The echo

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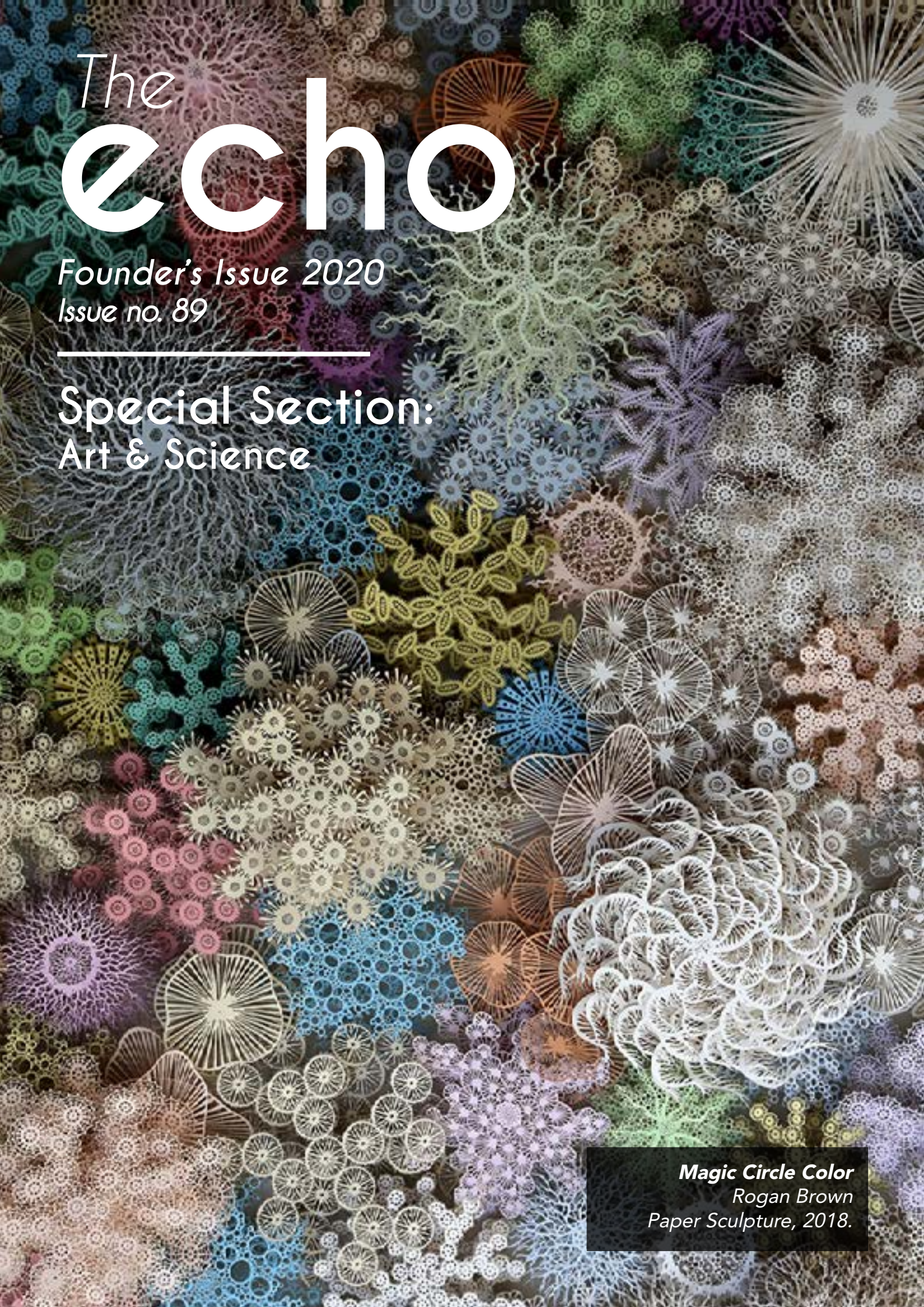
Special Section:
Art & Science



Magic Circle Color
Rogan Brown
Paper Sculpture, 2018.

FROM THE EDITOR

Amidst all the chaos and existentialism of the past year, creativity in science was inadvertently overlooked, often criminally understated. Various aspects of scientific research and application experienced unprecedented inactivity as the world descended into a fervent, yet necessary response to the enveloping pandemic. However, now with significant progress having occurred, it is imperative that we reassert the importance of a fundamental trait of human nature: creativity.

This issue reflects a defiant assertion of the inherent creativity we possess. A special section dedicated to the intersection of art and science and the ways in which these two ostensibly discrete notions harmoniously coexist and interact reflects this effort. After all, both art and science have similar purposes: to better understand the world and ourselves. We have maintained diversity in our other points of research as well, which range from abstract possibilities such as imagining practice to urgent issues such as the growing threat of space debris. Moreover, the inclusion of a list of influential, recent research papers serves to highlight exciting, perhaps revolutionary, scientific research occurring in various scientific disciplines such as astronomy and medicine.

We, at the Echo, believe in unrestricted scientific knowledge and have thus, incorporated hyperlinked websites throughout the issue to extrapolate your understanding to the greater body of information available on the internet. Now, a simple, convenient click on the uniform icons will redirect you to the initial source of the article as you truly understand the described ideas from the perspective of the writers themselves. Moreover, the more extensive implementation of hyperlinked videos and hand-drawn illustrations constitutes a diverse, interactive design which aims to make this issue more engaging and appealing to the reader.

We hope that you delve into this issue and surely enhance your existing knowledge in some way or the other. Furthermore, we implore you to never hesitate in expressing your creativity, in whatever discipline it may concern. After all, the greatest scientific discoveries have often stemmed from the most radical of initial thoughts. Our creativity is boundless, and so should be our efforts to express it.

Signing Off,

Rushil Chowdhary

> **“After a certain high level of technical skill is achieved, science and art tend to coalesce in aesthetics, plasticity, and form. The greatest scientists are always artists as well.**
>
> Albert Einstein (1879-1955)

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The Golden Record

Rishabh Goyal looks at humanity's attempt to contact extra-terrestrial life - 40 years ago.

Our entire solar system is bound to die some billion years from now when the Sun will swell into a red giant and swallow every single object, including Earth. If we wish to extend our survival in the universe, we will have to discover another habitable planet soon. However, with current advancements in technology and space travel, it is highly unlikely for us to discover another life-sustaining planet. Even if we do discover it, transferring everyone to that planet would be highly impractical. So, will all the living creatures and our planet Earth just vanish without leaving any trace in the universe? Interestingly, the answer is 'no'.

In the early 1970s, NASA engineered a way to capture audio and images of life on Earth - sounds of nature, animals, human voices, music from different cultures, etc. - in two phonograph records. The records are made of copper and electroplated with 24 karat gold and an ultra-pure sample of the isotope uranium-238 and therefore were given the name - the golden records. In 1977, NASA launched Voyager 1 and Voyager 2 into space in different directions, each containing one golden record. The main intention of NASA of launching

> "While we may not get any signal from another civilization immediately, the records can act as a time capsule for future communication with civilizations which can take as long as a billion years from now."

the golden records is to communicate with another intelligent extraterrestrial civilization, existing in some corner of the universe and informing them about life on Earth and achievements of humanity. While we may not get any signal from another civilization immediately, the records can act as a time capsule for future communication with civilizations which can take as long as a billion years from now.

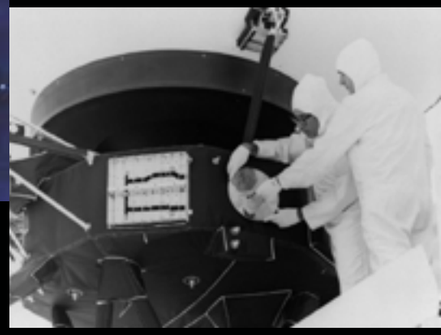
The records roughly play for 54 minutes from start to end and begin with voices greeting the interceptor of the record in 55 different languages including the universal language of science. Any civilization who finds the record can determine the location of the Earth by analyzing the Pulsar Map which shows the position of Earth relative to various neutron stars. The audio is fairly easy to play as only the correct speed and rotation of the record needs to be figured but processing the images can get very complex. With modest technological advancements in 1970s, it was impossible for NASA to upload hundreds of images digitally. So instead, NASA converted the images into audio waveforms which were easy to add to the records. However, converting the audio waveforms back to images will not be an easy task. Instructions to operate the record are inscribed on the cover plate to guide the interceptor, written in the complicated mathematical language of binary numbers. Today, the images can be decoded with complex programming methods using Python, but naturally, the extraterrestrials might not be having such advanced technology and therefore will have a hard time decoding the records. The intercepting civilization must be smart and intelligent enough to decode even a small amount of the information. It's no surprise that this is what NASA is apprehensive of: if no one is able to decode it, then the entire thing will be a pointless piece of metal sailing blindly in the space.

