Cogito

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Blood Pheasant
by Kushankur Bhattacharyya

IN THIS ISSUE

Editorial

The Show Must Go On

Arunita Banerjee

We are living through dismal days, among political wars, while the earth is steadily running a fever and life-forms are being pushed to a biological annihilation.

About three decades ago, while the world leaders battled to prove their worth in terms of nuclear power and space travel, quite similarly like today; Harvard biologist E.O. Wilson, attributed the existence of human beings to 'lower animals' - animals without a spinal cord - invertebrates. In a journal article titled 'The Little Things That Run the World', he wrote, "If invertebrates were to disappear, I doubt that the human species could live more than a few months."

A callous human-ego has led to this nomenclature, in which humans and other vertebrates - animals with a spinal cord - are referred to as 'higher animals'. And although this nomenclature pertains to intelligence among animals, the higher ones - humans - are not acting quite like it.

We live in the Anthropocene - the human dominated era of natural history. And we have been shaping and sizing the world to suit ourselves. The cost is the immense damage we have been doing to nature and natural systems. What started off as pollution of land, air and water, has led to a profound problem - climate change.

Three global agencies – NASA (National Aeronautics and Space Administration), NOAA (National Oceanic and Atmospheric Administration), and the UK Meteorological office, have confirmed that the warmest cardinal decade ended with 2019, among records dating back to the mid-19th century, and the warming trend will continue in 2020. While we may not feel the temperature rise very much, we have been surrounded by marked examples of climate change in action – Unpredictable cyclones in South East Asia, snowfalls in hot deserts, devastating floods in South America and parts of Asia, ice-caps melting in the poles and the most recent Australian bush fires due to extreme drying of land, to name a few.

Seventeen year-old Swedish teenager Greta Thunberg, successfully managed to provide a world stage to the climate crisis campaign, by her sudden rise to international prominence. The last year witnessed an unprecedented number of climate strikes across the globe. Greta received humongous support globally, especially from the youth and children, alongside general public. In the 'global climate strike' week of September, 2019 alone, over 7.6 million people, across 185 countries, took to the streets demanding governments and other organisations to take action and implement policy changes to save the planet we live on.

And while the last few months saw climate change movement gain momentum, socio-political turmoil equivalently paced up in different parts of the world

Hostility between Saudi Arabia and Iran, along with the US involvement, is empowering the humanitarian crisis in the entire Middle-east: from Yemen to Lebanon. The Boko Haram insurgency in Nigeria, civil war in Sudan and increasing tensions in Cameroon, have piled up on to the already existing economic crises that the African countries struggle with. Political violence in Hong-Kong and India are steadily reaching proportions of becoming a global concern.

We are thus, moving towards a dystopian world of hate mongering, civil wars, unbreathable air, water shortage, natural calamities, poverty, hunger, all at once – 'The Uninhabitable Earth', that David Wallace-Wells described. Consequences of climate change will wreak havoc in social economic and political terms, by creating an indispensable refugee crisis, when people start fleeing from uninhabitable areas.

With the rise of political turmoil all over the world, the worldwide 'climate-strike' has taken a back-foot. Although 2019 gave us hope of having spread enough awareness among the public and the leading nations of the world joining hands in comprehensive action; 'climate change denial' was surely defeated. But the real battle still awaits.

With each passing day we spend, still trying to raise awareness about the climate crisis and implementing measures to contain the havoc, we also continue to add to our respective carbon footprints. However, the UNDP website holds that "Climate change is running faster than we are, but this is still a race we can win."

At this point, it is imperative that we realise, this is a race we 'have to' win. Species extinction rates are higher than ever now. Life-forms are being wiped out from the face of this earth in the ongoing 'sixth mass-extinction', which is being referred to as a process of 'biological annihilation', by the scientific community. And even though if this may take you by surprise, the progress of the climate crisis has the potential to wipe out human beings as well, just as any other obscure species about whose existence or extinction, you didn't care.

While humans fight each other and superpowers continue to become more powerful, the nemesis of mankind, which they themselves gave rise to, might just play a masterstroke and put an end to all wars and conflicts, by putting an end to the human race itself.

Arunita Banerjee is a research scholar at IISER Kolkata and a freelancer at Research Matters, India BioScience, Live Wire. She is also the Chief Editor of Cogito.

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Opinion

Collaborative Science as a Path to the Future

Subhayu Bagchi

"When the snow falls and the white winds blow, the lone wolf dies but the pack survives."

