocation of the normal life, all other vaccine candidates across the globe have been similarly fast-tracked," the agency claimed. In reality, no other country has announced plans to roll out a vaccine this fast, and ICMR did not explain how it thinks it can accelerate the process. Bharat Biotech declined *Science's* request for comment.

India is eagerly awaiting a COVID-19 vaccine. It just surpassed Russia as the country with the third-highest number of cases, after the United States and Brazil. There were 24,000 confirmed new cases on Sunday; the national tally stands at 697,413 cases and 19,693 deaths.

But India should keep in mind that most vaccine candidates fail, says Seth Berkley, CEO of Gavi, the Vaccine Alliance. "Normally, the probability of success for a vaccine in the preclinical phase is around 7%, rising to 15% to 20% for vaccines that reach clinical tests," such as Covaxin and ZyCov-D, Berkley says.

"ICMR's actions lower the credibility of Indian science," says T. Sundararaman, global coordinator of the People's Health

Movement, a network of grassroots health activists, civil society organizations, and academic institutions. “It’s not about getting there first but to be able to do it well and it is good that India has been able to come up with candidate vaccines, which is not a small achievement.”

https://bit.ly/2DtYW50

Using Epo against Covid-19

The doping agent erythropoietin could attenuate severe progression of COVID-19

Erythropoietin (Epo) is actually a medication for anaemia. According to researchers at the Max Planck Institute of Experimental Medicine in Göttingen, the doping agent Epo could also be effective against Covid-19. The growth factor could mitigate severe disease progression and protect patients from long-term neurological effects when the Sars-CoV-2 virus attacks the brain. Initial case studies indicate a positive effect of Epo. The researchers are now planning a randomized clinical trial to systematically investigate the effects of Epo treatment in Covid-19 patients.

At the end of March, a patient with severe Covid-19 symptoms was admitted to an Iranian hospital. Because the patient also had poor blood values, the doctors prescribed the haematopoietic growth factor Epo. Seven days after the start of treatment, the patient was able to leave the hospital.

Another indication of the protective role of Epo in the case of Covid-19 comes from South America, where severe illness is rarer in higher-lying regions than in the lowlands. This may be because people living at higher altitudes form more Epo and are better adapted to oxygen deficiency because they have more red blood cells. Could Epo have contributed to the rapid healing of the Iranian patient and could it also explain the differing frequency of the disease in South America?

Milder disease progression thanks to Epo?

Hannelore Ehrenreich thinks this is possible. She is a scientist at the Max Planck Institute of Experimental Medicine and has been researching the effect of the endogenous growth factor for over 30 years and suspects a connection between the administration of Epo and the mild illness progression. "For example, we have observed that dialysis patients withstand Covid-19 remarkably well - and it is precisely these patients who regularly receive erythropoietin", says Ehrenreich.

Epo is released as a natural reaction to oxygen deficiency. The molecule stimulates the formation of red blood cells and thus improves the supply of oxygen to the brain and muscles. This effect is also exploited by athletes who take synthetic Epo as a doping agent. Epo stimulates not only blood cells but also many other tissues.

Epo improves breathing in case of oxygen deficiency

Ehrenreich and her colleagues have now summarized the various studies on the effects of Epo. Animal experiments suggest that Epo acts on areas of the brain stem and spinal cord that control breathing. As a result, breathing improves when there is an oxygen deficiency. Epo also has an anti-inflammatory effect on immune cells and could thus attenuate the frequently exaggerated immune response in Covid-19 patients. It could also protect against neurological symptoms and long-term effects of the disease such as headaches, dizziness, loss of smell and taste, and seizures.

The protective effects of Epo have been shown in animals as well as in numerous studies in humans with various brain disorders. Unfortunately, pharmaceutical companies have only limited interest in financing further studies on approved active ingredients such as erythropoietin for which patent protection has expired. "Because Covid-19 can have such severe health-related consequences, we must investigate any evidence of a protective effect of Epo. After

all, there is currently neither a vaccine nor a medication for the disease. We are therefore preparing a 'proof-of-concept study' to investigate the effect of Epo on Covid-19 in humans", says Ehrenreich. In this clinical trial, severely ill Covid-19 patients will also receive Epo. The researchers will then investigate whether the growth factor can alleviate severe disease progression.

Original publication

Ehrenreich, H., Weissenborn, K., Begemann, M. et al. Erythropoietin as candidate for supportive treatment of severe COVID-19. Mol Med 26, 58 (2020).

https://bit.ly/325hx1m

Scientists Discover Extremely Tiny Dinosaur Ancestor in Madagascar

Its name was Kongonaphon kely, which means 'tiny bug slayer', and it was about the size of a coffee cup. But big things lay ahead for this little creature. Very big things indeed.

Peter Dockrill

The tiny bug slayer, which lived on Madagascar approximately 237 million years ago during the Triassic period, stood just 10 centimetres (about 4 inches) tall. Nonetheless, scientists say *K. kely* belonged to the ancient group Ornithodira: the last common ancestor of all the dinosaurs and pterosaurs that would one day reign in the bug slayer's wake.

Frank Ippolito/AMNH

"There's a general perception of dinosaurs as being giants," says palaeontologist Christian Kammerer from the North Carolina Museum of Natural Sciences.

"But this new animal is very close to the divergence of dinosaurs and pterosaurs, and it's shockingly small."

How did such colossal creatures evolve from such unassuming origins? The answer has never been entirely clear, since relatively few specimens from the root lineage of Ornithodira have ever been discovered and studied.

That's why the bug slayer's old bones are so important. They were first found during field work in 1998 at a fossil site in southwestern Madagascar, along with the remains of hundreds of other ancient specimens.

"It took some time before we could focus on these bones, but once we did, it was clear we had something unique and worth a closer look," says palaeontologist John Flynn from the American Museum of Natural History.

Artist's impression. **Alex Boersma**

K. kely is the smallest known species in a family of early dinosauromorphs called Lagerpetidae. These early examples of Ornithodira are known to be small, but with recent discoveries such as the tiny bug slayer, researchers are coming round to the idea that the smallness of discovered specimens is no accident.

"Although dinosaurs and gigantism are practically synonymous, an analysis of body size evolution in dinosaurs and other archosaurs in the context of this taxon and related forms demonstrates that the earliest-diverging members of the group may have been smaller than previously thought, and that a profound miniaturisation event occurred near the base of the avian stem lineage," the team writes in a new paper.

Evidence to support this comes in the form of the tiny bug slayer's teeth and pitted abrasions on them, consistent with a diet of hard-shelled insects, the team says. If they're right, it's possible that these smaller dinosaur and pterosaur ancestors adapted their diminutive

frames to "invade resource zones not previously occupied by archosaurs" as a kind of evolutionary advantage.

In doing so, it's also possible that the shift to this tiny body helped *K. kely* and its archosaur peers unlock and develop other traits that would go on to become a mainstay of their descendants' survival: innovations in bipedal movement, the origins of fluff to warm small bodies, and even the beginnings of flight, the researchers suggest.

The tiny bug slayer didn't get to see or enjoy all that for itself, of course. But those ambitious tomorrows had some of their beginnings here.

The findings are reported in *PNAS*.

https://bbc.in/3ehRfva

Coronavirus: Spanish study casts doubt on herd immunity feasibility

A Spanish study has cast doubt on the feasibility of herd immunity as a way of tackling the coronavirus pandemic.

The study of more than 60,000 people estimates that around just 5% of the Spanish population has developed antibodies, the medical journal the Lancet reported.

Herd immunity is achieved when enough people become immune to a virus to stop its spread. Around 70% to 90% of a population needs to be immune to protect the uninfected.

The prevalence of Covid-19 antibodies was below 3% in coastal regions, but higher in areas of Spain with widespread outbreaks, the report said. "Despite the high impact of Covid-19 in Spain, prevalence estimates remain low and are clearly insufficient to provide herd immunity," the study's authors said in the report.

"This cannot be achieved without accepting the collateral damage of many deaths in the susceptible population and overburdening of health systems. "In this situation, social distance measures and efforts to identify and isolate new cases and their contacts are imperative for future epidemic control."

The study is thought to be the largest of its kind on the coronavirus in Europe. There have been studies of a similar kind in China and the US and "the key finding from these representative cohorts is that most of the population appears to have remained unexposed" to the coronavirus, "even in areas with widespread virus circulation," the Lancet article said.

Prof Danny Altmann, British Society for Immunology spokesperson and Professor of Immunology at Imperial College London, described the study as "sobering".

"Findings such as this reinforce the idea that faced with a lethal infection that induces rather short-lived immunity, the challenge is to identify the best vaccine strategies able to overcome these problems and stimulate a large, sustained, optimal, immune response in the way the virus failed to do," Prof Altmann said.

What's the latest in Spain?

The country has recorded more than a quarter of a million cases and at least 28,385 deaths. But daily fatalities have been in the single figures for most of the past three weeks.

However, officials in the north-western region of Galicia have re-imposed restrictions on an area of 70,000 people following an outbreak. Officials linked local outbreaks to bars in the area. Capacity in bars and restaurants have been limited to 50%.

There are now 258 cases of Covid-19 in Galicia, including 117 in Lugo province, authorities say.

On Saturday the autonomous government of Catalonia re-imposed controls on an area of 210,000 residents after a sharp rise in infections there. Catalan President Quim Torra said no-one would be allowed to enter or leave Segrià, a district west of Barcelona that includes the city of Lleida.

The search for a fit response

Herd immunity can be reached either by widespread vaccination or if enough of the population is exposed to an infection and recovers.

If enough people are immune to a disease, it is unlikely to keep spreading from person to person. Letting the coronavirus infection run and risking lots of people getting very sick with it is not an option - it would put too many lives in danger.

And currently, there is no vaccine for coronavirus - even though hundreds are in development. The challenge is to make a jab that provides enough protection. It needs to train the body's immune system to learn and remember how to make antibodies that can fight off coronavirus.

Scientists are concerned that this "memory" might be too short-lived though, given the nature of the disease. While some people who catch coronavirus develop protective antibodies, experts do not yet know how long these last.

Common colds are caused by similar viruses and the body's immune response fades quickly to those.

https://go.nature.com/2ZZzGej

Ancient voyage carried Native Americans' DNA to remote Pacific islands

Finding that some Polynesians have genetic ancestry from South America supports long-held theory that ancient populations met and produced offspring.

Ewen Callaway

Traces of Native American ancestry have been found in the genomes of modern inhabitants of some Polynesian islands, suggesting that ancient islanders met and mixed with people from South America hundreds of years ago.

