

GET, SET, KNOW!

ISSUE 9, 2021

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NANO-MACHINES WORK

ADVANCED SCIENCE
ARTIFICIAL INTELLIGENCE

GREAT LIVES
GILBERT LEWIS

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GET, SET, KNOW!

ISSUE 9, 2021

Dear Readers,

It's been quite some time, hasn't it? This particular issue of GSK went through several ups and downs in the making, most of the work finally coming together in just a few weeks before the release. There are two new sections which have been introduced, as well as plenty of our characters present along to help make the entire adventure interesting. The still-grave situation of the world did make it tough for our contributors, but we are grateful to have been helped beef up the content by all of you in the very last moments, ha! So readers, brace up for an intense tour of some of the fascinating things surrounding us.

Yours,

The GSK editorial team

EDITOR

Muhammed Muaaz, XII, Syed Hamid Senior Secondary School (Boys)

CARTOONIST AND ASSOCIATE EDITOR

Muhammed Zaid, VII, The Blossoms School

COVER AND BACK: Muhammed Zaid



www.getsetknow.org



getsetknowmagazine@gmail.com



www.twitter.com/getsetknowmag

PREVIOUS PUZZLE ANSWERS

Great Lives— Mohammed Misbah Tamanna, XII, Syed Hamid Senior Secondary School (Boys)

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FIRST TILL THE LATEST

SUBMARINES

Cartoonist's Desk



Representation of the Nautilus from Jules Verne's 20,000 Leagues Under the Sea



People have been exploring the seas to salvage precious items since time immemorial...



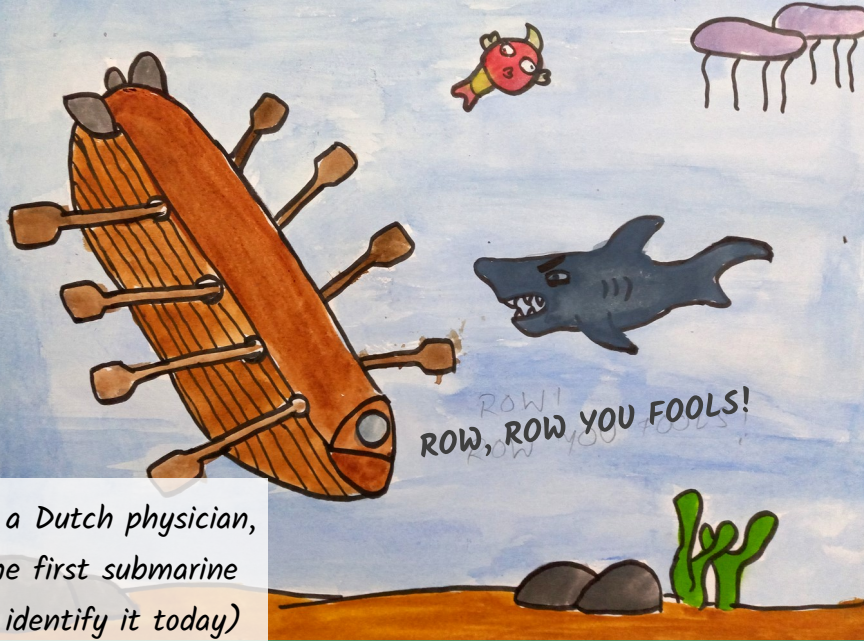
Factors such as limited breath-span were an obvious limitation to their extent...



For a long time, ocean exploration was limited to exploration in little canoes (Polynesia) or ships (as Europeans colonized the New World)



Aristotle was the first recorded to have proposed an idea of a submersible—a diving bell filled with air. It was built and used by Alexander later in the Siege of Tyre.



Drebbel, a Dutch physician, built the first submarine (as we identify it today) centuries later in 1620. It had watertight oars on its sides for propulsion.



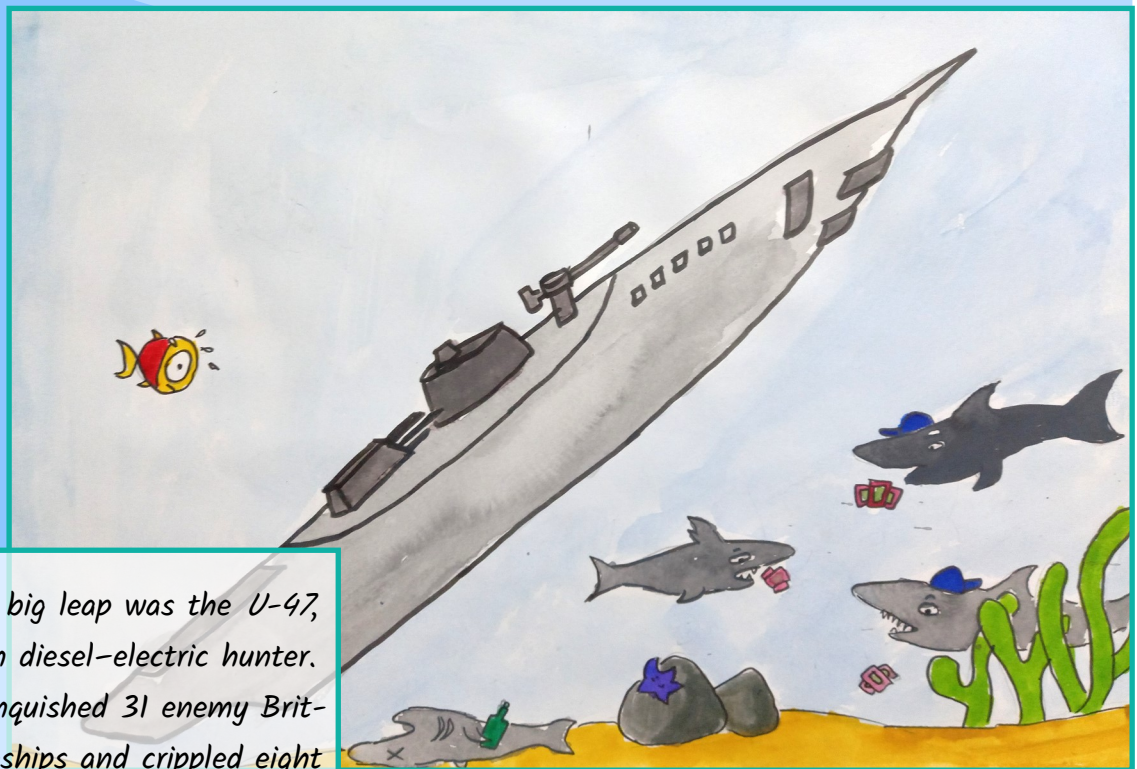
Renowned astronomer Edmund Halley built a working diving bell whose air could be replenished. It is said to have gone to depths upto 18m.



Renowned astronomer Edmund Halley built a working diving bell whose air could be replenished. It is said to have gone to depths upto 18m.