Popular media and history have long glorified the stereotypical image of a scientist as a lone individual toiling away in a tower of isolation; grappling with the fundamental questions of nature. Sometimes embroiled in mad experiments with pipettes and colorful chemicals and dissect ed frogs; sometimes armed with the humble weapons of a blackboard and chalk.

This is how generations of scientists-to-be grew up perceiving this profession. I, however, firmly believe all that is a thing of the past. As the modern age dawns, scientific progress has shifted more and more towards collaborative progress, which has produced feats of human intelli gence that boggles the mind. If one were to tell Isaac Newton about the Large Hadron Collider, the shock would probably render him mute.

I believe that the following are the reasons behind it. Globalization and ease of access in this era have made it easier for collaborations to flower. When Satyendra Nath Bose sent over his paper, from Dhaka, via post to Albert Einstein in Germany, it took weeks to see the light of day. Nowadays all one needs is a reliable internet connection, with most major collaborations conducting weekly meetings over Skype for progress updates or reporting issues.

With Early Career Researchers (ECRs), I believe collaborations are a way of stepping outside the safe, focused domains of their PhDs to apply their skills to vastly different problem sets. Encouraging collaborative research allows cross-pollination of ideas between different fields, leading to major breakthroughs. For example, the concept of machine-learning, developed as an algorithmic tool in digital space, has now grown to applications in virtually every sphere of scientific analysis.

With the current trends of interdisciplinary research, collaboration as a method of scientific research has become even more important. This allows a diverse collection of people to each bring something unique to the table which contributes to the overall goal of the project, without requiring that all participants be an expert in each and every facet. Fields like Bioinformatics, Computational Astrophysics, Material Sciences all have their roots in such kinds of collaborative research.

Lastly, the oil that burns our lamps: funding. In giant collaborative endeavors like the LHC or LIGO, it is practically impossible to secure funding from a single source or donor. To secure a substantial funding thus requires results to show for it. In terms of efficiency and resource utilization, collaborations, thus, have few parallels in scientific methodology.

The question thus remains, are the days of the Einsteins and Pavlovs gone? Is the legacy of the lone genius dead? I hope not. There still are plenty of problems that require long hard thinking, perseverance and sheer willpower, which are all the hallmarks of a lone tour-de-force that we commonly associate with individual brilliance. For the rest, collaborations help to go a long way.

Subhayu Bagchi is an alumnus of IISER Kolkata. He is currently a grad physics researcher at University of Mississippi.

Interview

A Scientist's Perspective

Prof. Narayan Banerjee, in conversation with Suvadeep Roy

Interviewer: We are really very honoured to have you with us, Sir. You have truly been an inspiration to generations of scientists and continue to be so. Thank you for lending me some of your valuable time for this conversation.
You are a recipient of the prestigious Vaidya-Raychaudhuri endowment award, which has two eminent physicists in the name. However, they themselves did not get the popular recognition that they deserved. We see the trend continuing, with other Indian scientists as well. What do you think is the reason behind this?

Prof. Banerjee: You are right. They are not well known amongst the common people although their contribution to knowledge is so fundamental. But see, scientists are not really public figures. So, it is in a way expected. Vaidya found out the exact solution of Einstein's equation for a radiating star and the stars do radiate you see. And Raychaudhuri's equation deals with singularities. We hear so much about Hawking-Penrose singularity theorem, that in the realm of general relativity singularity is bound to happen if some energy conditions are fulfilled. That can be ascertained from Raychoudhuri's equation. But the Hawking-Penrose energy theorem is much more abstract, which involves a lot of mathematical structure. On the other hand, Raychaudhuri's equation is much simpler. Their (Vaidya and Raychaudhuri) work easily stand out in the field of gravity and cosmology, and they have far reaching effects. Of course they are widely respected amongst the gravity community, all over the world, but not other than that because their work did not find any everyday application. I think that is the reason but anyway, I don't believe that scientists will ever be public figures like a football player, a film star or a cricketer.

Interviewer: Recently India is making a name in the world stage for doing rocket science on a shoe-string budget, the latest achievement being that of Chandrayaan 2. Also, the recent invention of room temperature semiconductors, by Indian scientists is making legitimate news. But pseudo-scientific ideas are making a lot more noise. How do you think the scientific community should tackle this?
Prof. Banerjee: The attitude of a scientist should be to question everything and test everything against logic as well as observation. So, I think the most important responsibility of a scientist or scientists, as a community, is to make people aware that you should ask the rationale, the logic and what are the observations, logical explanation before believing pseudo-scientific ideas. As a scientist one has a responsibility in his own way to work in at least a smaller scale. Try to train your friends and members of your family and anybody who comes close to you about asking questions and help them understand that they have to logically accept something before believing it. Of course there will be people who will oppose these but everyone has at least a minor responsibility to train people around them to think scientifically.

