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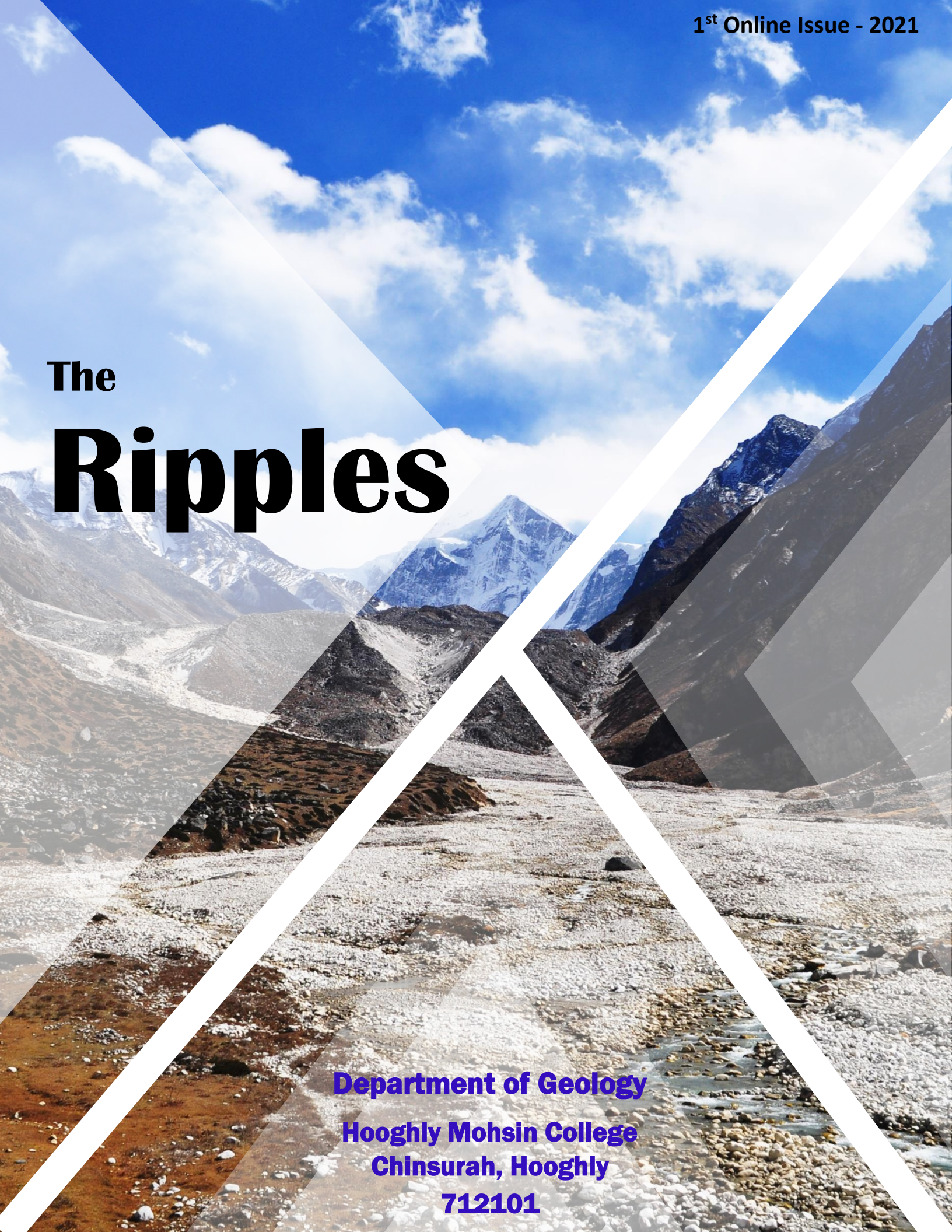

The Ripples

Department of Geology

Hooghly Mohsin College
Chinsurah, Hooghly
712101

Acknowledgement-

We would like to extend our heartfelt gratitude to all the members of the Geology family of Hooghly Mohsin College for their active participation, without which, this magazine could not have seen the light of the day. We would also like to acknowledge Prof. Purushottam Pramanik, Principal, Hooghly Mohsin College, and Prof. Suresh Nath Bairagya, Coordinator, IQAC, NAAC, for their ungrudging support and constant encouragement. We express our gratitude to Mr. Subhankar Dutta, Director, GSI, Marine Wing, Kolkata, for his constructive criticism, which has enriched the magazine.

We thank the Almighty for keeping us safe during this grim pandemic situation.

Foreword -

When a pebble is tossed in water, ripples are created, which spread around with increasing radius. Similarly, a spark in the mind gives rise to new ideas and concepts, which lead to the upliftment of the knowledge, creativity and the morals residing in the mind.

We are very happy to welcome the first edition of online magazine 'The Ripples' from the Department of Geology, Hooghly Mohsin College; which has gone beyond the confinements of academic interests and evoked new areas of thrust.

I appreciate the diligence, interest and patience of the students in shaping the magazine in the successful way.

Dr. Samiran Mahapatra
Head, Department of Geology
Hooghly Mohsin College
Chinsurah, Hooghly - 712101.

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Cover Page Photograph: Aditya Bera

ARTICLES -

Candid Minds and Candid Eyes Make the Difference

Have you ever thought that when we deal with ore deposits, we are actually talking about Trace Elements (TE)?

Let me throw some light on it. The elements which we need for our day today life are not abundant on the earth's crust. Only 11 elements, O, Na, Mg, Al, Si, P, K, Ca, Ti, Mn and Fe, constitute 99 % of the rocks. So, all other elements occur in amount < 0.1 wt. %; hence are called trace elements

Now, we may have a look on LED lamps, which are replacing traditional lamps and CFLs at a rapid pace. What is the composition of the electronic unit in an LED lamp?

Compositionally, LED lamps have a chip of a piece of crystal formed from the successive deposition of chemical elements like indium, gallium, aluminum, phosphorus, silicon, arsenic, andboron, among others (De Santiet al., 2015). However when end of life LEDs are analysed, they give the following result:

Metals	Digested with Nitric Acid	Digested with Aqua Regia
Aluminium	85071.60 ± 4888.01	110923.00 ± 3641.78
Antimony	143.20 ± 15.83	212.50 ± 14.41
Arsenic	67.71 ± 3.20	66.00 ± 2.65
Cerium	16.29 ± 0.48	ND
Copper	83379.54 ± 2216.58	94492.00 ± 6255.39
Yttrium	20.80 ± 0.07	ND
Nickel	851.44 ± 265.30	761.00 ± 425.54
Gold	ND	348.50 ± 55.06
Silver	47.37 ± 35.60	384.00 ± 22.00

Table-1: Concentration of metals (mg. kg^{-1}) in end-of-life LED Lamps (analysis of 6 samples) after Rebello et al., 2020 (ND means not detected)

Fig. 1: LED Lamps and LED Strips

Among the nine elements listed in the table, only Aluminium is a major element; all others are in the TE categories. Interestingly, these trace elements are represented by some REE and precious elements. So it is felt that recycling of LEDs is important. It is important not only for retrieving the metals of interest but also to curb down the hazards of arsenic toxicity.

Sources:
1. De Santi, C., Dal Lago, M., Buffolo, M., Monti, D., Meneghini, M., Meneghesso, G., Zanoni,E., 2015. Failure causes and mechanisms of retrofit LED lamps. Microelectron. Reliab.https://doi.org/10.1016/j.microrel.2015.06.080.
2. Rebello, R. Z., Lima, M, Yamane,L and Siman, R, 2020. Characterization of end-of-life LED lamps for the recovery of precious metalsand rare earth elements. Resources, Conservation & Recycling (153). https://doi.org/10.1016/j.resconrec.2019.104557.

Dr.Sandip Bandyopadhyay
Associate Professor of Geology
Hooghly Mohsin College

Extra Terrestrial Life- A Possibility

The existence of life forms beyond the terrestrial sphere has always been a matter of speculation. One natural satellite becomes the centre of lime light whenever this topic comes up.
Europa, the fourth largest Jovian satellite is making scientist curious in this context. It has an icy terrain, formed predominantly of water ice. The surface has many discontinuous cracks and ridges called **"Linea"**. These linea are darker in colour, probably due to the filling up of the cracks by a warmer material oozing up from beneath. These cracks are formed when the icy surface stretches and contracts in reaction to the tidal forces exerted on it by Jupiter, similar to how Earth's water system reacts to the lunar tidal forces.

Scientist believe that below this ever-frozen crust is a subsurface ocean of liquid water, kept warm by the same tidal forces and hydrothermal activities.

Evidences of the presence of water were detected by **Voyager** and **Galileo** probes in late 1900s. Between these missions, a drastic change in **Europa's** magnetic field was reported, possible only if an electrically conductive fluid existed beneath the surface. Later another satellite detected huge water vapour plumes from **Europa's** southern hemisphere.

So, the presence of liquid water and a warming source, the Jupiter, makes this subsurface ocean a probable habitable zone. We know microbes can literally thrive in any conditions, provided there is water. Some scientists assume that hydrothermal vents in this ocean floor emit chemicals that mix with the water and make it saline and nutritious for microbes.

The discovery of this ocean and maybe some life in is just a matter of time now. NASA has designed two probes which will be launched in early 2020s and will examine Europa when they reach.

Soumili Dutta
M.Sc., Semester II, 2021

Use of corals in Global Amelioration

The researchers looked at 250 prior studies on coral reefs to see how effective they were in breaking waves. Only 3% of a wave's energy made it across a reef on average, with the majority of that energy exploding when the reef crest meets the open ocean. However, the exact quantity of energy disruption is determined by a number of factors, including the depth of a reef and the roughness of its texture.

The study concludes that jagged reefs at a shallow depth are the best barriers, thus making them an indispensable resource that helps protect against climate change perpetuated by man, such as the sea level swelling by 3 feet and also the increasing hurricanes, of level 4 and level 5. This will be only possible if the corals survive. Human interference in the form of water pollution, and other factors like invasive species like lionfish and ocean acidification are causing coral reefs to dwindle. Elkhorn and staghorn coral find themselves on the US endangered species list, the major perpetrator being the acidic and warm waters in the Caribbean Sea.

Marine protected areas (MPAs) provide place-based management of marine ecosystems through various degrees and types of protective actions. Ocean acidification, global warming, rising sea level, changing circulation patterns, increasing severity of storms, and changing freshwater influxes have given a death blow to the coral reef community. MPA networks provide modified management laws which help to curb the harm-causing agents. MPA(s) in conjunction with dealing with other factors like fisheries, land-pollution, invasive species and diseases may improve the overall health of the oceans.