Polynesia was one of the last corners of the world that humans settled, as island-hopping groups from Asia and Oceania began to push farther east some 1,000 years ago. A study published in *Nature* on 8 July supports the long-standing, but unproven, theory that ancient Polynesians had contact with Native Americans[1].

Researchers had thought that this was most likely to have happened on Easter Island, also called Rapa Nui, because of its proximity to South America. But the latest data suggest that these encounters — or perhaps a single meeting — happened on islands thousands of kilometres farther away from the continent.

Stone statues on Easter Island. **Credit: Gregory Boissy/AFP/Getty**

Abundant archaeological and genetic evidence indicates that Polynesian islands were first settled by humans travelling east from Asia, but there are some clues that these people made contact with South Americans. Sweet potatoes, which originate in the Andean highlands, grow across eastern Polynesia, and samples of Polynesian sweet potatoes from the eighteenth century share genetic markers with coastal South American varieties[2]. A 2014 genome study found that the ancestors of modern inhabitants of Rapa Nui had produced offspring with Native Americans[3], but DNA from ancient-human remains from that island and another in French Polynesia found no such signs[4,5].

Mixed ancestry

To broaden the search, a team led by population geneticist Andrés Moreno-Estrada, at the National Laboratory of Genomics for Biodiversity in Irapuato, Mexico, analysed DNA from 166 people currently living on Rapa Nui, as well 188 individuals from more than a dozen islands across the Pacific. They identified Native American ancestry not only in the Rapa Nui, but also in people from the remote eastern Polynesian islands of Palliser, Nuku Hiva in the Northern Marquesas, Fatu Hiva in the Southern Marquesas and Mangareva. Comparisons of this genetic material with that from Native American groups suggested that Zenu people, an

Indigenous group in Colombia, carry DNA most like that found in Polynesians.

Moreno-Estrada's team then attempted to determine when the two populations had produced offspring — to distinguish 'pre-Columbian' contact between the groups from the mixing that took place in the centuries after European colonization of South America and Polynesia. On the basis of the length of shared DNA segments — which shorten in successive generations — the researchers estimate that people in remote eastern Polynesia produced offspring with South Americans between ad 1150 and ad 1230, whereas those in Rapa Nui mixed closer to ad 1380. They also found evidence of mixing in the eighteenth and nineteenth centuries.

Some researchers have proposed that Polynesians voyaged to the coast of South America. But Moreno-Estrada thinks that contact occurred in Polynesia — and that it might have involved a single group of Native Americans. The team calculated similar dates for the appearance of Native American ancestry on different islands, and another analysis found that the South American DNA segments in the genomes of people from different Polynesian islands appear to have come from the same Native American people. Archaeological evidence suggests that there were maritime trade routes between Mexico and Ecuador around that time, Moreno-Estrada says. "Maybe a small raft of Native American sailors got adrift into the Pacific."

Moreno-Estrada thinks that the Polynesians who settled Rapa Nui around ad 1200 already carried South American ancestry. But Paul Wallin, an archaeologist at Uppsala University in Sweden, wonders whether groups of Native Americans might have also travelled there from South America at a later date. Large stone monuments, similar to those in South America, were first constructed on Rapa Nui around ad 1300–1400, hundreds of years before they appeared on other Polynesian islands, he notes.

"The results are very convincing," says Lars Fehren-Schmitz, an anthropological geneticist at the University of California, Santa Cruz. He thinks too much focus has been placed on Rapa Nui, and that it makes sense for contact to have occurred elsewhere in Polynesia.

"It is a very fascinating story," says Cosimo Posth, a palaeogenomicist at the University of Tübingen, Germany. He and his colleagues are scouring the region for the remains of ancient islanders who carry a mix of the two ancestries — or better yet, those of South American people who might have made the long voyage. "Only ancient DNA from eastern Polynesia can settle this riddle," he says.

doi: 10.1038/d41586-020-02055-4

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https://bit.ly/3iVCIc6

Milking algae mechanically: Progress to succeed petroleum derived chemicals

Algae holds a lot of untapped potential for use in industry.

So far algae has provided invaluable nutrition in the health food sector but has struggled to be competitive against petroleum-derived chemical production. Algae is favorable to petroleum from an environmental standpoint but the production cost of culturing, collecting, extracting and refining adds up to make it too expensive for practical use. There is a need to improve production efficiency

to reduce the cost of algae derived products in order for them to be a viable alternative to petroleum-derived products.

A research team led by Alice Uchida and Masaki Ihara of Shinshu University succeeded in developing a method of cultivating microalgae by solving three issues of cultivation; collection/recovery of compounds and extraction/purification of products with this new method. First, it was necessary not to kill the algal cells during extraction. By preserving the algae, there is no need to cultivate and multiply the algae. Secondly, the algae they chose naturally gather together for ease of collection.

Thirdly, the compounds wanted for harvest; polysaccharides (carbohydrates) and phycobiliproteins are released outside of the algae and bound to the cell surface. There is no need for a solvent for extraction or purification, dramatically simplifying and decreasing the cost of processing. This non-destructive continuous milking system is a practical and effective method of algae-derived chemical production.

Micrograph of algae **Masaki Ihara Ph.D., Interdisciplinary Cluster for Cutting Edge Research Institute for Biomedical Sciences, Shinshu University**

In the beginning of the study, the researchers struggled to find a type of algae that could withstand mechanical shearing. They were not sure such an algae existed. However, after an extensive search, they were able to find the Tolypothrix filamentous cyanobacteria and were able to cultivate it continuously for 2 years with little cell damage despite mechanical shearing of the compounds bound to the cell surface. They grew the algae in non-sterile agricultural water and performed 87 day milking cycles which yielded 90 to 140 mg/L of extracellular carbohydrates every 3 weeks. Phycobiliproteins are currently in demand for food additives and cosmetic applications.

The Ihara lab hopes to enable petroleum-based products to be replaced by algae-derived products that inflict less strain on the environment. In order to do so, algae production needs to happen on a much, much larger scale. He continues to look for tough algae that can survive in a variety of environments. He hopes to be able to collaborate with researchers from a variety of fields including fermentation engineering, chemical engineering, polymer chemistry- specifically algal biomass conversion technology, environmental and forest conservation studies in order to study the effects of large-scale algae culture on the environment.

The realization of a post-petroleum society would cause the landscape to be altered, similar to how rice cultivation changed the landscape of Japan through the introduction of rice paddy fields. Although the researchers are optimistic about the future potential of algae, they proceed with caution to consider all the potential effects of change.

For more information on the study, please read Production of extracellular polysaccharides and phycobiliproteins from Tolypothrix sp. PCC7601 using mechanical milking systems in the journal Algal Research.

This research was supported by Japan Society for the Promotion of Science (JSPS) Grants-in-Aid for Scientific Research (KAKENHI) Grant Number JP17K07717.

https://bit.ly/2W6cs51

HIV Patient Reportedly Becomes 'First in Remission' Without a Transplant

May be first patient effectively cured of the illness without needing a bone marrow transplant

Patrick Galey, AFP

A HIV-positive man in remission may be the first patient effectively cured of the illness without needing a bone marrow transplant, researchers said Tuesday in a potential breakthrough.

HIV affects tens of millions of people globally and while the disease is no longer the automatic death sentence it once was, patients need to take medication for life.

In recent years two men - known as the "Berlin" and "London" patients - appear to have been cured of the disease after undergoing high-risk stem cell bone marrow transplants to treat cancer.

Now an international team of researchers believe they may have a third patient who no longer shows sign of infection after undergoing a different medicine regimen.

The patient, a 34-year-old Brazilian who has not been named, was diagnosed with HIV in 2012. As part of the study, he was given several potent antiviral drugs, including maraviroc and dolutegravir, to see if they could help him rid the virus from his body.

He has now gone more than 57 weeks with no HIV treatment and he continues to test negative for HIV antibodies.

Ricardo Diaz, an infectious diseases expert at the University of Sao Paulo, said the patient could be considered to be free of the disease.

"The significance for me is that we had a patient that was on treatment and he is now controlling the virus without treatment," he told AFP. "We're not able to detect the virus and he's losing the specific response to the virus - if you don't have antibodies then you don't have antigens."

'Provocative' findings

Diaz's findings were released as part of the first-ever all-virtual International AIDS Conference, held online this year due to the coronavirus pandemic. The United Nations said Monday that 1.7 million people contracted HIV last year and there are now more than 40 million people living with it.

Diaz said his team's treatment method, which needs further research, was a more ethical avenue for gravely ill HIV sufferers than the bone-marrow transplant route. "They come with a high mortality rate, there have been a series of patients who have either died from the procedures or it didn't work," he said.

Sharon Lewin, co-Chair of the International AIDS Society Initiative Towards an HIV Cure and director of the Doherty Institute for Infection and Immunity in Melbourne, said Diaz's findings were "very interesting".

She struck a note of caution however, due to the study's limitations.

She noted that the Brazil patients' antibody test had gotten weaker over time - suggesting a diminishing immune response.

"This is very unusual to see in someone off antivirals," she said.

"The Berlin and London Patients may be the only exceptions. This very provocative data needs more in-depth analysis."

https://bit.ly/2ANPfNG

From floating guts to 'sticky' blood – here's how to do surgery in space

It has been estimated that there will be one surgical emergency every 2.4 years on a mission to Mars.

by Nina Louise Purvis, The Conversation

Earlier this year, it was reported that an astronaut in space had developed a potentially life-threatening blood clot in the neck. This was successfully treated with medication by doctors on Earth, avoiding surgery. But given that space agencies and private spaceflight companies have committed to landing humans on Mars in the coming decades, we may not be so lucky next time.

Surgical emergencies are in fact one of the main challenges when it comes to human space travel. But over the last few years, space medicine researchers have come up with a number of ideas that could help, from surgical robots to 3-D printers.

Mars is a whopping 54.6 million kilometres (33.9 million miles) away from Earth, when closest. In comparison, the International Space Agency (ISS) orbits just 400 kilometres above Earth. For surgical emergencies on the ISS, the procedure is to stabilise the patient and transport them back to Earth, aided by telecommunication in real time. This won't work on Mars missions, where evacuation would take months or years, and there may be a latency in communications of over twenty minutes.

As well as distance, the extreme environment faced during transit to and on Mars includes microgravity, high radiation levels and an enclosed pressurised cabin or suit. This is tough on astronauts' bodies and takes time getting used to.

We already know that space travel changes astronauts' cells, blood pressure regulation and heart performance. It also affects the body's fluid distribution and weakens its bones and muscles. Space travellers may also more easily develop infections. So in terms of fitness for surgery, an injured or unwell astronaut will be already at a physiological disadvantage.

