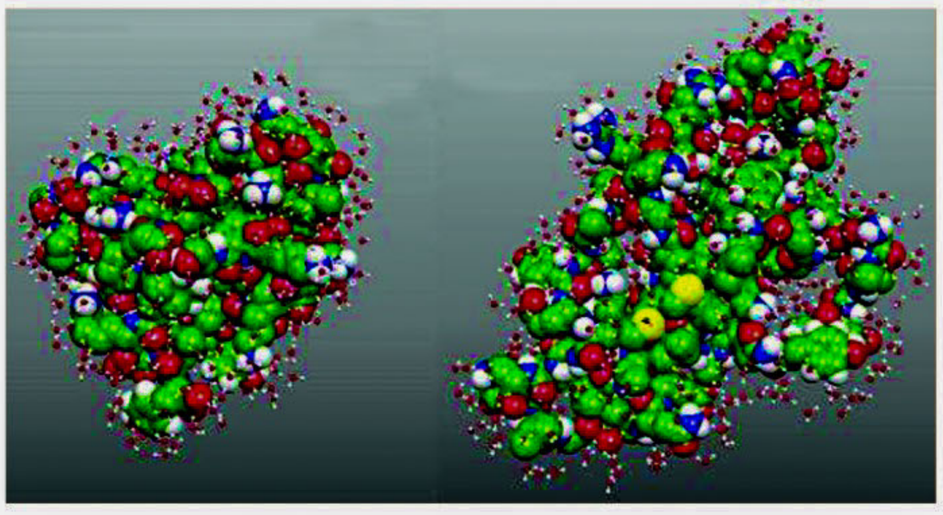
Magic of protein architecture

MD. RIAJUL HOSSAIN

PROTEINS are, simply, the product of genes. Genes, the basic unit of information for the living systems, are the guide to create thousands of different types of proteins in a particular cell type to enable the cell to carry out its assigned function. It is the protein molecule that makes the different cell types different by having been created in certain combinations in a cell type specialized to perform a particular task. Hence, we get our arms, legs, eyes different from one another. Scientists, for long, have believed that the proteins need to have a rigid structure to play their roles inside the cell. In fact, the biochemistry text books will tell you that the genes encode proteins, which are simply the chain of different amino acids linked together by peptide bonds and after the formation of the polypeptide chains, they need to get a definite three dimensional shape which will react with the target molecules by lock-and-key system. However, recent research is revealing a new architectural design of the proteins. A host of proteins carry out their biological tasks without ever completely folding; others fold only as needed. Perhaps one third of all human proteins are intrinsically disordered carrying some unfolded or disordered regions.

Hundred years back, scientists knew that many antibodies, one type of protein of the immune system, can bind to multiple targets which is the obvious deviation from the strict lock-and-key model. In the 1940s, this concept of the deviation from the previously known model was strengthened. From then on, various observations showed that not every protein follows the dogma that proteins' functions require a rigid three dimensional structure. However, proteins showing deviations from the dogma was considered as freak exceptions to the rule. But through several observations from some scientists it was evident that the dogma itself needed some revision. In 1953 scientists noticed that milk protein casein is largely unstructured, that is not folded properly and it probably helps in digestion for the infants. In the 1970s, a part of fibrinogen protein was found unstructured (which plays crucial role in blood clotting). In 1996, Kriwacki et al; performed NMR (Nuclear Magnetic Resonance) spectroscopy on p21, a protein involved in the control of cell division and hence an important player in preventing cancer. The group found something shocking. The p21 protein was almost entirely disordered, changing itself from one conformation to another within fraction of a second. However, it was able to carry out its normal regulatory function- this was the shocking part of their observation. This was the first demonstration that lack of folding does not make a protein useless. Indeed, NMR, together with other technologies has confirmed that many proteins are intrinsically unstructured and they constantly change their conformation and still they are perfectly functional. Calcineurin, a protein of the immune system, removes phosphates from particular proteins having phosphate group attached already. The functional site of the Calcineurin performs this task in a lock and key manner. But it also has an unstructured region which self regulates the protein's catalytic activity. Until recently, around six hundreds partially or totally unstructured proteins have been identified and likely many more to come in the scenario.



Proteins after their synthesis get a rigid three dimensional conformation and become capable to carry out catalytic activities

The investigators have found that roughly 35 percent of human proteins have long unstructured regions and deviate from the lock and key dogma. It is now clear that a combination of these two types of proteins are necessary to carry out normal function in a living being where the rigidly structured ones are mostly involved in enzymatic activity and the unstructured ones are specialized for signaling and regulation. Moreover, the intrinsically disordered proteins can be involved in certain diseases and might be a target for drug discovery. Many laboratories are working to find a treatment for cancer, retinoblastoma and many other diseases. Surely, the detailed study of the partially or fully unstructured proteins along with the rigid ones will help better understand life and living processes.

The writer is a Lecturer in Biotechnology at BRAC University

FLIGHT NOT THE DRIVE

How did birds originate?