From a 2014 study it is known that the coral reef can prove to be an indispensable part of the oceans, since they can absorb the blow of incoming waves and create enormous breaks. It is reported by the Nature Conservancy that they can reduce the wave’s energy by 97 per cent. The reef crest alone — the shallowest area where waves break first — dissipates most of the energy, absorbing about

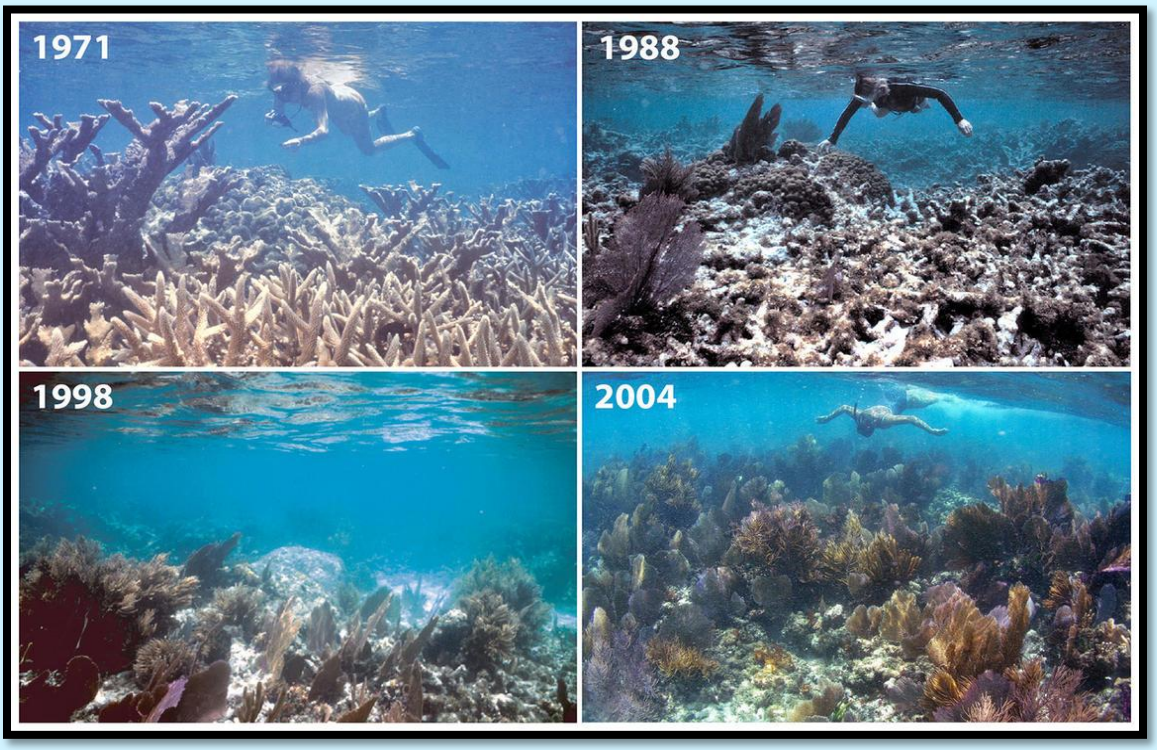
86 per cent of a wave's power before it reaches the reef flat or lagoon. Without such a buffer, coastal residents must face the full brunt of rising seas and stronger storm surges driven by climate change.

"Coral reefs serve as an effective first line of defence to incoming waves, storms and rising seas," said Michael Beck, lead marine scientist for the Nature Conservancy and a co-author of the study. "200 million people across more than 80 nations are at risk if coral reefs are not protected and restored." The coral reef community is in a major threat now because of ocean acidification. As per Zeebe 2012, the ocean pH has fallen by 0.1 units from approximately 8.2 to 8.1 from the year 1750 to 2000. And, by 2300 it can fall by 0.7 units. A decrease of 1 unit can increase the acidity by ten-folds. Oceans absorb at least 1/3rd of the atmospheric carbon dioxide. But, due to the rising carbon dioxide levels in the atmosphere, the ocean has also increased the carbon dioxide uptake. Ocean acidification is often known as the other CO2 problem; the first being climate change. Although much more intensive studies are required to have a clear speculation, but, if the ocean does not form its own adaptability, then this devil would definitely show the doomsday of the ecosystem. Increase in acidity in the ambience decreases the bioavailability (carbonate ions) required by corals to build their skeletons. They gradually become weak. If the ocean temperature increases, which is the result of global warming, the harm multiplies. Then, the corals release their algae which provide them food and energy and eventually lose colour and die.
When the corals grow, they form rings just like trees. Scientists study them and find out about climate change in the respective years.

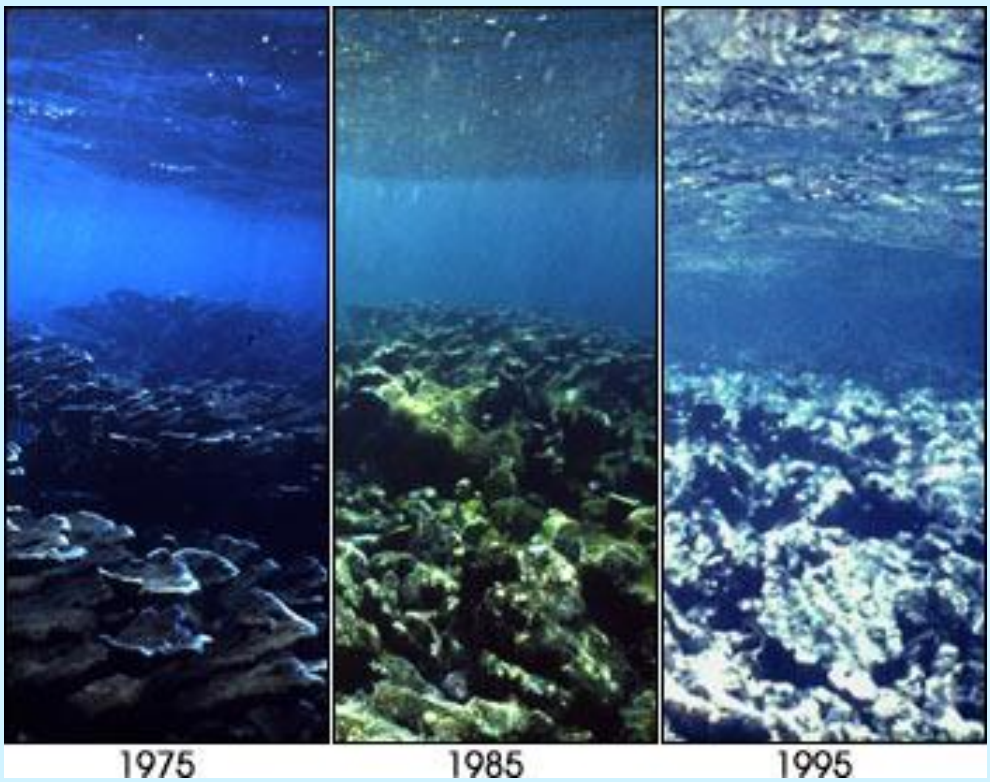
With the help of diamond shaped drill bit coral coring is done and the organism is examined. X-ray imaging further gives a clear look at the intrinsic patterns. Analysing the trapped oxygen in corals, the oxygen isotope curve is prepared which tells the past climatic situations. It is found out that by scrutinizing the coral reef in Pacific Ocean, the ENSO pattern of the past hundred years can be traced which would show light to the future conditions. 36

million Indians are dependent on coral reefs. It is high time that we become much more vigilant.

Invasive species (Red lionfish)



Time series of Grecian Rocks coral reef showing21% decrease on calcification rates (USGS, https://www.usgs.gov/media/images/time-series-grecian-rocks-coral-reef)



Decline of Coral Reefs in Florida Keys. From- NASA Earth Observatory

Mr. PINAKI SAHA[1] & Miss PRAJNA SAHA[2]
1-Associate Proffessor,
Hooghly Mohsin College
2- Department Alumnus,
B.Sc. Batch, 2020.

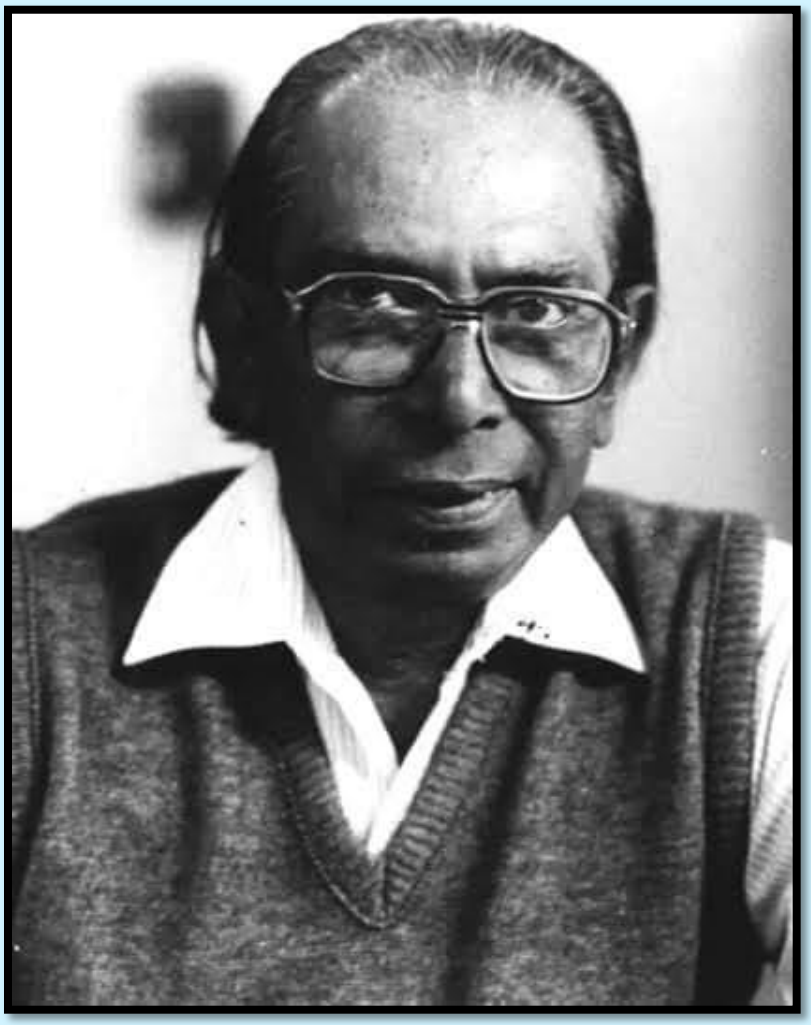
Out of Print

India shares a rich past in terms of 'Geological Literature.' Published textbooks and articles have manifold in numbers, with a rise in the number of publication houses and journals. However, this is not the case for vernacular publications in this field. Authors made a shift long back, with the low acceptance of such works with time. This brief essay is an effort to highlight few such Bengali books which are now out of print.