(continued)

Interviewer: Nowadays, curtailing of research funding is a global issue of concern among the scientific community. On one hand, we see some taking to the streets to 'March for science' and on the other hand, we find some scientists keeping themselves excluded from social and political affairs. What is your take on this?
Prof. Banerjee: : When you live in a society, you have some responsibilities towards that. One cannot forget that a scientist is a social being, as a social being a scientist has his or her responsibility as well. Right? And with the social aspects, invariably comes politics. I'm not talking about a definite political philosophy, I am talking about the social requirements. I do not support this idea of staying away from all social issues.
One should not forget, that industry is fine, we cannot survive without that. But although Science and Technology are intimately related, but they're not identical. And today's science research is costly. So, for the sake of civilization, one needs to fund science, without expecting an immediate industrial application. However, every scientific discovery sooner or later gives birth to some kind of technology!

Interviewer: You have actively been involved in scientific research for more than three decades now. So, why did you choose Theoretical Physics in the first place, specifically Gravitation?
Prof. Banerjee: As a student, I was interested in two things, one is general relativity, the other is elementary particles. It worked out like that I ended up doing general relativity.
Presently I'm interested in various aspects of gravitation and cosmology. One is, that our universe, our habitat, is expanding. But you know that gravity is attractive. So that the universe expands is fine. That maybe due to some initial condition, initially, there was some push for it's expansion, but the expansion should have been decelerated. The two galaxies are moving away from each other, but they attract each other, right? So, the velocity of separation should be decelerated. That was the expectation. But, but for the last 20 years, we know that the universe is actually expanding with an acceleration as if someone is pushing the galaxies away from each other, so, that is quite surprising, goes against your knowledge and belief. The gravity is attractive. So, there are all sorts of attempts to explain this kind of an acceleration. The kind of matter that gives rise to an accelerated expansion or repulsive gravity is called a dark energy. So, one of my present interest is to look at different aspects of dark energy. I try to construct models of dark energy.

Interviewer: Can you tell something very lucidly about dark matter?
Prof. Banerjee: Dark energy is some kind of matter which has a kind of effective negative pressure and this negative pressure gives you repulsive gravity. So, my interest is to try to find out what the dark energy is all about. It is still not known. See, in physics it's all about evolution. So, if something is moving, then you talk about velocity with which it changes its position. Right now, if you see velocity is changing, then you think about the evolution of velocity you know, think about acceleration, right? So, it was thought that the acceleration of the universe was constant. Acceleration is related to a dimensionless parameter called the dissolution parameter which was thought to be a constant. Now, we see that, the acceleration of the universe is evolving. Meaning at some stage the universe had decelerated expansion and in the recent past, let's say for a few giga years, it is having an accelerated expansion. The evolution of velocity is called acceleration. The evolution of acceleration is called jerk. We try to use the observational data to find out an expression for this jerk and from that try to reconstruct the model of the dark energy.

Interviewer: Do you think learning science in mother tongue can make students understand science better? What are the pros and cons involved?
Prof. Banerjee: Yes, absolutely. But there are problems as well. It is easier to learn anything in one's mother tongue, but in science, in any subject for that matter, you have to communicate everyday. You cannot do science, sitting alone under a tree. So, communication will be a problem. The internationally accepted language of communication in science today is English. So I would rather play safe and suggest that students who want to do science should be taught in English rather than anything else at the higher level.

Interviewer: Please share some stories or happy moments you remember from your scientific career.
Prof. Banerjee: I'm not so sure. See, every moment is a happy moment in that sense. Because, working in science, it's not likethat you are finding something new all the time, but you are always on the lookout for something. So that gives you fun. But I think, the happiest moments I have spent is the time I have spent with my students.. There are so many happy memories. Don't ask any incident because I shall not be able to do justice which one I am more fond of. One very exciting moment for me was perhaps the news that the gravity wave has been detected, but the excitement was slightly less than what it could have been, because somehow I had anticipated it. It was not a public news. But I had heard rumours and had anticipated that this is going to be announced shortly.