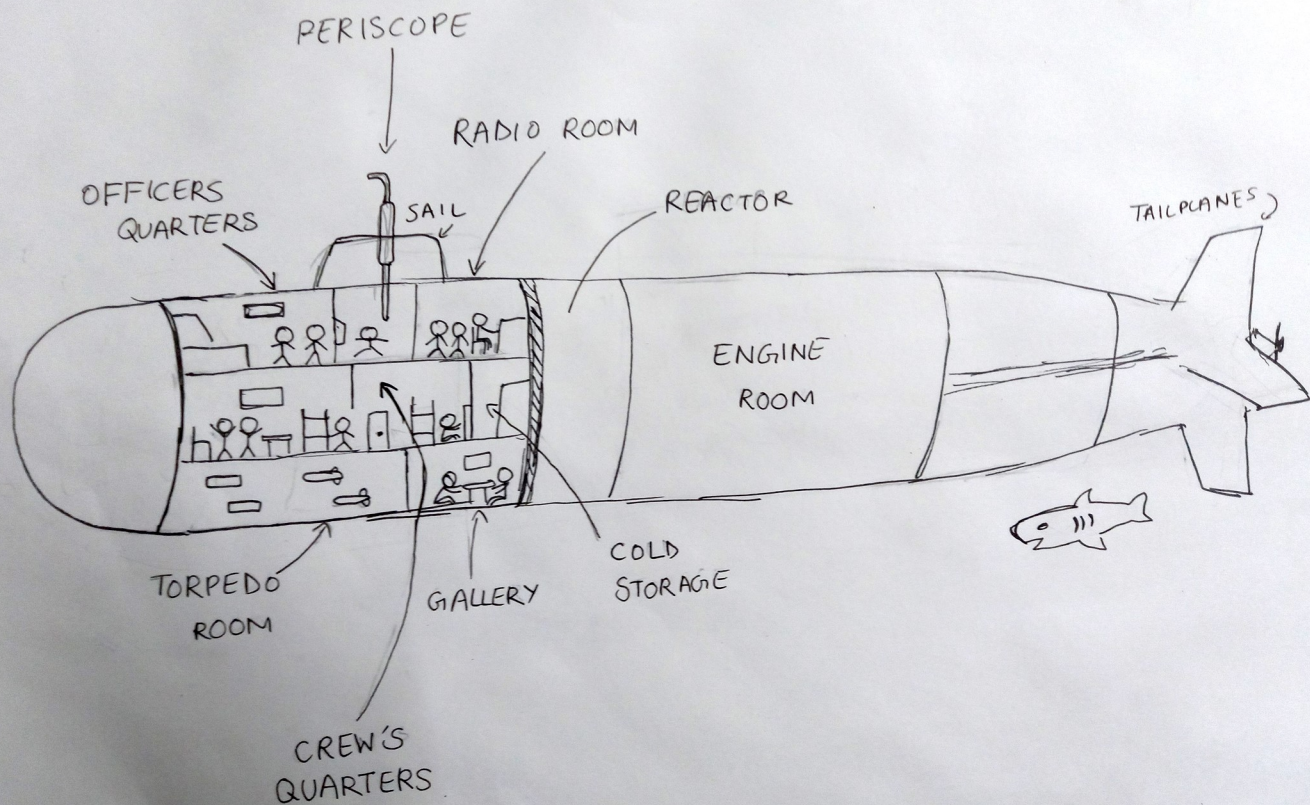


A few experimental models later, the submarine took a brand new form with the invention of the Whitehead Torpedo. The H.I. Hunley, whose weapon worked on a ram-and-collide basis, had proved to be lethal for its deployer as well.



The next big leap was the U-47, a German diesel-electric hunter. It had vanquished 31 enemy British battleships and crippled eight more in the Second World War. It had a maximum speed of 18 knots and was equipped with 14 torpedoes.





The Working

The submarine moves with the help of propulsion generated by a **rudder** at the back. Initially, rudders were hand propelled; later submarines progressed through steam, diesel, electricity, and some now even operate on nuclear power. A submarine's depth is controlled by several ballast tanks attached on its side. These fill with water or air depending on whether the vehicle has to descend or ascend respectively. The **periscope**, an instrument almost exclusively used in submarines, was first built in 1647 but put in its naval use much later in 1902.

SONAR (Short for Sound Navigation and Ranging) is the lifeline of submarines, used to detect obstacles and features in its close proximity. This technique is similar to echolocation used by various animals like bats and dolphins. The sub emits a sound wave which strikes an object undersea, gets reflected, and comes back to a detector fixed on the submarine. By identifying the nature of sound emitted by an enemy vessel, a sub can hide and track its movements.

A **diving suit** is the other common form of underwater exploration. It comes in two broad categories—the heavy deep sea diving suit that has a pipe for air to be pumped in and the scuba diving suit (pic on right) which has a cylinder of limited oxygen supply. The maximum depth for a diving suit though, is 200m, far less than the depths of the Mariana trench which have been reached through submarine. Scuba diving is today done mostly for research or recreational purposes.





Shahid Ullah Khan, Doctoral Student,
University of Antwerp, Belgium

Synthetic micro- and nanomotors (MNMs), also known as '**nanomachines**', belong to a growing topic of the interdisciplinary sciences. The idea of a micromachine was first proposed by Richard Feynman (based on his student Alber Hibbs idea) in his famous talk 'There is Plenty of Room at the Bottom' delivered in 1959, where he outlined a vision for the field called nanotechnology.

He imagined that development in the field could allow us to arrange atoms the way we want. This idea soon inspired several science fiction novels and movies, the most famous being the film "Fantastic Voyage" in 1966 that presented a visionary concept of miniaturizing devices down to the microscopic size for achieving incredible tasks.

The plot of the movie was based on the miniaturization of a submarine crew comprised of a team of scientists, who were shrunk to the microscopic size and later injected into the blood stream of an injured scientist to treat a damage in his brain. The film portrayed a nanomachine that can operate in the human body. About sixty years later, miniaturization of macroscopic objects is no more of a fantasy; the world has witnessed a significant progress in the development of tiny synthetic MNMs.

The potential of this field was acknowl-

edged by the award of a Nobel Prize 2016 in Chemistry to Jean-Pierre Sauvage, Sir James Fraser Stoddart and Bernard L. Feringa, for their pioneering work on the development of molecular machines.

Nanomachines have the highest potential in the medical field: they are being developed to be used in DNA gene editing, active drug delivery (for selective elimination of cancerous cells), water remediation and controlled manipulation of matter at the scale of less than 1 micrometer (10^{-6}m). At this scale, ordinary optical microscopes fail to work; special microscopes called **electron microscopes** are used to view molecules at this size. Using and building biomolecules that function like the common ATP molecule (used as a power source in living cells) can solve the problem of a nanorobot's power supply for good. Other



Poster for the 1966 Fantastic Voyage film

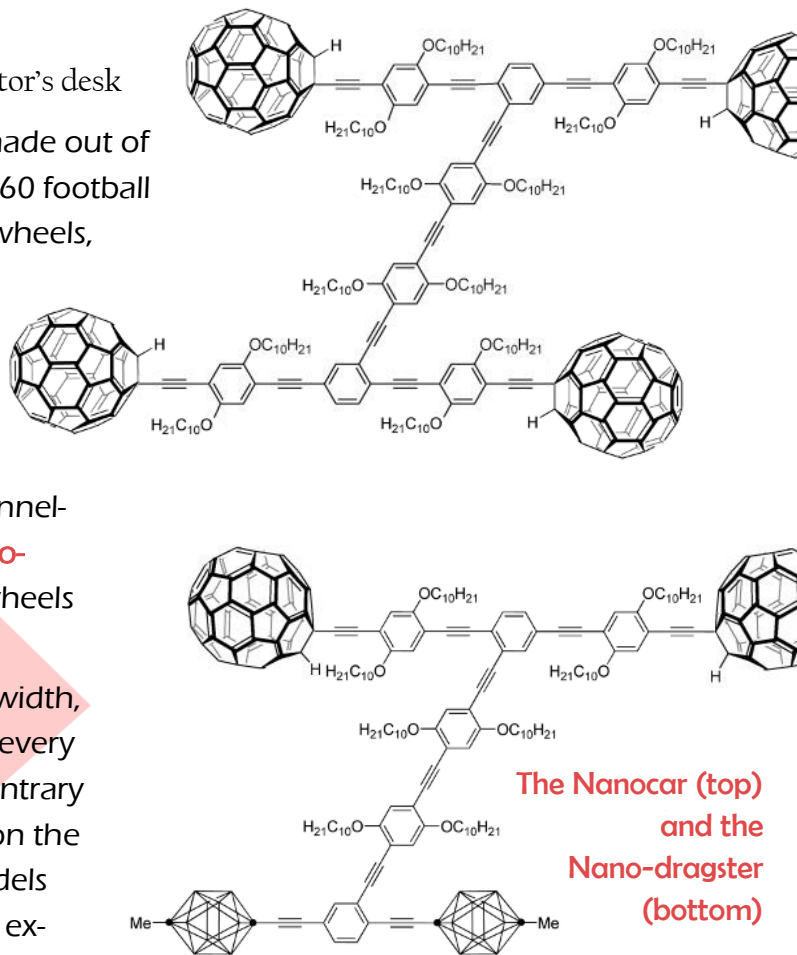
than that, external magnetic field, light irradiation, are other methods that can also be employed to initiate movement.