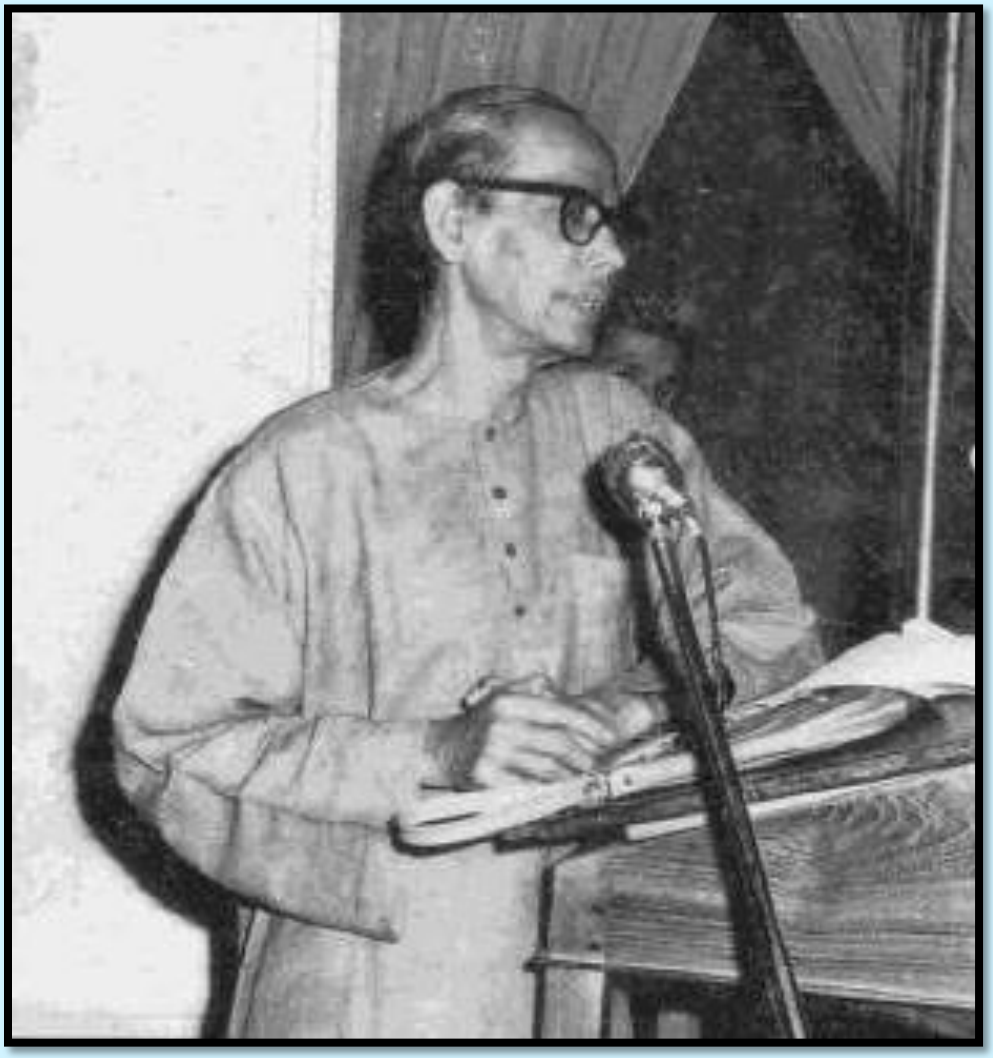
The first Bengali text (although not geological in context) containing geological elements relating to rock types and fossils is an essay by Hara Kumar Tagore called '*Shilachakrarthabodhini*,' published in 1891. It accommodates a weak classification of ammonites found in black shales based on their form and structure. The first book on Indian Geology that was written in Bengali, came out in May 1974 called '*Bharater Shilastar O Bhutattwiya Itihas*' by Timir Ranjan Sarbadhikari. In the preface of this text, the author clearly states the need for Bengali books in geology, which led him to author it. The text contains a vivid description of the stratigraphy and historical Geology of the Indian subcontinent, and includes few hand-drawn images of micro-fossils. Shortly after, in September, Prof. Santosh Kumar Ray published '*Crystalmurti Vidya O Alokranto Mineral Vigyan*.' It deals with the elaborate description of crystallography and optical mineralogy, and is a real saviour for students looking to clear their concepts. The text is illustrated with several hand-drawn images and annotations that further help the reader develop an obvious idea of the topic. In April 1975, Dr. Subir Kumar Ghosh published a book on Structual Geology called '*Gathan Samparkiya Bhubidya*.' This was 18 years before his more popular book (which is now a standard text in most universities across the country), '*Structural Geology - Fundamentals and Modern Developments'* had released. The book is similar in every way, yet more merged, compared to its English translation. Almost every theory, deduction and concept that is described, is explained with images in the book. '*Purajivavidya*' by Subhendu Kumar Baksi is a book on Palaeontology that was published in June 1976. This book too explains (with hand-drawn pictures) all

the major concepts of Palaeontology that are taught in undergraduate courses in India.

After 1976, there are no published textbooks on the core branches of geology in Bengali. However textbooks on Hydrogeology and Remote Sensing published by the CGWB and others in this language are available in the market. It is also to be noted that the above mentioned textbooks were some of the first textbooks in geology, which were published in a vernacular language in the country. Hence, in conclusion, it is to be hoped that the new generation of geology students do not forget these gems that remind us of our golden past.

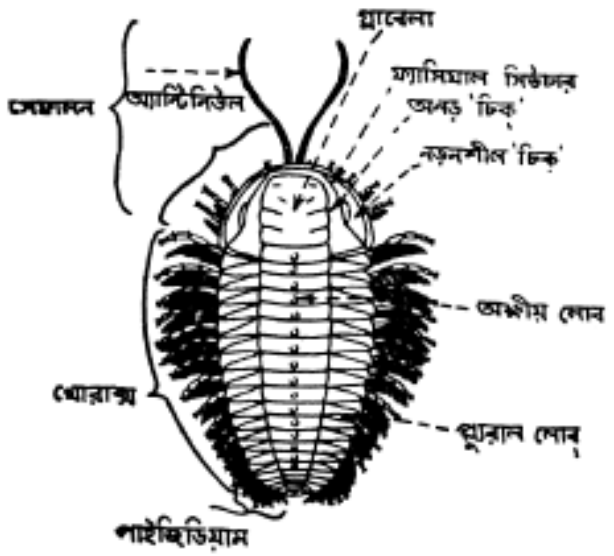


Dr. S. K. Ghosh



Prof. S. Ray *delivering his talk on 'Data for interpreting crustal tectonics in India,' GSI, 1976*

আসিলে ইহাদের সার্বভৌমত্ব ক্ষুণ্ন হয়। পার্মিয়ানের শেষে ইহারা একেবারেই বিলুপ্ত হয়। ঐ সময়ে ইহারা পৃথিবীময় ছড়াইয়া পড়িয়াছিল। অল্প সময়ে ইহাদের আধিক্য এবং পৃথিবীময় বিস্তৃতির জন্য শিলাস্তরের অনুবন্ধন কার্যে ইহাদের গুরুত্ব অনেক। আজ পর্যন্ত সংখ্যায় প্রায় পনের শতেরও অধিক গণ বর্ণিত হইয়াছে।

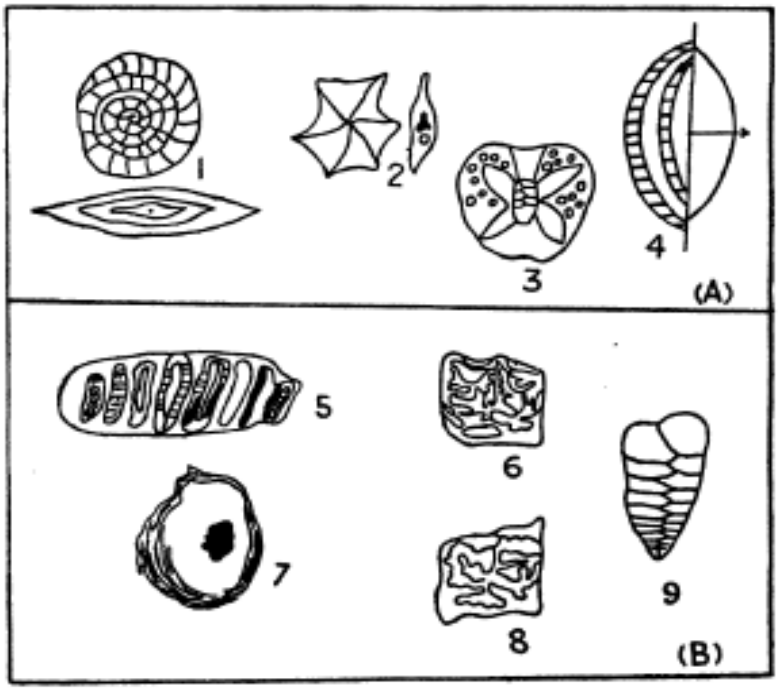


চিত্র 11·1 : ট্রাইলোবাইটের সাধারণ অঙ্গসংস্থান।

অঙ্গসংস্থান : জীবের নরম দেহাংশ সম্পর্কে বিশেষ কিছু জানা যায় না। শক্ত বহিঃকঙ্কাল (Exoskeleton) নরম দেহাংশগুলি ঢাকিয়া রাখিত, ইহাতে জলজ জীবদেহ শুষ্কতার প্রকোপ হইতে বাঁচিত। ইহা ছাড়া, মাংস পেশীগুলি ইহার সহিত শক্তভাবে আটিয়া থাকিত। এই বহিঃকঙ্কালটি কাইটিন্ দ্বারা গঠিত, সাধারণতঃ পাতলা নমনীয়, কিন্তু যে সকল জায়গাতে কোনরূপ নড়াচড়া হইত না, সেইগুলিতে ক্যালসিয়াম কার্বনেট পুঞ্জীভূত হইয়া অত্যন্ত দৃঢ় এবং পুরু হইত। জীবাশ্মের নজীর হইতে নিঃসন্দেহে প্রমাণিত হয় যে এই প্রাণীগুলি বিশেষ সময়ের ব্যবধানে খোলস ছাড়িত এবং ইহা সহজেই অনুমেয় যে এই খোলসগুলি এক একটি পৃথক জীবাশ্মরূপে সনাক্ত হইবার সম্ভাবনা রাখে। শ্রেণীবিভাগে ইহা একটি জটিল সমস্যা। অধিকাংশ ক্ষেত্রে এই বহিঃকঙ্কালই জীবাশ্মরূপে সংরক্ষিত হয়। বহিঃকঙ্কালটি জীবদেহের পৃষ্ঠদেশের সম্পূর্ণভাগ ও অঙ্কদেশের কিছু অংশ

