

Jurassic 'Sea Monster' Fossil from India: A Jewel in Gujarat's Crown

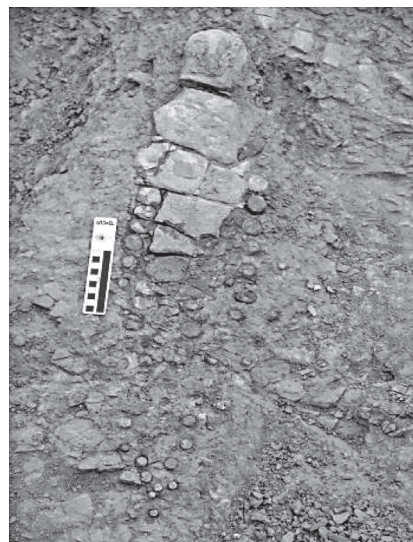
A stunning discovery in the field of paleontology was reported at the end of last year in *PLOS ONE* (vol. 12, no. 10: e0185851; DOI:10.1371/journal.pone.0185851). The nearly intact fossil of an ichthyosaur, a class of marine reptiles that prowled the seas during the age of the dinosaurs in the land, was dug from the south of the village Lodai, Kutch Dist., Gujarat in 2016. Since the ichthyosaur was embedded in extremely hard sedimentary rock, the region was arid and harsh and the daytime temperature used to be as high as 35°C, its excavation was indeed a tiresome job. It took 1,500 man-hours of digging to complete the excavation. These 'sea monsters', each of the size of a small boat, moved about restlessly and stealthily in the deep waters of the seas in search of prey more than 150 million years ago.



Fossil of ichthyosaur found in Gujarat

Based on the preserved length of the axial skeleton and taking into consideration other relevant factors, it was suggested that the specimen is probably that of an adult with a length of 5.0-5.5 m. It is estimated that this Indian 'Sea Monster' lived between 152 and 157 million years ago. The backbone of the ichthyosaur was still in the shape of more or less a continuous line. Also, its left forefin had the shape that it had when it was alive. G.V.R. Prasad, a palaeontologist at the University of Delhi and a co-author of the article in *PLOS ONE*, studies vertebrates belonging to the dinosaur-era. He said, the newfound fossil was not

only a fossil from the Jurassic period but also the first, nearly complete fossil recovered from India. According to him, all previous finds are about 50 million years younger and comprised merely isolated teeth or poorly preserved vertebrae. The cracked, worn out teeth of this 16 ft-long ichthyosaur suggested that its preys were tough, armoured fishes and ammonites and spiral-shelled molluscs that resembled 'today's nautilus'.



Left forefin of ichthyosaur

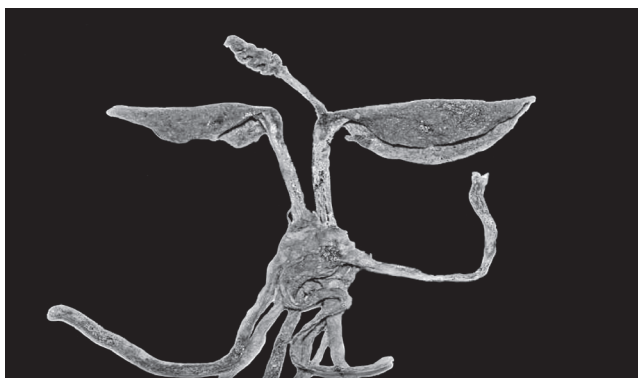
The reported study revealed that the skeleton belongs to the family Ophthalmosauridae. Since the ophthalmosaurids are usually found in the upper Jurassic deposits of western Tethys, Madagascar and South America, the finding of its occurrence also in India is expected to provide insights into the diversity and evolution of these marine reptiles in the Indian subcontinent and the former Gondwanaland. To be more precise, the co-occurrence suggests possible exchanges of fauna between the western Tethys and Gondwanan continents through a southern seaway – an evidence of sea monster globalisation. The fossil has clearly the potential to reveal many secrets about the evolution and palaeobiogeography of ichthyosaurs. □