The Nanocar

Editor's desk

Behold the world's smallest car — made out of single organic molecule. Sporting four C-60 football-like Buckminsterfullerene spheres as its wheels, it moves onto a strip of fine layer of gold heated to 200 degrees Celsius. Originally thought to be an implausible idea, the nanocar was assembled by James Tour and his team at Rice University using the fine tip of a scanning tunneling microscope. Another model, the **nano-dragster** was synthesized with its front wheels made out of p-carbonane instead.

With size just a few nanometers in width, the nano-dragster travels its own length every second, at the optimum temperature. Contrary to its predecessor, its front wheels *slide* on the surface rather than roll over it. Nano-models with bio-molecules as power sources are expected to be developed in the coming years.



The Nanocar (top)
and the
Nano-dragster
(bottom)

The Kind Boatman

STORY

Once upon a time there was a village named Yamunayam as it was situated on the bank of river Yamuna. In that village lived a man named Amar. Amar was a very kind and honest man. every day he would go to the other side of the river on his boat to the city for some important work. One day when he was going, he saw a man standing sadly by the river bank. Amar asked the man why he was sad. The man said that he wanted to go to the city to meet his brother who is unwell. But he had no boat and the river had no bridge. Amar felt sorry for the man. He asked the man to get into his boat. The man did so and soon they were on the other side. The man thanked Amar again and again. Amar smiled and the man went on his way.

One day, Amar was crossing the river with his friend. Suddenly, they realised that their shoes were getting wet. Then only they realised that

Nomaan Ashraf, VI, Hill Top school, Jamshedpur

there was a hole in the boat through which water was coming in rapidly. They both prayed to God for help. Suddenly they saw a piece of wood floating on water. Then Amar had an idea. He took the piece of wood and held it over the hole. The wood stopped the water for a long time. When they reached the other side safely, then only Amar realised that this was the help sent by god in return of the good deed he had done to the man. Amar thanked God continuously for saving him and his friend. Then he had his boat repaired. He lived happily ever after.

Zunaira Habib Alvi, Senior Secondary (Girls), Aligarh Muslim University



Democracy, in theory, is the rule of the people. The medium of elections ensures that there is a representative of every group of people under a government. Various institutions are essential for the healthy working of a government; be it representative or not. These include—the judiciary, the opposition, the people themselves, and most importantly, the media. For a democracy to run smoothly, freedom of speech, expression and the

Propaganda:

Biased information or opinion; usually tends to be in favour of a political institution

press are vital. Many regard the press as the fourth pillar of democracy — as it is independent of all government offices and protocols.

But alas, age-old sayings with fancy texts do not define the form media and journalism has taken in contemporary times. Media in the modern world has become a double-edged sword — a tool for dissent as well as a weapon of propaganda. Freedom of speech and dissent is being hushed out by ruling groups worldwide — by both attacking journalists and media who oppose them and by spreading tales of their own glory through channels they own. Examples are common

everywhere—North Korea, Israel, the

new Afghan regime, China, as well as our very own India, which ranks 142nd out of 180 spots, a visibly dangerous country for journalists and ‘free’ media.

It is common for the press to be under various kinds of pressure — regulatory measures and public denunciation enforced by the government or its ‘owned’ media channels, or being offered funds and precious state information in exchange for freedom. The pattern followed by propaganda-oriented media is the same — a popular leader is presented as the defender of the majority, who ‘rightfully’ works against ethnic minorities. Their origins, loyalties and their very citizenship is questioned; clever manipulation of media interests en-



Military journalists hold some of the most dangerous of jobs

asures that people find it legit that principles like press freedom and open non-violent criticism can be suppressed for the 'greater interests' of the State.

Mainstream media thus faces a catastrophe of credibility, for it refuses to question the government or hold it accountable for its policies or acknowledge the malfunctioning of the system. Such partisan nature of the press extends beyond television and print media; Twitter, Facebook and other social media sites too have a tendency to be biased on the whole towards the ruling majorities. Ignorance of common people towards topics of actual importance makes them easy targets of being 'brainwashed' by the media — inclining them towards forces and ideologies they understand little of. By keeping people diverted, issues of rising unemployment, protesting farmers, lack of medicinal facilities, presentation of inaccurate State data and freedom violations remain unreported.



However, the current status of global press freedom is not bleak *everywhere*. Several countries — Ethiopia, Malaysia, Armenia and Ecuador have undergone some improvement in media environments. Just as antidemocratic forces often involve attacks on independent media, reformist leadership can be characterised in part by its willingness to accept criticism from free press. In many cases, the lifting of political pressure on media allows them to revert from censorship and other forms of

The Boatman's Humanity

STORY

Arham Ashraf, Delhi Public School, Bokaro

Once upon a time there was a village known as Raavinagar the village was divided into two parts by a river called Raavi. There was a man named Rohit who had a business of taking the people up from one side of the village and drop them on the other side of the village. So, people often used his boats to travel from one side to another of the village. Once, Rohit was returning from a side of the village in his boat, he started hearing some voices of a man. The voices were coming from a nearby place. He started searching for the man and when he reached near him the man's voice was audible. The man was shouting for help, somehow Rohit found the man and rescued him in his boat. Soon the man came in his senses and came to know that he was in a boat and was rescued by Rohit. He thanked Rohit for his kind act. Rohit dropped him to the side where he

lived he took him to his home and gave him medicines. One day Rohit was traveling in his boat. By some reason his boat started to sink in the river. He started shouting for help none of the people noticed him. The man who was rescued by Rohit was standing on a side of the village and saw air bubbles coming from the water. He thought how come the air bubbles are coming out of the river water. He instantly jumped in the water realising that it may be a human being. He rescued Rohit and helped him come to the shore of the river. Rohit came in his senses and saw the man whom he rescued was right in front of him. He came to know that the man helped him to come to the shore. He thanked the fellow person and became good friends with him. After that day they both became good friends.



Tarun Kundu, B.E. (Chemical Engineering), P.G. Diploma Environmental Management Kesoram Rayon, Kolkata

Those shreds of thermocol that go down the trash aren't *that* bad, are they? Turns out that these very crumbs of plastics — microplastics have infiltrated much deeper into our lives than we could have ever imagined. Rolling down from the mid-eighteenth century to the modern 'digital' age, civilization has seen numerous technological innovations made by man. The

start of the Industrial Revolution in Europe marks a major turning point in World history.

Power driven mass production plants and machinery in the fields of iron & steel, textiles, chemicals opened a new era of affluence in goods and products. All power started being sourced from the burning of fossil fuels. The planet rapidly fell into the curse of pollution.

Global warming took birth and transformed into the crisis that it has become now. But that's not all.





As evident, fossil fuels weren't just used for fuels. One of the major products of such petroleum fuels was **plastic**. The planet is now facing the devastation caused by the disposal and piling up of post used polymeric goods, *especially* short-lived packaging material. The extent of this devastation makes Global Warming itself seem like a polite threat.

The term '**Microplastic**' was first coined by _____ Thompson in the year 2004. It has been listed as the second most important scientific issue in the field of environment and ecology. Microplastics are small plastic pieces less than five millimeters in length. Many of them come from larger plastic articles, most of which are thrown away after being used. Natural weathering effects and photo-degradation break these into smaller fragments.