In December 2018, NASA announced that both the Voyagers, currently travelling at a speed of over 15 km/s, are by far the farthest-reaching objects ever launched by humanity and the only two human-made objects to cross interstellar space. It is expected that by the year 2025, the battery which generates the signals from the probe to Earth will run out and so we will eventually lose contact with it. However, it will still keep sailing through space and the audio and images recorded in it will never be lost until the records are physically damaged. That being said, when our solar system embraces the apocalypse, the golden records can be considered as the final remnants of human civilization and life on Earth. Undoubtedly, it is one of the greatest achievements ever accomplished by humankind.

In the Making

An Artist's Representation: Voyager

'Loading' the Record



A Littered Cosmos

Advay Gupta explores the growing problem of the accumulation of garbage in space

We think that garbage and pollution exist only on Earth, but have you ever thought about what happens to the parts of satellites and spacecrafts that get separated from their bodies? Well that produces garbage, called space debris. The accumulation of space debris around our planet is an escalating problem, and one that will affect the human race in the years to come.

Astronomers are always in such a rush to launch satellites and spacecrafts, that they often ignore the space debris, which, since 2010, have added a 50% risk of a 1cm long fragment crashing into a spacecraft or satellite at 7km/s. In 1983 the Challenger Space Shuttle was struck by a 0.2mm of fragment, which shattered its window. The fragment consisted of 44% aluminum alloys, 37% paint chips, 12% steel, 5% copper and 2% titanium. In 2009 the USA's Iridium 33 communications satellite collided with the Cosmos 2251, a retired Russian communication satellite. The collision occurred at a speed of 42,000km/h, resulting in the formation of thousands of chunks of space debris. These kinds of collisions have become increasingly frequent, so now satellites are being made which, not only, can sustain these kinds of damage, but can also dodge the existing debris, so that no more is created.

Space debris, however, is not always formed when a spacecraft or a satellite is launched. Sometimes, countries create it on purpose. The most recent case of this was, on the 27th of March 2019, when India's Defense Research and Development Organization(DRDO) executed "Mission Shakti". They destroyed a satellite in the lower Earth orbit, a completely unnecessary task, as it would have been easier to dodge a satellite than thousands of pieces of it. These anti-satellite missions have also been carried out by the USA (known as "Operation Burnt Frost"), Russia, and China. Due to this, a lot of fragments have returned to the ground and have caused harm, along with making the path of many satellites very inconvenient.

> "Unless we start managing our cosmic neighborhood better, this 'space junk' will cause serious problems for future expeditions."

The ISS has now made satellites which are able to sustain the damage of small, untraceable fragments and that can dodge the larger objects which can be tracked. The ISS now uses a Whipple shield, as opposed to the original aluminum plating, to protect their space vehicles more effectively. This uses the debris' own velocity to decrease the impact of the collision. The shield consists of two walls: bumpers and rear walls. The bumpers break down the debris into thousands of tiny, high energy fragments, and the rear walls stop them from entering the space shuttle. Another way to prevent collisions is by using ground-based radars, like the Haystack radar, which alerts satellites of the incoming space debris. Most radars can detect and warn spacecrafts of their collision probability with any amount of debris within a 25 kilometer radius.

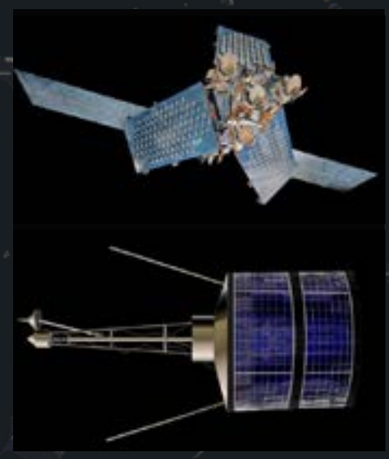
Chris Hadfield, a Canadian astronaut, explains that navigation through space is like driving car down a lazy street, "There is always a possibility that, while driving, there might be an accident, so you have to be very cautious while doing so." The astronauts must also be extremely careful to not get their suits cut when they go on space walks.

Unless we start managing our cosmic neighborhood better, this "space junk" will cause serious problems for future expeditions. Some scientists have even mentioned that all that debris that we are putting into space might stop us from space travel altogether, because of the risk it would take to get in and out of the garbage heap. Other than the fact that the space around our planet is getting congested, space debris increases the chances of spaceship damage and destruction, which would not only result in the deaths of the astronauts, but would be a heavy economic loss, as it takes millions of dollars to manufacture, launch and equip a spaceship.

Methods for removing the debris are being discussed every day. One idea is breaking the pieces using a laser. Another is moving dead satellites out of the Earth's orbit. The removal of space debris is a crucial step in the path of humanity's space exploration and requires the support of all the countries, working together. Only then will we be truly ready for space - as a planet.

Above: All the debris surrounding Earth

Commander Chris Hadfield



Iridium-33 & Cosmos 2251 Satellites

THE PERFECT PASSWORD

Hridayam Tusnial sheds light on the idea of a biometric authentication system that uses brain signals and reactions to recognise individuals.

With the evolution of internet connectivity and digital technology and our almost indispensable dependence on it, the meaning of cyber security underwent a paradigm shift. In today's world security is of utmost importance, be it in our homes or our digital phones. It relieves us of a lot of additional troubles like worrying about the safety of important belongings, documents etc. We always feel safe knowing that our homes are locked when we are not there or that our mobile phones are password protected. But owing to the exponential development of technology, no security system is fool-proof.

For instance, consider a cell phone. Current technologies offer a variety of methods to unlock a cell phone namely- passcodes, passwords and biometrics like fingerprints and face recognition. However, they too are faulty and do not work very well after a certain period. For example: Recent studies have shown that cell phones can be unlocked by simply turning the face recognition sensor towards the owner's face by another person. If the owner's eyes are open, then the phone will unlock. So, the current security system of the mobile phone offers no credibility of the person who is accessing the phone or his intentions. Therefore, even such an advanced technology such as face recognition has a loophole. As a result, numerous complaints are filed against companies selling mobile phones enabled with the face recognition system, arguing that the feature is erratic and does not work consistently. In this case, people necessitate something which is more personalised and can be concealed, unlike fingers and faces which are visible to every person. Recently, scientists have developed a new technology called 'Brain Printing'. Scientists believe that every brain is different and therefore would react differently to a set of instructions or numbers. The Brain Print operates by reading the electrical signals which circulate in the brain when people are given the same set of acronyms. The model is based on the uniqueness of each brain and concludes that every brain will respond differently and will produce an exclusive response to the same stimulus.

'In the test conducted by scientists, the subject is fitted with a patented headband equipped with sensors and shown a series of relevant words or pictures on a computer screen. When the brain recognizes something familiar, it elicits a wavelike response known as a MERMER (Memory and Encoding-Related Multifaceted Electroencephalographic Response). The MERMER in turn contains the brain response in the form of data called P300.' This brain response,P300, is then evaluated and interpreted by the computer.

