COGITO137

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Cogito137
The Thought Capsule

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EDITORS NOTE

After the grand success of Cogito137's anniversary issue and sending copies of our magazine to over a hundred national institutes across the country, we are back with yet another thoroughly engaging issue.

The issue begins with a discussion of the basics of vaccines and the importance of getting vaccinated. With the vaccination drive going across the country, it is essential to know how important it is to get vaccinated. The editorial also covers the ins and outs of herd immunity and the repercussions of vaccine refusal.

How would you like to know someone who is not a human being but rather a human-like being? Intrigued? Our cover article takes us into the world of AI-powered virtual beings. This article by SciRa, tells us all about Samsung Neons, their creation, and the many ethical and privacy issues surrounding them. The brilliant cover design is an artwork by our designer, Naman Agarwal.

We also have a fascinating article by Divyansh Dewan about magnetic monopoles. It revolves around the long-believed fact that magnetic monopoles do not exist and the contradictory theories that predict their existence. Gunjan Misri presents to us a study on heavy metal pollution across Kolkata. It also mentions the health risks pertaining to heavy metal pollution. We have a very thought-provoking article by Dakshesh Vasan that delves into the coronavirus outbreaks seen by the world in all of history and comes to a conclusion if COVID-19 is a case of the evolutionary arms race or not. Shubhangi Antil has created a very interesting comic about ants and pheromones. Last, but not the least, this issue also consists of a beautiful illustration accompanied with an explanation of the rare secretary bird by Sanskruti Biswal and Mukil M.

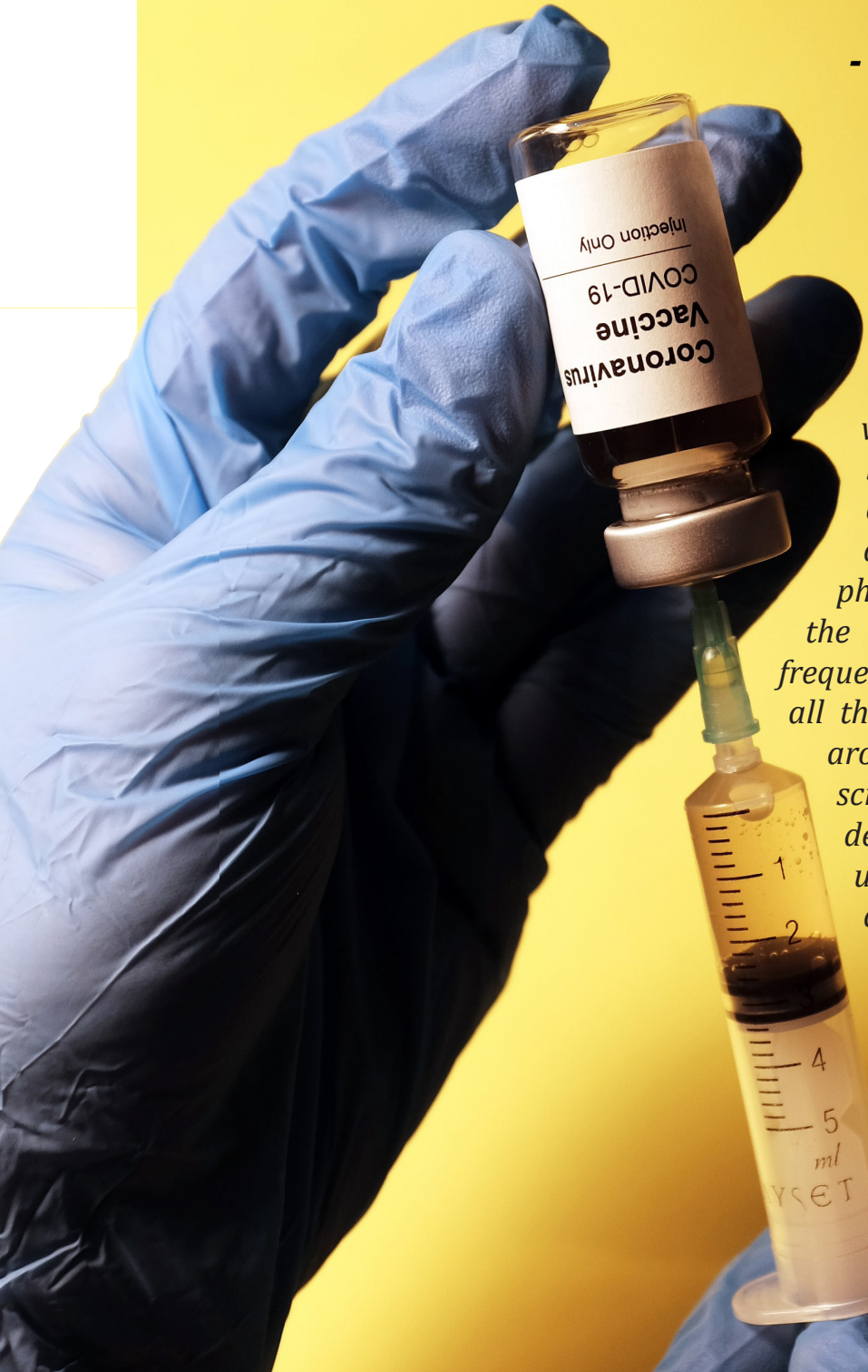
With the number of COVID-19 cases on the rise again in India, we urge you to stay safe, be vaccinated, and strictly stick to the protocols for our wellbeing. Stay vigilant, stay aware. Don't forget to subscribe to our website and YouTube channel to never miss our new articles and videos. Please keep us posted with your suggestions and content on scicomm@iiserkol.ac.in

Srujana Mohanty
Managing Editor, Cogito137

VACC

A review of their structure and function

- *Srujana Mohanty*



"The COVID-19 vaccine" - the silver bullet we were all eagerly waiting for and perhaps the phrase in which we hear the term "vaccine" most frequently these days. With all the discussions buzzing around, ranging from scientific, to political debates about this, let us take a quick look at what vaccines are, how they work, and their importance in our lives.

CINES

The commonly prevalent methods to control the spread of an infectious disease can be classified into two broad categories - prevention and treatment.

There are two common ways to prevent the spread of disease. First, by avoiding contact with infectious agents, and second, by preventing the further spread of the agent from individual to individual. Effective prevention of a disease depends primarily on the understanding of the transmission dynamics of the particular infectious agent. The other control effort, i.e., treatment, refers to treating the infected population and thereby stopping the further spread of the disease.