Microbeads are the other potential sources of Microplastics. These are very tiny pieces of manufactured polyethylene plas-

tics that are added as exfoliants to health and beauty products like shampoo, cleansers, and toothpaste. These notoriously tiny pieces can pass through water filters which leaves hardly any mechanism to arrest them from draining down to water bodies like oceans, lakes, rivers and soil. This has the following propagative effects on ecology-

- Microplastics in the form of fibers, fragments, pellets are widespread in oceans and natural sediments.
- Microplastics interact with POPs and contaminate marine biota when ingested.
- Marine food webs are affected by bio-

magnification. Microplastics consumed by small organisms accumulate in larger animals who prey on them in much larger quantities. This makes them even harder to extract from the environment. Chronic biological effects in marine organisms are the result of accumulation of microplastics in their tissues.





Many organisms confuse microplastics as food and feed on them in place of right food articles. Their stomach gets filled up with plastic debris and this restricts optimal food intake and then jeopardizes the life mechanism of the micro-organisms and as a result, whole ecology of that particular ecosystem. Smaller aquatic animals are already highly affected but we as common people, get to know about this only when the death of a whale breaks the news.

Bio magnification:

Accumulation of high quantities of harmful substances in predatory animals, acquired by consuming prey which had them in lesser amounts

The most frequent microplastics range from 0.1 to 2 mm, however, transparent fibers are more prominent in this range. Polyester, the mostly used fiber for clothing is most common type of microplastic in marine debris as well as beach sediments. Besides, polyvinyl acetate and polyvinyl chloride are used as engineering plastics; polyethylene and polypropylene used in packaging material are abundant in marine bed and coastal parts around the world.



Ingestion of microplastics can cause alteration in chromosomes in humans, which leads to infertility, obesity and other critical health hazards.

Microbeads are not a recent issue. They came into use in personal care products around fifty years back but awareness came only in recent years with growing social and environmental movements against plastic pollution. Since 1950, global plastic production has increased from 1.5 to 311 million tons per annum till 2014. Due to increasing production of synthetic polymers and their low biodegradability, plastic pollution has become a serious environmental problem. It has been estimated that every year 4.8 to 12.7 million tons of plastic debris enters into the marine environment and this will increase manifold by the year 2025.



Soil pollution by microplastics is another matter of increasing concern. The main sources of microplastics in soil include mulching film, sludge, wastewater irrigation and atmospheric deposition. Besides this, there is the huge carry-over of microplastics from road runoffs, urban debris, and vehicle tyres. With increasing usage and uncontrolled disposal of plastic, treatment practices like lime stabilization, anaerobic digestion or thermal drying are not sufficient to remove microplastics. Since plastic is non biodegradable, it accumulates within the soil in an unnoticed way for a long time. The case is worse when untreated waste water from urban effluents is directly used in irrigation. Huge amount of plastic debris is carried away to the fields both in micro and macro form.



Once microplastics are accumulated in soil, the topsoil provides a environment for degradation in presence of UV light, excess oxygen availability, agricultural tilling, microbial and other terrestrial organisms activities on plastic. All these effects turn plastic debris into microplastics. There are a number of mechanisms by which microplastics from topsoil percolate to deeper soil – agricultural tillage, leaching , heavy rains, floods , bioprocess , micro-organisms and transportation by small animals like earthworms. The serious ill effects include - contamination of ground water, loss of soil integrity in form of severe soil erosion and of course soil fertility. Additionally, illegal dumping of waste near roads and tire abrasion can also contribute to microplastic occurrences in the soil. For tire abrasion, a report showed that the annual emission of rubber dust may go upto the level of 110,000 MT in country like Germany.

For tire abrasion, a report showed that the annual emission of rubber dust may go upto the level of 110,000 MT in a country like Germany.

The highest concern with this sort of pollution lies in its irreversibility. Several ways and means are emerging to control this devastation. The direct way is limiting plastic production. Debris has to be prevented from draining down to water streams and thus ending up at sea. The other ways being adopted to combat plastic pollution are mainly ECO labelling, recycling and introducing alternatives to plastic. Eco-labelling identifies the environmental interaction of the product in its life cycle especially at end of its useful life or till its intended purpose is fulfilled. Labeling like 'ECO –friendly', 'biodegradable', 'compostable', 'recyclable' etc. helps in growing environmental awareness in people.

Recycling of plastic requires its own management. Plastic products bear a Plastic identification Code (PIC) - a short nomenclature which helps the re-processor in identifying and segregating similar type of plastic for reprocessing. Governing bodies in different parts of the world have imposed regulatory laws in view of arrest-



ing plastic pollution. The Government of India has also put forward the Plastic Rules 2016 with an exhaustive regulation against plastic pollution.

The sustainable action against plastic pollution is to find an ECO-friendly substitute. Lots of products of natural origin like paper, bamboo, wood with low lifecycle and various others are taking place of plastics. Cellulose film and polylactic acid (PLA) film, the known industrial product may play a major role in acting as a sustainable substitute of plastic thin film packaging which now is the cause of an uncontrollable plastic nuisance and source of microplastic hazards to our environment. Above all, a widespread awareness percolated down to all levels of people in all spheres of our life around the globe may rescue us from the danger of irrecoverable plastic pollution.

NUTRITION BITES

ICEBERG LETTUCE



Muhammed Zaid, VII, The Blossoms School, Aligarh

Lettuce, either in salad or a burger, is a crunchy and leafy vegetable of which mostly the leaves are eaten, but sometimes stems and seeds are consumed too. This vegetable comes in many shades of green or a purplish red, and is mostly crisp and ruffled. It normally tastes neutral to mildly sweet. It needs a well-drained and fertile soil for cultivation and 75% of it is grown in China, India and the U.S.A. The most common type of lettuce is Romaine and Iceberg Lettuce.

Iceberg Lettuce, or crisphead lettuce, is the most iconic variety of lettuce, and was produced by the name in 1894 by a gardening industry founded by the Burpee

Seed Company. It was named after the way it was packed and transported which was by laying bundles of them on crushed ice (to keep them fresh), which gave their heads a look similar to that of Icebergs, and hence, the name was coined.

Iceberg Lettuce is low in fibre, but there are many advantages of taking it once in a while too. First things first, It is 96% water, being great for hot summers, and has a sufficient amount of Vitamin A, B, C and K, Calcium, and Potassium. An interesting fact is that Iceberg lettuce is real low in sugar, fat and calories, with a baffling average one calorie per leaf!

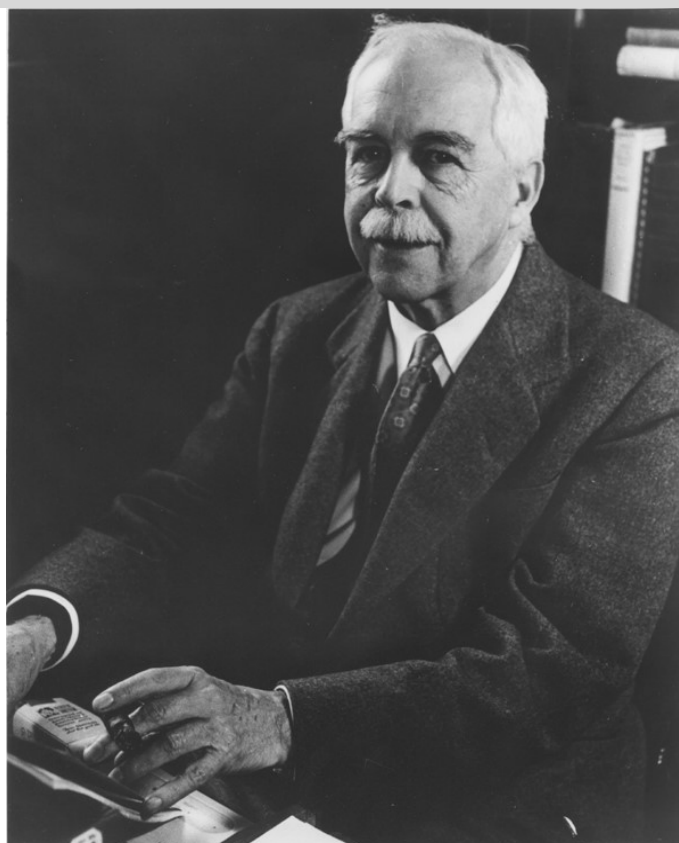
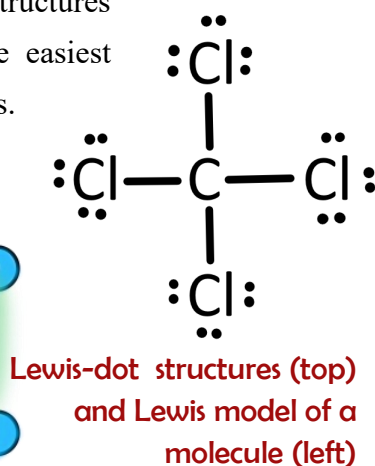
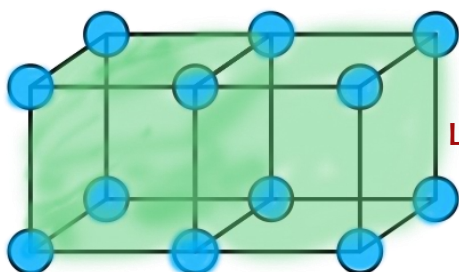
Professor Tarasankar Pal, Department of Chemistry, Indian Institute of Technology, Kharagpur