But how likely is it that an astronaut will actually need surgery? For a crew of seven people, researchers estimate that there will be an average of one surgical emergency every 2.4 years during a Mars mission. The main causes include injury, appendicitis, gallbladder inflammation or cancer. Astronauts are screened extensively when they are selected, but surgical emergencies can occur in healthy people and may be exacerbated in the extreme environment of space.

Floating intestines

Surgery in microgravity is possible and has already been been carried out, albeit not on humans yet. For example, astronauts have managed to repair rat tails and perform laroscopy – a minimally invasive surgical procedure used to examine and repair the organs inside the abdomen—on animals, while in microgravity.

These surgeries have led to new innovations and improvements such as magnetising surgical tools so they stick to the table, and restraining the "surgeonaut" too.

One problem was that, during open surgery, the intestines would float around, obscuring view of the surgical field. To deal with this, space travellers should opt for minimally invasive surgical techniques, such as keyhole surgery, ideally occurring within patients' internal cavities through small incisions using a camera and instruments.

A laroscopy was recently carried out on fake abdomens during a parabolic "zero gravity" flight, with surgeons successfully stemming traumatic bleeding. But they warned that it would be psychologically hard to carry out such a procedure on a crew mate.

Bodily fluids will also behave differently in space and on Mars. The blood in our veins may stick to instruments because of surface tension. Floating droplets may also form streams that could restrict the surgeon's view, which is not ideal. The circulating air of an enclosed cabin may also be an infection risk. Surgical bubbles and blood-repelling surgical tools could be the solution.

A Mars settlement would need a traumapod. Credit: NASA

Researchers have already developed and tested various surgical enclosures in microgravity environments. For example, NASA evaluated a closed system comprising a surgical clear plastic overhead canopy with arm ports, aiming to prevent contamination.

When orbiting or settled on Mars, however, we would ideally need a hypothetical "traumapod", with radiation shielding, surgical robots, advanced life support and restraints. This would be a dedicated module with filtered air supply and a computer to aid in diagnosis and treatment.

Robots and 3-D printing

The surgeries carried out in space so far have revealed that a large amount of support equipment is essential. This is a luxury the crew may not have on a virgin voyage to Mars. You cannot take much equipment on a rocket. It has therefore been suggested that a 3-D printer could use materials from Mars itself to develop surgical tools.

Tools that have been 3-D printed have been successfully tested by crew with no prior surgical experience, performing a task similar to surgery simply by cutting and suturing materials (rather than a

body). There was no substantial difference in time to completion with 3-D printed instruments such as towel clamps, scalpel handles and toothed forceps.

Robotic surgery is another option that has been used routinely on Earth, and tested for planetary excursions. During NEEMO 7, a series of missions in the underwater habitat Aquarius in Florida Keys by NASA, surgery by a robot controlled from another lab was successfully used to remove a fake gallbladder and kidney stone from a fake body. However, the lag in communications in space will make remote control a problem. Ideally, surgical robots would need to be autonomous.

There is a wealth of research and preparation for the possible event of a surgical emergency during a Mars mission, but there are many unknowns, especially when it comes to diagnostics and anaesthesia. Ultimately, prevention is better than surgery. So selecting healthy crew and developing the engineering solutions needed to protect them will be crucial.

https://cnn.it/2ZmazU1

Baby raptor discovered in Alaska may have been a permanent resident of the ancient Arctic

Paleontologists may have identified a new species of dinosaur that lived, mated and nested in the Arctic 70 million years ago.

By Katie Hunt, CNN

(CNN) - Analysis of the tip of a fossilized jawbone, just 14 millimeters long, found in northern Alaska, showed that the creature was a type of dromaeosaurid, a group of predatory dinosaurs closely related to birds, whose members include the Velociraptor, the dinosaurs that terrorized in "Jurassic Park."

The jawbone would have been from a young dinosaur chick, and the early developmental stage of the bone suggests it was born nearby.

Many paleontologists believe the Arctic was a migration path for many types of dinosaur when they crossed between Asia and North America, but so far there's been little evidence found to suggest that the animals lived there year in, year out.

"If juveniles from these dinosaurs are being found, it means that these animals had to spend a great deal of time mating and nesting in these sites," said Tony Fiorillo, a paleontologist at Southern Methodist University in Texas and chief curator of the Perot Museum of Nature and Science.

The fossilized jaw belonged to a dinosaur that may have lived permanently in the Arctic.

"A young chick for these small dinosaurs could probably not migrate long distance, giving indirect indication that these animals were probably perennial residents of the ancient Arctic."

The baby dinosaur would have been the size of a small puppy, Fiorillo said, but fully grown dromaeosaurids can range from 6 to 9 feet. By comparison, to withstand the rigors of migration, modern caribou need to be at least 80% of its adult length, he said.

Dromaeosaurids lived all over the world, but their bones are often small and delicate and have not been preserved well in the fossil record, the study said, complicating efforts to understand the paths they took as they spread across continents.

The partial jaw fossil, with one black erupted tooth, was found on a bank of the Colville River near the Arctic Ocean, about 250 miles north of the Arctic Circle. It's part of the Prince Creek Formation of northern Alaska, which preserves the largest collection of polar dinosaur fossils in the world, dating to about 70 million years ago.

"What is extraordinary about this finding is that not only bones from carnivorous dinosaurs are rarely found in these sites, but discovering one from a very young individual, which can easily get broken up, destroyed and then not entering the fossil record is like finding a needle in the haystack," said lead author of the study Alessandro Chiarenza, a paleontologist at University College London.

An illustration from Andrey Atuchin depicting the environment in the Prince Creek Formation 70 million years ago, with a juvenile dromaeosaurid on the branch close to an adult.

He said a more complete skeleton was needed to confirm it was a completely new species of dromaeosaurid.

Seventy million years ago, the Arctic would have been warmer than it is now -- with a climate similar to Seattle's or Portland's and a rich environment of conifers, mosses and ferns. However, winter temperatures might have dropped to 14 degrees Fahrenheit (-10 degrees Celsius), said Chiarenza, and the creatures would have had to contend with up to four months of winter darkness that could have affected their bone growth.

In the past, it was considered unlikely that dinosaurs, which were regarded as big, cold-blooded lizards, would live in cold conditions, he added.

"Now we know that they probably had more bird-like metabolisms and adaptations, allowing them to survive harsher environments, and for herbivorous dinosaurs to survive on a lower supply of fodder," he said.

The baby raptor may have fed on a thumb-size marsupial called Unnuakomys or the tiny mammal Cimolodon, the study said. Their fossils have been found in the Arctic region.

https://bit.ly/2ZiqvXq

Supergenes play a larger role in evolution than previously thought

Massive blocks of genes—inherited together 'plug and play' style—may play a larger role in evolutionary adaption than previously thought, according to new research in Nature.

Biologists identified 37 of these so-called 'supergenes' in wild sunflower populations, and found they govern the modular transfer of a large range of traits important for adaptation to local habitats. Those include seed size, timing of flowering, as well as the ability to withstand environmental stresses such as drought or limited nutrient availability, among many others.

"We were quite surprised," says University of British Columbia (UBC) geneticist Marco Todesco. "Cases in which individual supergenes controlled adaptive traits had been reported before, but it wasn't clear if they were the rule or just a small number of odd exceptions. What found is that supergenes have a pervasive role in adaptation, and can be truly massive."

The largest of the supergenes identified in the study is comprised of more than 100 million base pairs (larger than many human chromosomes) and 1,819 genes.

The study could help resolve a question left unanswered by Darwin's theory of natural selection—namely, how populations of organisms that live side-by-side and mate with each other are still able to adapt unique traits and diverge into separate species.

Silverleaf sunflowers found on coastal barrier islands (left) flower much earlier than plants growing in nearby plains (right). Credit: Brook T. Moyers, University of British Columbia.

"Initially, evolutionary biologists believed that geographic isolation between populations was required for them to differentiate into ecological races or separate species," says UBC evolutionary

biologist Loren Rieseberg. "But recent research shows that populations that exist side by side can, and do, differentiate."

"The traits that govern such differentiation often appear to be inherited together as supergenes despite genetic exchange with non-adapted populations that are nearby. In many cases, plants are able to adapt to a new environment by borrowing a supergene or two from a related species that is already adapted."

Examples of habitats in which supergenes played a major role in sunflower species adaption include the Texas coastal plain, sand dunes, and coastal barrier islands of the Gulf of Mexico. In the latter case, a 30 million base pair-long supergene controls a difference in flowering time of more than two and half months between sunflowers adapted to Texas' barrier islands and coastal plains. The early-flowering version of the supergene found in the barrier island populations came originally from the common sunflower.

In some instances, the donor species for the supergene might be extinct. "What we think could have happened is that a species arrives in a new habitat, 'steals' adaptive supergenes from a local related species, and then replaces that species," says Todesco. "We could call this a 'ghost supergene', the lingering contribution of a species that no longer exist."

Because of their diversity and ability to adapt also to inhospitable habitats, wild sunflowers have become a model system for evolutionary studies.

Supergenes help the prairie sunflower adapt to the harsh environment of sand dunes. Credit: Nolan C. Kane, University of Colorado Boulder.

"Genome BC has been investing in this work since 2009," says Lisey Mascarenhas, Sector Director, Agrifood and Natural Resources at Genome BC. "A convergence of vision, strategic investments, and scientific leadership has helped propel innovations in sunflower genomics research that will have significant implications for food security and continue to attract global investment to BC."

The researchers sequenced the genomes of more than 1,500 plants from three wild sunflower species: the common sunflower (Helianthus annuus), prairie sunflower (Helianthus petiolaris), and silverleaf sunflower (Helianthus argophyllus). They then looked at associations between genetic variants and more than 80 traits that they monitored throughout the plants' growth, as well as with the soil and climate of their populations of origin. The result is the largest and most comprehensive demonstration to date that structural variants—rearrangements of chromosome structure that are largely responsible for creating the supergenes in the first place—play a fundamental and widespread role in adaptation and speciation.

In addition to the supergenes, the study also identified numerous independent genes that appear to confer resistance to the environmental stresses wild sunflowers face, including drought, heat and low nutrient stress. These independent genes will be invaluable to sunflower breeders as they develop cultivars that can tolerate the more extreme growing conditions predicted under future climate change. From an agricultural standpoint, they offer more flexibility than the supergenes.

"Because they work as a package, introducing a supergene into a cultivated sunflower would mean carrying over both the beneficial and detrimental traits associated with it,' says Todesco. "While supergenes contain several genes that could be beneficial in an agricultural setting, they also contain hundreds of other genes, some of which might not be so beneficial in a crop. For example, by reducing yield or modifying the oil content of seeds."