Interviewer: On a lighter note you have such a wonderful voice, have you ever thought to use it in theatre or film?
Prof. Banerjee: No. As a student when I was in college I played in theatres but not for the voice. In fact, most of my friends said that I was a good actor. So, I had some popularity as an actor but no points for the voice. But anyway, when this interview is published, please don't miss it! I can actually show it to my family that I have some quality, the voice!

Interviewer: So, as an end-note what is your message to budding scientists?
Prof. Banerjee: Enjoy! enjoy your science and enjoy doing your science. It needs a lot of hard work as well. Have you ever seen, at least on TV, Kapil Dev fielding? You will see that it is effortless. Do you think that he does it by God's grace? No, there's nothing like that. He worked hard. Worked very hard. What a tremendous effort is required to make it effortless. So, everything if you want to do above a certain level one has to work hard. But the bottom line is that you have to enjoy it. Unless you enjoy it, you can't do that. And as you asked before, whether you actively participate in everything or not, that is a separate stor, but don't forget amidst anything that you are a social being, you have social responsibilities. You will not be able to do everything by yourself. So you have responsibilities too. These two things I would say, and yes, always be true to your own self!

Suvadeep Roy is currently a final year BS-MS student in Theoretical Physics at IISER Kolkata. His research work deals with string theory and holographic duality. He is also the editor of a bengali little magazine 'Vorer Pakhi'.

News

The main culprit for pollution over Kolkata

Nandana Goswami

A recent collaborative study by scientists from India and China, has found that sulphur is the major chemical component, responsible for a long term increase in the aerosol amount over the city of Kolkata, an Indian metropolitan. Aerosols have become one of the biggest concerns for climate researchers in current times.

These tiny solid particles or liquid droplets suspended in the air are responsible for maintaining an optimum heat balance on earth by scattering and absorption of sunlight. However, presently, owing to the overloading of different aerosols in the atmosphere and their harmful chemical composi tions proving to be hazardous to human health, they have been defamed as one of the leading pollutants worldwide.

Our country is home to 14 of the 20 most polluted cities in the world with a huge exposure to aerosols."India should be worried", says Bijay Sharma, a research scholar at Indian Institute of Science Education and Research (IISER), Kolkata, associated with this study.

Aerosols having a diameter less than 2.5 microns are particularly dangerous. They are estimated to be the major contributing factor to about 570000 mortalities in India about 42 % of which has been reported from the Indo-Gangetic plains . However, due to lack of a dense network of ground measurement facilities like sun photometers in India, it is a challenge for the environmentalists to report about the country's long term aerosol trends.

"But understanding long term aerosol trends in India holds a vital key to understanding the air pollution here!", claims Prashant Rawat, the primary investigator of of this study, at the Centre for Climate and Environmental studies, IISER Kolkata. Mr. Rawat gathered the aerosol data for the last 17 years over Kolkata and adjoining areas from a state-of-the-art instrument called MODIS, on-board NASA's Terra and Aqua satellites, alongside MERRA-2 , one of the latest analytic tools from NASA. His approach has uniquely overcome the long-standing hurdle of ground measurement deficiency in aerosol levels.

According to this research, Kolkata has suffered a 32% increase in total Aerosol Optical Depth (AOD) - the amount of aerosols in the vertical column of atmosphere over an area of interest from 2001-2017. AOD for sulphate shows the largest increase of 70%, followed by organic carbon and black carbon with increases of 40% and 20% respectively. The study thus leads to a conclusion that sulphate literally drives the entire AOD rise in the region.

It has also been found that there is a dominance of finer aerosols over the Gangetic plains especially during the post-monsoon season relative to the dry summer. Mr. Rawat explains that summers, being dry, may cause the uppermost soil to erode away and the coarser soil dust remains suspended in the air. On the other hand, during post-monsoon and winter, a relative spike in biomass burning might be a relevant candidate as a source for the finer aerosols.

The wind trajectories of these aerosols have been used to identify their sources - locations of major thermal power plants and regional burning of agricultural crop residue, in the Gangetic plains. This indicates that long-range transport of aerosols from the central or north-western Gangetic plains also add to the aerosol load over Kolkata.

Mr. Rawat acknowledges that their research comes with certain degrees of uncertainties. "However," he emphasizes," the report is legitimate enough to strongly imply that the air quality of the country is degrading faster than we expect."

Scientific research should always play a vital role in government policies. Therefore, these recent findings should act as an eye-opener for the authorities so that climate policies in the country can be introduced or reformed accordingly, to mitigate the delicacy of the current situation.

Nandana Goswami is a MS student in the Petrology Lab of IISER Kolkata. She studies metamorphic rocks and traces history through them.