The architect of the Modern Periodic Table – Dmitri Mendeleev had missed the Nobel Prize by just one vote. Gilbert Newton Lewis, another great scientist didn't receive it either, despite being nominated **forty-one** times for it; quite unfortunate indeed! Lewis has many achievements in his name — however his proposition of the possible arrangement of atoms in a cubical arrangement (with one atom each at the corners) was what made him popular among students. His theory explained Newlands Octet Rule, an early interpretation of the recurring properties of the elements.

He explained his rudimentary proposition to his students at Harvard around 1902, but published his 33 page-long paper in the year 1916 from Berkeley, university of California. He, for the first time, introduced that bonding can take place as the result of *sharing* of electrons between two atoms. Lewis's model of covalent explained the tetrahedral arrangement of bonds in carbon atom, the property on which our entire understanding of organic chemistry is based today.

Lewis's bonding model spread as scientists and researchers started to modify and use it in the fields of coordination (semi-polar) bonding and quantum physics. Linus Pauling presented his modified version as the valence Bond Theory later in 1939. However, Lewis-dot structures continue to be widespread as the easiest way to represent valencies of atoms.

Lewis was shy, diffident and



not a good orator. He was somewhat disappointed by the attitude of physicists as they considered his theory as a crude model. In turn, Lewis was critical to conceive the idea of completely mobile electrons. Lewis theory stood on a strong background of chemical evidence that molecules have definite shapes, and in fact, several common solids like table salt exhibit lattice structure similar to what Lewis had suggested.

His work on thermodynamics had made him to conclude that thermodynamic systems— chemical reactions, involved quantities more than just the heat and pressure of a system. Quantities like 'entropy' and 'free energy' were later used in unification of thermodynamic equations. On March 23, 1946, Lewis was found dead in his Berkeley Laboratory. After Lewis's death, his children followed their father's career in chemistry.

Mohd Saqib, M.Tech, Department of Mathematics and Computing, IIT (ISM) Dhanbad, Jharkand



“Intelligence is the ability to adapt to change” - were the words of the prominent scientist and writer Prof. Stephen Hawking. He had suffered from a devastating neural disease in an early stage of his career and had become paralyzed. However, his disability failed to stay ahead of him in his field of cosmology and from introducing the world to his groundbreaking research. It became possible only because of his iconic wheelchair, which became his backbone throughout the rest of his life. Thanks to artificial intelligence, people with special needs can drastically improve their own lives to the pinnacle of ability where they even can deal with even the Lucifer of tragic events.

Many branches of AI dramatically influence people who are dealing with any kind of accessibility problems. For example - **Computer Vision (CV)** and **Natural Language Processing (NLP)** technologies are working for visually impaired people. For decades, CV improved the level of AI, up to the point that object recognition has become easy and is being implemented in various fields like driverless cars, smart homes, e-health systems, early disease diagnosis, etc. Similarly, it can also work as an eye for visual patients to help them recognize objects and walk on the roads without fear.

Second, NLP can transform human language to a computer understandable form and vice versa, influencing not only the blind but also the people suffering from vocal and hearing diseases. For instance, smart-home automation has reduced the need for local mobility they find tough to the point that they almost have an assistant for routine works.

Alexa - an NLP-based voice recognition system is another



**Two famous ALS patients —
Stephen Hawking (top)
and Jason Becker**

er example of home automation using which the orthopaedic disabled can order food without needing to move their fingers. Moreover, AI has also changed the lives of neural patients like autistic children. It is not only empowering their accessing capabilities but also helping neurologists to diagnosis autism at an early stage. Although there is no certified treatment available for autism, the deep learning branch of AI is helping in reading indications given by an autistic person or even recognizing their needs by facial impression.

Similarly, a hybrid technique of deep learning and NLP is being used for enhanced digital features for text summarization, caption reading, image acknowledgment, and web accessibility for mental impairments. Although AI holds limitless potential for the impaired, still a big drawback of technology is being out of reach for ordinary people. It would not be wrong to say that Prof. Hawking was privileged enough to have access to cutting-edge technologies and instruments with tremendous applications. There are people in overwhelming numbers who are fighting with disability as well as economic strain. Researchers, policymakers, and governments should come together for such initiatives that make Tech-for-All.

The Digital Divide

Editor's desk

The already gaping divide between those who could afford an education and the rest who could not was clearly deepened by the pandemic which struck two years back. It brought a still developing field of technology — namely **online education**. Till now, people of many poor sections of society could afford to send their children to school with teeming hope of building their future. Yes, the future lies in the new generation, the generation that was hit worse by the digital divide. Shutting down of schools in campus due to the situation urgently being so resulted in students having to switch over to this new method of learning. Electronic devices — laptops or mobile phones, either requiring an active internet connection, became the new prerequisite of learning.

A look at where we stood before — India, a developing nation, had a Gross Enrolment Ratio of just 27%, which means that only that percent of students pursued higher, post-school education. Just 24 percent of the population are in possession of a smartphone, and a mere 11.5% with an internet connection. With such poor statistics, it is not surprising to state that 24 million children are on the verge of dropping off from school altogether. On the other side of the ravine are the teachers — struggling with the teaching using technology they know little of. If learning from home *has* to be the new norm, then surely the limited accessibility of the technology here is far more of a problem than the system itself.



And what about the section of students who *could* afford to have online classes? This is something which doesn't need stats to invoke menace in the hearts of all students and teachers dealing with it. The most obvious limitation to the learning process is the lack of interaction itself. Schoolgoing kids used to do much more than just copy facts from the blackboard — Interaction was limited not only between the teacher and the pupil but also in between the students themselves. Studying by watching pre-recorded videos is indeed a far cry from that. Apart from that, several health impacts of prolonged device use have escalated manifold — extended screen time, mental strain, lack of offline extracurricular activities, deterioration of social and conversational (how do you say thank you to a relative, again?) skills, health issues from sitting in the same position for hours, etc. in short, all life-developing activities that are essential to the overall development of a learning child. It's just that we realised it now.

Mariam Nusrat Khan, Senior Secondary (Girls), Aligarh Muslim University

Ever noticed having a tendency to color the number 7 *orange* whenever the instance came? Like a green colored 7 seemed *odd* amongst its other multicolored mates? There are people out there who can taste shapes, some can taste my name and yours, while some can see colors in musical notes. Academic John Locke, in 1690, recorded a case of a blind man who claimed that trumpets (when played) sound scarlet in color. German physician George Sachs wrote of 'colored hearing'. Francis Galton — cousin of Charles Darwin, wrote about 'visualized numbers' in "Nature", 1880. Such records surfaced for a while around the late 19th century, but soon fell out of public interest after the emergence of Behaviorism. Now these works have been revived over the past 20 years, and this peculiar phenomenon has fascinated neuroscientists and psychophysicists once again.