More information: *Massive haplotypes underlie ecotypic differentiation in sunflowers, Nature, DOI: 10.1038/s41586-020-2467-6 , www.nature.com/articles/s41586-020-2467-6*
Journal information: *Nature*

https://bit.ly/2DA8rQ7

Comet NEOWISE Could Be Spectacular: Here's How to See It

Already visible to the naked eye, the object may soon brighten to create the greatest celestial light show in decades—or it could simply fade away

By Scott Hershberger

This month a cosmic visitor is gracing the skies. A comet swept past the sun on July 3, and it has since become visible to the naked eye. The rare opportunity to glimpse the chunk of ancient ice from the outer solar system should continue next week, when astronomers hope it will become even brighter.

Comet NEOWISE (C/2020 F3), as seen above Lick Observatory on July 7, 2020. **Credit: Elinor Gates UCO Lick Observatory**

Scientists using the Near-Earth Object Wide-Field Infrared Survey Explorer (NEOWISE) space telescope first spotted the comet as it hurtled toward the sun on March 27. Informally dubbed NEOWISE after the telescope but officially labeled C/2020 F3, the comet gradually brightened as sunlight and solar wind caused it to release gases and form a tail. In early June it reached the far side of the sun, as seen from Earth. The resulting glare prevented astronomers from observing the comet for several weeks. By late June, however, it swam back into the optics of another space telescope, the Solar and Heliospheric Observatory (SOHO). Its fate was still unclear, however: Would Comet NEOWISE brighten or fade?

On July 3 observers watched closely as the comet began the most perilous part of its journey: its nearest approach to the sun, which brought it within 44 million kilometers of our star. The intense light and heat from such close proximity tends to make comets disintegrate and disappear from the night sky. Earlier this year, such breakups befell two other comets, ATLAS and SWAN, that astronomers had hoped would light up Earth's skies. But NEOWISE survived and emerged brighter than before to dazzle stargazers—provided they know where to look. Now, for the next few days at least, residents of the Northern Hemisphere can greet the passing visitor at dawn.

"For many people in the Northern Hemisphere, especially if you're closer to the midlatitudes, [the comet] should be visible an hour before sunrise, very low in the northeastern sky," says Kerry-Ann Lecky Hepburn, a meteorologist and astrophotographer who captured an image of Comet NEOWISE over Toronto. "Right now it's located in the constellation Auriga." She recommends finding the comet's exact spot using specialized smartphone apps with interactive maps of the constellations. Although already visible to the naked eye, the object is still faint, and binoculars would offer a better view.

Starting around July 12, Comet NEOWISE will be visible in the evening as well, Lecky Hepburn says. About an hour after sunset, it will appear near the northwestern horizon. As the month progresses, it will rise higher in the sky, moving from the constellation Lynx toward the Big Dipper. On July 22 the comet will reach its closest point to Earth—a distance of 103 million kilometers—before continuing its cosmic flight. Whether it will still be visible to unaided eyes by then is uncertain, however.

"Comets are like cats," says Franck Marchis, an astronomer at the SETI Institute. "They are unpredictable." If Comet NEOWISE's outgassing exhausts its reserves of icy material, its bright tail could dissipate, effectively removing the object from view. On the other extreme, ongoing heating from the sun could cause the comet to disintegrate in a bright outburst, potentially resulting in a highly visible "great comet" of historic significance. This possibility

would be “a spectacular event and a great show for the earthlings,” Marchis says. But “personally, I recommend walking up early and going to see it now, while we know it’s here.”

After this encounter, astronomers expect Comet NEOWISE to bid farewell for quite some time. Its long, looping orbit around our star will next bring it back to Earth’s vicinity some 6,800 years from now.

https://lat.ms/2C3qy0f

COVID-19 and blood type: What’s the link?

Scientists are finding evidence that blood type may be a risk factor for COVID-19. In one study, people with Type A blood were more likely to be hospitalized for the disease.

By Karen Kaplan Science and Medicine Editor

If there’s one thing we want to know about COVID-19, it’s probably this: What’s my risk of getting it?

Researchers have identified certain things that make some people more vulnerable than others. Men are at greater risk than women. Older people are at greater risk than younger people. Those with chronic health problems like Type 2 diabetes, obesity and serious heart conditions are faring worse than those without them. Black and Latino Americans are at greater risk than Asian Americans and whites.

Now there’s evidence that blood type could be a risk factor too.

A handful of studies have suggested that people with some blood types are more likely to be hospitalized with COVID-19, while those with other blood types are less likely to require that level of care. The most recent evidence was published last month in the New England Journal of Medicine.

Here’s a look at what scientists have learned about blood type and its role in the COVID-19 pandemic.

How many blood types are there?

Eight. Yours is determined in part by the presence (or absence) of A and B antigens on your red blood cells. If you have only A antigens, your blood type is A. If you have only B antigens, your blood type is B. If you have both, your blood type is AB, and if you have neither, your blood type is O.

In addition, red blood cells may have a protein called Rh factor. If you have it, you’re Rh positive; if not, you’re Rh negative.

The combination of A and B antigens and the Rh factor produces the eight major blood types: A-positive, A-negative, B-positive, B-negative, AB-positive, AB-negative, O-positive and O-negative.

What did the New England Journal of Medicine study say about blood types?

Researchers analyzed genetic data from more than 1,600 patients hospitalized with severe cases of COVID-19 in Italy and Spain and compared them with about 2,200 others who didn’t have the disease. After making adjustments to account for the effects of age and sex on COVID-19 risk, the researchers found striking differences in blood types of the sick patients compared with the controls.

In this population, having Type A blood was associated with a 45% increased risk of having severe COVID-19. On the other hand, having Type O blood was associated with a 35% reduced risk of the disease. Those relationships held up whether the Italian and Spanish patients were analyzed separately or together.

No other blood groups were associated with a greater or lesser risk of the disease. In addition, blood type did not seem to be linked to the risk of needing to be put on a mechanical ventilator.

The study design did not allow researchers to make any determination about whether blood type was associated with the risk of coronavirus infection, or, if infected, the risk of becoming severely ill.

“The hope is that these and other findings yet to come will point the way to a more thorough understanding of the biology of COVID-

19," Dr. Francis Collins, a geneticist and director of the National Institutes of Health, wrote on his blog. "They also suggest that a genetic test and a person's blood type might provide useful tools for identifying those who may be at greater risk of serious illness."

How does that line up with other research?

At least two other groups have looked for links between blood type and COVID-19 risk and found similar results.

The first inkling that blood type might have something to do with disease risk came in March from researchers in China, who compared 2,173 COVID-19 patients in three hospitals in Wuhan and Shenzhen to more than 27,000 "normal people." They found that people with Type A blood had a 21% greater risk of the disease than their counterparts with other blood types, and that people with Type O blood had a 33% lower risk.

The following month, a team from Columbia University examined 1,559 people in the New York City area who were tested to see whether they were infected with the coronavirus that causes COVID-19. They found that having Type A blood was associated with a 34% greater chance of testing positive, while having Type O blood was associated with a 20% lower chance of testing positive. In addition, people with Type AB blood were 44% less likely to test positive, although only 21 of the 682 people who tested positive for the coronavirus had AB blood.

The Columbia researchers noted that their findings about the risks associated with Type A and Type O blood were consistent with the results from China, even though the distribution of blood types was significantly different in the populations of New York, Wuhan and Shenzhen. Both of these reports were posted to the MedRxiv website, where researchers share preliminary data before it has been subjected to peer review.

Why would blood type have anything to do with COVID-19?

That's not clear. Perhaps different combinations of A and B antigens change the immune system's production of infection-fighting antibodies or have some other unknown biologic effect, the authors of the New England Journal of Medicine study wrote.

Another possibility is that the genes associated with blood type also affect the ACE2 receptor on human cells, which the coronavirus seeks out and latches onto, they wrote.

How can I find out what my blood type is?

Your doctor may have it on file if it's been tested in the past.

If not, you can test it at home with a kit that includes an Eldoncard. The kit will require you to prick your finger to obtain a small blood sample, then mix it with antibodies to the A and B antigens that come on the card. If your red blood cells contain A or B antigens, they will react with the antibodies and clump up on the card.

If you only see a reaction to A antibodies, your blood type is A. Ditto for the B antibodies. If you see a reaction to both, your blood type is AB, and if there's no reaction, your blood type is O.

An additional circle on the card contains antibodies to the protein called Rh factor. A reaction there indicates you are Rh-positive; if nothing happens, you're Rh-negative. If that sounds like too much trouble, you can donate blood. If go to the Red Cross, they'll send you a donor card that indicates your blood type.

Should I be taking extra precautions if my blood type is A?

Everyone should be as careful as possible all the time, regardless of blood type. (That goes for those with Type O blood too.)

If you've been outside or came in contact with high-touch surfaces, wash your hands for at least 20 seconds. Wear a mask if you leave home and maintain at least six feet of distance between yourself and others who are not members of your household. Try not to touch your face so the virus can't sneak into your body through your eyes, nose or mouth. And be sure to clean doorknobs, faucets, phones and other frequently touched surfaces every day.

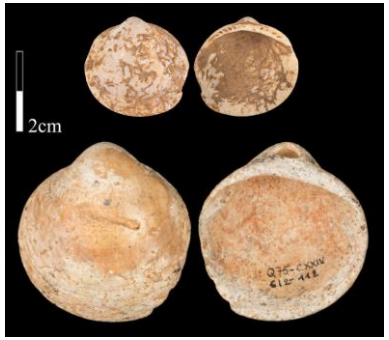
https://bit.ly/2OgGgaT

120,000-year-old necklace tells of the origin of string

String may have been invented between 160,000 and 120,000 years ago.

Kiona N. Smith - 7/10/2020, 3:20 AM

People living on the Israeli coast 120,000 years ago strung ocher-painted seashells on flax string, according to a recent study in which archaeologists examined microscopic traces of wear inside naturally occurring holes in the shells. That may shed some light on when people first invented string—which hints at the invention of things like clothes, fishing nets, and maybe even seafaring.



Oz Rittner

Seashells by the seashore

Picking up seashells has been a human habit for almost as long as there have been humans. Archaeologists found clam shells mingled with other artifacts in Israel's Misliya Cave, buried in sediment layers dating from 240,000 to 160,000 years ago. The shells clearly weren't the remains of Paleolithic seafood dinners; their battered condition meant they'd washed ashore after their former occupants had died.

For some reason, ancient people picked them up and took them home.