Vaccines prepare our body for fighting against disease-causing agents and thus the effective prevention of a particular disease relies on vaccines. Vaccines are defined as a substance used to stimulate the production of antibodies - the ammunition in our bodies to fight diseases These antibodies provide immunity against one or several diseases. Vaccines are prepared from the causative agent(s) of the disease, its products, or a synthetic substitute, treated to act as an antigen (identified by our body as a disease-causing trigger) without inducing the disease.

Discovery of vaccines

The discovery of vaccines goes back to the 18th century when smallpox was raging havoc through human societies like a wildfire. Smallpox was caused by two closely related virus strains - Variola major, which was very virulent and had a 30% mortality rate, and Variola minor, which was less virulent with a 1% mortality rate. Eventually, science was triumphant in eradicating the smallpox virus.

In fact, smallpox was the first and the only human disease to be eradicated by vaccines.

Now, it is ironic that medicinal science asks to intentionally infect a person in order to prevent disease, and that in fact, is the very backbone of the process of vaccination.

It is believed that this process of infecting an individual with small amounts of the virulent or disease-causing agent, originated from India or China. It was first introduced to the western world in 1721 by Lady Mary Montagu, in England. This process involved deliberate administration of the smallpox virus in small amounts to uninfected individuals so that they develop a mild but protective infection. This small amount of infection, which was not enough to cause the disease but enough to initiate the process of antibody production within the bodies of these individuals, now armed them to fight further and a serious dose of infection.

There were three serious drawbacks in this process of variolation. Firstly, it did not always stimulate immunity (antibody production). Secondly, it sometimes caused smallpox and resulted in the patient's death. Thirdly, it could set off a transmission chain and cause collateral cases in other susceptible individuals. However, with the progress of science, such drawbacks were minimized, and the methods of vaccination matured. Nonetheless, variolation still remains an active area of research and continues to remain the vaccination method for some diseases.

How did the smallpox vaccine come into being?

When the smallpox virus was around, it was a common observation that milkmaids were mostly immune to the virus. Edward Jenner, now referred to as the father of Immunology noted that cowpox, a virus naturally circulating in wild rodents and infecting cows, caused a mild infection in humans, thus generating an immune response in those humans, against similar viruses. To test this theory, Jenner infected (inoculated) his gardener's son with cowpox blisters from a milkmaid. He and 23 other infected individuals were exposed to variola. It was observed that they were all immune to variolation. The Latin word for cow is "Vacca," and hence Jenner initially named the method "vaccinus," which means "from cows."

How do vaccines work?

Our body has its own immune system, composed of a type of cells called the white blood cells. Among the different types of white blood cells are three primary kinds called the macrophages, B-lymphocytes and T-lymphocytes. B-lymphocytes produce antibodies - a type of protein that binds itself to the disease-causing agent or foreign particle (antigen) that has entered the body. Macrophages are responsible for engulfing this antibody-antigen complex that is formed. T-lymphocytes have a certain memory and can remember these antigens or foreign particles and thus remain ready to re-initiate this process whenever the body is again attacked by those foreign particles.

Now, vaccines contain live or inactivated infectious agents (foreign particles/antigens) that mimic an infection, thus causing the immune system to initiate this process. Once this simulated infection subsides, the body is left with memory T-lymphocytes as well as B-lymphocytes that will produce an immune response if the body comes in contact with the same infectious agent in the future.

Types of vaccines

Although the common knowledge is that vaccines are either live or inactivated forms of infectious agents, this is often an oversimplification. A more detailed classification of vaccines is as follows:

Live (attenuated)vaccines: These vaccines contain the live but much-weakened version of the infectious agent so that they mimic the infection and yet do not cause a severe infection, all the while stimulating our immune system. Examples include vaccines against Measles, Mumps, Rubella (MMR), and chickenpox.

Inactivated vaccines: These vaccines are made up of dead infectious agents that can stimulate an immune response. Often multiple doses of this vaccine are required to maintain the required immune function. A classic example of such kinds of vaccines is the oral polio vaccine.

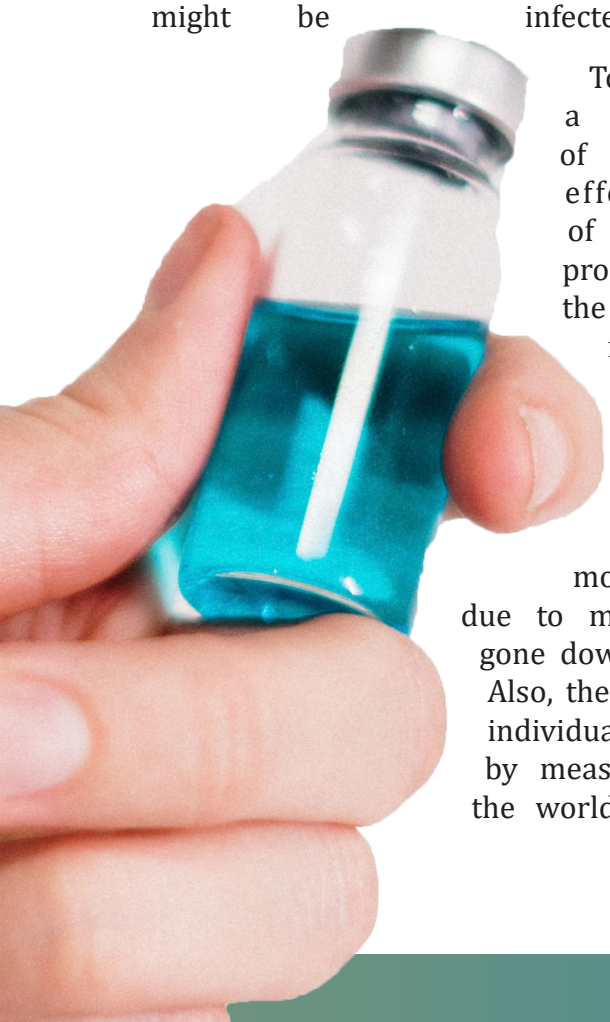
Subunit vaccines: These vaccines include a part of the infectious agent instead of the live or the inactivated form of the entire germ. This part is usually the component of the antigen which is responsible for triggering the immune response. Subunit vaccines are known to have the least side effects. An example of this type is the pertussis component of the DTaP (Diptheria, tetanus, Pertussis which causes whooping cough) vaccine. This vaccine is also a conjugate vaccine.