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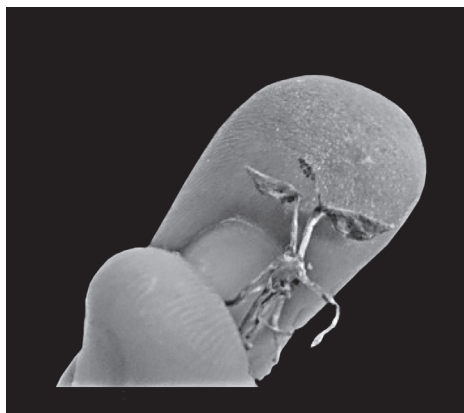
World's Smallest Land Fern Discovered: The Second Jewel in Gujarat's Crown

In a recent botanical expedition of the Jakhana village (20°37'23.6792" N, 73°44'23.1472" E, altitude ~471 m) in the Ahwa forest Division, Dang Dist., Gujarat, Mitesh Patel and Mandadi N. Reddy of Bapalal Vaidya Botanical Research Centre, Veer Narmada South Gujarat University, Surat, Gujarat have **discovered the world's smallest terrestrial fern**, *Ophioglossum malviae* which is minuscule, **measuring only 1.0-1.2 cm, almost the size of a fingernail**. Their findings have just been published in *Scientific Reports* (vol. 8, article no. 5911, 2018). It is nice to know that the scientists named the species as *O. malviae* in honour of the lady, Malvi Surti who inspired Mr. Patel to pursue research in this particular field in the early part of his career.

Ferns belonging to the genus *Ophioglossum* are commonly known as 'adder's tongue fern' because of the shape of the spike. It is a common knowledge amongst the plant biologists that these ferns, comprising nearly 46 species so far, are well recognised for their minuscule size with the highest chromosome number in any organism so far known in the biological world. The Western Ghats region is one of the biodiversity hotspots in India and



Ophioglossum malviae



O. malviae on a fingernail

worldwide. A total of 14 *Ophioglossum* species have so far been reported from India, the majority of them having been found in the Western Ghats region. Patel and Reddy identified the fern and differentiated it from all other known *O. sp.* using morphological, palynological (study of live and fossil spores, pollen grains and similar plant structures) and molecular methods. In particular, molecular phylogenetics study of three cpDNA regions of this fern unambiguously designated it as an adder's tongue fern.

The scientists were able to collect only 12 of these ferns from the village. The reproductive season for this fern is August-September, and it lives only for a few months. New plants are born through its spores in the following year. But the scientists are apprehensive that the survival of these ferns might be at stake since the local tribal community uses the area as the grazing ground for their livestock. Finally, although this species is the world's smallest terrestrial fern, somewhat smaller aquatic fern, *Azolla caroliniana* (average size: 0.5-1.5 cm) is known to exist. □

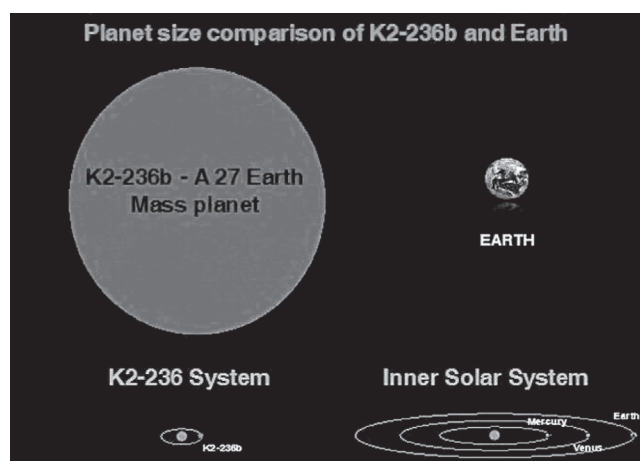
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A New Exoplanet Discovered: The Third Jewel in Gujarat's Crown

In a post in the ISRO website, a team of scientists, led by Professor Abhijit Chakraborty of the Physical Research Laboratory, Ahmedabad, have recently claimed to have detected the presence of a sub-Saturn or super-Neptune size exoplanet that revolves round its sun-like star which is some 600 light years away from the Earth. They named both the star and the planet as EPIC - the host star as EPIC 211945201 and the planet as EPIC 211945201b. The planet orbits round its star once every 19.5 days. The planet is said to be seven times nearer to its star than the Earth is to Sun. No wonder that its temperature was found to be over 600°C, which suggests that life, as we know it, is unlikely to exist in this exoplanet.