Synesthesia is a neurological condition that occurs when two senses, say hearing and sight, merge together in the mind when they normally aren't. What this means, is when one sense would be stimulated, another sense would get an involuntary reaction. Synesthetes have their brains cross-wired in a unique fashion — when one sense is triggered, say a sound is made, then circuits associated with another sense, say gustatory, put forward a reaction. In other words, a synesthete could

'taste' the shape of objects, or 'see' colors in musical notes, even 'feel' texture in abstract concepts such as time.

Synesthesia appears to run in families and may be passed down from parent to child. Brain imaging shows that the

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Graphemes, which are individual letters and numbers, appear to be tinged with colour to people. Although different people have different associations made, the letter 'A' is most likely to be red.

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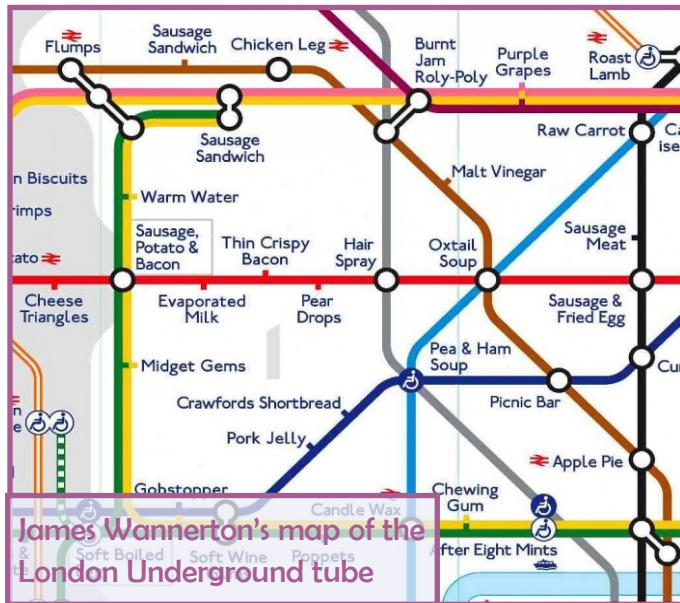
brains of synesthetes have way more interconnections between individual sensing parts than normal brains do. Neurologists speculate that people who experience synesthesia are usually either born with it or develop it in very early childhood. The theory is that it occurs in people who have excessive myelination.

Myelin is a substance made of fatty lipids and proteins which accumulates around neurons. It starts at 36 weeks of gestation and is completed by the end of the second year of life. The thicker this sheath is, the more efficiently electric signals are transmitted. This way, the brains of synesthetes have this unusual interaction between sensory parts that usually aren't supposed to interact.

In short, synesthesia has two overall forms: **projective** and **associative**. In projective variants people either see actual colours, forms or shapes when the related sense is triggered while in associative type people feel very strong, involuntary intuitive connections between the stimulus and the sense that it triggers. One of the most common types of projective synesthesia is grapheme-colour synesthesia. Graphemes, which are individual letters and numbers, appear to be tinged with colour to people. Although different people have different associations made, the letter 'A' is most likely to be red. Chromesthesia is another common type, where everyday sounds, music and talk can trigger seeing colours.

Again, these associations vary from individual to individual. Composers Franz Liszt and Niko-

lai Rimsky-Korsakov, both chromosthetic, often disagreed on the colours of notes. People who can see musical notes may also have perfect pitch because then they have a privilege in identifying different notes and keys. There are at least 80 types of synesthesia, maybe even more, but very less scientific analysis has been done for these.

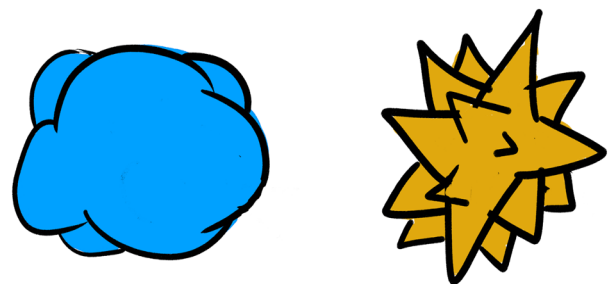


When synesthetes experience these sensations, they perceive it in terms of location. They mention about "going to" a particular place when they perceive these extra sensations. Synesthesia rather than a disease or disorder, is a gift for most in possession of it. Synesthetes have used their abilities in memorization of names and telephone numbers, mental arithmetic, and more complex creative activities like producing visual art, music, as well as theatre and poetry. Some studies suggest people who have it do better on memory and intelligence tests than those who don't. Four percent of the population has synesthetic capacities, a great majority of them particularly coming from artistic fields.

Some famous synesthetic creatives include musicians like Stevie Wonder, Mary Jane Blige and Billie Joel; visual artists such as Carol Steen and David Hockney. Writer Vladimir Nabokov in his autobiography has mentioned of having 'a fine case of coloured hearing'. Musician Pharrell Williams has spoken as to how lost he and his music would be without his synesthetic capabilities. James Wannerton, also president of the UK Synesthesia Association, has got a type of synesthesia called

Lexical- Gustatory Synesthesia. As the name suggests, he can taste words and sounds, and also texture. It's a full eating experience for him. The funny part is that whenever he receives any sort of sound, his brain is fooled into pumping acids across his digestive tract, to digest food that actually isn't there. James has used his synesthesia and created a map of the entire London Underground Tube, as shown, and each location is named after what the place tastes like to him.

There is however one famous synesthetic creative who did not necessarily always consider this ability of his as a privilege. The great artist Vincent van Gogh mentioned in his letters to his brother how yellow and blue sounded like fireworks to him. In the modern world, he is considered a post-impressionist art genius, because his synesthesia has played a crucial role in the overall composition of his artworks. His admirers are aware of how important his coloured hearing was to him and his heart, but in his period, his synesthesia was just a characteristics for him to be declared 'crazy'. His art wasn't taken seriously. When van Gogh complained to his piano teacher about the colours the keys made, he was called insane and immediately kicked out.



To finish off, here's a light-hearted experiment based on the concept of ideasthesia and such multisensory related research. In this picture, try to decide which shape would be named 'Kiki' and which would be named 'Bouba... Almost all participants name the angular figure Kiki, and the rounded one Bouba.

Aminul Islam, Professor, Department of Chemistry, Aligarh Muslim University, Aligarh



(Continued from previous issue...)

2002

The first round of the 2002 World Cup (Korea/Japan - the first time in Asia) reflected a changing football world as upsets and surprises thrilled right from the start. The tone of the group stage was set in the opening match as African debutantes Senegal shocked the holders France with an impressive 1-0 victory. The Lions of Teranga made it to the second round, beating Sweden on a golden goal, and *then* only fell to a Turkish golden goal in the quarter-finals. The Golden Generation of Portuguese defeated by United States, came back to beat Poland, but then fell to the group D's other surprise package, the Korean Republic, as another high-profile European power went home far earlier than expected.

The most hotly anticipated match of the entire opening stage was perhaps the Argentina v. England. David Beckham, who was sent off in the corresponding contest at France '98, successfully put his ghosts to rest as his penalty kick was the only goal in the always fascinating confrontation between the teams. Argentina, a pre-tournament favourite for many, could only manage a draw in their last match against the Swedes, and they joined the ranks of big-names on their way home earlier than expected.

Knockout rounds rather followed a more predictable pattern than the startling group stage. In the Round of 16, Korea faced illustrious Italy and claimed an electrifying 2-1 victory from Ahn Jung Hwan's golden goal. Even more unlikely was what followed next - a penalty shootout win in the quarter-final over hardened and excellent European side, Spain. A 1-0 loss in the semi-final to Germany could not dampen the incredible enthusiasm of the Korean people, who flooded the streets like a sea of red during and after every match.