*A page from the Trilobites chapter of the book '**Purajivavidya**'*

ইহা টিপম শ্রেণীর উপরে বিন্যস্ত। প্রায় ১০,০০০ হইতে ১১,০০০ ফুট গভীর ক্লে-বেলেপাথর অনুক্রমে এই শিলাশ্রেণী গঠিত। নিম্নাংশের ২০০০ ফুটের মধ্যে মোটা লৌহময় বেলেপাথর প্রধান উপাদান। ইহার ঊর্ধ্বে বিচিত্রবর্ণের বেলেপাথর প্রধান উপাদান। জয়ন্তিয়া পর্বতের দক্ষিণাংশে ইহার শ্রেষ্ঠ শিলাছেদ দেখিতে পাওয়া যায়। আসামের অন্যান্য অংশে (উত্তর আসাম ইত্যাদি স্থানে) দুপিতিলা শিলাস্তরকে নামসাং (Namsang)



চিত্র 6—নবজীবীয় কালের কয়েকটি বিশিষ্ট ভারতীয় জীবাশ্ম :

(A) নিম্ন টার্শারি : (1) নুমুলাইট (2) হাস্টকেনিয়া (3) ব্রেনিয়া (4) অ্যালভিওলিনা

(B) ঊর্ধ্ব টার্শারি ও কোয়াটারনারি : (5) ষ্ট্রেগোডন (6) হিপারিয়ন (7) অষ্ট্রিয়া (8) ইকোয়াস (9) টেক্সটুলারিয়া।

স্তর (পূর্বের Num Rong Khu) নাম দেওয়া হইয়াছে। নামসাং নদী হইতে ইহার নূতন নামকরণ হইয়াছে। দুপিতিলা শ্রেণী প্রধানত অজৈবিক। স্তরীয় অবস্থান হইতে মনে হয় ইহার বয়স প্লায়োসিন, সম্ভবত ঊর্ধ্ব প্লায়োসিন।

A page from the book ***'Bharater Shilastar O Bhutattwiya Itihas'***

Atmadeep Chakraborty,
Department Alumnus,
B.Sc. Batch, 2018

Global Dimming

Global dimming is a term describing the gradual reduction in the amount of sunlight observed reaching Earth's surface since 1950s. In 1989, Atsumu Ohmura, a researcher in geography at the Swiss Federal Institute of Technology first reported the levels of solar radiation striking the earth's surface had declined by more than 10% in only three decades. Although Ohmura was the first to report global dimming, he was not alone. In fact, the scientific record now shows several other research papers published during 1990s on the subject, all finding the levels were falling significantly. Most starling of all was the discovery that levels of solar radiation reaching parts of the former Soviet Union had gone down almost 20% between 1960 to 1987. In 2001 by comparing Israel's sunlight records from 1950s with current ones, the English scientist Gerry Stanhill was astonished to find a large fall (22%) in solar radiation.

WHAT CAUSES GLOBAL DIMMING?

The first thing to say is that it has nothing to do with changes in the amount of radiation arriving from the sun. Although that varies as the sun's activity rises and falls and the Earth moves closer or further away, the global dimming effect is much larger and the opposite of what would be expected given there has been a general increase in overall solar radiation over the past 150 years.

Dimming appears to be caused by air pollution. Burning coal, oil and wood, whether in cars, power stations or cooking fires produce not only invisible carbon dioxide (CO_2) – the principal greenhouse gas responsible for global warming – but also tiny air borne particles of soot, ash, sulphur compounds and other pollutants. The visible air pollution reflects sunlight back into space. Moreover, they also change the optical properties of clouds. Clouds are made of droplets, which form by latching onto tiny particles called condensation nuclei. These occur naturally in the atmosphere, but by emitting more particulate pollution into the

atmosphere; human activities help make even more condensation nuclei. The result: instead of fewer, larger droplets forming, many smaller water droplets form. In other words, polluted clouds contain a large number of droplets than unpolluted clouds. Recent research shows that this makes them more reflective than they would otherwise be, again reflecting the sun's rays back into the space. In effect, this is like the difference between two sieves, one coarse and the other fine. Like a coarse sieve, the cloud with fewer larger particles lets more solar radiation to the ground, whereas like the fine sieve the cloud with lots of very small particles lets less sunlight pass through.

EFFECT OF GLOBAL DIMMING

Global dimming may have caused large scale changes in weather pattern. Scientist are now worried that dimming by shielding the oceans from the full power of the sun, may be disrupting the pattern of the world's rainfall. Moreover, another alarming aspect of global dimming is that the effect of global dimming has masked the effect of global warming and consequently it may have led scientists to underestimate the true power of greenhouse effect.

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Dr. Samiran Mahapatra
Associate Professor and Head,
Department of Geology,
Hooghly Mohsin College.

Graph theory in a fun way!

• What is graph theory?

Graph theory, in mathematics, is the study of graphs. The two main aspects of the graph are nodes (or points or vertices) and edges (or lines or links).

• What is weighted graph?

Where, each edge of the graph has a numerical value assigned which shows its weight.

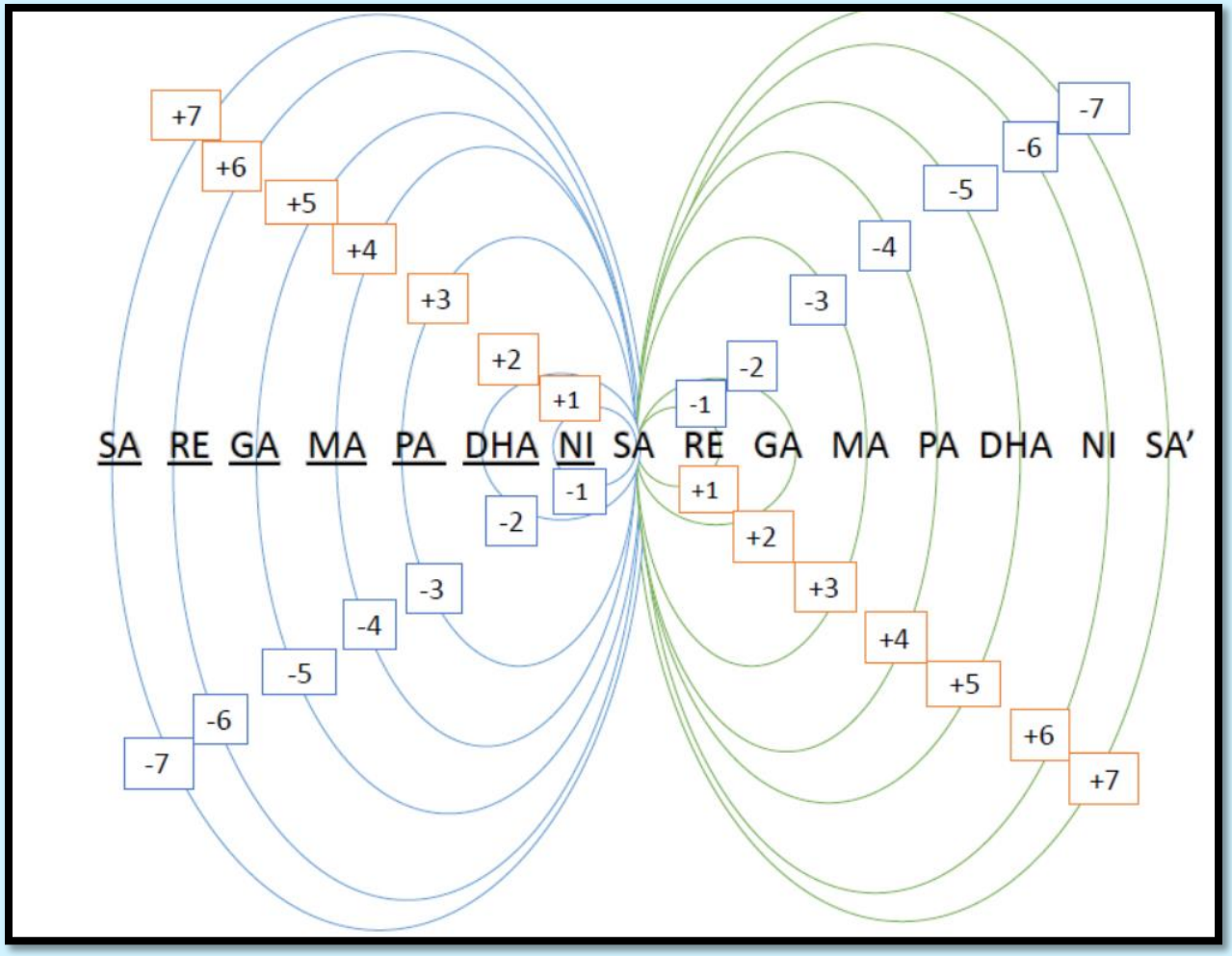
• What is tried to be shown here?

Here, it is tried to explain the different 'Sargams' in Indian Classical music. This can be further extrapolated to nature's several other aspects. The sargam goes like:

1) Sa Re Sa, Sa Ga Sa, Sa Ma Sa, Sa Pa Sa, Sa Dha Sa, Sa Ni Sa, Sa Sa' Sa.

2) Sa Ni Sa, Sa Dha Sa, Sa Pa Sa, Sa Ma Sa, Sa Ga Sa, Sa Re Sa Sa Sa Sa.

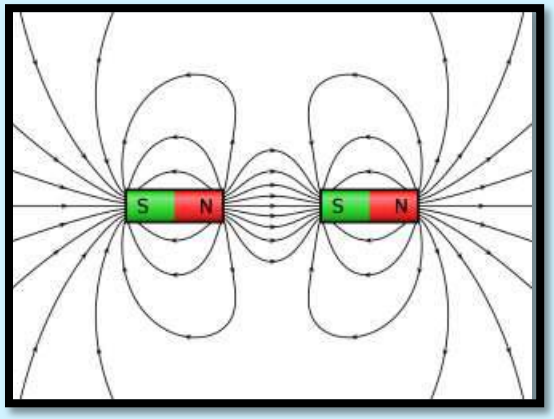
The lower notes are shown by underline and the highest octave by '. The notes are considered to be the vertices, while the journey of the note from 'Sa' to the next note is the edge. Each of the edges is weighted and the weight is determined by the number of notes it skips. Since, everytime, it returns to 'Sa', the similar weight is reduced and this forms a cyclomatic directed graph. The similar pattern is followed in explaining the lower notes.