A developmental biologist at New York Medical College is proposing a new theory of the origin of birds, which traditionally has been thought to be driven by the evolution of flight. Instead, Stuart A. Newman, Ph.D., credits the emergence of enlarged skeletal muscles as the basis for their upright two-leggedness, which led to the opportunity for other adaptive changes like flying or swimming. And it is all based on the loss of a gene that is critical to the ability of other warm-blooded animals to generate heat for survival

Dr. Newman, a professor of cell biology and anatomy, studies the diversity of life and how it got that way. His research has always centered on bird development, though this current study, "Thermogenesis, muscle hyperplasia, and the origin of birds," also draws from paleontology, genetics, and the physiology of fat.

Dr. Newman draws on earlier work from his laboratory that provided evidence for the loss, in the common dinosaur ancestors of birds and lizards, of the gene for uncoupling protein-1 (UCP1). The product of this gene is essential for the ability of "brown fat," tissue that protects newborns of mammals from hypothermia, to generate heat. In birds, heat generation is mainly a function of skeletal muscles.

"Unlike the scenario in which the evolution of flight is the driving force for the origin of birds, the muscle expansion theory does not require functionally operative intermediates in the transition to flight, swimming, or winglessness, nor does it require that all modern flightless birds, such as ostriches and penguins, had flying ancestors. It does suggest that the extinction of non-avian dinosaurs may have been related to a failure to evolve compensatory heat-generating mechanisms in face of the loss of UCP1," says the scientist

Source: Science Daily

Ostriches in South Africa's Kruger National Park

STEP-BY-STEP

Managing glacial lake

The method depends on accurately assessing risk

A team of Nepali and international researchers has developed a risk assessment method to manage the threat of devastating floods that can be triggered by a glacial lake outburst (GLOF).

The new method, tested on glacial lakes in Nepal, is expected to help the country's government develop a national strategy for GLOF pre-disaster management.

National strategies for disaster risk management broadly address GLOF hazards, while specific guidelines for managing glacial lake flooding are being conceived.

Current research on glacial lakes in the region does not follow a systematic, coordinated and standardised process, according to Pradeep Mool, a remote sensing specialist at the International Centre for Integrated Mountain Development (ICIMOD), the lead facilitating organisation of the initiative.

"One of the advantages of this step-by-step method is that it can be applied across the Hindu-Kush-Himalayan region," Mool told SciDev.Net.

The new risk-based approach, developed and detailed in Glacial Lake and Glacial Lake Outburst Floods in Nepal, an ICIMOD publication released last month (April), minimises uncertainties around predicting the occurrence of natural disasters in an environment constrained by limited manpower and financial resources.

Lakes are classified according to degree of risk by identifying the magnitude and frequency of a possible hazard in relation to the vulnerability of exposure for downstream communities.

The researchers identified six high-, four medium- and eleven low-priority lakes in Nepal, and further selected three high-priority lakes Imja Tsho, Tsho Rolpa and Thulagi for detailed field investigations. They found all three lakes to be relatively stable, based on measurements of the physical conditions of the moraine dam, water volume, triggers and hydrometeorology.

Source: Sci Dev Net

LAND OF SURPRISES

Earth's ecological haven

OBAIDUR RAHMAN

AFTER the spectacular discoveries in Madagascar, it is now the turn of New Guinea to display some of the magnificent arrays of new species of floras and faunas that the world has ever known. According to World Wildlife Fund (WWF), from the years between 1998 and 2008, at the rate of twice a week, more than 1000 new species were discovered by the researchers of the reputed nature conservation organization. Published, very recently, in a report titled, "Final Frontier: Newly Discovered Species of New Guinea", WWF, as part of its 50th anniversary celebrations, proudly stated that New Guinea's forests and rivers are among the richest and most bio-diverse in the whole world. In this decade long study, a total of 1060 species of new life-forms were discovered and amongst them include 218 new plants (one of them is a flesh-like a orchid), 43 reptiles, 12 mammals, 580 invertebrates, 134 amphibians, 2 birds and 71 species of fish.

But what is exactly so special about New Guinea? New Guinea, (and Melanesian island of New Guinea was the concentrated area of the study), is the 2nd largest island on Earth, after Greenland and is divided between Indonesia in the West and Papua New Guinea to the East. This locale is believed to house the planet's one of the least-spoilt and most stunning ecosystems. It was already known among the conservationists regarding the breathtaking nature of New Guinea as its rainforests are the 3rd biggest in the world, right after the Amazon and the Congo. This place is also known as the "coral triangle", a region with the most diverse marine ecosystems on Earth. Besides, it is understood that even though the island covers just about 0.5% of Earth's entire landmass, however, according to WWF, with its extensive forestry, water and wetlands, New Guinea contains up to 8% of the world's total number of species! So there is no wonder that this ecological haven will display such magnificent collection of new stellar species in this recent research endeavor of the WWF.