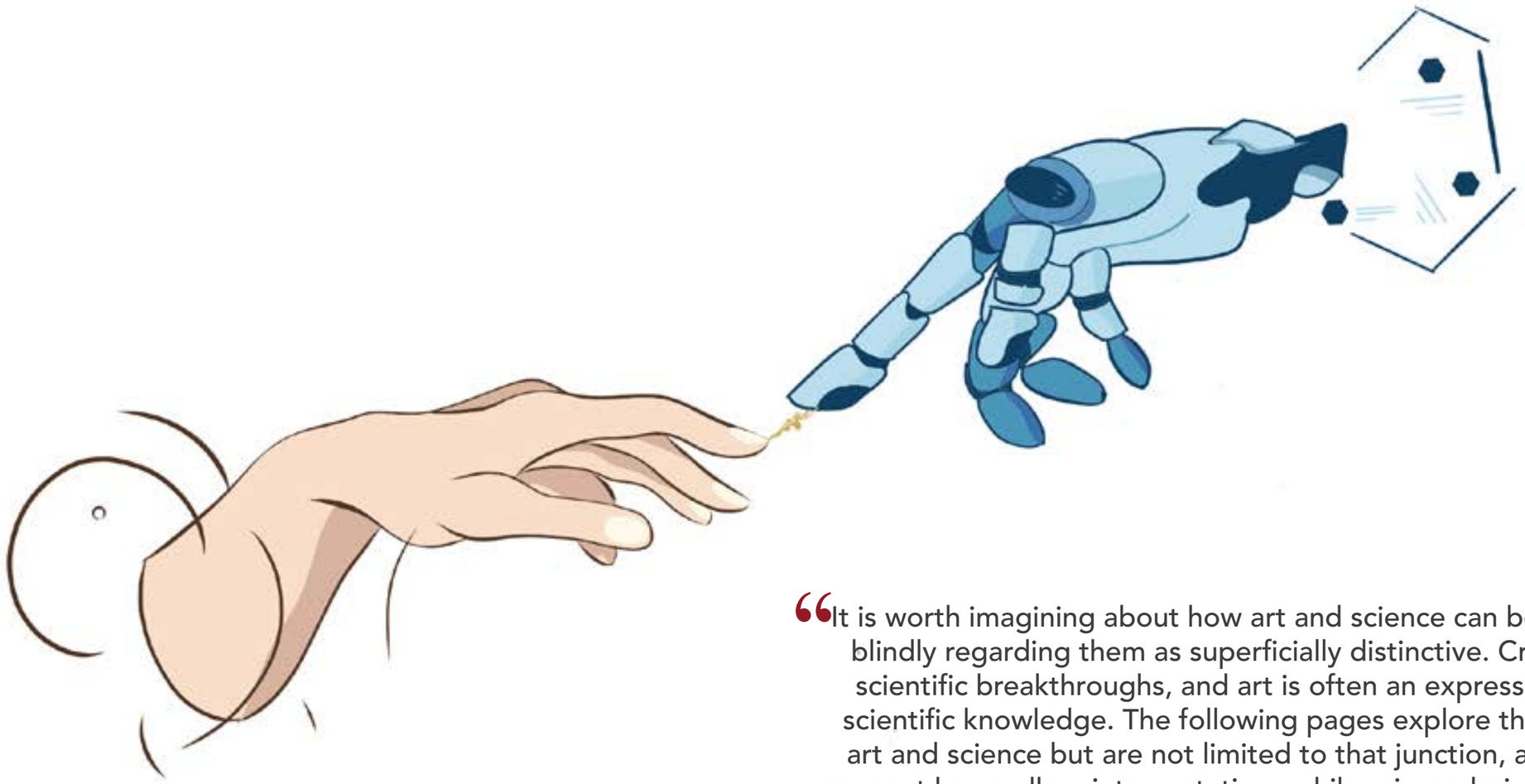
This technology is effective because the brain does not change the way it processes information. This valuable piece of evidence can authenticate individuals through their thoughts. That is the reason why people perceive things differently and have different emotional quotients. They laugh at different jokes and have different likes and dislikes. By this technology, scientists have successfully proven that the most common difference between human beings is their brain. Since the brain controls all the processes in the body, the difference in the functioning of the brain will mean that their bodies function differently as well. This is why it is almost impossible for an imposter to use any fraudulent methods to gain access in a system protected by this kind of technology.

There is one more application where Brain Printing is used. In a criminal case, the technology of Brain Printing was used as an alternative for normal lie detector tests. Each suspect was shown pictures of the crime scene and their brainwave responses were measured to determine which person had seen the crime scene before. Claiming that the test is 99.99% infallible, the test results convinced the court to prosecute the accused who finally admitted he was guilty.

The model is based on the uniqueness of each brain and concludes that every brain will respond differently and will produce an exclusive response to the same stimulus.

Although promising, this technology is still in its infancy, but scientists believe that a few modifications would push it to be of 100% efficiency. There are some concerns that this technology would not be feasible for the larger section of the society because of it being too expensive. Another drawback of this technology is that currently people have to wear sticky electrodes equipped with Electroencephalography (EEG) sensors on their heads which are quite uncomfortable and noisy. However, scientists are working on modifying the technology to make the procedure more comfortable.

The conquest of science in matters related to the brain and its functions undergo developments by each passing minute. Innovations such as Brain Printing is yet another development which opens up new frontiers and pathways for improvement in reliability of security systems.



Art & Science

"It is worth imagining about how art and science can be integrated rather than blindly regarding them as superficially distinctive. Creativity is essential for scientific breakthroughs, and art is often an expression (or the product) of scientific knowledge. The following pages explore the intersection between art and science but are not limited to that junction, as art being an abstract concept has endless interpretations while science being empirical is continually evolving.

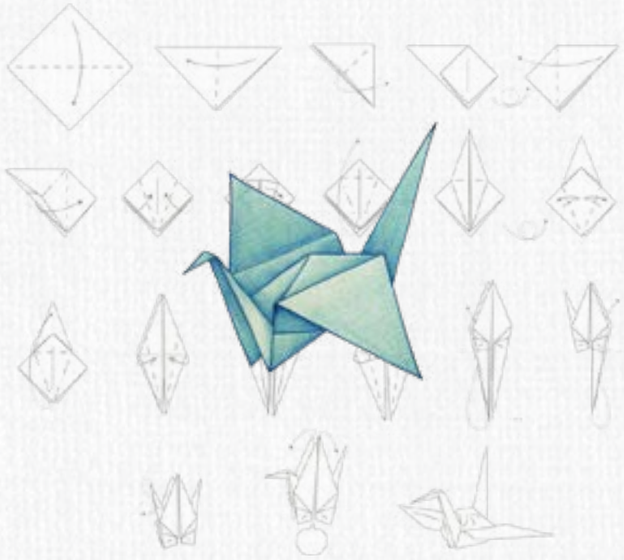
In the public eye, art and science take two different roads. Yet, they exist side by side and lead in the same direction. Having the ability to complement each other, not only on the basis of their similarities but on their differences as well, gives space for innovation. Joined by their end goal, that of the quest for an understanding of the universe and life, artists in their studios and scientists in the laboratories employ their specialized skills to reciprocally manifest the ethos of the other.

It is fair to credit this intersection with the rise of unique ways of thinking and interacting with our world. These two seemingly opposite disciplines unite in a shared curiosity for exploration. In the following pages, we have investigated the applications based on new developments that leverage the combined power of the rigorous scientific approach with the subjectivity and experimentalism of the creative arts."

Origami

The Art of Folds

Paper
That's it. That is all one needs for origami. An art so old that its origins are muddled due to the degradation of that very paper. Once a luxury, the affordability of paper has slowly brought the pleasures of the fold from luxury to the common people and with time, the craft has diluted and distributed across the globe, finding new meaning and new purpose everywhere it goes. And so, it has become so much more than just a piece of paper. It is a crane, paper plane or a few thousand other wonders, but it has also found its place in numerous scientific applications and in doing so, *science has borrowed from the arts yet again.*



Origami folding is a curious art – through different folds one can not only make different creatures and designs but also allow intricate & clever movements of the structure. Herein lies the synergy between science and origami.

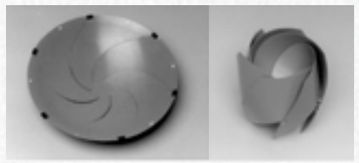
Origami - like many other arts, has its own subsets of styles and techniques for creation of these intricate structures. Original origami is straightforward but in no way simple- one sheet of material, no cuts, just folds - just like this dragon.
More often than not, a mixture of each of the rules governing each style are used for implemnetation.

Kirigami

Kirigami uses cuts in its creation process to create shapes otherwise difficult or impossible to make with single sheets of paper. It is often argued that it may not be considered origami and the enthusiast community is divided on their views. From making snowflakes as elementary school children to inspiring the design for non-slip shoes, kirigami has potential to go very far.

A classic paper snowflake

Kirigami-inspired bandages

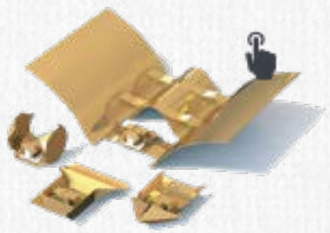


With a few cuts, this structure could roll up when it couldn't before

Origami Robotics

Using folding, unfolding and new foldings, origami robots can be autonomous, adapt their shape to specific tasks and environments, and achieve agility of motion, with no restriction on what materials may be used to create them. Origami robots are made from single composite sheets and can self-assemble, manipulate its own shape, move or perform a combination of all of these tasks through folding.