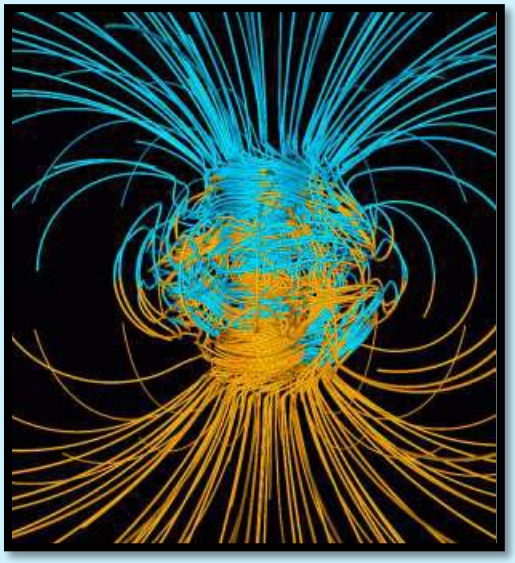


Applications in real life –

Bivalve shells

Flowers





Magnetic field lines

Prajna Saha
Department Alumnus,
B.Sc. Batch, 2020.

Amore Tragico

Still his tears are shedding like the sparks of fire, still his blind rage of love flames in those agitated lava of the enraged volcano.

Thousands of years ago, a sudden flame of joy spread out through ***Tenochtitlan***, a pleasant, wealthy valley of Mexico, reigned by *Aztecs*. Their noble Empress gave birth to a child, who was as beautiful as the petals of newly bloomed *Daisy.* Looking at the mesmerizing beauty of the newly born princess, all of the Aztecs, along with their admiring Emperor named her ***Iztaccíhuatl*** (means White Lady in *Nahuatl)* and blessed her. Times passed through ups and downs, *Iztaccíhuatl* grew up to be a young gorgeous, elegant lady. Her divine beauty and noble heart won love of all the natives. The Chieftain prepared her to be the Empress of the *Aztecs*. One day *Iztaccíhuatl* met a young, charming, warrior ***Popocatepetl,*** the great captain of the *Aztecs* tribe. Like the cherishing smell of newcoming spring, *Izta* and *Popo*, fell in love with each other. But their journey of love did not go long, as a severe war broke out with the fate of the Emperor at stake, and *Popocatepetl* as the chief warrior had to go with all of his men, to fight the enemy. Before leaving *Izta, Popoca* asked the Chieftain for his daughter's hand, professing deep love for *Izta.* The father gladly agreed and promised to welcome him back with a big celebration to give his daughter's hand to him, if he returned victorious from the battle.

After several months of combat, while *Popoca* was away at war, one of the jealous suitors of *Izta*, as well as the largest enemy of *Popoca*, delivered a false message to *Izta*, that though the army won, her beloved had died in combat. Crushed and overwhelmed with this sudden shock, *Izta* couldn't stop crying until her heart stopped. Poor girl couldn't eat, sleep, couldn't even breathe. One day her father found her grief-stricken daughter in a locked, lone, palace, had already breathed her last. In the meantime, with utmost surprise of the grieved Chieftan, *Popocatepetl* returned victorious to his people, hoping his beloved princess. Upon arrival, he received the terrible news of his beloved's death, as a result of the conspiracy of his enemies. Ignited like the agitated fire, *Popoca* killed and destroyed everyone who lied *Izta*. Yet the poor lover

remained inconsolable and wandered the streets, day and night, mourning her.

Finally, he decided that he would build a massive tomb for beloved and lay her body atop it, as a homage to her. Walking a long way, he arrived at some mountains where he ordered his men to build a funeral table with flowers. With a heavy heart, he put *Izta* lying on the top and knelt down with smoke torch to watch *Izta*, until his last breath. Centuries passed, *Popoca* remains there forever, looking after his beloved *Izta*. Even Mother Nature, being deeply touched by the tragedy and the great lover *Popoca's* sacrifice, covered both of them with, dirt, rock, snow and turned them into great volcanoes. *Popoca's* torch is still smoking as a reminder of what happened. Being an active volcano, *Popoca* is still raining fire on earth with blind rage and morn at the loss of his beloved.

This epic melancholy of *Popocatepetl* and *Iztaccíhuatl* is the *Aztec* Romio-Juliet – couldn't stay together while living but destined to spend eternity together. Now as two volcanoes that set the backdrop of Mexico City, *Izta* and *Popo*, as they are affectionately called, are a symbol of love everlasting.

As a part of circum *Pacific Ring of Fire,* Mexico hosts several of the world's most continually active volcanoes, including the massive ***Popocatepetl*** (*Aztec* for "Smoking Mountain") and ***Iztaccíhuatl*** (*Aztec* for "Woman in White"; also spelled as *"Ixtaccíhuatl"*) a dormant volcano, situated on the Puebla state in the central Mexico.

The faint plume emanating from Popocatepetl's 250-450-meter deep summit crater attests to the significant, ever-present hazard,

the volcano represents to the 25 million people living in that region. Popocatepetl had produced small, intermittent eruptions since 1994. In addition to the constant danger of eruptions producing ash, deposits, pyroclastic flows and lava, the summit of Popocatepetl also hosts glaciers. These can melt during eruptions to form dangerous mudflows the blanket areas to south.

In contrast to Popocatepetl well-defined symmetrical cone, Iztaccíhuatl is formed from several overlapping smaller cones trend N-NW to S-SE. There have been andesitic, dacitic, Holocene eruptions from vent or summit. As seen from the Federal capital, the snow-covered peaks resembled the head, breast, and feet of a recumbent woman – hence popular designation of Sleeping woman. Iztaccíhuatl last erupted. Deep valleys have been eroded into the massive apron of ash and pumice deposits, glacial outwash and alluvium to the east of the volcano. Despite its close proximity similar age and similar geologic character to Popocatepetl, Iztaccíhuatl has not erupted as frequently as Popocatepetl. This has encouraged the establishment of numerous agriculture fields on the eastern flank of the mountain.

The tragic ballads of the *Sleeping Beauty*- Iztaccíhuatl and the *Kneeling Warrior*- Popocatepetl can be heard from every Aztecs in the Mexico City. Even after death of *Popoca*, he is still alive, and residing over his heart, princess *Izta*. On occasion *Popoca* will spew ash, fire, smoke; reminding those watching that he is always in attendance, that he will never leave the side of his beloved *Izta*. Proving the eternity and immortality of their love, which couldn't touch by the horizon of Death.

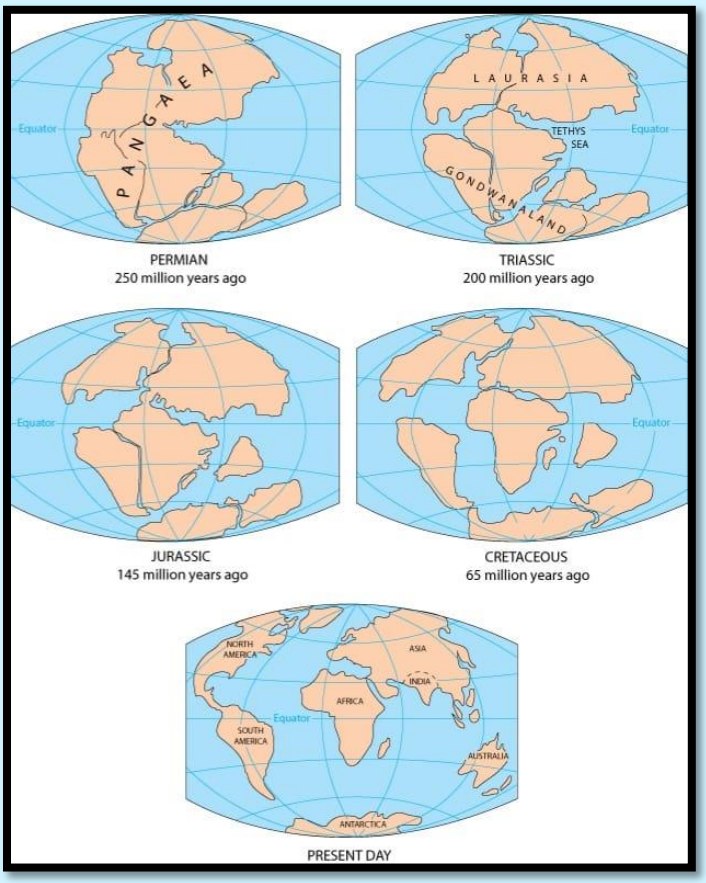
Surarsi Pal
B.Sc Sem II, 2021.

জন্মচক্র

পৃথিবী সৃষ্টি থেকে আজ অবধি যা যা ঘটেছে এবং নিরন্তর যা যা ঘটে চলেছে তার ইতিহাস-ই হলো Geology। সৃষ্টির অমোঘ রহস্য মাটির তলায় উপরে ছড়িয়ে থাকা নুড়ি, পাথর, পাহাড়, নদী - এসবের মধ্যেই যে লুকিয়ে রাখা আছে তা এই Geology পড়তে এসেই প্রথম অনুভব করি। আজ, এই ইতিহাস আর অনুভবের একটা ছোট্ট অংশ গল্পের ছলে বলবো বলেই এই লেখা।

কোটি কোটি বছর পূর্বে যখন পৃথিবীর বুকের উপর প্রথম কঠিন পাথর তৈরী হয়েছিল, (Igneous Rock) তবে থেকে আজ পর্যন্ত পুরো সময়কালকে ভূ-তাত্ত্বিকরা দুটি বড় ভাগে ভাগ করে ফেলেছেন। তার মধ্যে বৃহত্তমটি হলো Precambrian আর দ্বিতীয়টি Phanerozoic। এই Precambrian যেদিন cambrian –এ এসে পৌঁছলো, সেইদিন থেকে পৃথিবী সাক্ষী থাকলো প্রাণের এক অপূর্ব বিকাশের, যা উদ্ভিদকূল ও প্রাণীকূল দুই জায়গাতেই স্ফুরিত হলো। সময়ের স্রোত যত এগিয়েছে ততই বিকশিত হয়েছে প্রাণের আলাপ। কিন্তু এর পাশাপাশি ধরিত্রীর অন্তঃস্থলে ঘটে চলেছে এক মহা আলোড়ন যাকে ভূ-তাত্ত্বিকরা Geo-tectonic Activity বলেন। এর প্রথম প্রকাশ দেখা যায় Permian যুগে। তার আগে পৃথিবী পৃষ্ঠের সমগ্র স্থলভাগ একত্রিত হয়ে এক বিরাট মহাদেশের জন্ম দেয়, যার নাম দেওয়া হয় Pangea। Permian - এর অন্তে, Pangea ভেঙে দুটি মহাদেশে পরিবর্তিত হয়। উত্তর গোলার্ধে রইলো Laurasia এবং দক্ষিণ গোলার্ধে Gondwana Land। প্রসঙ্গত আমাদের সারা বিশ্বের কয়লার মজুত ভান্ডার Gondwana Land। আজকের পৃথিবীর মহাদেশগুলি যেমন আন্টার্টিকা, দক্ষিণ আমেরিকা, আফ্রিকা, মাদাগাস্কার, ইউরেশিয়ার দক্ষিণাংশ এই Gondwana Land এর ভাঙ্গন ও প্রবাহের (Drifting) ফল। এইবার সেই গল্পে আশা যাক।