The present discovery has its roots in NASA's recent Kepler2 (K2) photometric observation. The Kepler mission (NASA Discovery's 10th mission), i.e. Kepler space station fitted with a telescope, was first launched in March, 2009. Its goal was to "survey the Milky Way and hunt for Earth-size and smaller planets near the galaxy of habitable regions of planets' parent stars." In 2014, the second Kepler

mission, called K2, was launched. It continues to hunt for planets outside our solar system, i.e. exoplanets along with its other cosmic tasks. When a planet, while orbiting its star, comes in between the star and the observing telescope, it blocks a tiny amount of the star-light. By measuring the tiny loss or dip in brightness coming from the star, the size and mass of the planet can be determined.



The initial photometric information provided by K2 pointed to the possible presence of an exoplanet but could not confirm it and provide its other details. Using indigenously designed ‘PRL Advance Radial-velocity Abu-sky Search’ (PARAS) spectrograph integrated with 1.2 metre telescope located at PRL’s Gurusikhar Observatory, Mount Abu, Rajasthan, the Indian team determined the mass of the planet to be 27 Earth Mass and its size to be 6 Earth Radius. The gravitational pull caused by a planet on its host star makes it wobble around their common centre of mass, shifts the spectra and can be measured in terms of radial velocity. The high resolution spectrograph PARAS precisely measured the radial velocity of the exoplanet, which led to the determination of the planet’s mass.

To acknowledge the contribution of Kepler2, the team named the host star as K2-236 and the newfound exoplanet as K2-236b. The Indian scientists observed the target planet for 420 days to get information necessary to calculate its mass. Based on the mass and radius of the planet, the PRL scientists made model-dependent calculations and suggested that heavy elements like ice, silicates and iron constitute more than 60% of the total mass of the planet.

The ISRO website on June 8 said, “*The spectrograph (PARAS) is the first of its kind in the country which can measure the mass of a planet going around a star. Very few such spectrographs exist around the world (mostly in the USA and in the Europe) that can do such precise measurements*” – what a compliment! Gratifyingly, PARAS

was designed and developed by the Astronomy and Astrophysics Division of the PRL, Ahmedabad.

Jayant Murthy, a Senior Professor of the Indian Institute of Astrophysics, Bengaluru commented, “*The work — is important in characterising the nature of the exoplanet and they were able to show that the candidate is a close to Saturn-size planet orbiting near its star. These planets are very unlike those in our own solar system and understanding them will tell us more about how planetary systems are formed.*”

ISRO has pointed out that the detection of this exoplanet makes a total of 23 confirmed exoplanets that have a mass and radius in this range. This contribution from Abhijit Chakraborty’s team at PRL, Ahmedabad is indeed the third jewel to Gujarat’s crown of recent discoveries. □

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Scientific Discussion in Workshop on Vector-Borne Diseases

A Workshop on ‘Prevention and Control of Vector-Borne Diseases’ was organized by Kolkata Municipal Corporation (KMC) at Rabindra Sadan, Kolkata on 28th April, 2018. It aimed to make general physicians, primary health care practitioners, doctors of KMC aware of the guidelines and protocols laid down by National Vector-Borne Disease Control Programme (NVBDCP) regarding treatment of dengue and malaria patients.

Sri S. P. Kar, Director, State Urban Development Agency opined that dengue is most vulnerable during May-September. Low-lying areas where water stagnate, regular cleaning of garbage, routine removal of contents of open garbage vats, etc. should be taken care of. Dr. Satyajit Sen, Regional Director, NVBDCP Eastern Region stated that no death occurred due to malaria in Kolkata in 2017, mostly due to measures taken up by KMC. Using mosquito nets at night, we can get rid of malaria-causing mosquitoes but female *Aedes aegypti*, that transmit dengue, bite during daytime. Dr. Sen emphasized on solid-waste management in dengue prevention. Mosquitoes cannot be destroyed using bleaching powder or lime.

Dr. Krishnangshu Roy, Former Director, Calcutta School of Tropical Medicine; Dr. Tapas Bhattacharya, Joint Director, Directorate of NVBDCP, GoI; Dr Debashis