A folding robot that can crawl and jump



An robot which folds heat-activated exo-skeleton layers around itself and can move

A self-assembling origami robot which can turn completely flat

Rigid Origami

Rigid origami is the branch of origami utilising flat rigid sheets connected by hinges so the sheets cannot bend during the folding at all. This type of origami doesn't need to be made from just one sheet of material and thus making it a practical method of design.

Even a paper bag utilises the principles of rigid origami!

A very interesting look at the use of 'Miura Map folds' for an unfurling solar shield

Action Origami

This form utilizes spatially organized folds to allow for motion of the structure in clever ways – exhibiting a semi-soft structure - rigid yet allowing for motion. In terms of application, this type of origami is, arguably, the most widely explored and implemented with the other styles.

Paper cranes can flap their wings just by one moving their tail

Fluid-driven artificial muscles inspired by origami

> It is believed, according to ancient Japanese legend, that if one folds a thousand paper cranes, they shall be granted one wish of their own choosing

Left: Creating the 'net' for a rigid origami ball
Below: The net for a paper crane

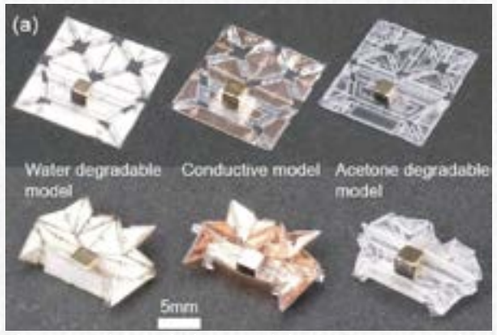
Technical Origami & Computer-aided Design

An advantageous feature of any origami-based design is manufacturing as these structures can often be 3D printed or carved from a single composite sheet using laser printers, which is easier than creating individual pieces. However, this is still difficult. Despite the availability of theoretical algorithms, bringing these systems to life is challenging. Even for rigid origami structures (that is, bending occurs only along defined folds), commercial computer- aided design (CAD) tools are not well suited due to the unique nature of such systems. Moreover, currently available software applications often cannot simplify the complexity of such structures.

4D printing & Smart Materials

With the sizes of robots becoming smaller and our machines becoming more autonomous, material science comes to the rescue. 4D or smart materials are materials that change their physical appearance or shape upon exposure in a controlled manner to an external stimuli as long as the micro-architecture and etchings are appropriate. This can be anything from a change in pH to heat to magnetism. Biomaterials are tailor-made to react to changes in biological and chemical factors, magnets laid in a particular way interact with magnetic fields and so so much more - some of which have been mentioned through out the section.

An ingestible origami robot steered by magnetic fields that can help remove a small hazard or patch a wound in the stomach.



The several exo-skeletons of the MIT origami robot

Innovations & Artwork

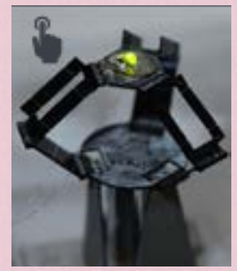
The late Akira Yoshizawa, widely considered as the 'grandmaster of origami'

Soft Origami folding techniques utilised in air bags

Kirigami-inspired materials

Origami-based self deplyable stent

Destructors III by Erik and Martin Demaine



The milliDelta robot

WHEN ART MEETS SCIENCE

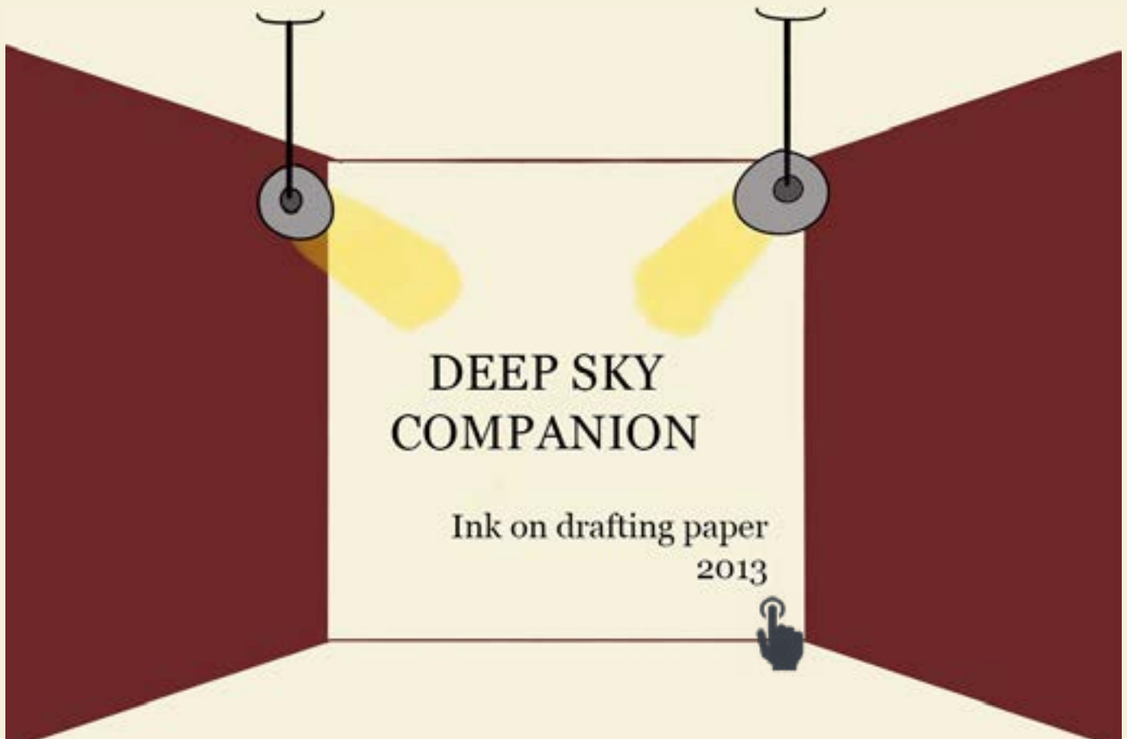
Lia Halloran is an artist, academic and a teacher of painting and courses that explore the intersection of art and science, at Chapman University in California's Orange County. Halloran has participated in numerous interdisciplinary projects to curate exhibitions and experiment with new media technologies.

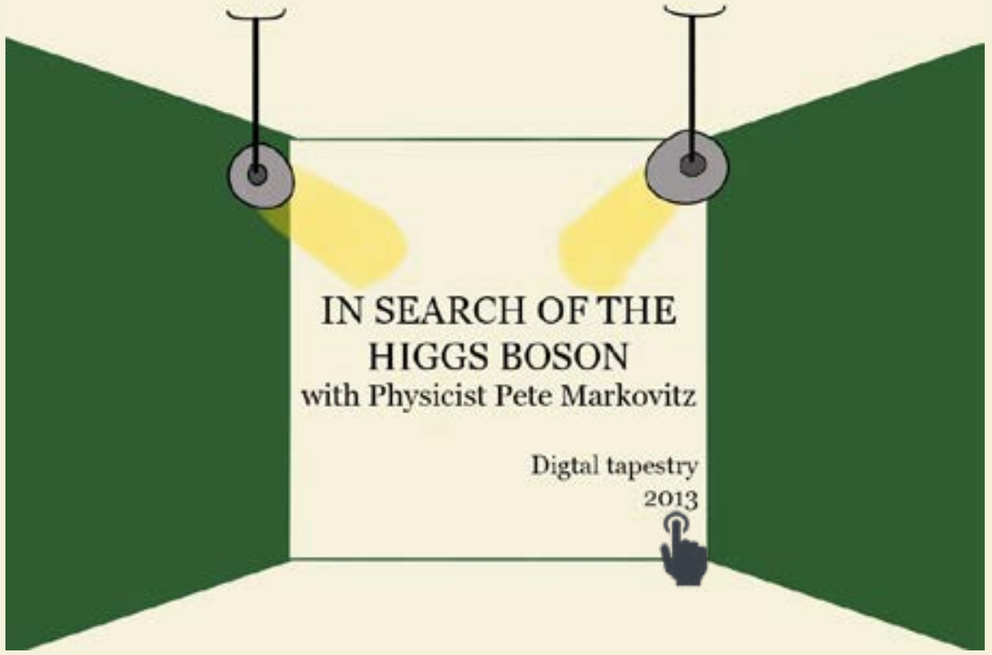
About her artwork

Deep Sky Companion is a series of 110 pairs of paintings and photographs of night sky objects drawn from the catalogue of the 18th-century French astronomer Charles Messier.

Each painting in the Deep Sky Companion series was created in ink on semi-transparent paper, which was then used as a negative to create a positive photographic equivalent using standard black-and-white darkroom printing.