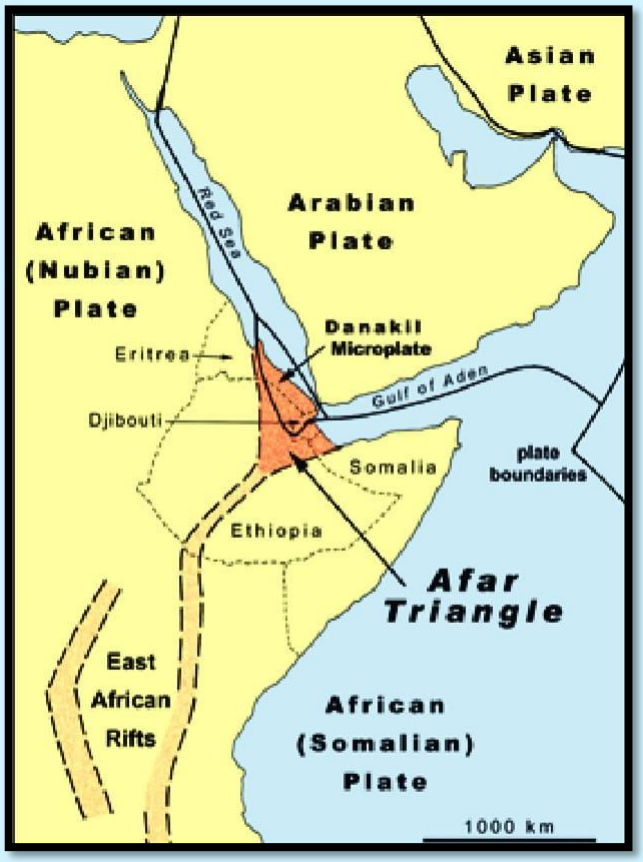
Triassic এর অন্তে প্রথম এই Gondwana Land থেকে বিচ্ছিন্ন হয়ে বেরিয়ে আসে একটি ছোট্ট টুকরো, যা আজ আমাদের ভারতবর্ষ, যদিও তার রূপরেখা আজকের থেকে ছিল অনেকটাই আলাদা। Jurassic -এ এই ভারতবর্ষ



প্রবাহিত হতে আরম্ভ করে প্রথমে পূর্বে ও পরে উত্তর-পূর্ব দিকে। Cretaceous এর শেষে সে এসে পৌঁছলো Tethys মহাখাতের (Geosynclines) কূলে। এর পরবর্তীকালে তার উত্তরার্ধের দিকে ভ্রমণ এবং ইউরেশিয়ান plate এর সাথে সংঘর্ষের ফলে সৃষ্টি হলো পৃথিবীর সর্বোচ্চ ও সর্ববৃহৎ শৃঙ্খলিত ভাঁজ পর্বতমালা (Fold Mountain Chain), যা চিরতুষারাবৃত থাকায় নাম হয় হিমালয়। হিমালয়ের বিস্তৃতিই বলে দেয় কত বৃহৎ জায়গা জুড়ে ছিল Tethyn মহাখাত। Gondwana Land এর বিভাজন শুধু ভারতবর্ষকেই তার ভৌগোলিক অবস্থান দিয়েছে তা নয়, তার সাথে সৃষ্টি করেছে অতলান্তিক মহাসমুদ্র যা, আমেরিকান Plate এবং আফ্রিকান Plate এর মধ্যের প্রবাহের ফল (Result of drifting)।

ভূত্বকের ওপর হিমালয়ের উত্তরণ জন্ম দিলো আরেকটি ছোট খাত যা তৈরী করলো Siwalik পর্বতমালা, Isostatic Adjustment -এর ফলস্বরূপ। এই Siwalik পর্বতমালা তৈরী করলো আজকের দীর্ঘ ও গভীরতম গঙ্গা-ব্রম্ভপুত্র নদীখাত, ওই একই কারণে।

এসবই হলো অতীতের স্মৃতিচারণ, এবার আসি এক নতুন সূচনায়। 2005 সালের 14ই সেপ্টেম্বর আফ্রিকার ইথিওপিয়ার 400 কিমি উত্তর পূর্বে অবস্থিত Dabbahu অঞ্চল 4.7 Magnitude এর ভূকম্প প্রত্যক্ষ করে। ওই দিন থেকে 4th অক্টোবর এর মধ্যে মোট 163 বার এই রকম ভূমিকম্প ঘটে যার প্রত্যেকের ক্ষমতা রিখটার স্কেলে 3.9 এর উপর। এই ঘটনা প্রবাহ ও তৎসংলগ্ন অগ্নুৎপাত এবং ভূকম্পতত্ত্ব আমাদের গোচরে আনে যে, ঘটে যাওয়া ভূকম্পন মাত্র 3 সপ্তাহের মধ্যে একটি 8m লম্বা খাত তৈরী করতে সক্ষম হয়েছে। পরবর্তীকালে এই খাতটি Magma দ্বারা পরিপূর্ণ হয়ে dyke এর রূপ নেয় যার গভীরতা 2-9 km পর্যন্ত। সমগ্র মানবকূলের কাছে উন্মোচিত হলো এক নতুন মহাসমুদ্রের গর্ভাবস্থান, যা সৃষ্টি হওয়ার কারণ African Plate থেকে ইথিওপিয়ার উত্তর পূর্ব এবং এরিথ্রিয়ার ছিঁড়ে (Tearing) বেরিয়ে আসা। ভূতাত্ত্বিকদের মতে, কয়েক লক্ষ্য বছর পরে, ভূমিষ্ঠ হওয়া এই ছোট্ট সমুদ্র এক সুবিশাল ও পরিণত মহাসমুদ্রের রূপ নেবে। ভাঙা গড়ার এই খেলায়, সেপ্টেম্বরের 14 তারিখে, আফ্রিকার আফার ট্রিপল জাংশনে, প্রকৃতি যেন হটাৎ করেই গেয়ে উঠেছিল - "হে - নূতন, দেখা দিক আর-বার জন্মের প্রথম শুভক্ষণ।"



স্বাতীলেখা সরকার, ভূতত্ত্ব বিভাগ,

স্নাতকোত্তর সেমিস্টার- IV

Travelogue-

An escapade to the other side of Bagh Caves

Our Mother Earth, a library which stores all the past records and that is beyond price. It is the sacred duty of the Geologist to study all the pages with utmost care and translate the hidden meanings to fill in the best of his abilities and if possible, even replace the missing pages.

Back in the year 2019, while I was doing my dissertation field work along with my thesis guide, I was fortunate enough to visit the Bagh Caves, located in the Dhar district of Madhya Pradesh. As a kid, I always had an obsession towards these kind of historical sites and hardly got an opportunity to hit one. Hence my interest was on another level.

Reaching the entrance of the caves, we could see a lot of visitors waiting for their turn to get entry. January of MP is quite wintry and hence a lot of travellers, which mostly included families. Also known as the Buddhist cave, is famous for its mural paintings and Indian rock cut architecture. The families were mainly stuck at the lost art while we were mesmerized to find something else.

It was more than an hour that we spent gluing our gaze at the walls of the those fifty or more stairs that we were climbing. The walls were made of Nimar Sandstone formation which at places contained lime mudstone. If we look at the stratigraphy of the Bagh Beds then we can find Nimar Sandstone formation at the base lying conformably over the Precambrian basement. What excited us was the unbelievably beautiful sedimentary structures reserved on the

walls of the steps. Starting from the planar cross stratification to tabular cross stratification and the very attractive herring bone cross stratifications, one can study the whole of sedimentary structures just by striking a cave. The herring bone stratifications were so proper and its existence in not just the walls but at many other field locations that we explored gave an evidence of the tidal environment.

As we were investing so much time just on the staircase, instead of hitting the actual cave part, some of the families got curious and happened to approach us about what we were basically glancing at. Actually it was funny since nobody found that fascinating. We went on to have a look at the rock cuts and once again our eyes gripped at the walls wherein we found graded beddings as well as normal bedding structures. Never in my life before had I had the scope to see those structures in outstanding states of preservation. Those were so real and genuine and as pretty as pictures.

All these views were captured by me but maybe it was my misfortune that I lost my phone the very next day. Hence all those charming sight lost. But as it is said that “we see with our brain and not with our eyes” so the memories are going to stay with me forever.

Pritishna Das
Department alumnus,
M.Sc. 2019.

Gangani – "*The Grand Canyon of Bengal*"

In the outskirts of West Medinapur lies a small town called Garbeta though not so densely populated but has an asset both geologic and scenic. The landscape of this place is disrupted by tall gorges formed by gully erosion by Silabati River that flowed over it for thousands of years. This wide red soil gorge is known as 'Gangani'.

18th November 2018, I and a friend of mine started our weekend getaway to Gangani. At 6 O'clock in the morning we boarded train from Seoraphuli Junction and reached Tarakeshwar Station, outside the station stood lines of buses side by side each waiting for its turn to get filled up. Dribbling through the crowd with our heavy backpacks we managed to reach the bus and got ourselves a seat. Slowly the bus filled up and so did our joy and excitement, the bus ride was indeed a pleasurable one, aside from the fact that the bus was not so well maintained and overcrowded. As we passed the Joypur forest, we expected to see some elephants, but the corridor was empty. The total journey was of two and a half hours and the bus halted at a deserted bus stand. First we started to look for cheap place to stay for the night and luckily we found an ashram where they served us lunch and gave a room for two. Having got our energy back we started our exploration.

Long stairs reached down to the bank of Silabati river and the view was astounding. The area is a part of Chhotanagpur plateau margin which is extremely dissicated and

discontinued. The rock type is pebbly to coarse-grained micaceous sandstones, medium to fine grained sandstones and red and green coloured mudstones. The sun already did start to set and the gullies started to darken up almost bringing up a mystic ambience. We started to pack up and almost hoping to skip the night to reach the next morning.