Shell collectors at Misliya seemed to like mostly intact shells, and there's no sign that they decorated or modified their finds. But 40,000 years later and 40km (25 miles) away, people at Qafzeh Cave seemed to prefer collecting clam shells with little holes near their tops. The holes were natural damage from scraping along the seafloor, but people used them to string the shells together to make jewelry or decorations. Tel-Aviv University archaeologist Daniella Bar-Yosef Mayer and her colleagues examined five shells from Qafzeh and found microscopic striations around the edges of the holes—marks that suggest the shells once hung on a string.

Archaeologists even have a good idea of what that 120,000-year-old jewelry looked like. Wear marks around the holes suggest hanging on a string, and other wear marks on the edges of the shells suggest that the shells rubbed against each other, so they probably hung close together. And four of the shells still carried traces of red ocher pigment. The only thing missing is also the most interesting piece: the string.

String theory

To find that missing piece, Bar-Yosef Mayer and her colleagues collected some seashells of their own. The archaeologists rubbed their modern clam shells against sand, wood, clay, stone, leather, reeds, and several different kinds of fibers, and then they used a scanning electron microscope to examine the patterns of pits, polishing, and striations left behind. They even made strings of wild flax and hung shells—with natural holes—on them, then examined the resulting wear marks under a microscope.

The tiny marks left behind by a flax string rubbing against the edges of the hole looked just like the marks on the Qafzeh shells. Even though the string itself didn't survive, the wear marks on the shells reveal its presence.

One hundred sixty millennia ago, people were collecting shells but, apparently, not doing much else with them. By 120,000 years ago, people had started stringing shells together and decorating them with red ocher. What changed in that 40,000 years? According to Bar-Yosef Mayer and her colleagues, someone invented string.

If you're not an archaeologist, dating the invention of string might sound esoteric. But twisting plant or animal fibers into thread is the key to a lot of other technologies, from clothes to seafaring.

"When one makes a string, you can make it much longer than a leather strip. This would allow you, for example, to make a rope that will tie together wooden logs to make a raft (or to tie a rigout to a canoe)," Bar-Yosef Mayer told Ars. String also means people can make things like fishing nets, more complicated kinds of animal traps, and new kinds of clothing and bags. Dating the invention of string also hints at when people could have invented those other important technologies.

Maybe it was a tie

But which people? "We do not know who invented string—*Homo sapiens* or Neanderthals," Bar-Yosef Mayer told Ars.

The oldest actual piece of thread we know of so far came from a Neanderthal site called Abri du Maras in France, and it's around 50,000 years old. *Homo sapiens* didn't reach Western Europe until a few thousand years later, but the two species had probably interacted in the Levant for tens of thousands of years (*Homo sapiens* and Neanderthals seem to swap places a few times in the archaeological record at sites like Qafzeh, Misliya, and Skhul caves). Either species could have borrowed the idea of thread from the other. But who deserves credit for the original invention?

The case for Neanderthals rests partially on a fragment of fiber—which may or not actually have been thread—found clinging to a 130,000-year-old eagle talon at the Krapina rock shelter in Croatia. Elsewhere in Europe, Neanderthals removed eagle talons, and one possible explanation is that they were making jewelry or some other kind of ornament. And at Cueva de los Aviones in Spain, archaeologists found seashells decorated with red and yellow pigment—with holes deliberately punched in them. But without looking for the same kinds of wear marks as the ones on the Qafzeh shells, it's impossible to say whether the Cueva de los Aviones Neanderthals were using string or leather.

On the other hand, archaeologists have found seashells with naturally worn holes in them at sites in South Africa and Morocco, ranging from 115,000 to 70,000 years old. "It would be reasonable to assume that much like the Qafzeh shells, these were also strung in order to be displayed," wrote Bar-Yosef Mayer and her colleagues. So far, no one has examined those shells for traces of wear from string, however.

It's going to take more evidence to unravel the origins of string and all the technologies that tie into it. But Bar-Yosef Mayer is optimistic. "It is only in the last decade or so that we started finding these finds, due to increased use of microscopy in archaeological research," she told Ars. "So I'm confident there is more to come."

A note from Ars Technica

Archaeologist Ofer Bar-Yosef, a co-author of the study, died in March 2020. He spent nearly 60 years researching Paleolithic archaeology in the Levant, China, and the Republic of Georgia. At the time of his death, the study had been completed and the paper was still awaiting publication.

His wife, the study's first author, Daniella Bar-Yosef Mayer, told Ars, "I know he would have been very happy and proud to see this paper out."

PLOS One, 2020 DOI: 10.1371/journal.pone.0234924 (About DOIs).

https://bit.ly/326SOtG

Study shows that aerosol box used to protect healthcare workers during COVID intubation increases, rather than decreases, exposure to airborne particles

And thus casts doubt on their usefulness

A new study shows that certain aerosol boxes of a similar type to those that have been manufactured and used in hospitals in the UK and around the world in order to protect healthcare workers from COVID-19 can actually increase exposure to airborne particles that carry the virus, and thus casts doubt on their usefulness.

The authors - who include Drs Peter Chan, Joanna Simpson and colleagues, Intensive Care and Anaesthesia Specialists at Eastern Health, Melbourne, VIC, Australia - say that "the consequences of

promotion of such untested devices include either a false sense of security using these devices, or paradoxical increase in healthcare workers exposure to COVID-19". The study is published in *Anaesthesia* (a journal of the Association of Anaesthetists).

The danger posed to frontline health workers exposed to infectious COVID-19 is significant. The sickest COVID-19 patients often need to be placed onto a ventilator, which is also when the risk to the health worker of exposure to virus is potentially at its greatest. This has created a race to manufacture aerosol containment devices including improvised protection strategies and devices for use during tracheal intubation.

This has taken on even greater urgency in the last week, with a global "second wave" becoming more likely, and a recent open letter to the World Health Organization from 239 global scientists in 32 countries warning that we have probably been severely underestimating the amount of COVID-19 spread through fine aerosol droplets over large distances. On Wednesday, July 8, WHO formally acknowledged this emerging evidence regarding potential spread of COVID-19 through these tiny droplets.

Aerosol boxes have been promoted by multiple worldwide news organisations in print, television, online and across social media (see examples below) as not only a quick and simple solution to protecting frontline workers but also an example of private industries stepping up production to support frontline healthcare workers.

However, these devices were produced outside the normal regulatory framework, and thus were never clinically tested or validated for effectiveness and safety. They were subsequently heavily promoted in the media and on social media. Yet despite this heavy promotion, no international guideline on personal protective equipment (PPE) has ever endorsed their use.

In recent months there have been increasing concerns from the medical community that these devices might be either not helping, or potentially exposing frontline medical staff to unforeseen harm, but as this could not be proven, the devices continued to be used across the globe.

In this new study, Drs Chan and Simpson and colleagues partnered with Ascent Vision Technologies, a Melbourne-based engineering company, to test the effectiveness of varying methods of aerosol containment, including the so-called aerosol box (see links to photos below), which various private companies have offered their services to manufacture.

The study was carried out in a self-contained intensive care unit room at Box Hill Hospital, Melbourne, using seven adult volunteers (four male, three female), who took turns in random order acting as the patient or the doctor (the person performing the intubation).

The study simulated exposure of the doctor to airborne particles sized 0.3 - 5.0 microns using five aerosol containment methods (aerosol box; sealed box with and without suction; vertical drape; and horizontal drape) compared with no intervention. As each of the seven volunteers did all six trials (the five interventions plus no intervention), the study generated 42 sets of results.

To simulate aerosolisation, the patient volunteer held a bottle of fluid just under their mouth, and coughed every 30 seconds. Over five minutes particle detection devices were used to count different sized particles and assess particle spread.

Compared with no device use, the aerosol box surprisingly showed an increase in airborne particle exposure of all sizes over 5 minutes. Assuming that COVID-19 particles act in the same way as the fluid used in this simulation, the results of this study suggest that this aerosol box was increasing exposure to COVID-19 particles, in some cases by a factor of 5 times or more.

The authors say: "We were surprised to find airborne particle contamination of the doctor increased substantially using the aerosol box compared with all other devices and with no device use. Spikes of airborne particles were clearly seen, coinciding with patient coughing. We believe that these represent particles escaping from the arm access holes in the aerosol box."

They add: "The race to generate sustainable equipment to protect healthcare workers during intubation procedures in patients with suspected or proven COVID-19, particularly in settings where PPE supply is limited, has flooded the scientific community and social media with a variety of novel devices meant to contain potentially infectious aerosols produced by patients. Evidence for the safety and efficacy of these devices is lacking."

They conclude: "This study demonstrates that devices such as the aerosol box we tested - which is typical of designs used worldwide - confer minimal to no benefit in containing aerosols during an aerosol-generating procedure and may increase rather than decrease airborne particle exposure. The use of any aerosol containment device has been eliminated from our intubation protocols until their safety can be properly established."

Dr Chan adds: "If this box were a sold as a product, and therefore regulated, it would likely need to be immediately recalled due to a potential infection risk to the healthcare worker. Unfortunately, because these devices have been donated and are not regulated in any way, healthcare workers might be continuing to increase their exposure to COVID-19 while thinking they are protecting themselves."

https://lat.ms/2OhjrnA

A plasma shot could prevent coronavirus. But feds and makers won't act, scientists say

It might be the next best thing to a coronavirus vaccine.

By Emily Baumgaertner Staff Writer

Scientists have devised a way to use the antibody-rich blood plasma of COVID-19 survivors for an upper-arm injection that they say could inoculate people against the virus for months.

Using technology that's been proven effective in preventing other diseases such as hepatitis A, the injections would be administered to high-risk healthcare workers, nursing home patients, or even at public drive-through sites — potentially protecting millions of lives, the doctors and other experts say.

The two scientists who spearheaded the proposal — an 83-year-old shingles researcher and his counterpart, an HIV gene therapy expert — have garnered widespread support from leading blood and immunology specialists, including those at the center of the nation's COVID-19 plasma research.

But the idea exists only on paper. Federal officials have twice rejected requests to discuss the proposal, and pharmaceutical companies — even acknowledging the likely efficacy of the plan — have declined to design or manufacture the shots, according to a Times investigation. The lack of interest in launching development of immunity shots comes amid heightened scrutiny of the federal government's sluggish pandemic response.

There is little disagreement that the idea holds promise; the dispute is over the timing. Federal health officials and industry groups say the development of plasma-based therapies should focus on treating people who are already sick, not on preventing infections in those who are still healthy.