Biswas, Chief Vector Control Officer, Health Department of KMC and Dr. T. K. Mukherjee, Honorary Advisor (Health), KMC spoke in panel discussion session. Dr. Roy spoke about four serotypes of dengue virus (DEN 1, 2, 3 and 4). Due to global warming, biting habits of mosquitoes have become more frequent, and now it takes only ten days to complete their life cycle, favouring huge reproduction. Dengue mosquitoes are changing their tactics for survival and breeding habit, accordingly disease etiology is changing. Presence of dengue NS-1 protein antigen is consistent with acute-phase infection; dengue is detected by NS-1 antigen test (ELISA) within first five days from appearance of clinical fever, Dr. Roy explained. From 6th day, anti-dengue IgM antibodies appear in blood and Ig-based diagnostic test is performed. Condition turn very serious when platelet count of patients drop to 30,000-35,000 cubic mm blood, bleeding symptoms may arise and then platelet transfusion is required, Dr. Bhattacharya stated. Clinical descriptions of dengue fever and Dengue Haemorrhagic Fever were discussed. G6PD enzyme keeps the membrane of erythrocytes intact and prevents haemolysis, but is not produced in everyone due to genetical reason. The anti-malarial drug *primaquine* can cause haemolytic anaemia in patients with G6PD deficiency.

Dr Biswas explained that mosquitoes came into existence much before human beings, and are better equipped to face of 'struggle for existence'. Female *A. aegypti* bite us at workplaces, educational institutions, and are more attracted to people who experience excessive sweating or dress in deep colour roads. *A. aegypti* larvae can survive in 5mm water depth, but *Anopheles* sp cannot. Dr Biswas further stated that peak biting hours of *A. aegypti* is 6.00-9.00 am and 4.00-6.00 pm. Effect of dengue lasts between 7-14 days.

Mosquitoes can sense the compounds that we exhale (lactic acid, octenol, uric acid, CO₂), and get a clue that there is human target nearby. According to WHO, people can use mosquito repellants (cream, coil, vapourizer, wipes containing cypermethrin) quite liberally to avoid mosquito bites. *A. albopictus*, a secondary dengue vector, grows mostly in tree crevices. Dr Biswas opined that people with 'O' blood group get more mosquito bites than those belonging to the 'A' and 'B' blood groups; research is continued to firmly establish this fact. Dr. Mukherjee highlighted on studies conducted in Tanzania and Peru on benefits of using repellent and medication-impregnated mosquito nets after drying. In Philippines, platelet count was found to drop in dengue patients on 3rd day but become normal on 7th day when they drink sufficient water to avoid dehydration.

Mosquitoes even breed in water contained in discarded plastic tea cups, halves of green coconut shell, narrow space of left-over upright bamboo in bamboo plants (after cut), halved shell of freshwater mussel, in axil region of pineapple and banana plants. KMC has established 140 dengue diagnostic centres in 141 Wards. Dr. Bhattacharya stated that 98% of dengue patients recover to normal state after basic treatment. □

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New Dengue Vaccines on the Horizon!

Dengue is caused by the dengue virus (DENV), which is transmitted by *Aedes aegypti* mosquitoes. The disease has a global distribution in all tropical and sub-tropical regions where the *Aedes* mosquito is present. The prevalence of dengue cases in India is a staggering ~6 million! The disease manifests as *dengue fever* (also called "breakbone fever"), *dengue hemorrhagic fever (DHF)*, and *dengue shock syndrome (DSS)*, which is potentially fatal. There is no specific treatment for dengue. Only supportive therapy can be given. Currently, the mainstay of prevention is mosquito vector control.

The availability of a dengue vaccine in the public sector will bring about a paradigm shift from treatment to prevention. This is likely to dramatically bring down the number of dengue cases as well as substantially reduce the mortality and morbidity.

The difficulty in developing a dengue vaccine stems from the fact that there are four serotypes of DENV (DENV1, DENV2, DENV3 and DENV4) that circulate in nature. Attenuation of the virus by chemical treatments so that it does not cause disease, yet is still strong enough to stimulate the immune system to generate a protective immune response is very tricky, especially because the four serotypes require equal levels of attenuation. This problem has been solved in the new dengue vaccine developed by Sanofi Pasteur.

Dengvaxia® (CYD-TDV), developed by Sanofi Pasteur, Lyon, France has been extensively evaluated in more than 40,000 individuals in 15 different countries, including India. The Sanofi vaccine is recommended by WHO for use in individuals aged between 9 and 45 years in dengue endemic areas. Dengvaxia® is a live-attenuated

dengue vaccine produced by recombinant DNA technology or genetic engineering. The vaccine has been evaluated in Phase III clinical trials and was first registered in Mexico in 2015 and first commercially available in 2016 in the Philippines and Indonesia. The vaccine has since been adopted in 7 other dengue-endemic countries, namely, Brazil, Paraguay, El Salvador, Costa Rica, Peru, Guatemala, and Singapore, where more than 500,000 people have been vaccinated with over 1.5 million doses distributed so far. The vaccine is yet to be available in India.