Next morning we continued to explore and now deeper into the canyon, the river did a great job in creating incredible gullies and the intricate features, and there was also a feature that was almost eroded to form a room like shape and the roof was empty to bring in light, as if made to look up into the heavens. This is when we heard a local guide speak about the mythological significance of the place, “This is the cave that used to belong to the demon Bakasur, and Pandava prince Bheem fought the demon to kill him. The intense fight is what caused the topography.” His words echoed through the gullies and made us think how geology and mythology are intertwined and how a land feature can be cause of a great folklore.

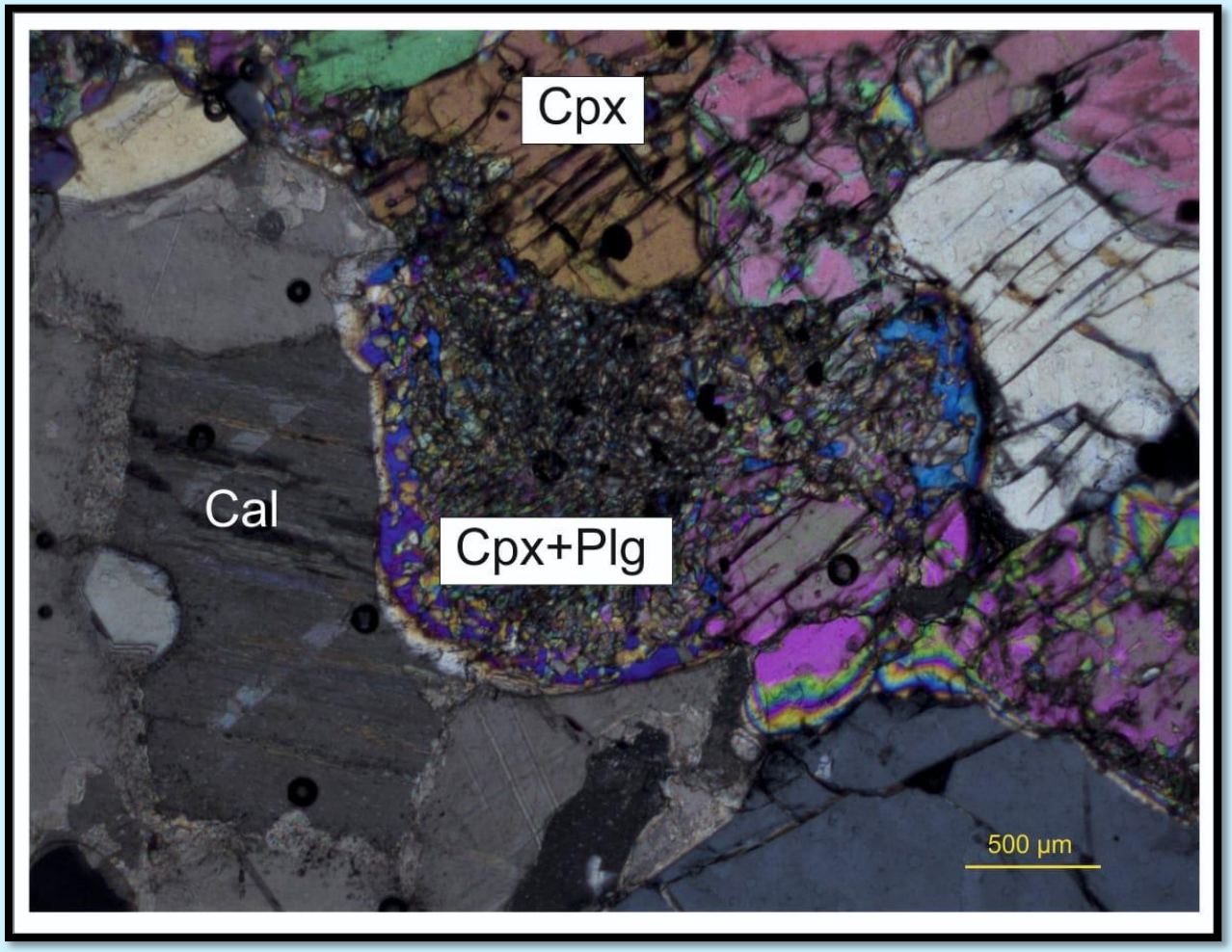
The sun was about to set we made a small fire and prepared some instant noodles and tea. It's better to leave the place before nightfall so we headed back.

It was an end to our small weekend trip and with heavy hearts we headed back home.

Avik Dhar

M.Sc. IV Semester, 2021

Geo-photography-

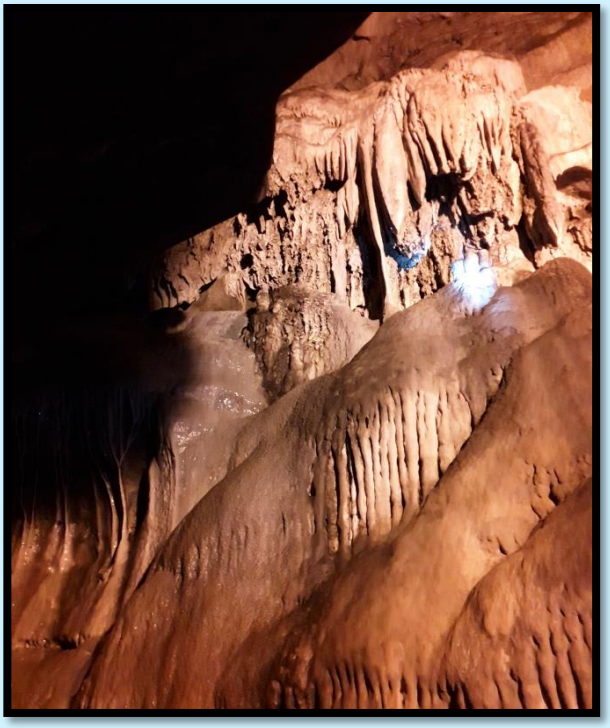


Ask the grains to tell their story,
Vibrant colours full of glory;
"We meet once, we make pair,
Welcome! Welcome! Stranger there;
Let us know your history of birth
Time and depth down the path.

-**Miss Nivedita Lahiri**
Assistant Professor
Hooghly Mohsin College.

Borra Cave. Elevation: 750 m height over sea level; base to roof height is 12 m and runs a distance of 200 m.
Location Araku valley (Vishakhapatnam).
Made of karstic limestone
Famous for it's irregular stalactites and stalagmites.
Discovered in 1807 by British geologist William King.

Ritam Mondal, *BSc. Sem. II*



Hornfelsic Texture : Contact Metamorphic Feature.

Location : Galudih, Jharkhand

Pujon Das, *M.Sc. Sem. IV*

“Somewhere far off are snow-shrouded HatiGori (elephant-horse) mountains and on the left is the Bagini Glacier. Going forward along the left-lateral moraine of Bagini Glacier, this photograph is taken from the Changbang basecamp (attitude- 14815 ft) turning backwards.”

Aditya Bera

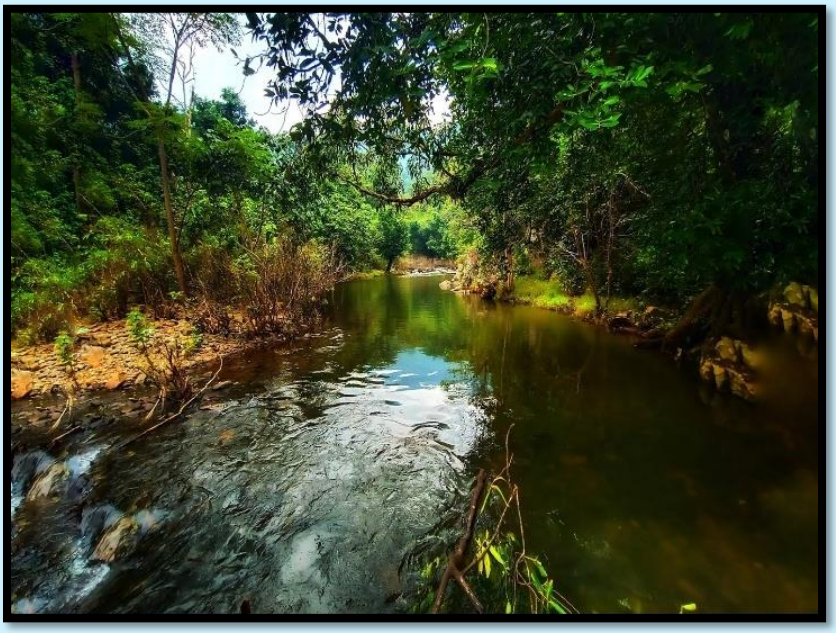
Departmental Alumnus
B.Sc. 2019.

Bluish – green patches of malachite indicates presence of copper rich minerals.

Location- Singhbhum Shear Zone

Pujon Das, *M.Sc. Sem. IV*

2021



Location-Devkund, Orissa.

Indrani Roy

B.Sc. Sem II 2021

“Photograph showing cross stratification overlain by a unit of massive, tabular granular diamictite.”

Location- Asan River Section, Sadhukul, Himachal Pradesh.