Some of the standouts of this discovery include a large green tree-dwelling frog named Litoria dux, a round-headed and snub-finned dolphin, Orcaella Heinsohni, (which sure was the highlight of the entire study), a blue-eyed spotted cuscus (a species of Australasian possum) called Spilocuscus Wilsoni, another frog dubbed Litoria sauroni which owes its naming because of its striking red and black spotted eyes that resembled, according to the discoverers, the evil character Sauron from J. R. Tolkien's epic novel "Lord of the Rings". Other notable findings include, a one centimeter long and vampire-like fanged frog, a new bird species, the wattled smoky honeyeater, 9 new vibrantly colorful snail species, a brightly colored apricot crayfish, a monitor lizard, Varanus Macraei, a 2.5 meter-long river shark, Glyphis garricki, and a 12-14 centimeters long snake that had scales over its eyes, which clearly made it a blind and venom less of its kind. Researchers also believe that 1sq. Km (247 acres) of the island's lowland rainforest might as well contain around 150 new species of birds. Amongst the 33 new fish species that have been found in the waters around the island, the most notable ones includes the damselfish, a strikingly brilliant blue wrasse (a type of marine fish) and seven species of zigzag rainbow fish, an 11cm-long creature that lives in shallow waters.

But unfortunately it's not all good news. Just like Amazon and Borneo rainforests, the natural habitat of New Guinea is deteriorating at an alarming rate. Some of the growing threats for such are illegal and unsustainable logging, forest conversion for palm oil plantations, mining, road construction and unsustainable fishing. Even though the island has relatively low level of human population however it has been estimated that illegal logging will likely to strip the island from half of its forest cover by the year 2020.

This contributor is a freelance science writer.

Damselfish, Chrysiptera cymatilis

LOW DIVERSITY

Devil in danger

TWO new complete sets of Tasmanian devil genetic blueprints hold some good news and bad news for the species. The bad news is that the marsupial's genetic diversity is among the lowest known for any species. The good news is that the devil's low diversity has a long history and may not be reason for as much concern as once thought.

This low genetic diversity "does not mean the species is doomed," says genomicist Stephan Schuster of Pennsylvania State University. "If you maintain the entire diversity this can still be a viable species."

An international team of researchers led by Schuster and Webb Miller, also of Penn State, deciphered the genetic blueprints of Tasmanian devils named Cedric and Spirit that hail from opposite ends of Tasmania, the team reports online June 27 in the Proceedings of the National Academy of Sciences. The two devils also represent a contrast in their response to the infectious cancer that has decimated wild devil populations. The work was done as part of an effort to better understand the deadly disease and save the species.

Cedric was one of the few devils whose immune system could fight off the infectious cancer, which started in a single long-dead devil and has since swept over more than half the island. As part of efforts to study the disease, Cedric survived two attempts to infect him with the facial tumor disease, but finally succumbed to a third strain. Spirit was already infected with five tumors and was near death when she was captured. Researchers hoped that cataloging and comparing the two animals' genomes would show why Cedric was partially immune to the fatal cancer while Spirit and so many others are not.

The initial analysis of the two genomes doesn't provide a clear answer, but researchers believe that further work will reveal secrets to defeating the deadly disease that may be buried in the animal's blueprints. Scientists suspect that most devils have variants in certain genes that make them more susceptible to the tumor disease.

"The really exciting discoveries are yet to come," says Katherine Belov, a geneticist at the University of Sydney who was not involved in the study. "We are very excited to be able to jump in and start mining this genome."

Source: Science News

Tasmanian devils have very low genetic diversity

HOT BIRTH

Mammals from hot magma!

Hot magma deep within Earth may have heated carbon-rich rocks, releasing methane into the atmosphere and leading to an ancient warming event

Source: Live Science

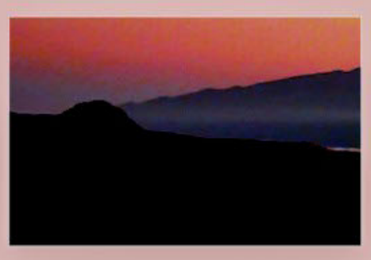
The rise of modern mammals, which came with a dramatic warming of the Earth, may be traced to hot magma, new research suggests.

The Eocene epoch, which saw the emergence of the first ancestors of modern mammals such as hoofed animals, began almost 56 million years ago with global temperatures rising 9 degrees Fahrenheit (5 degrees Celsius) on average over a few thousand years.

The oldest known members of these species were relatively small, weighing less than 22 pounds (10 kilograms) hinting the heat favored smaller creatures. Larger animals, with their greater body mass, would not be able to handle the excess heat so well.

DID YOU KNOW?

Which is the tallest mountain?



The highest mountain on Earth is not Mount Everest, but Mauna Kea in the Pacific Ocean. This volcano rises to 10,203 m (33,476ft) from the sea floor to form one of the Hawaiian islands. Mount Everest is the highest mountain on land, at 8,848 m (29.029ft).

Mauna Kea is the tallest mountain in the Hawaiian Chain. Its summit rises to an elevation of 4205m above sea level and it is located on the island of Hawaii. It is the second largest in subaerial surface area of the five shield volcanoes that comprise the island of Hawaii.