This process connects to the historical drawings by Messier, here redrawn and then turned back into positives through a photographic process mimicking early glass-plate astrophotography.





Xavier Cortada is a painter based in Miami, Florida and a Professor of Practice at University of Miami. His art frequently involves collaboration with scientists. Cortada has also been commissioned to create art for CERN, the White House and the World Bank.

About his artwork

Cortada was invited to see the planet's largest science experiment at the CERN Laboratory in Geneva. His art wound up honouring the Nobel Prize-winning discovery of the Higgs boson, the particle that imbues all the others with mass.

The oil painting technique honours those who came before us, the repetition of motifs across the five works celebrates internationalism, and rendering the work as 'banners' marks this as a monumental event.

The background is composed of words from the pages of 383 joint publications and the names of more than 4,000 scientists, engineers and technicians that were involved in the discovery of the Higgs Boson particle.

Daniel Zeller is a New York based illustrator and painter. His work is spurred by instructive images and maps produced by scientific inquiry, mirrors microscopic views of intricate cellular structures. Zeller seeks to push the compositional confines of a restricted range of media, working with just ink, acrylic and graphite on paper.

About his artwork

The probe generated so much fascinating source material it was difficult to choose any single viewpoint, but there was something particularly intriguing about the image of Titan I finally settled on.

Greyscale imagery naturally lends itself to broad interpretation, and the radar-mapping method suited my curiosity and my process; it seems to relay its subject as somehow simultaneously familiar and completely alien. Titan's surface became a scaffold on which I could build and explore.

The Cassini mission was a truly amazing foray into the unknown. We are greatly enriched by the knowledge it collected. My work is but a humble homage to our immediate neighbourhood – once so far away and now a little bit closer – and to what is yet to be discovered on many frontiers.

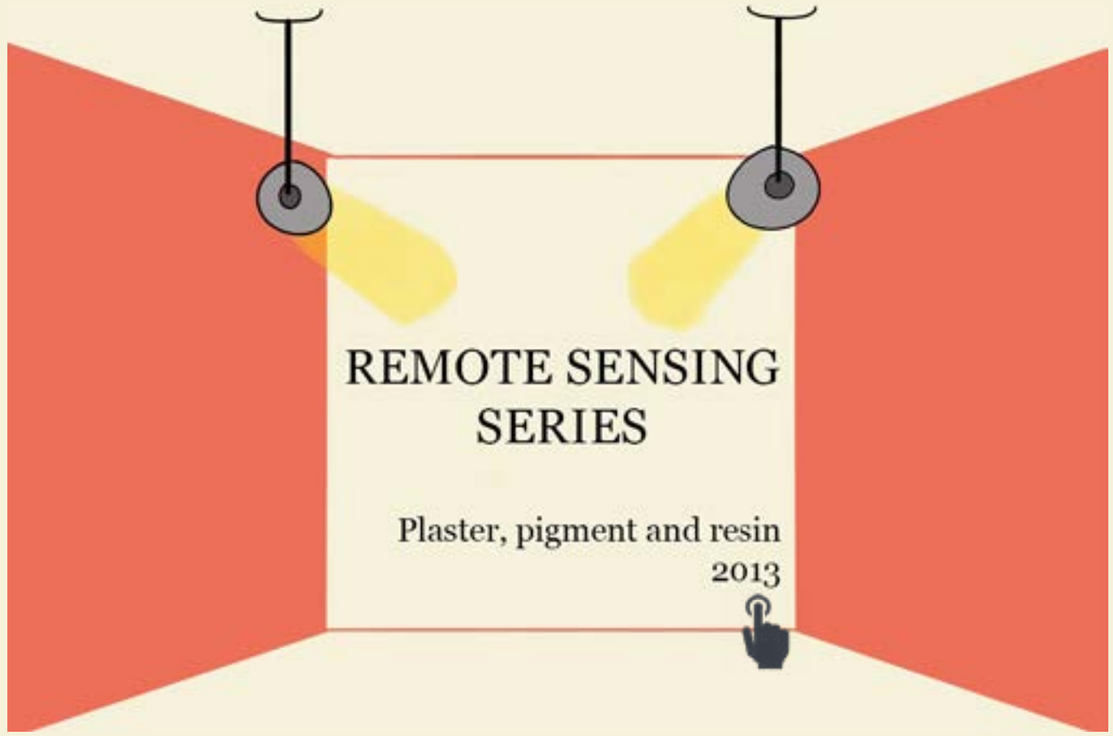
Suzanne Anker is a Bio Art pioneer, distinguished visual artist and theorist working at the intersection of art and the biological sciences. Based in New York, Anker works in a medley of traditional mediums ranging from digital sculpture and installation to large-scale photography and plants grown under LED lights.

About her artwork

She uses the petri dish to juxtapose microscopic and macroscopic worlds. The title 'Remote Sensing Series' refers to new digital technologies that can picture places too toxic or inaccessible to visit.

These micro-landscapes offer the viewer a top-down topographic effect assembled by zeros and ones. Each configuration of these works takes the geometry of a circle, inspired by the Petri dish, and crosses the divide between the disciplines of art and science.

The fabrication of these pieces began with 2D digital photographs, which were then converted into 3D virtual models. This petri dish with its luxuriant growth emerged from the 3D printer.



KIMCHI AND CHIPS

KIMCHI and CHIPS studio is a Seoul based art studio founded in 2009 by Mimi Son and Elliot Woods. Their practice begins at the recognition that the arts, sciences and philosophy are not distant disciplines which must be bridged, but act as alternative maps onto the same territory, and that employing these maps in tandem allows the territory to be navigated more readily.

HALO, 2018

Somerset House Edmond J. Safra Fountain Court-
yard, London UK
99 robotic mirrors, mist, sun, wind
18,500mm x 4,800mm x 8,100mm

> “Everyone can discover something in their own way. We hope that the audience encounters a transient moment when the Halo is formed.”

Fields of intersection

Robotics

Architecture

Engineering

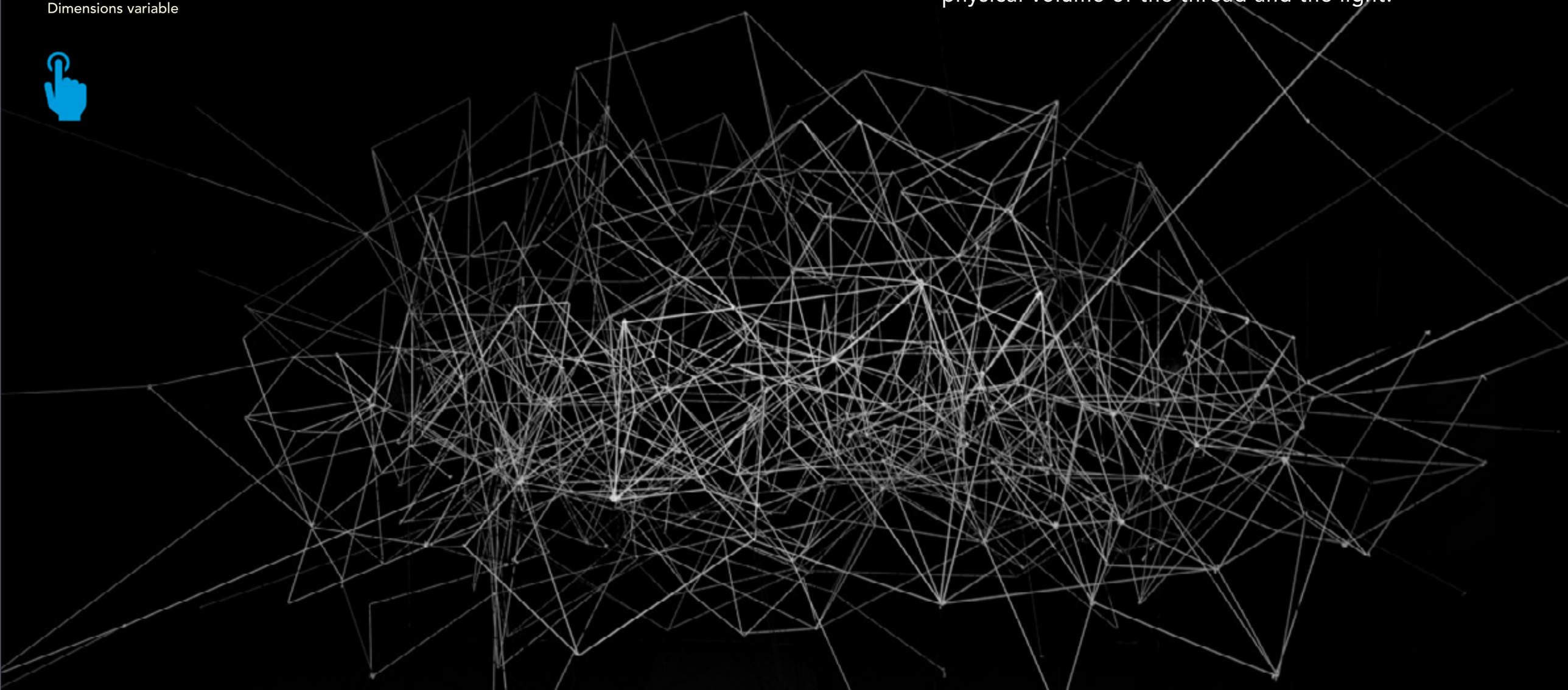
How it works?