Arpita Kundu

Departmental Alumnus
B.Sc. 2017

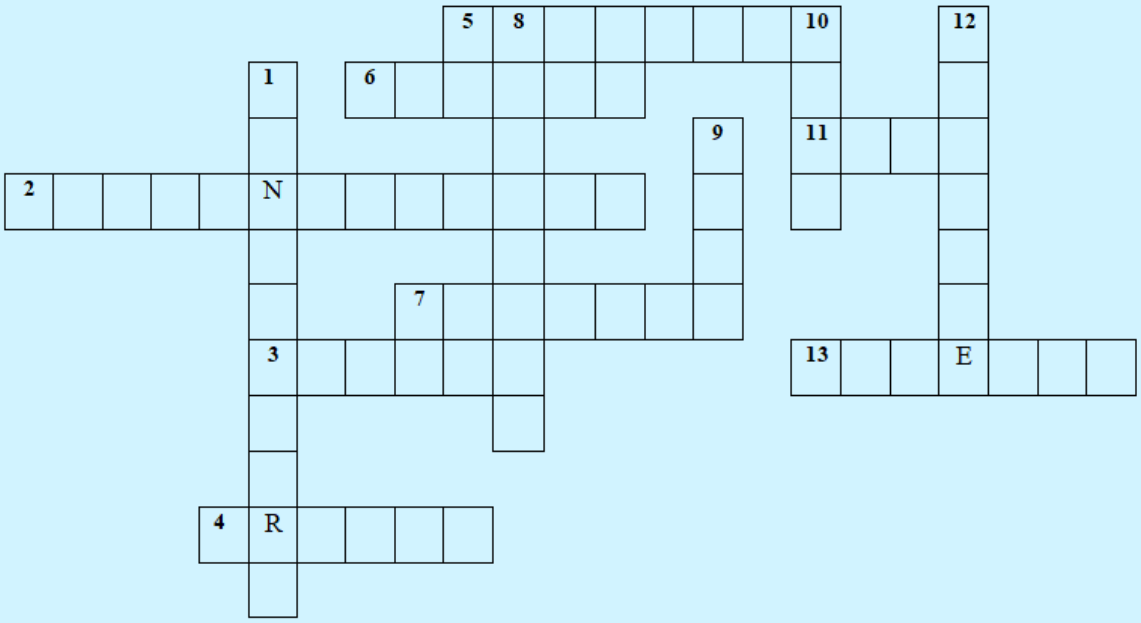
Word Find -

V	E	E	B	C	L	V	H	K	D	E	A	C	O	S
O	T	N	A	O	H	E	G	N	A	I	M	R	E	P
L	I	O	S	N	Z	V	K	Y	A	N	I	T	E	E
C	N	T	A	G	J	L	I	M	E	I	C	I	T	E
A	A	S	L	L	F	A	U	L	T	L	A	P	O	L
N	R	E	T	O	P	V	G	A	I	C	M	S	P	B
O	G	M	W	M	K	I	A	I	Q	S	T	B	P	R
E	Z	I	I	E	L	B	R	C	O	A	L	C	B	A
S	M	L	Y	R	A	T	N	E	M	I	D	E	S	M
A	C	W	P	A	H	L	E	G	O	R	B	B	A	G
Z	A	P	O	T	C	W	T	A	I	C	C	E	R	B
Y	I	B	L	E	A	P	K	S	Y	E	N	I	T	E
C	S	A	N	D	S	T	O	N	E	L	A	H	S	G
I	B	O	S	S	C	O	R	R	U	N	D	U	M	Q
F	E	T	I	T	A	P	A	A	Z	L	F	T	D	H

N.B.: Words can be found from top-to-bottom, left to right as well as bottom-to-top and right to left.

Answers to word find- chalk, permian, marble, kyanite, mica, fault, garnet, opal, bivalve, coal, sedimentary, soil, apatite, corrundum, sandstone, conglomerate, volcanoes, syenite, gabbro, basalt, granite, topaz, limestone, breccia.

Cross Ripples -



Down:

1) A belt around the Pacific Ocean where volcanoes and earthquakes are very common.
8) Rocks are made of.
9) Small quartz grains found on the beach.
10) Soft mineral.
12) Igneous rock used for countertops.

Across:

2) Top layer of the earth that contains the crust and the upper part of the mantle.
3) Remains of a prehistoric plant or animal.
4) A steep-walled depression around a volcano's vent.
5) Purple form of quartz.
6) Salty mineral.
7) Hardest mineral in the world.
11) Magma that comes out of volcanoes.
13) Type of rocks made from volcano lava.

Answers to Cross Ripples-

1. Ring of Fire
2. Asthenosphere
3. Fossil
4. Crater
5. Amethyst
6. Halite
7. Diamond
8. Minerals
9. Sand
10. Talc
11. Granite
12. Igneous

Current Ripples –

1. Paleonursery offers rare, detailed glimpse at life 518 million years ago. Deposit contains exceptionally preserved fossils of soft-bodied, juvenile organisms from the Cambrian.

Date: June 28, 2021
Source: Penn State
Summary: All life on Earth 500 million years ago lived in the oceans, but scientists know little about how these animals and algae developed. A newly discovered fossil deposit near Kunming, China, may hold the keys to understanding how these organisms laid the foundations for life on land and at sea today, according to an international team of researchers.

2. Discovered in Bhimbetka, India's lone fossil of world's oldest animal.

Date: February 10, 2021
Source: TOI
Summary: Hidden in plain sight, one of the rarest fossils in the world may have been discovered in the fascinating Bhimbetka rock shelters, a Unesco site about 40km from **Bhopal**.

Researchers believe they have found the first-ever fossil in India of a **Dickinsonia** —the Earth's *'oldest animal'*, dating back 570 million years — on the roof of what's called the 'Auditorium Cave' at Bhimbetka. Dickinsonia fossils have shown they could exceed four feet in length but the one found in Bhimbetka is 17 inches long.

3. Mining precious rare-earth elements from coal fly ash with a reusable ionic liquid.

Date: June 23, 2021
Source: American Chemical Society.
Summary: Rare-earth elements are in many everyday products, such as smart phones, LED lights and batteries. However, only a few locations have large enough deposits worth mining, resulting in global supply chain tensions. So, there's a push toward recycling them from non-traditional sources, such as waste from burning coal - fly ash. Now, researchers report a simple method for recovering these elements from coal fly ash using an ionic liquid.

4. Scientists hail stunning 'Dragon Man' discovery

Date: June 25, 2021.
Source: BBC
Summary: Chinese researchers have unveiled an ancient skull that could belong to a completely new species of human. The team has claimed it is our closest evolutionary relative among known species of ancient human, such as Neanderthals and Homo erectus. Nicknamed "Dragon Man", the specimen represents a human group that lived in East Asia at least 146,000 years ago. It was found at Harbin,

north-east China, in 1933, but only came to the attention of scientists more recently. The researchers say the discovery has the potential to rewrite the story of human evolution. Their analysis suggests that it is more closely related to Homo sapiens than it is to Neanderthals. They have assigned the specimen to a new species: Homo longi, from the Chinese word "long", meaning dragon.

5. The Earth has a pulse -- a 27.5-million-year cycle of geological activity, researchers say Analysis of 260 million years of major geological events finds recurring clusters 27.5 million years apart.

Date: June 18, 2021.
Source: New York University.
Summary: Geologic activity on Earth appears to follow a 27.5-million-year cycle, giving the planet a 'pulse,' according to a new study.

6. Geological riddle solved: Roof of the World has gotten higher.

Date: May 26, 2021 *Source:* University of Copenhagen - Faculty of Science.
Summary: There has long been controversy about whether the world's highest region, Tibet, has grown taller during the recent geological past. New results indicate that the 'Roof of the World' appears to have risen by up to 600 meters and the answer was found in underwater lava. The knowledge sheds new light on Earth's evolution.

7. **Airborne radar reveals groundwater beneath glacier**

Date: May 20, 2021
Source: Stanford University
Summary: Researchers have detected groundwater beneath a glacier in Greenland for the first time using airborne radar data. If applicable to other glaciers and ice sheets, the technique could allow for more accurate predictions of future sea-level rise.

8. **Earth's oldest minerals date onset of plate tectonics to 3.6 billion years ago Ancient zircons from the jack hills of western Australia hone date of an event that was crucial to making the planet hospitable to life.**

Date: May 14, 2021
Source: Smithsonian
Summary: Scientists provide new evidence that modern plate tectonics, a defining feature of Earth and its unique ability to support life, emerged roughly 3.6 billion years ago. The study uses zircons, the oldest minerals ever found on Earth, to peer back into the planet's ancient past.

9. **Is Earth's core lopsided? Strange goings-on in our planet's interior Model of how Earth's inner core froze into solid iron implies it may be only 500 million years old**.

Date: June 3, 2021

Source: University of California - Berkeley
Summary: Seismic waves generated by earthquakes travel through Earth's solid iron inner core faster in the direction of the rotation axis than along the equator. Scientists created a core growth model to explain this. To fit seismic data, the model predicts that asymmetric growth of the core leads to crystal movement that preferentially aligns iron-nickel crystals north-south. The model implies that the core is only 0.5-1.5 billion years old, a fraction of Earth's age.

10. Earth's meteorite impacts over past 500 million years tracked.

Date: June 8, 2021
Source: Lund University
Summary: For the first time, a unique study has tracked the meteorite flux to Earth over the past 500 million years. Contrary to current theories, researchers have determined that major collisions in the asteroid belt have not generally affected the number of impacts with Earth to any great extent.

11. Study of past South Asian monsoons suggests stronger monsoon rainfall in the future.

Date: June 4, 2021
Source: Brown University
Summary: New research finds that increases in monsoon rainfall over the past million years were linked with increases in atmospheric CO2 and the import of moisture from the

southern hemisphere, which suggests stronger rains in the future as CO2 levels rise.

12. Diverse fossil flora from 400 million year ago.

Date: June 8, 2021
Source: University of Liege
Summary: The greening of continents or terrestrialisation is undoubtedly one of the most important processes that our planet has undergone. For most of the Earth's history, the continents were devoid of macroscopic life, but from the Ordovician period (480 million years ago) green algae gradually adapted to life outside the aquatic environment. The conquest of land by plants was a very long process during which plants gradually acquired the ability to stand upright, breathe in the air or disperse their spores. Plant fossils that document these key transitions are very rare. The analysis of very old plant fossils discovered in South Africa and dating from the Lower Devonian period documents the transition from barren continents to the green planet we know today.

13. Geology helps map kidney stone formation from tiny to troublesome.

Date: May 25, 2021
Source: University of Illinois at Urbana-Champaign, News Bureau.
Summary: Advanced microscope technology and cutting-edge geological science are giving new perspectives to an old medical mystery: How do kidney stones form, why are some people more susceptible to them and can they be prevented?

"The process of kidney stone formation is part of the natural process of the stone formation seen throughout nature," Illinois geology professor Bruce Fouke said. "We are bringing together geology, biology and medicine to map the entire process of kidney stone formation, step by step. With this road map in hand, more effective and targeted clinical interventions and therapies can now be developed." Previous work from Fouke's group found that kidney stones form in the same way as geological stones in nature: Rather than crystalizing all at once, they partially dissolve and re-form multiple times, contrary to doctors' belief that they form suddenly and intact.

14. Dinosaur Fossil Found in China Named After 'Nobita' From Doraemon.

Date: July 10, 2021.
Source: News 18
Summary: A footprint fossil of a new dinosaur that was discovered in China last year has now been named after “Eubrontes Nobitai" as a tribute to popular cartoon character Nobita from the Japanese animation series Doraemon. According to Kyodo News, the fossil was discovered in July 2020 in China’s southwestern province of Sichuan.

Speaking about the decision to name the fossil after the cartoon character, Xing Lida, associate professor at the China University of Geosciences in Beijing, said that the Doraemon’s movies featuring dinosaurs were “excellent" and they have been part of childhood memories of many people in China.

He mentions the 1980 release Nobita’s Dinosaur and Nobita’s New Dinosaur (1920) and added that these films made children “come to like" dinosaurs.

The distance between the four footprints discovered at the site Is around 50 centimetres and the length of the sole is nearly 30 cms. Researchers estimated the body length of the animal could have been around 4 meters.

Source: News 18