Dr. Anthony Fauci, director of the National Institute of Allergy and Infectious Diseases at the National Institutes of Health, said an upper-arm injection that would function like a vaccine "is a very attractive concept."

However, he said, scientists should first demonstrate that the coronavirus antibodies that are currently delivered to patients intravenously in hospital wards across the country actually work.

"Once you show the efficacy, then the obvious next step is to convert it into an intramuscular" shot.

But scientists who question the delay argue that the immunity shots are easy to scale up and should enter clinical trials immediately. They say that until there's a vaccine, the shots offer the only plausible method for preventing potentially millions of infections at a critical moment in the pandemic.

"Beyond being a lost opportunity, this is a real head-scratcher," said Dr. Michael Joyner, a Mayo Clinic researcher who leads a program sponsored by the Food and Drug Administration to capitalize on coronavirus antibodies from COVID-19 survivors. "It seems obvious."

The use of so-called convalescent plasma has already become widespread. More than 28,000 patients have already received the IV treatment, and preliminary data suggest that the method is safe. Researchers are also looking at whether the IV drip products would prevent new infections from taking root.

The antibodies in plasma can be concentrated and delivered to patients through a type of drug called immune globulin, or IG, which can be given through either an IV drip or a shot. IG shots have for decades been used to prevent an array of diseases; the IG shot that prevents hepatitis A was first licensed in 1944. They are available to treat patients who have recently been exposed to hepatitis B, tetanus, varicella and rabies. Yet for the coronavirus, manufacturers are only developing an intravenous solution of IG.

Joyner told The Times that 600 COVID-19 survivors donating their plasma each day could, depending on donation volumes and concentrations, generate up to 5,000 IG shots. With millions of probable survivors in the United States, he said, capacity isn't a problem.

Plasma companies said they've focused their efforts on an intervention for the sickest patients. Grifols, for example, said it has not developed a shot because it is pursuing a federally supported IV formula "to treat patients already infected with a serious case of COVID-19," but the company acknowledged that an antibody injection would be a good choice for prevention.

Advocates for the immunity shots say businesses are reluctant to invest in a product that could soon be replaced by a vaccine, so the government should offer financial incentives to offset that risk. Billions of federal dollars are already being spent on vaccine research through Operation Warp Speed, and funding for an IG shot that could serve as a bridge to a vaccine would come with a relatively modest price tag, they say.

"Antibodies are the most precious resource on the planet right now, next to air. We have the industry, the technology, and the know-how to produce a proven product," said Patrick Schmidt, the chief executive of FFF Enterprises, a major distributor of IG products in the United States. "The amount of money and resources going into a vaccine, with no guarantee it will work — this could have saved lives by now."

The proposal for an injection approach to coronavirus prevention came from an immunization researcher who drew his inspiration from history.

Dr. Michael Oxman knew that, even during the 1918 flu pandemic, the blood of recovered patients appeared to help treat others. Since then, convalescent plasma has been used to fight measles and severe acute respiratory syndrome, or SARS, among other diseases.

Like other doctors, Oxman surmised that, for a limited time, the blood coursing through the veins of coronavirus survivors probably contains immune-rich antibodies that could prevent — or help treat — an infection.

On March 27, he and Dr. John Zaia, the director of City of Hope's Center for Gene Therapy, submitted a proposal to the federal Biomedical Advanced Research and Development Authority, or

BARDA, urging the rollout of IG shots for first responders and members of other high-risk groups.

The agency granted $12.5 million to Grifols and $14.5 million to Emergent BioSolutions to produce plasma-based COVID-19 medicines in IV form drips, among more than 50 different biomedical partnerships to fight the pandemic. But the immunity shot proposal was rejected.

The pair followed up with a detailed proposal to conduct a clinical trial at UC San Diego. They believed injectable 5-milliliter vials of IG could be given quickly by minimally trained healthcare workers, offering at least two months of immunity to doctors and nurses, as well as residents of nursing homes, college dormitories and military submarines. The submission was backed by four other infectious disease researchers and statisticians, but it was also rejected, records show.

A spokeswoman for BARDA told The Times that the agency had received thousands of submissions, and that "while we are interested in the potential of [IG] for treatment and prevention, we are focused intently on treatments for hospitalized patients to save lives."

The strategy baffled Oxman and Zaia, who said the IG shots are a far more efficient delivery system that can potentially reach many more people. What's more, prophylactic shots would probably require far fewer antibodies than IV treatments, Joyner said. With IG shots, plasma donations could possibly go twice — or even five times — as far, he said. If a second wave of the virus were to arrive before an effective vaccine, that stockpile would be all the more essential.

Oxman started focusing his attention on the key players in the industry — the manufacturers who dominate the development of plasma drugs. He held weekly phone calls with Schmidt, the distributor; together, the two tried to persuade seven companies to produce the shots themselves and bring them to health agencies for testing. They were unsuccessful.

Takeda and CSL Behring, two large companies who co-lead the new CoVIg-19 Plasma Alliance to develop an IG product for IV drips, said their efforts are trained on the sickest. The IV formula "represents the fastest path to reach patients, assuming the trial is successful," said Julie Kim, the head of the plasma-derived therapies business unit at Takeda.

Financial calculations may be another factor for companies. Intravenous plasma products are traditionally the main economic driver for the industry, supply experts said, in part because vaccines have replaced many short-term immunity shots over the years. The money-making antibodies are also far more diluted in intravenous drugs than in injectable ones, which boosts profit margins.

"They charge a fortune off of intravenous drugs in the hospital. They don't want to devote the manufacturing plant to something that won't make oodles of money," said one infectious disease expert, who has advocated for coronavirus IG shots but asked not to be publicly identified. Researchers also said industry executives have little incentive to produce the immunity shots for the coronavirus, given the possibility that a longer-lasting vaccine could replace it within a year.

Representatives for CSL, Takeda and Grifols all challenged that assertion. "The choice of one delivery method or another has no connection with the potential financial or pricing implications," a Grifols spokesman told The Times.

Throughout May, researchers and doctors at Yale, Harvard, Johns Hopkins, Duke and four University of California schools sent a barrage of letters to dozens of lawmakers. They held virtual meetings with health policy directors on Capitol Hill, but say they have heard no follow-up to date.

Dr. Arturo Casadevall, the chair of the National COVID-19 Convalescent Plasma Project, said he spoke to FDA officials who told him they do not instruct companies on what to produce. Casadevall told The Times that the leaders of the national project were “very supportive of the need to develop” an IG shot rapidly and that he believed it would be “very helpful in stemming the epidemic.”

Joyner, of the Mayo Clinic, said there are probably 10 million to 20 million people in the U.S. carrying coronavirus antibodies — and the number keeps climbing. If just 2% of them were to donate a standard 800 milliliters of plasma on three separate occasions, their plasma alone could generate millions of IG shots for high-risk Americans. “At a hot-spot meatpacking plant, or at a mobile unit in the parking lot outside a mall — trust me, you can get the plasma,” Joyner said. “This is not a biological problem nor a technology problem. It’s a back-of-the-envelope intelligence problem.”

The antibody injections, for now, do not appear to be a high priority for the government or the industry.

Grifols, on April 28 — the same day that the U.S. topped 1 million confirmed coronavirus cases — made a major product announcement that would “expand its leadership in disease treatment with immunoglobulins.”

The product was a new vial for IG shots — to treat rabies.

https://bit.ly/3qPqtMv

A new coronavirus mutation is taking over the world. Here's what that means.

A mutation in the protein that allows SARS-CoV-2 to enter cells might make it easier for the virus to spread — or it might not make a difference at all.

By Stephanie Pappas - Live Science Contributor

That's the crux of a debate over a mutation known as D614G, which affects the spike protein on the virus' surface. The mutation is not new. It appears in low levels in samples taken from COVID-19 patients as far back as February. But this variation of the virus (nicknamed the "G" variation) seems to show up in more and more of the virus samples taken from people infected recently compared to early in the pandemic.

A new paper, published July 2 in the journal Cell, argues that the rise in the "G" variation of the new coronavirus is due to natural selection. The study finds that virus particles with this mutation have an easier time making their way into cells, suggesting that it is outcompeting other strains of the virus to become the dominant version of SARS-CoV-2. Other, not-yet-published experiments have found similar results. However, some researchers are not yet convinced that the mutation has any real-world impact on coronavirus transmission at all. Instead, it's possible that the G variant's spread is due to chance, said Nathan Grubaugh, an epidemiologist at the Yale School of Medicine who co-authored a commentary accompanying the paper's publication.

"The virus could have easily gotten lucky," Grubaugh told Live Science.

G versus D

Original samples of the novel coronavirus out of Wuhan, China, were a variation that scientists now call the "D" clade. Before March 1, more than 90% of viral samples taken from patients were from this D variation. Over the course of March, G began to predominate. This mutation is caused by the swapping of an adenine (A) nucleotide to a guanine (G) nucleotide at a particular spot in the coronavirus genome. It always appears alongside three other mutations that similarly swap one building block of RNA for another. (The letters in RNA help code for the proteins the virus makes once inside a cell.)

The G variant represented 67% of global samples taken in March, and 78% of those taken between April 1 and May 18. During this

time, the locus of the outbreaks shifted away from China into Europe and the United States.

The mutation piqued interest because it seemed to take over even in areas were the D variation had initially held sway, said Bette Korber, the lead author of the new Cell paper and a computational biologist at Los Alamos National Laboratory in New Mexico. She and her colleagues at Duke University and the La Jolla Institute of Immunology in California inserted the G mutation and D mutations into pseudoviruses, which are viruses engineered to display the surface proteins of other viruses. Pseudoviruses are useful, Korber told Live Science, because they can't spread disease and because they contain molecular tags that researchers can use to track their movement into cells.

The researchers then exposed cell cultures to pseudoviruses with either the G or D variants of the coronavirus spike protein to track which was more infectious. They found that the G variations led to much higher amounts of virus in the cell culture, indicating increased infection and replication. The viral loads found from G variations of the spike protein were 2.6 to 9.3 times larger than from the D variations of the spike protein.

The pseudoviruses and cells used in the experiment were neither real coronavirus nor human lung cells, but another study that used infectious SARS-CoV-2 virions reached similar findings. That study, which was published July 7 to the preprint server bioRxiv and has not yet been peer-reviewed, was spearheaded by biologist Neville Sanjana at New York University. He and his colleagues tested the G and D versions of SARS-CoV-2 in cell cultures, including human lung cells, and found that the G variant infected up to eight times more cells than the D variant.