9 robotic mirrors are distributed around two 5 meter high towers and a 15 meter long track. Each mirror reflects a ray of sunlight into a cloud of water mist. The computer alignment of the mirrors enables the sunrays to from a bright ‘halo’ in the air. The work examines the opportunities and weaknesses of technology to catch what is out of control, relying entirely on the intervention of the sun for its completion making it a sophiscated crossover of nature, art and science.

LIGHT SEGMENTS SPACE, 2018

Seoul Art Space Geumcheon,
Seoul, South Korea
Nylon strings, digital emulsion
Dimensions variable

This work of art is an intricate web of nylon strings tied in a dark room. Light is then shone upon individual strings, making the artwork come to life. Dynamic imagery forms are articulated into physical volume of the thread and the light.



It hangs abstract and undefined, a set of thin positive elements segmenting the dark negative space between. Dynamic imaginary forms are articulated into physical volume by the material of this thread, and the semi-material of the light. The visual gravity of the filaments occupying the space between.

Fields of intersection

Audio

Visual

Engineering

BioArt

From glow in the dark frogs to silkworms spinning gold thread, the emerging field of BioArt flourishes in the avenue of science and creativity.

The term "bioart", originally coined in 1997, describes an emerging field of art, that is defined by artworks made with living tissues, bacteria, living organisms and life processes, and is pioneered by artists and scientists alike, using technologies such as tissue culture, genetic engineering and cloning. From bacterial manipulation to cellular sculptures, bioart has seen a soar in popularity since its invention.

Modern bioart was spearheaded by artists such as Eduardo Kac, Suzzane Anker, Joe Davis and artists from the bioart laboratory "Symbotica" in Australia, and although bioart is a fairly new field, the concept has been around for a while. In 1928, while taking a break in between experiments, Alexander Flemming would "paint" stick figures in the petri dishes he was using, with bacteria. Fleming noticed that some parts of his "germ painting" had been killed, as the marks had disappeared. The culprit of this disappearance? A nearby fungus - Penicillin. In 1938, Edward Steichen, an American photographer, used the chemical colchicine to produce genetically modified variations of flowering delphiniums, with new attractive patterns. This chemical would later be used by scientists to produce beneficial mutations in crops and ornamental plants. Today, bioartists such as research affiliate at MIT Biology and Harvard, Joe Davis, aim to foster creativity and technological development around genetic engineering and synthetic biology. Davis describes his experience working as a Bioartist as "being in Oz. It's pure and simple. The total amount of resources in this environment and the minds that are accessible… it's like I come to the city of Oz everyday!"

Currently, Davis is working with several other members of the George Church Laboratory at Harvard to perform metagenomics analysis of the dust that accumulates at the bottom of money counting machines. Another project involves genetically engineering silkworms, so that they can spin metallic gold - inspired by the fairy tale of Rumpelstiltskin!

Bioart may be an emerging field "but the number of bioartists is still small", Davis says, "partly due to a lack of finding of the arts in general. Accessibility to the types of equipments bioartists want to experiment with is also an issue". While Davis has been able to partner with labs over the past few years, other artists affiliate themselves with community access laboratories that are run by biologists with a "do-it-yourself" mentality.

Although bioart is viewed as an exemplary display of creativity and innovation, it has been scrutinized for its apparent lack of ethics. Various animal rights groups have accused the artists of using animals unfairly for their own personal gain, and conservative groups question the usage of transgenic technologies and tissue culturing from a moral standpoint.

Once, Eduardo Kac injected a rabbit embryo with jellyfish DNA to produce a "glow-in-the-dark bunny". Critics have accused him of harbouring a "Frankenstein fetish" by imposing his superior will on an unknowing animal. Dr Stewart Newman, of NY Medical College, accused him of manipulating living organisms for no "medical or scientific purpose" and claims that these practices have potential for cruelty. Dr Steve Zowistowski, a senior executive at the American Society for the Prevention of Cruelty to Animals, fears that "people may start ordering the bunny for Easter." In agreement is Alka Chanda, a senior researcher at People for Ethical Treatment of Animals (PETA), who also claims that using animals for the sake of art is no different from using animal fur for clothing. In response to these accusations, bioartists claim that they are manipulating cells and not entire organisms. For example "Victimless Leather",by Symbotica, shows how artificial animal products can be used to produce art. " An actualized possibility of wearing 'leather' without having to kill an animal is the starting point for cultural discussions", claim the scientists at Symbotica, "Our intention is not to provide another consumer product but rather to raise questions about our exploitation of other beings."

Regardless of the drawbacks, bioart has a lot of potential, and may be looked back upon as one of the factors that catalysed the evolution of humanity's culture and understanding of the convergence of artistic expression and scientific innovation.

It's pure and simple. The total amount of resources in this environment and the minds that are accessible...it's like visiting the city of Oz everyday!

DOES PRACTICE MAKE PERFECT?

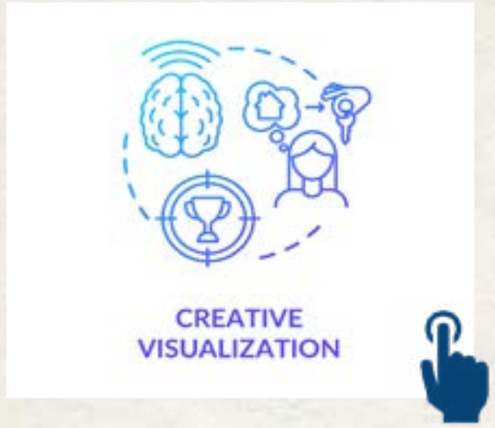
Yuvraj Sarda explores the real-world relevance of mental practice.

We generally believe that practice is the key to improvement. In essence, this practice continually reinforces the task till we become proficient at it. For Instance, while practicing a sport, we reinforce ourselves physically by training our unconscious mind to behave a certain way (what we often term as our muscle memory). Similarly, while revising for exams, we reinforce ourselves mentally by reiterating concepts over and over. Researchers term the former Physical Rehearsal and the latter Mental Rehearsal.

Fascinatingly, we don't have to restrict mental rehearsals to mental activities only; it can be applied to a variety of physical activities too. This conclusion draws on the fact that our brain mediates the received information and our response to it. If we could somehow replicate the reality in our minds, we would not actually need to play basketball for hours to perfect our free throws; mere vivid visualisation would suffice.

Over the past century, dozens of experimental studies have provided real-life data to test this claim. In one such experiment, four randomly-divided groups of players were treated with one of the following: no practice, mental rehearsal, physical rehearsal and both mental and physical rehearsal. As expected, the combination of mental and physical rehearsal turned up with the greatest improvement rates.

Surprisingly however, there were massive fluctuations in the effect of Mental Rehearsal, from no effect, to as good as Physical Rehearsal. Although many variables had not been controlled in these studies, there indeed was what causal inference experts say, 'a lot of confounding'. With the data by recent studies, we can make some useful inferences regarding the effects of Mental Rehearsal.



Logically, Mental Rehearsal is directly affected only by the vividness of the visualisation, or in simpler terms, how close it is to reality. The more vivid the Mental Rehearsal, higher the yield. There are a number of factors that help us scale the vividness.

Firstly, it depends on the aspects of an activity that practice cannot help you improve. For example, perfection in passing the ball (a skill) can be achieved by repetitive practice, but learning exactly when and whom to pass the ball (game sense) cannot. Therefore, in this context, the vividness of any visualization will be limited and hence, the improvement is also limited.

It also depends on one's skill level in the given task. Freshers are less accustomed to a task compared to someone advanced. This means that they might not be able to picture the task as vividly and therefore have less improvement.