Conjugate vaccine: Conjugate vaccines are the ones developed to specifically target the antigens that

have a complex sugar coating around them. This coating helps the antigens to disguise as other biological molecules. This makes it harder for an underdeveloped immune system (for example in children) to recognize the antigen and respond accordingly. However, conjugate vaccines are prepared such that they can recognise the coating as well as the actual antigen covered by it, and thus helps the immune system to act. The vaccine against pneumonia is an example of such a vaccine.

Effectiveness of vaccines

The evaluation of the effectiveness of a vaccine depends critically on keeping track of the number of people who have been prevented from contracting a disease because of vaccination. As one might imagine, this is a complicated business. Such complications can arise due to numerous reasons. For example, some doses of vaccines fail to stimulate immunity. Also, often infants who still have their mother's immunity passed on to them, do not develop their own immune protection despite being vaccinated. Moreover, vaccinating an individual also might prevent the transmission of the disease to people who might be infected.



To give you a perspective of the effectiveness of vaccination programs in the past, it is noteworthy to mention that the childhood mortality rate due to measles has gone down by 74%. Also, the number of individuals affected by measles around the world has gone down by 62%. It has also been estimated that nearly 700,000 deaths have been averted due to vaccination for Haemophilus influenzae type B and 3.8 million future deaths have been averted due to vaccination for Hepatitis B.

To estimate the actual impact of vaccination, we need to consider both its direct and indirect effects. Vaccination of infants, for example, can lead to a long-term effect on a population with respect to the particular disease that the vaccine targets. If P is the probability of successfully vaccinating an infant, P can also be described as P = (proportion of infants vaccinated) x (vaccine efficacy). Let us suppose, an infection removes susceptible individuals at a rate related to the basic reproductive number (the average number of secondary infections produced by a typical case of an infection in a population where everyone is susceptible), RO. Also, the number of new births adds to the number of susceptibles in the population. Therefore, the susceptibles reduce in number when we immunize a proportion P, of the new births. Thus the effective reproductive rate Reffective, for an infection, in a population, where P percent of individuals have been immunized, is, (1-P) RO. If Reffective is the expected number of new infections due to a single infection, when Reffective is greater than one, an epidemic is said to have broken out. The critical immunization fraction needed so that P is less than 1, i.e. an epidemic doesn't break out is, therefore, P>(1- 1/RO). This fairly simple infection model suggests that we can effectively prevent an infection from swooping across an entire population by immunizing less than 100% of the newborns. This is what is commonly known as herd immunity.

From the model discussed above, we can see immediately that as the reproductive number(RO) increases, the proportion of children born that would need to be vaccinated also increases. Thus the RO value for a population determines what proportion of children need to be vaccinated to prevent a particular disease. For instance, for a pathogen

like smallpox, with RO of approximately 5, we might only need to immunize 80% of the newborn children, whereas, for pathogens like mumps or chickenpox, with RO nearer to 10, about 90% of the children would need to be vaccinated. It should be noted here, that the herd immunity threshold is the percentage of the population that must be immunized, and not just vaccinated. Generally, pediatric vaccination, with pertussis or measles vaccine, stimulates immunity in less than 90% of infants due to its interactions with maternal immunity still present in the infants. So, infant-based vaccination strategies alone are often not enough to be effective in achieving the eradication of pathogens, with a high transmissibility. While herd immunity can be an effective strategy, indicating that eradication of a disease may be possible, it also comes with its inherent limitations and challenges for implementation.

Vaccine Refusal

Like any other medication, vaccines can also sometimes lead to health risks in the form of side effects. An example of such skepticism arose due to the usage of thimerosal (a mercury-containing compound) in vaccine preservatives. It was found that this component might be linked to many autism cases. After proper investigation, the use of thimerosal was banned. These instances led people to be wary of vaccination drives. These strong beliefs are an important contributor to the drop in vaccination rates. But on the other hand one should remember, it is because of the proven high effectiveness of the vaccines that the prevalence of some diseases in our society has rarified.

Alternatively, it would not be wrong to say that this has also created a false sense of safety where people believe that they or their children don't need to get vaccinated anymore because the disease is so rare anyway. But ironically, they fail to realize that in fact, the disease is rare because people get vaccinated, and if people stop getting vaccinated, the disease would become much more prevalent again.

Among other challenges in implementing a successful vaccination drive are the inability of some people to get vaccinated due to pre-existing medical conditions or even allergies to certain vaccines and their components.

Needless to say, clusters of unvaccinated people are at a high risk of causing a local disease outbreak. Even when the proportion of vaccinated people is high, the clustering of unvaccinated people can cause an outbreak because it can lead to long chains of transmission of the disease with an exponential growth characteristic. So as much as it is important to keep the vaccination engine warm, it should also be emphasised that large clustering of unvaccinated people should be avoided, to win the battle between Man and the Virus.

Srujana Mohanty is a third-year undergraduate student pursuing Integrated BS-MS in Chemistry, at IISER Kolkata. Besides writing, she enjoys coloring, singing, cooking, and watching series in her leisure time. She is also a cat lover.