But just because a virus is better at infecting cells in a lab culture doesn't mean it will be more transmissible in the real world, Grubaugh said. "If it just takes it [a] few more hours for the other variant to do the exact same thing, then the outcome essentially is the same," he told Live Science. And entering cells is just one part of the equation. There are many factors that affect transmissibility, he said, such as how efficiently the virus leaves the body and how stable it is in the outside environment as it awaits a new host.

Some clinical work has suggested that the G variant's apparent advantage might hold outside of the Petri dish. A study, posted May 26 to the preprint database medRxiv, also not yet peer-reviewed, led by Northwestern University Feinberg School of Medicine researchers Dr. Egon Ozer, Judd Hultquist found three distinct versions of SARS-CoV-2 circulating in Chicago in mid-March. Some matched the dominant version circulating in New York City, some matched the predominant version from the West Coast, and some seemed most closely related to the original samples from China.

"The virus kind of came both ways around the globe and smacked into Chicago and we got virus originally from China, we think thanks to O'Hare being such a transportation hub," Hultquist told Live Science.

The New York clade, which contained the G mutation, was linked to a higher viral load in the upper airways than the virus that was closer to the original China strain, the researchers found. Researchers in Washington state have released similar findings. If the results hold up, they could hint at increased transmission, because higher levels of virus in the upper airways might translate to more virus emitted when people breathe and talk, Ozer told Live Science. But it's impossible to say for sure, he said. Scientists don't even know how many virions a person needs to come into contact with to get infected, so it's not clear if the extra viral load makes a difference.

A lucky break?

It's possible that the G mutation in the coronavirus' spike protein is, indeed, giving it some kind of transmissibility advantage over other strains of the virus, Grubaugh said. But it's not yet proven. The G variant also could have taken over the world by pure luck, not by evolutionary fitness. That's due to something that epidemiologists call "founder" effects.

"If this virus got into a population of people that had a lot of connectivity, essentially like a super spreader event, then just because that was the founder in that population, it could spread really quickly," Grubaugh said.

How might this have worked for the G mutation? The strain had the good fortune to land in Europe, where major outbreaks infected many people. From there, it got even luckier, landing in the globally connected hub of New York City. The outbreak in New York seeded many of the outbreaks in the rest of the United States, including many places where the virus is now running essentially unchecked.

"What's going to be important now is to continue to monitor in these places," Grubaugh said. If the G variant continues to dominate even in places where both the G and D versions are present, that might be a sign that the G mutation does provide the virus a transmission advantage.

The G614 mutation is part of a cluster of four mutations that appear together, Korber said, so more work needs to be done on what the other three mutations might do. Another important line of work will be testing the genetic variants in animal models that better mimic human transmission. Scientists are working with a number of animals, from ferrets to Syrian hamsters to macaques, to study the coronavirus, but they haven't yet established which animals best represent how the disease spreads from human to human. (Hamsters and ferrets catch influenza much like humans, so scientists hope that they might also be a good animal model for coronavirus spread.)

The good news is that so far, there is no evidence that the G variant causes more severe disease than any other version of the coronavirus, nor does the mutation appear likely to affect the process of vaccine development, researchers agreed. But the findings indicate that it's important for scientists to keep track of the virus' mutations as it spreads. As the virus interacts with more and more immune systems, it will experience more evolutionary pressure and may continue to change, Ozer said.

"We have seen that in the course of one month, a particular form of the virus can go from being very rare to the globally most common form," Korber said. "It could happen again."

For the general public, the advice hasn't changed: Social distancing and wearing masks are still the best practices, post-lockdown, Korber said. The mutation is here to stay, Grubaugh said, and what it does for the virus is probably less important now than what people do.

"There are so many other more important things to worry about right now than this mutation," he said. "We can't even get a handle on testing, we don't have effective control measures really at all right now… If we keep allowing opportunities for the virus to have a new host, then it's going to keep on spreading, regardless of if it's a more fit variant or not."

https://bit.ly/2ZVLzlC

Deadly 'unknown pneumonia' outbreak in Kazakhstan is probably undiagnosed COVID-19

A Chinese embassy warned of a new and deadly pneumonia. But these cases are likely undiagnosed COVID-19 infections, according to WHO.

By Rachael Rettner - Senior Writer a day ago

A Chinese embassy has issued a warning about a deadly "unknown pneumonia" circulating in Kazakhstan, but authorities outside of China say these cases are still likely COVID-19.

On Thursday (July 9), officials with the embassy in Kazakhstan issued an alert to residents that the unidentified pneumonia had killed more than 1,700 people in Kazakhstan, including Chinese citizens, according to CNN. "The death rate of this disease is much higher than the novel coronavirus," the alert said, according to Newsweek.

However, authorities in Kazakhstan denied such an outbreak, saying that "this information does n'ot correspond to reality," CNN reported. A statement from Kazakhstan's health ministry said that there were "viral pneumonias of unspecified etiology" in the country. However, the statement said that the classification of "unspecified" was used for cases of COVID-19 that had been diagnosed based on symptoms but not confirmed with laboratory testing.

In a press briefing for the World Health Organization (WHO) on Friday (July 10), Dr. Michael Ryan, executive director of the WHO Health Emergencies Program, said that the news of this outbreak "is certainly on our radar," and that the organization is working with authorities in Kazakhstan to investigate it.

These cases are likely COVID-19, given that there has been a big surge in COVID-19 in the country recently, with more than 10,000 such cases diagnosed there in the last week, Ryan said. WHO is now looking at the quality of testing conducted and if some of these unspecified pneumonia cases are due to false negative test results for COVID-19, he said.

Ryan noted that clusters of atypical pneumonia can occur "anywhere in the world at any time," and can be due to a number of causes, including Legionnaires' disease (severe pneumonia caused by bacteria in the *Legionella* genus) or influenza.

"The upward trajectory of COVID-19 cases in the country would suggest that many of these cases are in fact undiagnosed cases of COVID-19," Ryan said. But, he added "we keep an open mind."

https://bit.ly/3qUcFk4

A new malaria vaccine made from the rodent malaria parasite is effective in humans

It reduced parasite load in clinical trial volunteers by 95%

Rita Ponce

Malaria is a life-threatening disease transmitted to humans by infected mosquitoes. In 2018 alone there were 228 million cases and 405,000 deaths worldwide, affecting mostly children under five years of age. Scientists have long been looking for an effective vaccine, but haven't yet been able to produce one.

Human malaria is caused by five species of *Plasmodium* parasites, with *Plasmodium falciparum* the most deadly of them. But there are other *Plasmodium* parasites that can infect and cause malaria in other mammals. About ten years years ago, a group of researchers in Portugal, led by Miguel Prudêncio, decided to explore the possibility of using a rodent parasite called *Plasmodium berghei* in a vaccine against malaria.

They developed a *P. berghei* parasite genetically modified to look like *P. falciparum*, meaning that it carried P. falciparium proteins on its surface. Being a rodent parasite makes it non-pathogenic to humans, and as it was covered by proteins from the human parasite they reasoned that it could potentially induce an immune response to the human parasite. They deliberately chose a protein active during the stage where the malaria parasite infects our livers. Acting at this stage blocks the life cycle of the parasite and prevent it from reaching the bloodstream.

A clinical trial for this rodent-inspired vaccine started in 2017. Last month the results of the first stages of this trial were published in *Science Translational Medicine*. The trial involved 24 healthy adult

volunteers in the Netherlands. After the trial showed that the new vaccine was safe at the tested doses, it entered phase two, aimed at testing the efficacy of the immunization. The vaccinated volunteers were actually infected with the human malaria parasite *P. falciparum*. When compared with the unvaccinated control group, the volunteers had 95% less parasites in their liver and also produced antibodies that recognized *P. falciparum*.

While the vaccine did not confer full protection to the infection, it looks to be a promising approach and may lead the way to create an effective malaria vaccine.

https://bit.ly/2Ol3ixC

Scientists Create a 'Time Tree' Showing How Flowering Plants Came to Dominate Earth

Biologists have been able to chart the rise of angiosperms over the last 140 million years.

David Nield

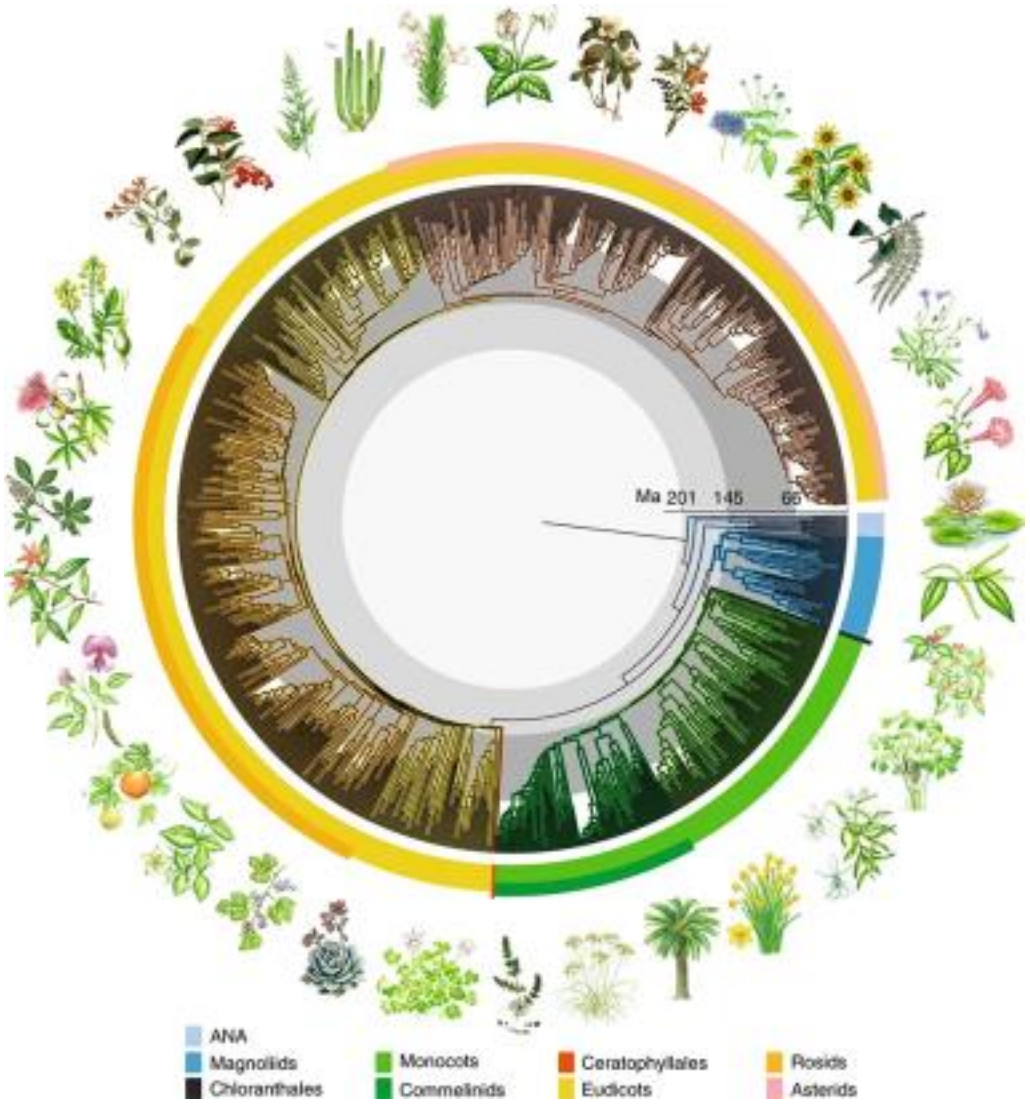
Today, flowering plants (or angiosperms) make up around four-fifths of all the green plants on Earth, but for billions of years they weren't around at all. Now biologists have been able to fully chart the rapid rise of angiosperms over the last 140 million years.