"Practice makes perfect, right? Well, you can even imagine playing a sport and improve..."

The conditions under which one pictures the task can also heavily influence mental rehearsal. Mental Rehearsals done in a relaxed setting show better results compared to in a chaotic environment. Similarly, one's concentration, mood and one's state of mind at that time also affects their performance.

Finally, how one visualises also affects how much he improves. Picturing an individual task (like diving in swimming) from a third person's eyes, like a movie, is unlikely to help. Alternatively, visualising from your own eyes in an interactive task may take the broad picture and is much more likely to help.

Mental Rehearsal can be an immensely powerful tool which can help you improve. But unless you truly are mindful of every little movement, it is futile. It should be alive, almost like a dream. You should feel every twist and turn, see the spin on the ball, realise the follow-through, and most important of all, see it swish down the hoop, ever so perfectly. Indeed, It is crucial to imagine success to succeed. Try it out. And just so that you don't drift off to an imaginary world, make sure you keep making regular visits to the courts to fine tune your perception.

DESIGNER GENES

Vivhaan Kothari evaluates the implications of CRISPR, a technology that allows DNA to be modified.

By allowing us to represent any living organism as a script of sequenced letters, CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats) has imparted to us the power to edit the gene sequence of an organism and even alter the course of its evolution, making it arguably one of the most significant scientific breakthroughs to date. Additionally, CRISPR can potentially eradicate terminal illnesses and prevent the inheritance of genetic disorders. As the technology of CRISPR has brought us one step closer to a Utopian world, a question has arisen, one based on an ethical and moral ground - "Should we do it?" Currently, however, both the medical and political worlds are irresolute about employing a tool which has the ability to change the course of human evolution, and perhaps even dictate it.

Our identity is defined by our genes, which are made of DNA – a code consisting of four bases A, T, G, and C. If you were to change your genetic base sequence, even minutely, you would achieve someone else's gene sequence; alter the base sequencing by 2% and now you have a chimpanzee's gene code. Diseases alter our gene sequence and thus derail the way that our body works. With the help of CRISPR, we could reprogram a damaged gene and make it functional again, and the triggered chain effect would render the bacteria, or virus, which causes the disease ineffective. This can be used for a plethora of diseases, ranging from blood disorders to hereditary blindness, and with further sophistication perhaps cancer.

Although CRISPR's potential is impressive, there could be problems related to the safety and efficiency of the technology in a clinical situation. However, CRISPR is being used in many locations around the globe. For instance, CRISPR Therapeutics in Massachusetts and Vertex Pharmaceuticals, Cambridge have attempted to treat two people suffering from sickle cell anemia and thalassemia, diseases that deter the ability of red blood cells to carry oxygen around the body. The idea was to use CRISPR to disable a gene that would otherwise restrict the production of hemoglobin, the protein that binds to oxygen in RBCs. Initial test results showed that the treatment reduced the symptoms of both the illnesses, but the patients would need to follow up on long term treatments for conclusive results. However, scientists have not only been using CRISPR to cure diseases, but a few scientists have also tried to change the characteristics of an individual human, by altering his or her genes at the embryonic stage of fetal development. Although these modifications could enhance a child's physical and mental abilities, they present indecisive consequences that limit us from applying them.

"He Jiankui, a Chinese biophysicist attempted to make the world's first genetically edited babies and consequently stirred global controversy."

Despite the erratic character of CRISPR, He Jiankui, a Chinese biophysicist, attempted to make the world's first genetically edited babies and consequently stirred global controversy. This precarious experiment was recognized as a crime by the Chinese government, which recently convicted He Jiankui. He has been incarcerated and fined with a hefty amount of $425,000 and has been banned from further involvement in reproductive medicine. The Chinese court released a statement saying that his team "deliberately violated the relevant national regulations on scientific research and medical management" and "rashly applied gene editing technology to human assisted reproductive medicine." The global scientific community also condemned his actions as premature and unethical. In addition to the punishment that he is facing, it was found that the babies' DNA did not turn out as expected.

Regardless of recent events, some countries are still willing to advance in the field of CRISPR, completely ignoring its potential risks. These plans, however, are supported by Jennifer Doundna, one of the co-creators of CRISPR, who believes that, if used in a controlled environment, CRISPR can benefit millions of people.

THE LIQUID THAT POURS ITSELF

Karmanyaraj Yadav touches upon the extensive possibilities a unique property of an arcane material proposes

“This method of Suspension polymerization grants this neat high-molecular-weight polymer the ability to self-siphon and pour itself out of a beaker.”

A biodegradable material that could expand up to 6 times while enduring strength and biocompatibility would have invaluable medical and commercial applications. In retrospection, this kind of unique property seems too convenient to be true. However, such a material exists in the form of polyethylene glycol (PEG), also known as Polyethylene oxide (PEO), which due to its enigmatic nature, has a unique property which can leave people without its intricate scientific understanding, baffled.

The polymer forms when ethylene glycol, the principal constituent of antifreeze, is added to water, resulting in a thick sticky liquid called PEG. This method of Suspension polymerization grants this neat high-molecular-weight polymer the ability to self-siphon and pour itself out of a beaker. Though this visualization can be bizarre, it is indeed the case. Imagine a long strand of gel formed due to entanglement of large molecules which are cross-linked, much like spaghetti, by water molecules attached to the oxygen on adjacent molecules. The result is a ‘viscoelastic’ gel that has a high viscosity due to a large number of hydrogen bonds and is elastic since these long molecules can slide past each other and even straighten when stretched. Therefore, it allows the polymer to stretch itself and literally pour itself out of a container! To put this into perspective, picture single molecules of a liquid toppling over the top of a beaker. Now consider joining the partners of the molecules together to create a co-ordinated chain reaction that visually seems to topple out of the beaker. Such a concept seems to defy the laws of gravity but it holds true because the nature of entanglement between the molecules Is such that the molecules pull each other with an almost unstoppable force.

PEG has many profound applications. It is one of the few polymers that is certified for clinical use. In the pharmaceutical industry, targeted drug delivery is a difficult task, and failure to do so can produce severe toxic consequences. PEG solves this problem as its biocompatibility allows the attachment of PEG to several drugs and therefore, make drug delivery effective and easy to implement.

Not limited to internal treatment, cross-linked (PEG) hydrogel composed through irradiation of PEG diacrylates, is developed for application to external wound dressings. In order to evaluate the healing effect of the hydrogel, wounds on the backs of mice have been assessed with different treatments. Results indicate that healing under wet conditions of the hydrogel treatment was faster than the typical treatment of haemostatic gauze. This analysis clearly illustrates the possibility of using robust and transparent wound dressing supplies with enhanced healing properties.

Surprisingly enough, almost everyone is unaware of the fact that they are in constant contact with PEG. Meeting commercial purposes, PEG is used in many personal-care products like shampoo, hair conditioner, and styling products. This long-chain polymer is widely used because of its relatively low cost and versatile nature. Moreover, its low functional concentrations in such products eliminates any threat to the health of consumers.

Polyethylene oxide certainly does more than present a visually aesthetic phenomenon as it is involved in our lives in innumerable ways. It is fair to say after exploring its properties and applications that PEG exposes us to opportunities never known before. Conclusively, considering the potency of the compelling nature of PEG, we can certainly expect new techniques and possibilities to develop with the advent of time.

The Meat of the Future

Soham Agarwal explores the suitability & possibility of lab-grown meat

A lot of us love biting into juicy steaks, broiled just right. However, even as our salivary glands go crazy over that delectable sizzling hunk of goodness on our platters, our inborn affinity towards animals really does want to conform with the harsh reality of animals being forced to death Wouldn't it be great if we could produce all the meat in the world without actually having to slaughter millions of animals for it? This seems possible with the innovative development of cultured meat.

The process of culturing meat starts with procuring stem cells from the animals by doing biopsy under anesthesia. The cells are then dipped in a medium containing nutrients and are exposed to experience the natural growth factors until the desired growth is achieved. The muscle cells multiply and merge naturally to form "myotubes", which are placed in a gel with 99% water to make them take the shape of muscle fibers. Eventually, these muscles form structures which, when given time, form meat.