The previously unheralded Eastern European - the Turks showed that they meant business after eliminating the Japanese in the second round and crowd-favourite Senegal in the quarter final. They,



however, lost to Brazil in a tight, single-goal match in the semi.

In the end however, it was two familiar faces - Germany and Brazil, who played for the world championship, and it was the South Americans who won their unprecedented fifth FIFA World Cup (extraordinary record of winning it on every continent). Ronaldo, who suffered a famously poor final four years earlier, was the hero for the coach Seleçao, scoring both goals in the 2-0 victory. He ended up with a total of eight goals in the tournament- the most in a FIFA World Cup since Gerd Müller scored ten times at Mexico '70. Germany recorded three consecutive 1-0 victories over their rivals in the knockout rounds to book a spot in their seventh final. Ironically, it was the previously flawless Kahn who gifted Ronaldo the final's decisive opener.

Brazilian captain Cafu became the first man to play in three World Cup final matches. Though he was often overshadowed by the flashy skills of the "Three R's", Rivaldo, Ronaldinho and Rivaldo, not to mention Roberto Carlos on the opposite flank. Another first was the pairing in the final. Amazingly, the FIFA World Cup's two most successful teams, Brazil and Germany, had never met each other at the tournament, not until their 87th and 85th matches respectively.

The third-place match also featured a remarkable first, as Hakan Sukur's goal for Turkey against Korea Republic came after just 11 seconds - the fastest ever scored in the finals. Europe got its revenge in what was termed "The Group of Death," where England and Sweden went through at the expense of powerful Argentina and always dangerous Nigeria.

2006

FIFA World Cup 2006 ended up with an *Azzurri* triumph (4th) with conceding just two goals but the abiding memory of the Final at Berlin's Olympic Stadium may be of Zinedine Zidane's meltdown, the France veteran earning a red card for headbutting Marco Materazzi. Their first victory on penalties came against Jurgen Klinsmann's mighty young Germans in semi-final,



laying to rest the ghosts of three past failures on the world stage - notably in the 1994 final.

Germany, however, took third place on the back of an attractive brand of high-tempo, attacking football with top scorers (14 goals) - five of them from adidas Golden Shoe winner Miroslav Klose and three from Lukas Podolski, the Gillette Best Young Player. German people displayed unstinting generosity towards its spectators attending 64 matches in the 12 magnificent stadiums that gave real meaning to the tournament motto 'A time to make friends'.

France saw off Portugal, Brazil and Spain en route to final with tremendous efforts of 33-year-old Zidane that earned him the Adidas Golden Ball. Although the semi-finals were an all-European affair, Argentina, before succumbing on penalties to Germany provided some sparkling football and scored the best 'team' goal when Esteban Cambiasso concluded a 4-man passing move in their 6-0 humbling of Serbia and Montenegro. Brazil's Ronaldo entered the record books with his 15th FIFA World Cup goal.

2010

In 2010, South Africa became the first to host the FIFA World Cup; it will live in the memory as much as the spirit and smiles of the host nation as for the success of a Spanish team who achieved their own first when Andres Iniesta's 116th-minute winner against the Netherlands put them into the record books as the eighth country to capture football's most prized crown - from an opening loss to Switzerland to win their remaining six matches, the last four all by a 1-0 score line.

Europe eventually gave us the winners - for the first time on another



continent. For the Netherlands, the memories will be mixed after they completed a hat-trick of final heartbreaks, adding to the defeats in 1974 and '78. Germany impressed the watching world with some scintillating counterattacking play when putting four goals past both England (2nd stage) and Argentina (Quarter final) before their charge ended with a repeat of their UEFA EURO 2008 final defeat by Spain in the semi.

The tournament's biggest surprise, Uruguay, returned to the semi-finals for the first time in 40 years with the scoring expertise of Forlan (Adidas Golden Ball) but lost to Netherlands in the other semi-final. African disappointment came when Ghana's run was stopped by Uruguay in the quarter-final. The Black Stars were a crossbar's width from becoming Africa's first semi-finalists; instead Asamoah Gyan's spot-kick in the last minute of extra time bounced off the woodwork.

2014

The 20th World Cup in 2014 was hosted by a nation (Brazil) that has come to represent the very best of football with the heavy splash of samba spirit. Germany reclaimed in style a Trophy they had won three times before and, in the process, become the first European team to triumph in the America with Mario Gotze's goal at 113th minute similar to that of Iniesta's in 2010.

In the group stage, Costa Rica, with three former world champions in group D, stunned the footballing

world by coming out on top, beating Uruguay 3-1, toppling Italy 1-0 and holding England to a goalless draw. Brazil took on neighboring country Chile in a high tempo match in the round of 16. Despite their solo efforts, Brazil held out and went on to win by 3-2 only on spot kicks. Colombia came up against Uruguay (without suspended Luis Suárez) and James Rodríguez picked his

moment to shine scoring two goals to send his side through. Costa Rica went through to their first-ever World Cup quarter-final after a thrilling shoot-out 5-3 against Greece. In the quarter-final, the career-defining performance of keeper Navas (Costa Rica) kept the Orange strikers at bay till the extra-time. However, it was the substituted keeper Tim (Netherlands) who saved two spot kicks to take into the semi-finals.

In a disastrous semi-final encounter Brazil without their suspended skipper Silva and injured striker Neymar lost to merciless Germany by 1-7. Both the Netherlands and Argentina were extremely cautious, perhaps as a result of the lessons learned from the first semi-final and the match had to be decided with penalties. While all four players converted for Argentina, Romero saved penalties from Vlaar and Sneijder to put Argentina through to face Germany in their fifth World Cup final.



In the final, after a scoreless 90 minutes, Germany substitute Goetze fired a powerful volley from Schürrle's cross to propel Germany to their fourth FIFA World Cup title at the Estadio do Maracana in Rio de Janeiro. The "wounds" of 2014 will probably never heal, concedes Lionel Messi.

2018

Russia thrilled from beginning to as a string of records were broken. Germany, the defending champions, were eliminated in the group stage. Host nation Russia was eliminated in the quarter-finals. France claimed their second World Cup by beating Croatia 4–2. A historic first own-goal off the head of Mario Mandzukic and it was the 12th own goal (highest till date) of this tournament.

Nineteen-year-old Kylian Mbappe became the second teenager in history to score in a World Cup Final, following in the footsteps of Pele who did so as a 17-year-old in 1958. Mandzukic broke English hearts and fired Croatia into the final after



scoring in 109th minute. In the quarter-final, Belgium overcame Brazil, and Croatia defeated Russia in a tiebreaker.

Cristiano Ronaldo equaled the record of scoring in four World Cups for Portugal in the 2006, 2010, 2014 and 2018 tournaments and also became the oldest player to score a hat-trick in the World Cup (against Spain). Iceland became the smallest country to participate in a World Cup. Egypt's Essam El-Hadary became the oldest player to feature in a World Cup match, at the age

The Farmer

Dr. Kamil Ashraf, Assistant Professor, Department of Medicine, JNMC, AMU

Once upon a time there lived a farmer called Lallu in a remote village of Champaran in the state of Bihar. Like every family in the village, his lone source of income was farming. He had a small piece of land in which he used to grow crops. He himself worked in the field. The produce was barely sufficient to feed his family. He lived with his wife, three children and his elderly mother who was sick. Any extra income would go into the treatment of his ailing mother. He also had one cow through which he managed milk for his children. He owned a cart to carry things to and fro between his house and his farm.

His village was far away from the town. The choices for a livelihood was very limited. One day, the river running nearby changed its course and ran through the village. The village got flooded with immense loss of lives and property. Luckily his home was on a raised piece of land which saved it from drowning. By God's grace his family members survived but the cow died. His crops were also destroyed.