Several other dengue vaccine candidates are under different stages of development in various countries. A few important ones are briefly highlighted below:

- **TDV:** This is a live-attenuated chimeric vaccine containing all four dengue serotypes. This dengue vaccine candidate has been developed by Takeda, Japan and is currently undergoing Phase III clinical trials.
- **TV003/TV005:** This vaccine has been developed jointly by the National Institute of Allergy and Infectious Diseases (NIAID), National Institutes of Health (NIH), USA, and the Instituto Butantan, Brazil. This is a live-attenuated chimeric vaccine that contains a mixture of the four dengue serotypes as separate vaccine formulations. The vaccine is currently undergoing Phase III clinical trials.
- **TDEN:** This is a purified inactivated (killed) whole virus vaccine. This tetravalent (containing DENV1-4) vaccine has been developed jointly by Glaxo Smith Kline (GSK), UK and the Walter Reed Army Institute of Research (WRAIR), USA. It is currently undergoing Phase II clinical trials.
- **V180:** This is a subunit protein vaccine produced in the cells of the fruit fly (*Drosophila melanogaster*). This vaccine, developed jointly by NIAID and Merck, USA, is currently in Phase I clinical trials.
- **D1ME100:** This is a dengue DNA vaccine, developed by the U.S. Naval Medical Institute and is currently in Phase I clinical trials.

Besides the international efforts, there are also Indian efforts for developing a dengue vaccine. For example, the International Centre for Genetic Engineering and Biotechnology (ICGEB), New Delhi has developed a dengue vaccine candidate that has been extensively

evaluated in various animal models, including monkeys. This vaccine candidate is currently awaiting clinical trials in humans. The researchers are hopeful that a “Made-in-India” dengue vaccine could be on the horizon soon. □

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Galaxy Without Dark Matter Detected

Dark matter is an enigmatic entity that has mass but is invisible because it does not interact with light. The primary evidence for dark matter came from calculations which showed that many galaxies would not exist. In fact, till recently it was believed that galaxies and dark matter go together and there cannot be one without the other. But the idea that dark matter is an essential ingredient for galaxies to form is being challenged by the discovery of a distant galaxy that seems to contain no – or almost no – dark matter. Dark matter cannot be seen or touched, but it outweighs all the normal matter in the universe by more than 5 to 1.

The discovery of the sparse, see-thru galaxy called NGC1052-DF2 was made by astronomers using the Dragonfly Telephoto Array – a New Mexico-based telescope built of camera parts that is designed to detect very faint galactic structures. The astronomers then followed up the analysis, collecting more data using the Hubble Space Telescope as well as the Gemini North and Keck Observatories in Hawaii (*Nature*, 29 March 2018, | DOI: 10.1038/nature25676). It is the first galaxy detected to contain little or no dark matter.

According to Pieter van Dokkum of Yale University in New Haven, Connecticut, USA, who led study, NGC 1052-DF2 is as large as our Milky Way, but it had escaped attention because it contains only 1/200th the number of stars. Moreover, it contains only about 1/400th the amount of dark matter that astronomers had expected. Given the object’s large size and faint appearance, astronomers classify NGC 1052-DF2 as an ‘ultra-diffuse galaxy’.

The researchers used NASA’s Hubble Space Telescope and the Gemini Observatory in Hawaii to uncover more details about the unique galaxy. Gemini observations revealed that the galaxy does not show signs of an interaction with another galaxy.

The ghostly galaxy, about 65 million light-years away, and based on the colours of its globular clusters, the galaxy is about 10 billion years old. □

Biman Basu
(Slightly edited)

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New Plastic-Eating Enzyme to Clear Plastic Pollution

Plastic is a well-known and widespread pollutant that is causing untold harm to the Earth's ecosystem. In less than a century of coming into market, plastics have become essential to modern society, driven by their incredible versatility coupled with low production costs. It is, however, now widely recognised that plastics pose a dire global pollution threat, especially in marine ecosystems, because of the ultra-long lifetimes of most synthetic plastics in the environment.

About 1 million plastic bottles are sold each minute around the globe and, with just 14% recycled, many end up in the oceans where they have polluted even the remotest parts, harming marine life and potentially people who eat seafood.