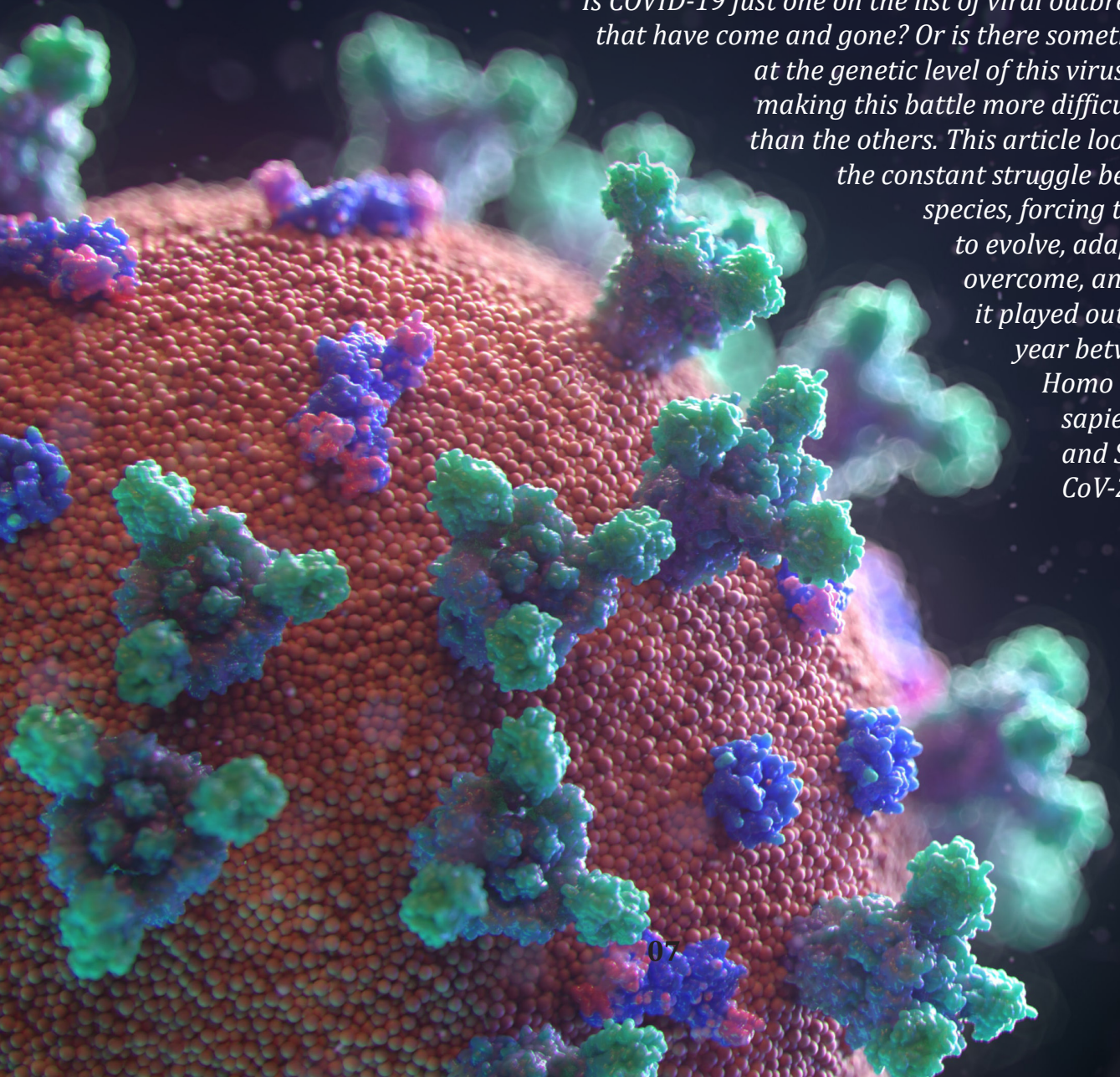
Chick HERE to read the article on our website with added referances.

REVIEW

An Evolutionary perspective of the COVID19 Pandemic

-Dakshesh Vasan

Is COVID-19 just one on the list of viral outbreaks that have come and gone? Or is there something at the genetic level of this virus, making this battle more difficult than the others. This article looks at the constant struggle between species, forcing them to evolve, adapt and overcome, and how it played out last year between Homo sapiens and SARS-CoV-2.



'Stay Home, Stay Safe'- across the globe, people have become used to this phrase, in light of the Covid-19 Pandemic. Home quarantine, lockdown, masks, sanitizers and social distancing have become the norm.

The severity of the COVID19 (Coronavirus Disease 2019) spread is evident from the escalation of a few reports in Wuhan, China to a WHO Phase-6 Pandemic within months. Coronavirus is a big family of pathogens. Covid-19 is caused by the Coronavirus strain, SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2).

Humans have battled SARS-CoV and MERS CoV (Middle East Respiratory Syndrome Coronavirus) earlier. SARS had previously spread across continents to 27 countries before being contained whereas MERS was relatively more concentrated in the Middle East and Africa, with only a few cases in the West. Both SARS and MERS spread through human contact. However, the spread never escalated to the level of COVID-19. Why? Does the answer lie in the genetic material?

Scientists of the Scripps Research Institute, have conducted extensive analyses of the genetic template for the protein coat armatures (protein shell of a virus which encloses its genetic material) that the SARS-CoV-2 uses to attach itself to cells and infect them. They have found that the Receptor-Binding Domain (a short fragment from a virus that binds to a specific receptor sequence to gain entry into host cells) was better equipped to effectively target a receptor involved in blood pressure regulation in human cells.

Coronaviruses mutate faster than most other viruses, due to their genetic make-up (RNA particles which are less stable and thus change fast). Evolution and natural selection provide a suitable explanation as to why Covid-19 has spread faster and wider than SARS and MERS. The evidence of adaptations in the Receptor-Binding Domain that help SARS-CoV-2 bind efficiently to human cells explain the stronger binding and easier human-to-human transmission and thus, farther reach.

While the spread is much wider, the mortality rate due to COVID-19 is much lower compared to that of SARS and MERS. People with lower immunity are at greater risk and the young, healthy population seems to be able to stay alive for a long time, even after infection. SARS-CoV-2 also spreads asymptomatically. In the case of SARS and MERS however, infection led to comparatively quicker and visible symptoms, suffering, and almost sure death.

Though counter-intuitive, this makes SARS-CoV-2 scarier. Why?

Consider the virus. It depends on the host to proliferate. The lesser the virus affects the host, the greater the chances of its replication and proliferation, and greater the spread across populations. Further, the delay of visible symptoms also delays identification and isolation, providing greater scope for human-to-human transmission. Evolution is thus once again to blame, for it seems to have provided the virus, not only better attachability to human cells, but also greater scope for survival and proliferation across populations. This also explains why SARS and MERS were more easily contained. Their human-to-human transmission was much less potent. The hosts showed symptoms comparatively quickly. Some even died before they could have contact with others to pass on the virus. All these factors reduced the scope for spread, allowing both SARS and MERS to be controlled and contained effectively.

At a first glance it would seem that in the evolutionary race amongst the strains, SARS-CoV-2 is winning. Within a month of the first confirmed case of the Covid-19, the global total number of cases surpassed that of SARS and MERS put together. However, all was not lost because the human race also evolved simultaneously.

Evolution in the genetic sense is impossible in humans in such a short period, given the long life span and the genetic make-up (DNA particles which are more stable and change

slowly). However, evolution must also include behavioural aspects. This includes the capacity of each individual's immune response as well as the accumulation of knowledge within the system. Lockdown measures, quarantine, social distancing and isolation are all learned behaviours after all, based on past experience and aspects of evolution from a behavioural perspective. A ray of hope is in the fact that, given its success in proliferation and survival across populations, the SARS-CoV-2 virus seems to mutate slower, allowing us time to develop a vaccine and put a stop to it. This is an evolutionary arms race between humans and the virus in its own right.

The focus so far has been on the relationship between SARS-CoV-2 and humans. However, coronaviruses are mostly animal viruses. What about the manner in which the virus jumped from its animal hosts to man?