A newly published 'time tree' of flowering plants shows in detail how this massive botanical upheaval came about, resulting in the 300,000 or so known species that are currently growing around us.

To come up with the timeline, researchers assembled the largest ever collection of angiosperm fossil records – 238 in total – often digging back through hundreds of years of data and translating documents from a variety of languages.

"Fossils are the most important pieces of evidence needed to understand these important evolutionary questions around angiosperm divergence times," says evolutionary biologist Hervé Sauquet, from the University of New South Wales.

"Previous studies of this nature only used 30 to 60 fossil records and we wanted to increase this number significantly and set a higher standard for fossil calibration by documenting every part of the process."



Besides amassing hundreds of fossil records, the team also compared their time tree with more than 16 million points of

geographical data indicating which plants are flowering where. It's by far the most comprehensive picture of these species that we've ever had, answering a lot of questions about the timing, location and origins of plant evolution.

Taking in 435 flowering plant families in all, the chart shows modern lineages starting to emerge around 100 to 90 million years ago, before they diversified into modern-day flowering spcies around 66 million years ago – this is the difference between the 'stem' age of a species (when it originated) and its 'crown' age (when it started to diversify into the species we know today).

The researchers were able to note these time differences in their tree chart, and were also able to confirm the idea that angiosperms originated in tropical environments – even though the rainforests of today, which are dominated by flowering plants, only appeared relatively recently in Earth's history.

"By estimating both the stem and crown ages for angiosperm families we found a difference of 37 to 56 million years between family origins and the beginning of their diversification into the living species we see today," says evolutionary biologist Susana Magallón, from the National Autonomous University of Mexico.

"To put this into context, the average time lag corresponds to around a third of the entire duration of angiosperm evolution, which is at least 140 million years."

Between the stem and crown ages of angiosperms, dinosaurs were roaming the Earth. It looks as though the world domination of flowering plants was delayed until after the dinosaur age – picking up speed around 66 million years ago. In that respect, angiosperms are relatively late bloomers among plants.

Considering that flowering plants now represent the primary food source for most organisms on land, including human beings, the more we can understand about this origin and evolution process the better.

One of the ways it will help is in figuring out how to best conserve these hundreds of species of plants for the future – if we want to continue to be able to rely on them, then it's in our best interests to understand what makes them flourish.

"Let's face it, the planet is running basically off angiosperms," evolutionary botanist Doug Soltis from the University of Florida, who wasn't involved in the study, told Suzannah Lyons at ABC Science. "Their success is our success, their demise is our demise."

The research has been published in *Nature Ecology & Evolution*.

https://bit.ly/38XEdCb

1 in 3 young adults may face severe COVID-19, UCSF study shows

Smoking habits trump asthma, obesity in risk factors for otherwise healthy population

As the number of young adults infected with the coronavirus surges throughout the nation, a new study by researchers at UCSF Benioff Children's Hospitals indicates that youth may not shield people from serious disease.

The study looked at data drawn from a nationally representative sample of approximately 8,400 men and women ages 18 to 25 and concluded that overall "medical vulnerability" was 33 percent for males and 30 percent for females. The impact of smoking surpassed other less common risks, the UCSF researchers reported in their study, which publishes in the *Journal of Adolescent Health* on July 13, 2020.

Data from the U.S. Centers for Disease Control and Prevention (CDC), not included in the UCSF study, indicates that while patients over 65 are significantly more likely to be hospitalized than younger people, the gap is narrowing. For the week ending April 18, there were 8.7 hospitalizations per 100,000 of the population for the 18-to-29 age bracket, compared with 128.3 per 100,000 of the population for patients over 65. By the week ending June 27, the

figures were 34.7 and 306.7 respectively, representing a 299 percent increase in hospitalizations for young adults, versus a 139 percent increase in hospitalizations for older adults.

The researchers, led by first author Sally Adams, PhD, of the UCSF Division of Adolescent and Young Adult Medicine, determined vulnerability by referencing indicators identified by the CDC. These included heart conditions, diabetes, current asthma, immune conditions (such as lupus, gout, rheumatoid arthritis), liver conditions, obesity and smoking within the previous 30 days. Additionally, the researchers added e-cigarettes to tobacco and cigar use, which the CDC had included, stating that all three were associated with adverse effects on respiratory and immune function. Since there was no data on the relative impact of each of the CDC risk factors, the researchers used an overall medical vulnerability estimate of having at least one of the indicators as the outcome variable, rather than a cumulative score of indicators. Thus, medical vulnerability was assessed according to each indicator, so that among smokers for example, 100 percent were vulnerable for severe COVID-19.

Most notable among their results was that medical vulnerability stood at 16.1 percent for the 6,741 non-smokers, versus 31.5 percent for the full sample of 8,405 young adults, which included smokers.

Smoking Linked to Progression of COVID-19

"Recent evidence indicates that smoking is associated with a higher likelihood of COVID-19 progression, including increased illness severity, ICU admission or death," said Adams. "Smoking may have significant effects in young adults, who typically have low rates for most chronic diseases."

Recent research also shows that young adults are starting to smoke at higher rates than adolescents, a reversal of previous trends, she noted.

The study, which used data from the National Health Interview Survey, found that over the previous 30 days, 10.9 percent had smoked a cigarette, 4.5 percent had smoked a cigar product and 7.2 percent had smoked an e-cigarette. The number of smokers - 1,664 or 19.8 percent - was higher than the number of people with asthma (8.6 percent), obesity (3 percent) and immune disorders (2.4 percent). Additionally, 1.2 percent had diabetes, 0.6 percent had a liver condition and 0.5 percent had a heart condition.

"The risk of being medically vulnerable to severe disease is halved when smokers are removed from the sample," said senior author Charles Irwin Jr., MD, of the UCSF Division of Adolescent and Young Adult Medicine. "Efforts to reduce smoking and e-cigarette use among young adults would likely lower their vulnerability to severe disease."

Gender differences were noted in five vulnerability indicators. Women were more likely to have asthma, (10 percent versus 7.3 percent), to be obese (3.3 percent versus 2.6 percent) and to have immune conditions (3.2 percent versus 1.6 percent). But significantly fewer young women smoked, which resulted in overall medical vulnerability of 29.7 percent compared with 33.3 percent for young men.

Co-Authors: M. Jane Park, MPH, Jason Schaub, MPH, and Claire Brindis, DrPH, of UCSF.

Funding: The study is supported by grants from the Health Resources ands Services Administration of the U.S. Department of Health and Human Services.

https://bit.ly/2We0NRW

Wriggling Roundworm Found in Woman's Tonsil After She Ate Sashimi

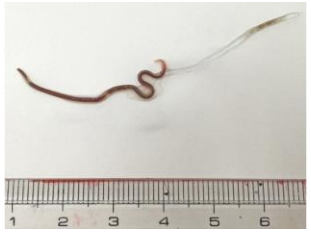
Eating raw meat of any kind carries with it a risk of parasites, but few are as well-known as those found in sashimi.

Michelle Starr

The Japanese delicacy can infect the eater with a number of unpleasant aquatic parasites.

In a new case report, doctors describe the unfortunate experience of a 25-year-old woman in Japan who had a particularly nasty surprise after eating sashimi. Five days after enjoying her meal, she rocked up to St. Luke's International Hospital in Tokyo with pain and irritation in the back of her throat.

Her blood tests were normal, and she seemed otherwise fine - but closer physical inspection revealed something awry - something black and squirming in her left tonsil. A short tweezer extraction later, the culprit was wriggling in a dish.



"The worm body was black, 38 millimetres long, 1 millimetre wide, and was moulting the outer cuticle [flexible exoskeleton]," the doctors write in their case report. "DNA PCR and the fact that the worm was in exuviation revealed this worm was a fourth-stage larva of *Pseudoterranova azarasi*."

(Fukui et al., Am. J. Trop. Med. Hyg., 2020)

P. azarasi is a type of nematode, or roundworm, and - alongside tapeworms and herring worms - is a known hazard of eating sushi. Infection of the throat is rare - of the over 700 cases reported in the literature by the mid-1990s across Japan, the North Pacific countries, South America, and the Netherlands, most have occurred in the stomach.

Although it's a member of the Anisakidae family, the symptoms *P. azarasi* causes are generally not as severe as those caused by the herring worm, called anisakiasis, in which nematode larvae attach to the lining of the oesophagus, stomach, or intestine.

Because PCR - the process to replicate DNA in order to obtain a large enough sample for testing - is not widely available, the doctors therefore note that it's important to be able to identify *P. azarasi* visually.

"Although oropharyngeal infection is rare," the doctors write, "this infection is known to cause 'tingling throat syndrome' and cough and should be considered a differential diagnosis of oropharyngeal parasitosis as consuming raw fish, including sushi and sashimi, has become more popular and the number of reported cases has markedly increased worldwide."

Generally, freezing the fish should kill any parasites therein, and different countries have different guidelines for doing so. Some regions, however, have lax guidelines, or no guidelines at all, so it can be hard to determine whether the raw fish you're eating is safe.

There is something good about a throat infection, though; it's generally easier to treat. There is little to no pharmacological intervention - the best treatment is simply removing the worms, which is much easier in the mouth than in the stomach.

As for our patient, after the worm was removed from her tonsil, her symptoms cleared up quickly and she was sent home. Although, she may think twice the next time she has a craving for raw fish.

The case report has been published in *The American Journal of Tropical Medicine and Hygiene*.