It is estimated that fish, birds, and other animals all unwittingly consume the five trillion tons of plastic strewn about the ocean and often get killed. Experts estimate that by 2050, there will be as much waste plastic in the ocean by mass as there are fish.

The problem of proper disposal of plastic waste has been engaging the attention of scientists for a long time. Now researchers from Britain's University of Portsmouth and the US Department of Energy's National Renewable Energy Laboratory (NREL) have created – by accident – a new enzyme capable of breaking down plastic bottles. The breakthrough could help solve the global plastic pollution crisis by enabling for the first time the full recycling of bottles. (*Proceedings of the National Academy of Sciences*, 12 April 2018 | doi.org/10.1073/pnas.1718804115).

A patent has been filed on the specific mutant enzyme by the Portsmouth researchers and those from the US National Renewable Energy Laboratory in Colorado. "What we are hoping to do is use this enzyme to turn this plastic back into its original components, so we can literally recycle it back to plastic," said Prof John McGeehan, at

the University of Portsmouth, UK, who led the research. "It means we won't need to dig up any more oil and, fundamentally, it should reduce the amount of plastic in the environment." □

Biman Basu
(Slightly edited)

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Strange DNA Discovered in Human Cells

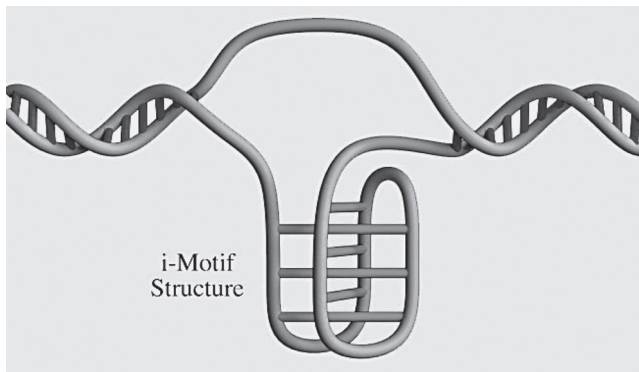
When we think of DNA, we mostly have in our mind a picture of the well known double-helix, a twisted ladder-like structure. But it has been known for a long time that DNA also comes in other shapes as well, though none has been detected within human cells. Now comes the news of the discovery of a new form of DNA – a four-stranded knot-like structure called an 'i-motif' – in human cells. Scientists had known about i-motif DNA about two decades ago, but only under lab conditions.

However, in recent years, studies have pointed to the possibility that this bizarre form of DNA could, in fact, exist in living humans and a new study led by Marcel Dinger, head of the Kinghorn Centre for Clinical Genomics at the Garvan Institute of Medical Research in Sydney, Australia provides the first direct evidence that it does exist and that it may play an important role in regulating our genes (*Nature Chemistry*, 23 April 2018 | doi:10.1038/s41557-018-0046-3).

According to the researchers, this is how the i-motif forms: Imagine a small section of the DNA double-helix where the hydrogen bonds that connect the two major strands come apart while the helix suddenly untwists. If one of the strands is full of cytosine (one of the four major nucleic acids that makes up DNA), it will loop outward like a tied shoelace and hydrogen bonds would form within the loop itself, binding those cytosines to one-another (instead of to guanine, as is normally the case in the double-helix). Thus they essentially form a scaffold, where each C-C bond is 90 degrees to its corresponding C-C pair.

A unique feature of the i-motifs observed by the researchers was that their folded shape was not permanent; they folded into existence and then unfolded, repeatedly. In particular, the researchers found that the DNA folded into i-motifs at higher rates during a specific stage of transcription – the process that kicks off the translation of genes into proteins – when the DNA was just beginning to actively transcribe. Later, the DNA unfolded back into its usual form, and the i-motifs disappeared. According to

Dinger, this probably means the i-motifs play a very specific role in regulating the transcription process.