When viruses, in general, enter a non-compatible host, the immune system of the host successfully destroys the virus. However, when by some chance, the virus escapes said destruction, it tries its best to adapt to the new environment of this new 'host'. Now and then, animal viruses manage to survive the human immune response and replicate within the human body. At this point, the virus can mutate and evolve under the human body constraints and improve itself for replication and proliferation in this species which is new to them.

Bats harbour several coronaviruses and still manage to live unaffected by them. Their unique immune capabilities enable them to carry a heavy viral load, without affecting their physiology. The SARS-CoV-2, like SARS-CoV and MERS-CoV, seems to have originated in bats and then jumped on to humans. However, the mode of infection, intermediate host and other details are still under study. As it stands, the human immune response to SARS-CoV-2 causes severe inflammation leading to the symptoms, which the bats have somehow evolved to cope with.

Even then, there surely must have been an evolutionary arms race between the viruses and the bats' immune response. Researchers from the University of California Berkeley, USA have found evidence of the evolution of the coronaviruses towards greater cell-cell transmission capabilities, as a counter to the bats' antiviral responses. This might have very well assisted the jump of SARS-CoV-2 from bats to humans, mostly through an intermediate host such as a Pangolin.

The question that begs to be asked here is that, in the event that the virus does mutate and evolve further, wouldn't natural selection direct it to a form where it manages to survive and proliferate without causing severe impairments or death to the human hosts, like in bats? Wouldn't it be in the best interests of both the human population and the virus, given the virus gets a host to live in, and the human population is unaffected? In the words of Christopher Coleman, University of Nottingham, "This is by no means [always] true, but a virus that adapts to humans might be less dangerous in the long term because the 'evolutionary arms race' between virus and host has reached a sort of stalemate where neither is perfectly happy, but neither is killed off."

Neither humans nor the virus, or any other organism for that matter, seem to be outside the grasp of an evolutionary arms race, trying to catch up with each others' evolution-derived superpowers, to ensure survival. The result? Only time can tell.

Dakshesh Vasan is a 3rd Year student at the Department of Mathematics, IISER Kolkata. While he is fond of tinkering Mathematics into anything, wherever compatible, he has always been in love with the very concept of evolution. When he's not in his room, he's probably out discussing the latest campus happenings, while simultaneously campaigning for Inquivesta, and recently - Revival: The all IISER online cultural fest!.

Chick HERE to read the article on our website with added referances.

Heavy metal Pollution From road dust is a Potential Health Risk :Warns study

Krishnendu Bandyopadhyay | TNN | May 3, 2018, 6:00 am IST, Victoria Memorial, Maidan, Kolkata, West Bengal

- Gunjan Misri

The article illustrates how heavy metal pollution in a developing country like ours severely affects the health of its residents. It is based on a recently published study carried out in Kolkata by a research group in IISER Kolkata's Department of Earth Science.

The city of joy - Kolkata, is the second-most polluted metropolis in India, as stated by the World Health Organization in 2018 (WHO, 2018). Prolonged exposure to heavy metals like magnesium, chromium, lead, nickel, copper, which are common city-pollutants, are known to pose significant threats to ecosystems and human health. Heavy metal accumulation in humans is known to cause adverse health problems leading to growth retardation, kidney disease and various forms of cancer.

Road dust acts as a mobile source a sink for the heavy metals released into our surroundings . We are exposed to it either through direct skin contact or inhalation through the nose and mouth while breathing. A group of researchers from IISER Kolkata collected road dust samples across 57 spots in the city, across 6 different types of land - residential, roadside, traffic, railway, port, and industrial, to check heavy metal contamination levels in the city. The road dust samples were analyzed for 11 major and trace heavy metals. Zinc, copper, lead, and chromium were found in

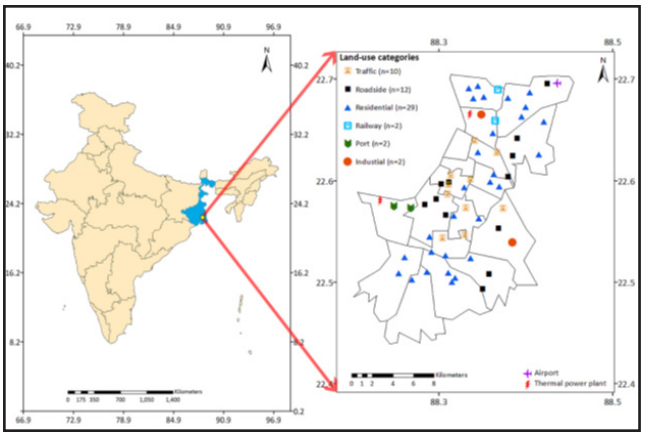
higher amounts than the others.

Lead is released into the environment by automobiles running on lead-based petrol, burning of fossil fuels like coal, and smelting industries. Although lead-based petrol in India was banned in 2001, lead has a high persistence time and can stay for long in the environment, once released (US-EPA, 2017). Chromium adds to the pool from metallurgy or electroplating industries. High levels of lead in blood have been associated with disorders like ADHD (Attention-deficit hypertensive disorder) and high chromium levels are known to impair neurological development in children.

"What we found was that there was no significant difference in heavy metal contamination levels between the different land use categories. Residential areas have almost similar levels of contamination compared to industries or traffic areas. Across the country of India, the different heavy metal contamination levels depends on the kind of industries and pollution sources present in the particular state" says Dr. Sayantan Sarkar, from the Department of Earth Sciences at IISER Kolkata and principal investigator of the research group that conducted the study.

Road dust acts as a matrix, between other sources of heavy metal pollution i.e. soil and water. During heavy rains, the road dust pollutants are washed into sewage waters which can then mix with the soil- the other two sinks for heavy metal contaminants. The results of this city-wide study showed similar heavy metal contamination levels across the different land use categories. The health index for adults and children was calculated and the contaminant levels of carcinogenic heavy metals like lead, nickel, and chromium indicated a higher risk of cancer in children. When compared to other countries, the heavy metal contamination level in the city of Kolkata was found to be similar to the industrial countries of China and Bangladesh, which report higher than safe levels of lead and chromium in road dust respectively .

In Kolkata, the north and central-west regions were found to be the heavy metal contamination hotspots in the city, compared to the recently developed south Kolkata. The older places in the city, with constructions dating back to British times, are more congested and lack a distinction between residential and industrial spaces. In the future, keeping separate land spaces and creating separate zones for industries and residential regions would reduce the exposure to heavy metal pollution, reducing health risks. Therefore, the findings of this study should be taken into consideration by policy-makers and city development officers during the development and construction of industries in any residential city.