Cultured meat usually takes the form of an amorphous lump, making it suitable for meat or burger patties. However, food like steak consists of muscles and requires to be grown in strict structures, causing difficulties in its cultivation. Plastic-like mats were introduced for such purposes, but they turned out to be inappropriate due to their plastic-like taste. In a recent study, a novel way was devised by a group of food scientists to solve this issue. The team spun corn starch into fiber mats that could provide support for the muscle cells. They observed that properly aligned fibers turned out to be stronger compared to crisscross patterns, without losing the ability to be edible. To make these starch scaffolds, the team used a wet electrospinning technique, which involved a device that dispensed the starch solution from a nozzle towards a rotating collection drum, that drew the material into long threads. This was done with the help of an electrical field around the drum, which was submerged in a bath of alcohol and water. To add further to their innovation, Lego bricks were used as the base for their device, which not only was cheap but also provided a sustainable composite material to base the device.

"This evolution of cultured meat will not only benefit millions of animals but will also save scarce natural resources used up to produce animal meat. It requires 99% less land, and it emits 96% less greenhouse gases."

This evolution of cultured meat will not only benefit millions of animals but will also save scarce natural resources used up to produce animal meat. It requires 99% less land, and it emits 96% less greenhouse gases. Clean meat is also found to be safer and healthier than processed meat due to the sterile and safe environment it is produced in, compared to the production of animal meat, which takes place in dirty slaughterhouses under heavy antibiotics. To obtain an original taste and to reduce the cost of production as far as possible, a phenomenal amount of research is being conducted.

Amongst the Covid-19 pandemic, the demand for this type of meat has skyrocketed due to the lack of supply of animal meat. People are buying cultured meat everywhere, and due to its efficient production, producers can to a large extent cover the demand. Governments and huge organizations, like PETA, are encouraging more companies to start producing meat this way. Following the rumor of the virus being a cause of stale meat, people have changed their mindset and are considering cultured meat as their future preference. Cultured meat still requires huge development before it challenges the real meat market. Hopefully, with the advent of time, we expect to see these cultured pieces sitting out on the front on supermarket shelves, and the animal-derived counterparts sitting at the back, if at all.

Tweezers made of light which can move single molecules of proteins

Justus Ndukaife

Laser beams focussed by a microscope can hold objects such as viruses and individual cells but any particle smaller than 10 nanometer can be damaged by these focussed beams and cannot be used for this purpose.To bypass this problem scientists have designed and experimented with a technique which involves creating tiny holes in a gold film and placing it in a chamber filled with fluid. Next, a laser will be shone on the film and will be applied with an alternating electric field to it, creating two opposing flows in the fluid. Now the researchers can move the trapped molecule by shifting the position of the laser. This approach will allow researchers to grip and study individual biological chemicals and molecules, hence comparing their sizes and contributing to the development of vaccines and medicines for rare diseases.

SEPTEMBER 2020
DOI: 10.1038/d41586-020-02539-3

THE RESEARCH GOES ON...

In the backdrop of this pandemic, news of any potential vaccine flood the media. Nevertheless, the world of science is always busy exploring ideas that change our view of the world everyday, Here are some notable pieces of research that have recently captured the eye of the scientific community.

The use of artificial atoms in quantum computing

University of New South

Quantum computing has been an active area of work since the 1980's and with the creation of artificial atoms in silicon chips earlier this year, it has paved the way for stable quantum computing.The ability to control the spin of the electrons in the outer shell of the artificial atoms has opened a lot of opportunities in this field.Scientists have also claimed that this technology will reduce the development time of quantum computers with countless qubits that can be used to tackle problems of global importance such as the design of medicines or chemical catalysts to reduce energy consumption.

FEBRUARY 2020
DOI: 10.1038/s41467-019-14053-w

Discovery of a new type of killer cells which can kill most cancer cells

Michael D. Crowther, Garry Dolton, Mateusz Legut, Marine E. Caillaud, Angharad Lloyd, Meriem Attaf, Sarah A. E. Galloway

Researchers at Cardiff University in the UK have identified a new type of T cell (type of lymphocyte white blood cell, which plays a central role in the immune response) which has been observed to kill skin, blood, colon, bone, cervical, ovarian, and kidney cancer cells. The extraordinary fact about this T cell is that it goes on killing cancerous cells, while leaving the non cancerous cells unharmed. Such selectivity has not been witnessed in other types of T cells. This breakthrough has massively impacted cancer research and large organisations have already started to research a feasible method of implementing it in the population.

JANUARY 2020
DOI: 10.1038/s41467-019-14053-w

Life on venus? A signal from the clouds

Sara Seager, Janusz J

Generally characterised as a toxic planet whose atmosphere is stifled by carbon dioxide and corrosive sulfuric acid, not many gazes were fixed on the brightest object of the night sky.The discovery of phosphine (PH_3) in the thick, toxic atmosphere of this rocky planet has led to several theories of its origin. Several molecular astrophysicists have associated this chemical as a "biosignature gas for an exoplanet" while others have speculated that some unexplained geological procedure has given rise to it.Whatever this gas may be an indicator to, it has definitely raised the interest and enthusiasm of the brightest minds of the world to delve deeper into the possibility of extraterrestrial life.

SEPTMBER 2020
DOI: 10.1038/s41550-020-1174-4

Nobel Prizes for 2020

Chemistry

Emmanuelle Charpenteir

Jennifer Doudna

The Nobel Prize in Chemistry 2020 was awarded jointly to Emmanuelle Charpentier and Jennifer A. Doudna "for the development of a method for genome editing."

This newly discovered method of gene editing can help recognize, cut and alter specefic genes in animals to create desirable or required traits in them.

This technology has the potential to cut out and exterminate genetic diseases, such as cystic fibrosis or down syndrome. The innovation also looks promising in discovering a future cure for cancer. CRISPR was accidentally discovered by them when studying how bacteria warded off viral invasions, it is a vital part of the bacteria's immune system.

"First time for two women to be awarded a Nobel Prize in Chemistry in the same year!"

Physics

Roger Penrose

Andrea Ghez

Reinhard Genzel

The 2020 Nobel Prize in Physics was awarded with one half to Roger Penrose and the other half jointly to Reinhard Genzel and Andrea Ghez.
Roger Penrose has been awarded the prize for his theoretical work proving Einstein's theory of black holes though mathematical calculations which had matched with Einstein's field equations.

Two independent groups of observational astrophysicists led by Prof Genzel and Prof Ghez respectively have been monitoring the centre of the Milky Way for nearly three decades. They were studying a Supermassive Black hole called Sagittarius A*. It is 25,000 light years away. Just imagine their challenging experiment from this great distance of 25,000 light years! They identified and tracked individual stars without being distraced by interstellar dust. Yet they managed to keep track of the stars using near infrared light telescopes and successfully proved that the mass of a black hole was indeed concentrated at its centre.

"Half of the Prize was awarded to Roger Penrose while the other half was shared between Andrea Ghez and Reinhard Genzel."

Medicine

Charles M Rice

Dr. Harvey J. Alter

Michael Houghton

The Nobel Prize in Physiology or Medicine was awarded jointly to Dr. Harvey J. Alter, Michael Houghton and Charles M. Rice for the discovery of the hepatitis C virus.
About 71 million people worldwide live with a chronic infection of the hepatitis C virus, a blood-borne pathogen that is caused due to direct mixing or exposure of blood which can be a life threatening disease if treatment is not administered.

A number of hepatitis viruses can infiltrate the liver and cause a range of health problems, some of which are fatal. So by successfully identifying the virus and labelling it, the scientists and medical researchers will now be able to develop cures and treatments for this virus. Thus starting a process which will save millions of lives from the Hepatitis C virus.

"This discovery can help save the lives of millions of people."

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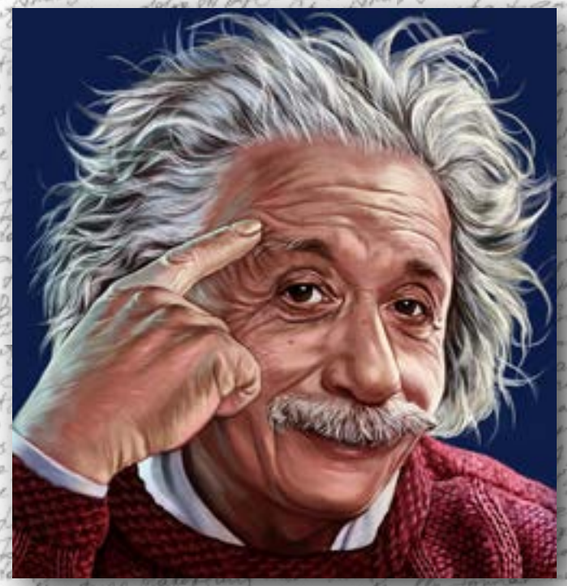
The important thing is not to stop questioning.
Curiosity has its own reason for existing.

Albert Einstein (1879-1955)



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