The i-motif DNA structure. (Credit: Garvan Institute of Medical Research)

Needless to say, there are years' or even decades' worth of follow-up research in store to learn more about what i-motifs are, how they work, why they exist, and how we might be able to harness their powers. □

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(Slightly edited)

Dream 2047, June 2018, Vol 20 No.9

Koko the Gorilla, who Used Sign Language, Dies at 46

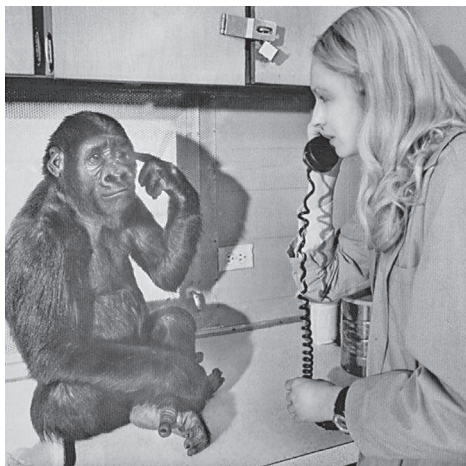
Koko, the sign language-famed Gorilla, died in her sleep in the morning of Tuesday, 19th April, 2018 at the Gorilla Foundation's preserve at Woodside, California in the Santa Cruz Mountains. The pet lovers across the globe deeply mourned her death and would remember her for her unusual ability to use American Sign Language (ASL), her adoration for kittens, wide publicity of her

life and activities in books, articles and documentaries and her charming, endearing gesture to all human beings including several celebrities.

Koko, a Western lowland gorilla (critically endangered species), was born on July 4, 1971 at the San Francisco Zoo. She was named 'Hanabi-ko', a Japanese word meaning 'Fireworks Child' which refers to her date of birth. It was a large-frame gorilla, weighing 280 pounds in contrast to 150-200 pounds, the average weight of gorillas. Francine Patterson, also known as Penny Patterson, then a doctoral student in psychology at Stanford University, was working with Koko at the San Francisco Zoo as a part of her doctoral research. In 1972, when Koko developed a life-threatening illness, she was loaned to Patterson, and since then Koko lived with Penny. By 1979, Dr. Patterson founded the Gorilla Foundation, a non-profit organisation to preserve and protect gorillas, and moved it to Woodside, California where Koko lived with a male gorilla, Michael, and after his death, with another male gorilla, Ndume, until her death.

Penny was like a mother to Koko. She used to feed Koko, brush her teeth, read to her, teach her, play games with her, give her tests and even reward her for right answers to questions, and help her get ready for bed at night. She taught Koko a modified version of ASL, which she named Gorilla Sign Language (GSL), right from her early days. When Koko was 4 years old, she mastered 170 words which grew to more than 2,000 at the time of her death.

Koko became a celebrity right from her youth because of her ability to use GSL. She appeared in the cover page of *National Geographic* twice – in October, 1978 (vol. 154, no. 4; caption: Conversations with a Gorilla) and 1985 (vol. 167, no. 1; caption: Koko's Kitten). The 1978 article introduced Project Koko to the world with a photo of Koko



Koko and her Trainer-cum-Caretaker, Penny Patterson

taking her own picture in the mirror (a self portrait). The 1985 article featured Koko's relationship with (and loss of) her first kitten *All-Ball*, which changed people's perspectives about gorillas forever. Koko entertained many celebrities including Robin Williams and Fred Rogers as well as their audiences. In fact, the show *Mister Rogers' Neighbourhood* featured Koko in an episode in 1998.

The much talked about Koko's love for kittens began in the Christmas of 1983 when Koko asked for a cat. Koko was provided with a life-size stuffed animal, but she was dissatisfied and continued to sign 'sad'. On her birthday in 1984, Koko chose a gray male cat and named him 'All Ball'. She cared for the kitten as if it were her own baby. Unfortunately, six months later, All Ball was hit and killed by a car. Koko's reaction was stunning – she started whimpering which is a distinct hooting sound made by gorillas when they are sad. In 1985, Koko chose two kittens – 'Lipstick' and 'Smoky'. In 1990, Penny wrote a children's book, *Koko's Kitten* that narrated the uncommon love of Koko for kittens. In July 2015, she was presented two more kittens – Miss Black and Miss Grey. The life of Koko, including her association with Penny, her adoration for kittens, loving demeanours with other human beings, and friendliness to visitors have all been the subject of several books and documentaries during 1978-2016.