Location of the sampling sites. The figure on the left shows the state of West Bengal (in blue) and the megacity Kolkata (yellow circle). The figure on the right shows the locations of the 57 sampling sites in Kolkata and their corresponding categorization based on land use. Also shown are locations of thermal power plants and the international airport

Gunjan Misri is a 5th-year BS-MS Student of IISER-Kolkata, majoring in Biology. Her hobbies include singing and trying hands at any instrument she sees or hears (currently into piano and ukulele). She enjoys reading occasionally and uses colors to express herself.

Chick HERE to read the article on our website with added referances.

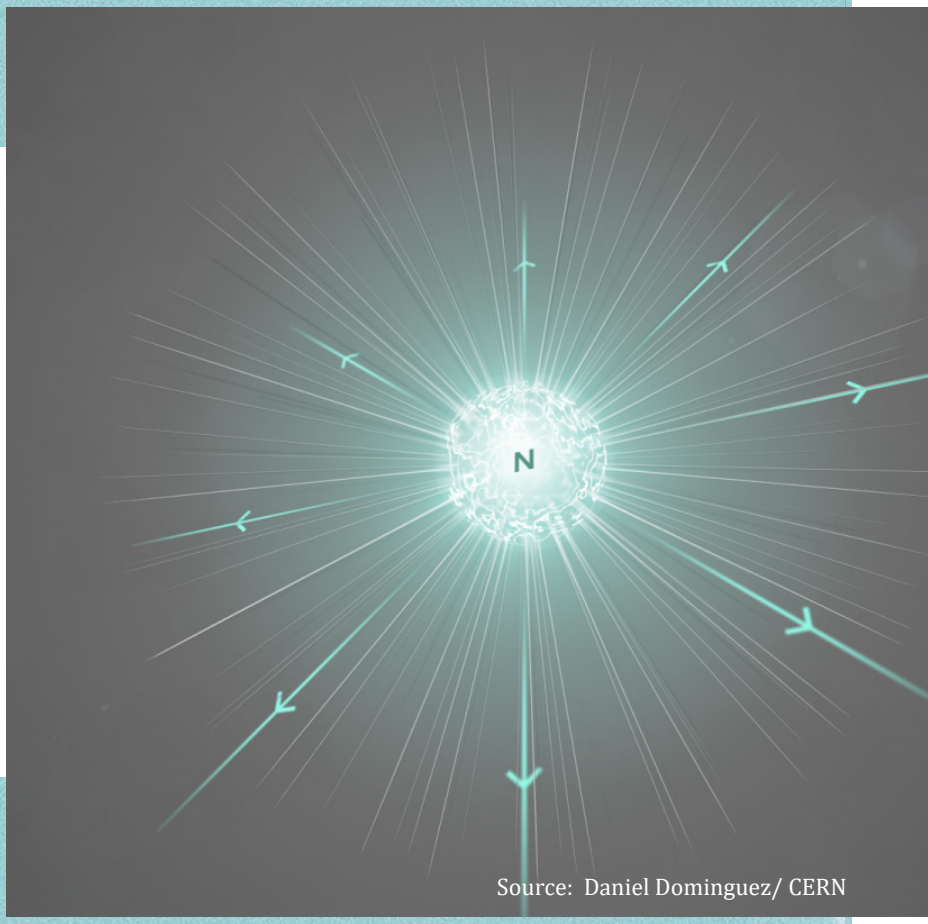
REVIEW

Magnetic M

Missing Piece of the Symmetry

- Divyansh Dewan

Electricity and magnetism seem to be intrinsically interconnected. But this connection isn't yet complete. While electric dipoles and monopoles both are commonly observed, so far we haven't observed any magnetic monopole, but instead told that they don't exist. So why does this asymmetry exists which so far, we were just told to accept?



Source: Daniel Dominguez/ CERN

This article encompasses a brief about magnetic monopoles & reflects upon how their existence has been predicted, but they haven't been directly observed.
It also talks about why we believe they exist, how they are envisioned, how they fit into the larger framework of science, the challenges in finding them & the efforts taken by scientists to observe them.

Monopoles

There's always that one over-smart person in the class who knows more than others. The one who knows about quantum entanglement, vector calculus or can derive Maxwell's equations, but can they?

What proof do they have of Gauss's law for magnetism, best summarized as "Magnetic monopoles do not exist." Cause I don't recall ever seeing any proof for that. And indeed, there isn't any. Paul Dirac was the first to propose the idea of magnetic monopoles in 1931 and in fact, the standard model of particle physics also predicted the existence of magnetic monopoles.

For those unacquainted with this term, a magnetic monopole is a particle having only one kind of net magnetic charge - either north or south, (which we have been told does not exist, in school) Well, they probably don't, until we dig a little deeper.

We must first understand why it is believed that magnetic monopoles do not exist. There is nothing as such that prevents the magnetic monopoles from existing. As mentioned above, current theories on particle physics predict their existence. But they have never been detected, nor have their effects been directly seen.

Paul Dirac envisioned magnetic monopoles as a semi-infinitely long, infinitesimally thin solenoid (called the Dirac string). The end of such a solenoid acts like a magnetic charge, but it makes sense to identify this object as a magnetic monopole only if no conceivable experiment can detect the infinitesimally thin solenoid. He proved that such a solenoid would be undetected to an electron interference experiment if the magnetic charge (g) is quantized and these lead to magnetic monopoles.

Magnetic monopoles are hypothesized to be massive particles - around 19 orders of magnitude heavier than a proton and require extremely high energies to be created. It is possible that in the early age of the universe, the temperature might have been hot enough to facilitate their formation, but again they haven't been detected (and not for lack of trying).

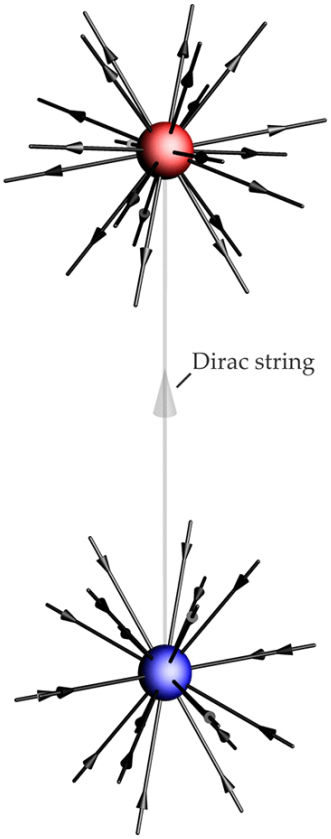
Just as the sun and the earth have their own magnetic fields, entire galaxies also have their magnetic fields. Given time, the monopoles

Paul Dirac

formed during the early universe should have been able to discharge these fields (just like electric charges can discharge the electric field between plates of a capacitor), but evidently, they haven't. Why? It's not that they can lose their magnetic charge over time by dissociating into uncharged smaller particles. Magnetic charge, just as electric charge isn't lost and remains conserved. Instead of discounting their existence, rather we concluded that the early universe must have been expanding at a much faster rate than we had earlier thought. This rapid expansion diluted the concentrations of the already hard-to-produce monopoles to the point where they won't be able to discharge the fields of entire galaxies.