When the flood water subsided it was found that the river had made a permanent course through the village, and to the misery of Lallu, it ran through his land which he used to grow crop. Left with nothing, Lallu became depressed but he did not lose faith in the Almighty. Suddenly an idea struck his mind — he dismantled his cart and fashioned it into a boat. He got hold of a fisherman from a nearby village who taught him how to sail and to fish. Now Lallu would go in his boat every morning and bring lots of fish from the river. Some, he kept for home and the sold the rest.

Through this he earned enough money not only to feed his family but also to keep some for future use. Steadily his business flourished. He would also sail through the river to a nearby town to sell his fish. His living condition improved and his mother became well with proper treatment. A time came when Lallu became a renowned fish merchant but he never forgot his past and kept thanking the Almighty for all he had.



Ancient texts are undoubtedly a major key to our understanding of the past. While artefacts — pots, jewelry, statues and more tell us about people might have used or built them for, texts tell us what our ancestors considered important enough to be recorded down; writing was not as common back then as it is today. However, the earliest documents we find today are from Mesopotamia — the Sumerians are said to have been the first people to have developed it 6000 years ago. The inscriptions were creative in the least — the baked clay tablets with indentations on them were presumably used for record-keeping of trade and merchant goods. They wrote down stuff they found difficult to memorize (no. of sheep sold to the Uruk guy...) or documents which

worked as a proof (upstart Bennu's unpaid rent...).

Some forms of writing existed before that too. The symbols or pictures drawn did not correspond to a language—they were rather symbols of abstract concepts. The **Jiahu** symbols from China (7000 BC) and the **Vinča** symbols from Neolithic Europe (6000 BC) remain undeciphered primarily because we have little knowledge about the lives of their creators.

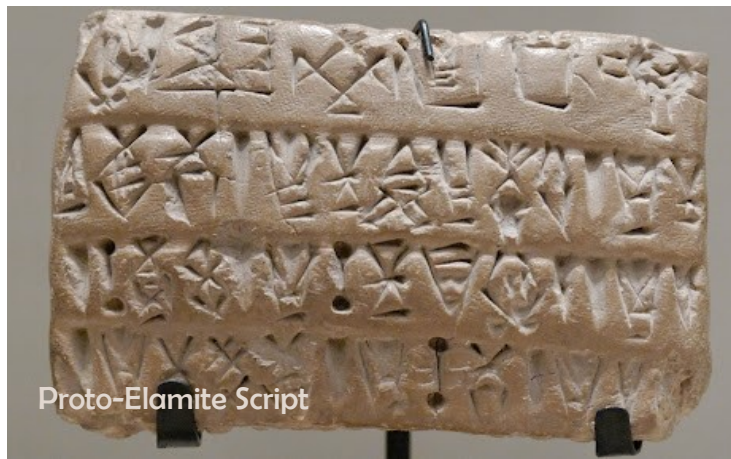
Writing is also considered to have originated independently in Mesoamerica, possibly to track the positions of the stars for religious rituals.

From Mesopotamia, writing (or the idea of it) spread elsewhere — southwards to Egypt and eastwards to China and India, each of which became the nucleus of a great civilization. The famous **Indus Valley** script from 3500 B.C. continues to be undeciphered today. Most of the writing there has been found on clay seals used on trade packages that found their way up North to Mesopotamia itself. The presence of limited characters on each seal could also imply that the script consisted of representative symbols rather than language as it was spoken.

Moving west, we find several tablets with inscriptions in present day Iran. Dating to 3000

The Indus Valley Script





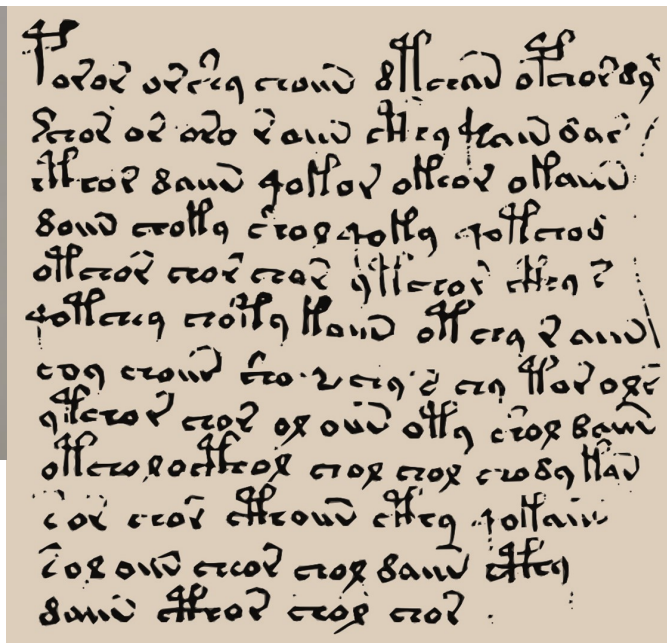
Proto-Elamite Script

BC, these are thought to have carried the precursor of what later became the Elamite script. Both proto-Elamite and Linear Elamite are largely undeciphered; The University of Oxford has released several photographs of the script with hope to get crowdfunding help. Dating to the same period are the famous Egyptian Hieroglyphs, which continue to be our most important source of whatever we know of the Egyptians.

From Egypt, hieroglyphs moved out to the Island of Crete in Mediterranean, home of the iconic Minoan and Mycenaean cultures. Linear A and B are the scripts that were found in the palaces in Minoan and Mycenaean times respectively. While Linear B — a syllabary, has been deciphered as being a precursor to Greek, Linear A remains undeciphered to this day. A unique artifact that dates from this period is the **Phaistos Disk** (1800 BC), the earliest object that had something *printed* on it. Yes, the symbols on the disk were imprinted using carefully crafted stamps with incisions marked on them. These stamps were pressed the wet clay just like the mechanism of early printing presses had been.



The
Phaistos disk



Though not an ancient book, the Voynich manuscript is widely regarded as the most mysterious book of all time. Undeciphered to this day, the odd manuscript has been dated to the fifteenth century. Written in a script (and probably a language), of its own, scores of historians have pondered over what seems to be a medical journal. It describes hundreds of plant species complete with elaborate diagrams out of which just a handful can be identified today. Other than that, it also holds a trove of deep astronomical knowledge, believed at that time to be essential for the carrying of several medical procedures.

To sum up the point we started with, writing is one of the largest pillars we have built our history on. Deciphering scripts and texts are many-a-times the only correct way to understand the ways our ancestors lived.



The
Voynich Manuscript

MEET THE GSK CHARACTERS!



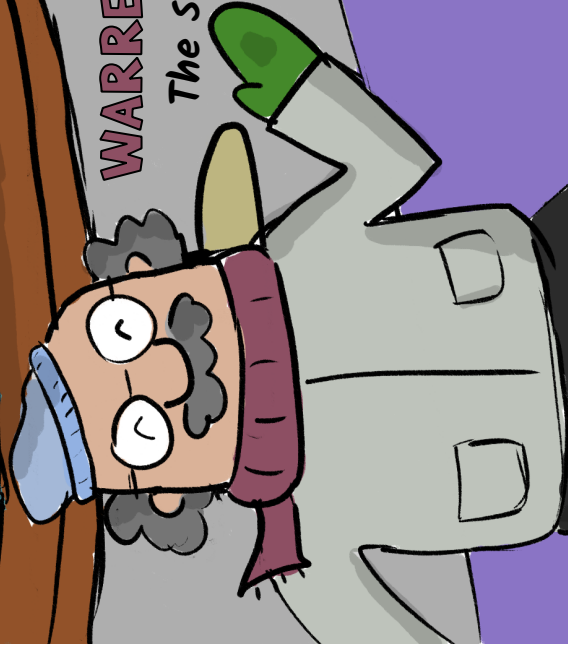
PENCILMIND

The Invention



WARREN

The Scientist



NICOLA

The Historian



NIGEL

The Journalist



CRAIG

The Mystery Hunter



MR. MOLE

The Archaeologist