At the news of her death, the social media were flooded with blogs, and the Gorilla Foundation released the following statement “— *her impact has been profound and what she has taught us about emotional capacity of gorillas and their cognitive abilities will continue to shape the world.*” The foundation further said, “*Koko touched the lives of millions as an ambassador for all gorillas and an icon for interspecies communication and empathy.*”

'Koko the gorilla' would be deeply missed by all of us. □

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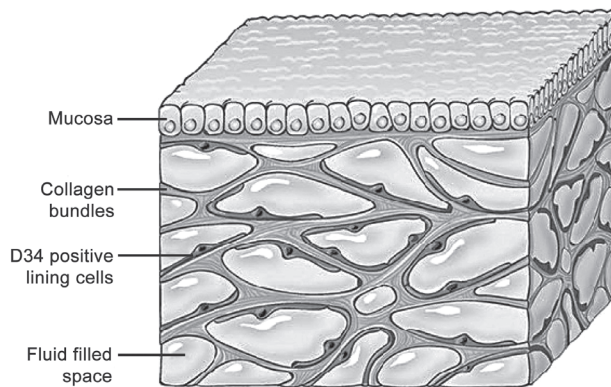
Interstitial, A Newfound Organ in the Human Body

It is well known that nearly 60% of human body comprises water, about two-third of which is inside the cells, but the rest one-third is outside the cells and is known as 'interstitial fluid'. As early as 2011, Dr. Michael Nathanson, Chief of the Digestive Diseases Section, Yale

University School of Medicine had reported that they observed a network of dark fibres inside the tissues, but they were not able to figure out what it exactly was. In 2015, Dr. David Carr-Locke and Dr. Petros Benias, both working at the Department of Medicine, Division of Digestive Diseases, Mount Sinai Beth Israel Medical Centre, Icahn School of Medicine at Mount Sinai, New York, USA at that time used a technology called 'probe-based Confocal LASER Endomicroscopy' or pCLE to examine the bile duct of a cancer patient to find out the spread of cancer. They observed something unusual – 'a series of interconnected fluid-filled cavities in the tissue layer' which did not match with any known anatomy. Confusion followed when a pathologist made slides out of the tissues in the standard way and examined the same under microscope – the cavities were not visible any more, they were simply gone!

In a recent article published by Benias *et al.* in *Scientific Reports* (8:4947(2018) | DOI:10.1038/s41598-018-23062-6), a team of researchers led by Neil D. Theise, a Professor of pathology at New York University Langone School of Medicine, used pCLE on cancer patients who were undergoing surgery for the removal of their pancreas and bile duct. They observed 'fluid-filled spaces in the connective tissue'. More importantly, when the tissue samples were removed from the body and quickly frozen, 'the fluid-filled spaces' could still be observed under the microscope using pCLE. When they observed more tissues, they found these fluid-filled cavities within tissues everywhere. They were jubilant and named these fluid-filled cavities within tissues 'interstitium'.

More importantly, the present researchers also explained the previously observed failures to detect this organ when the slides were made in the conventional way. To understand the reason for earlier failures, one also needs to know what pCLE is. It is an *in vivo* imaging technology that provides real-time histologic assessment of tissue structures during endoscopy, generally after intravenous



Interstitial, a newfound human organ

injection of fluorescein, a fluorescent dye. It is a tool that combines an endoscope with a LASER and sensors that analyse the reflected fluorescent patterns and furnish a microscopic view of living tissues. In standard procedures for preparing slides for microscopic observation, the samples are treated with chemicals, cut into thin slices and are dyed. This fixing process, Theise *et al.* said, drains off the interstitial fluid and cause the fluid-filled spaces to collapse. In support, the researchers found out that when the tissue samples were quickly frozen after their removal from the body, the fluid-filled spaces could still be spotted under the microscope.

These fluid-filled spaces were observed in connective tissues all over the body – below the surface of the skin, lining of the digestive tract, lungs and urinary systems, and surrounding muscles. Theise said, “The more I saw, the more I realized it’s everywhere.” They claimed interstitium to be a ‘new organ’ in the human body. Further support for the relationship between the observed histology and *in vivo* structure came from ultrasonography of tissues. Endoscopic ultrasound of the bile duct showed that it

consists of three layers, the middle one of which comprises 90% of the wall thickness and is fluid-filled, i.e. it corresponds to the submucosal interstitium.

In summary, contrary to the extant belief that the tissue layers are a dense wall of collagen — a strong structural protein found in connective tissue, the new findings revealed that the tissue contains an interconnected, open, fluid-filled highway supported by a lattice of thick collagen bundles. The fluid-filled spaces may act as shock-absorbers to protect tissues from daily functions. It is further suggested that the interstitium may be altered during diseases or may even play a role in driving diseases. A review of the existing scientific literature on all that is known about this body part is planned to verify if interstitium is indeed an organ of the human body. Anatomy books may have to be rewritten if the claim ultimately turns out to be correct. □

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