All of this is fine, but let's take a step back and think about it. Since 1931 physicists have been searching for magnetic monopoles in cosmic rays; trapped in bulk matter, in lunar dust, meteors, and at accelerators where they would be produced in high-energy particle interactions with no success. We alter our understanding of the early universe to account for these monopoles that no one has observed. All this when one of the four fundamental statements of electrodynamics state that they don't exist. Why are we so determined to prove ourselves wrong?

It is because Paul Dirac proved that Maxwell's equations can be modified to account for magnetic monopoles and still have quantized electric charge. All of our unified theories, from the



Source: The search for magnetic monopoles/Physics Today

Dirac's visualization of monopoles at the ends of a 'Dirac String'

Source: MoEDAL-MAPP Experiment/ CERN

The MOEDAL Experiment at the LHC

standard model to quantum electrodynamics, predict their existence. But more than that, nature loves symmetry. Electricity and magnetism are already so tightly intertwined that the idea of electric monopoles existing but not magnetic monopoles just don't feel right in the minds of physicists. While this is in no way to prove their existence, it is definitely an indication of it.

So, where are we most likely to find these elusive particles? Earlier it was believed that the only viable way to detect monopoles would be by looking deeper into the cosmos to detect those formed in the early universe. But nowadays, the most promising source seems to be CERN.

In 2010, the Large Hadron Collider (LHC) approved its seventh experiment - the Monopole and Exotics Detectors at the LHC (MOEDAL), specifically designed to detect monopoles that may form in the LHC. This detector is like a giant camera waiting to photograph the tell-tale signs of these new particles. These monopoles would rip through the detector, creating a minute trail of damage through it.

The MOEDAL experiment has already helped us narrow the energy window where these monopoles would be formed and the scientists at CERN are optimistic about getting more precise data from it.

Divyansh is a first-year student enrolled in the BS-MS program at IISER Kolkata. He is interested in physics and astronomy. Apart from that, his interests mainly lie in gaming and reading-particularly fiction.

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"Look deep into my eyes. What do you see?" Adults have a red-orange face with striking, long quill-like feathers on its neck.

It's no Secretary, it's the Boss!

Imagine an eagle, but with the legs of a crane and eyelashes to die for! Confused? This is a short article on the Secretary bird, which unfortunately might disappear from the wilderness even before many have heard of it.

- Sanskruti Biswal and Mukil M

The Secretary bird (Sagittarius serpentarius) is a bird of prey found in Africa. It is endemic to the Sub-Saharan African desert, which means this species is exclusively found in this region. Known for its killer looks and signature style of hunting, it is known to stomp its prey to death. Standing tall at close to 1.3 meters, it hunts on foot and kills the prey on the ground. For a bird of this size, it's extremely light, weighing approximately 4 kgs. Don't let that fool you though, because its strong legs can generate forces of 200 N, the human equivalent of breaking concrete slabs with bare hands. With a contact time of 15 milliseconds for a kick, this can beat its victim to pulp.

It derives its name from its unique gait and is called "Archer of snakes"; Sagittarius or "Archer" and Serpentarius or "snake bearer". The common name Secretary is thought to be bestowed because of its resemblance to 19th-century Secretaries who kept quills behind their ears. Often described as "Eagle on stilts," the Secretary bird has scaly legs and talons that help kill small animals and protect itself from snake-bites. Yes, snakes are its favourite meal! It thrives on a diet of insects, lizards, snakes, and small mammals like mice, mongoose, etc. There have even been reports of it feasting on young gazelles and cheetah cubs. To fish out prey, it stomps its foot on the ground and then kills it by striking blows with its legs with remarkable swiftness. The catch being, the very long legs it uses for stomping also lower its ability to run fast.

However, all's not well in paradise. The Secretary bird has been declared as an endangered species by the International Union for Conservation of Nature (IUCN), in the year 2020. A rapid decline in population has been observed lately due to habitat destruction and human encroachment. Timely and thorough ecological studies on the existing population of these birds will be the way forward for deciding on effective conservation efforts.

Artwork by Mukil M

A secretary bird hunting.

Sanskruti Biswal is a 5th-year Biological Sciences major struggling with her master's thesis who tries to dabble in Arts and Science.

Mukil M is a 5th-year Physics major with a passion for painting and wildlife.

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Samsung's NEON as a step towards an AI-assisted world

- SciRa

We all have read books or seen movies depicting a futuristic world with flying cars and personal AI assistants, a post-apocalyptic era where the earth as we know it has been completely transformed into a dystopian tech trash planet. One cannot say much about the flying cars or tech trash world yet, but in an attempt to make science fiction a reality, Samsung's future factory STAR labs have developed Neon, AI-powered virtual beings that not only look like real humans but also behave like them with emotions and intelligence.

How exactly human-like are NEONS in their behaviour?

Their various attributes and features include being able to sympathise and converse, move, express and talk like real human beings. They can even learn and remember things about their user and speak any language. Each NEON has its own personality bringing them closer in resemblance as well as behaviour to human beings.

Essentially, one can have an AI companion that will not only look like a normal human but behave like one too! One could imagine a NEON best friend who will listen to your daily life drama and tell you to break up with that inconsiderate significant other. In fact, you'll be wishing good morning to your NEON office receptionist daily or even watch a news channel with a NEON anchor whose political views you might not agree with. Given the current upward trend of people getting emotionally attached to animated characters to the point of getting married, it is perfectly plausible that in the future you might be crushing hard on a NEON actor starring in movies and TV shows. Soon you'll be calling up your NEON financial advisor who will tell you to spend less on silly purchases or a healthcare provider telling you to get the best health insurance package for your family. The possibilities will be endless as they evolve!

But what makes them human-like, rather than AI assistants, is that they won't be able to answer all your fact acquiring questions or obey your commands like Alexa or Siri. They won't be available to you 24/7, they will need rest and time for themselves like us humans too. According to Pranav Mistry, the CEO of STAR labs, calling NEONS machines or AI would defeat their purpose of making these human-like beings. They can be better called a new species just like many that already exist on our planet.

So how were these AI-powered virtual beings created?

The company revealed these AI chatbots on Consumer Electronics Show (CES) 2020, a world's gathering place for all those who thrive on the business of consumer technologies. NEONs are run by the long-time research executive and recently named CEO of STAR labs, Pranav Mistry. NEON is abbreviated from NEO(new)+humaN. Mistry said in an interview, "NEONS would be our friends, collaborators, companions, continually learning, evolving and forming memories from their interactions."

Keeping in mind the logical human behaviour, a CoreR3 technology platform was developed.

The 3 R's stand for Reality (do they look real?), Realtime (is there any lag in their movements?) and Responsive (do they react

to what I say?), together forming the pillars of CORE R3. A combination of canonical principles like behavioural neural networks, evolutionary generative intelligence and computational reality was employed to create these human-like beings. While it was easier to classify human behaviour but difficult to create it, these three combined together were able to achieve just that with computational reality helping to learn and remember various information and behavioural gestures.

An additional platform still in development, called Spectra, will compliment CORE R3 with more artificial intelligence, emotions and memory. NEON beta is planned to be released by the end of 2020, as was announcd in CES 2020.

Till what extent will be our privacy be sacrificed as we will be surrounded by technology all of the time?

As we wake up, many of us send good morning snaps to our friends, put our breakfast pictures on our Instagram stories and share even our most minute achievements on the internet. Throughout the day we are surrounded by technology and social media with our GPS based location "on" most of the time. In a way, we are already losing our privacy as time goes on. But with NEONS and other similar AI technology, certain rules and regulations have to be laid down by the government. Since we have only gotten a glimpse of NEON we cannot say how exactly it will function but the way technology has become an integral part of our lives, NEONS might soon be considered normal in our day to day lives.

The ethical and moral issues are also a concern as artificial humans come into play. Will the masses accept NEON companions?

Many of us are weirded out by machines and artificial intelligence that very closely resembles a person but is not a person at all, as seen as a response to the children's movie 'The Polar Express', where the graphics were used in a such a way that the characters had an almost human-like appearance, making people uneasy. NEONS seem to be flitting on this uncanny valley. Realism might backfire. Another concern is that "Is involving AI at such a level a step in the right direction?" it's not possible to answer this question at this point but it can be something to be pondered upon.

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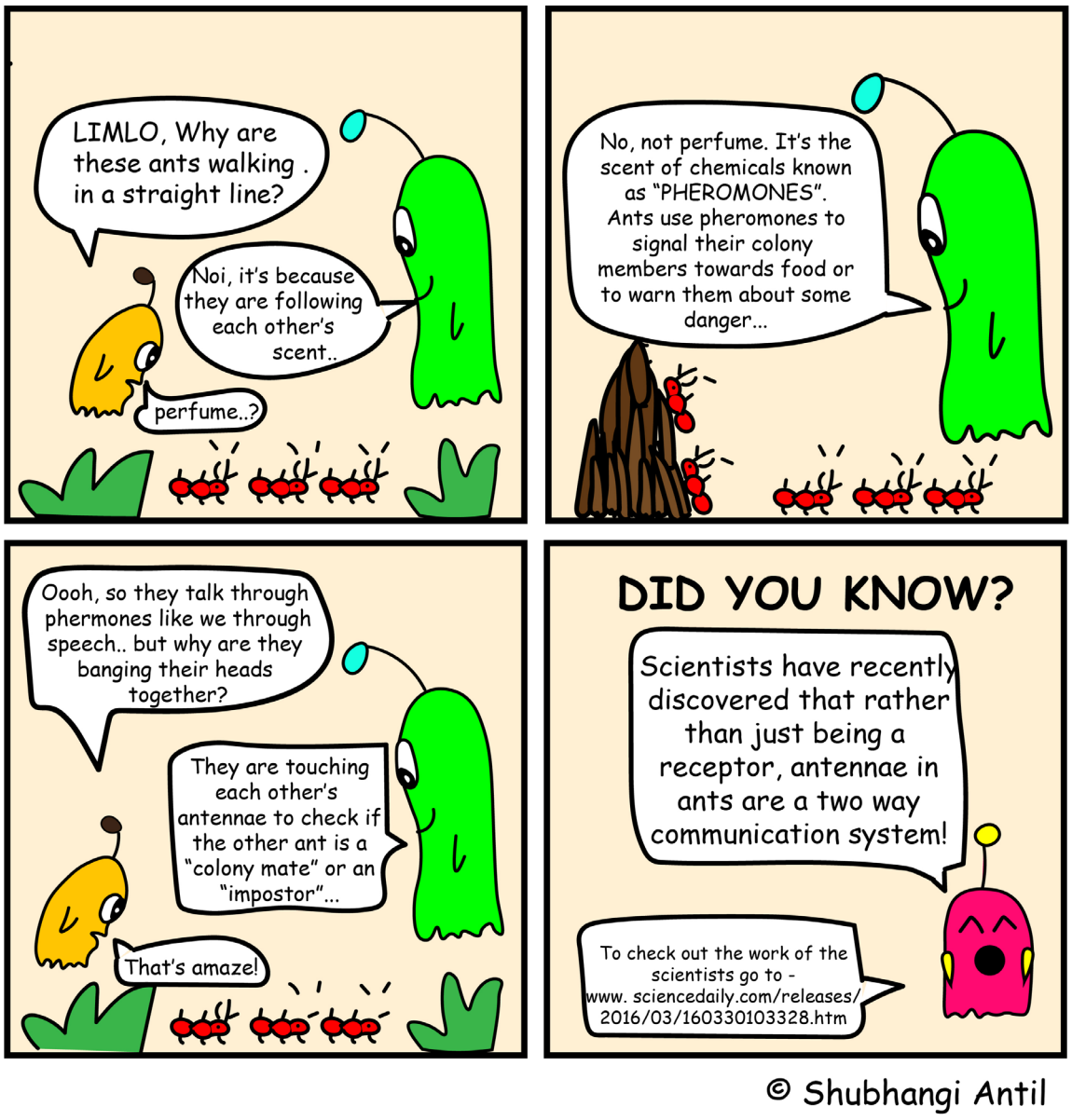
Limlo & Noi - Ant Mind

-Shubhangi Antil



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Shubhangi Antil is currently a biological science undergraduate student in Sri Venkateswara College, University of Delhi. She is a hobbyist writer, tennis player and have recently discovered a new hobby to create digital science based comics. She is aspiring to become a research scientist in future. Her interests lie in the field of neurobiology, ecology and biomedicine.


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