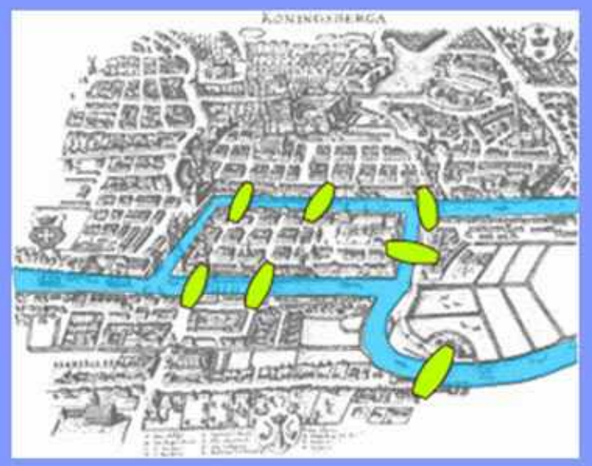
Review

Walking in Königsberg

Debmalya Bandyopadhyay

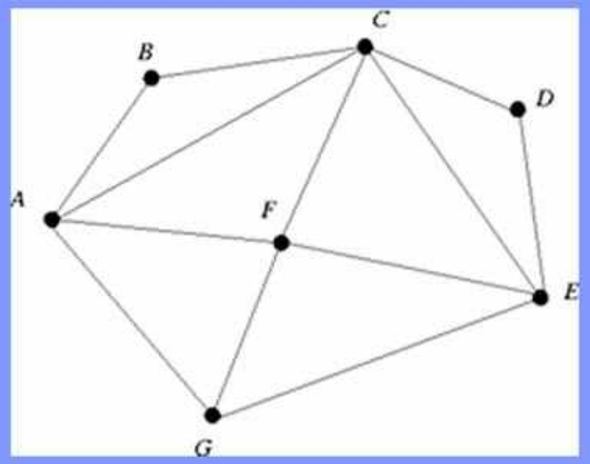
We start our walk by the river Pregel flowing through the city of Königsberg (now Kaliningrad) in Prussia. Did I say Prussia? Yes, we are in the early 18th century, so Hitler isn't around yet, and we can safely concentrate on the question that has been maddening the citizens of Königsberg for a while! To get to it, let us first take a look at a rough map of the city.

Our object of focus in this map is the river that divides the city into four distinct parts as you can see. The green bean shaped objects are bridges that connect different parts of the city. Now the question that had been bothering the citizens for a while, was the following: Can someone start walking from any point in the city and end the walk having crossed each of the seven bridges exactly once ? Does such a route exist? The reader is hereby urged to try finding such a route in the given map themselves before reading the next part!



The answer to this question was provided by the much revered mathematician (also physicist, astronomer, logician, geographer, engineer, you name it, he did it) Leonard Euler, one of the most magnificent human minds to have ever lived. In 1736, he published his solution to the problem, only proving that such a route does not exist! (My apologies to the reader) Surprisingly, in solving this problem he gave birth to the very exciting field of graph theory, the applications of which have infiltrated almost every aspect of our lives today.

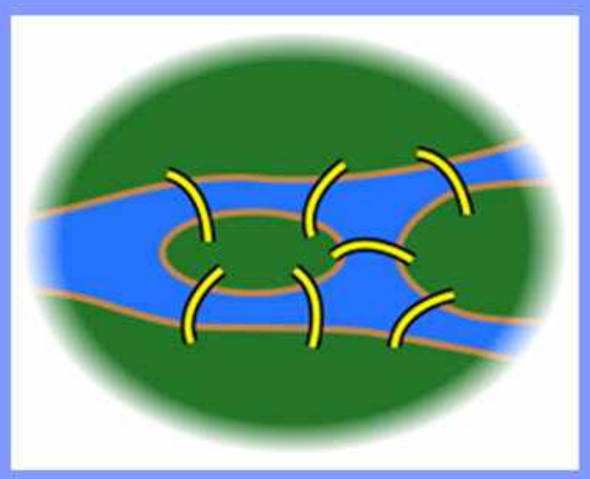
In order to understand Euler's simple solution, we shall arm ourselves with some very basic terminology. A graph is nothing but a set of points that we call vertices, and lines (called edges) each of which join two vertices.



The following is an example of a graph whose vertices are marked A to G, with 12 edges. Note that every combination is possible on a graph; we can have multiple edges between two vertices (called multi edges), we can have an edge going from one vertex to itself (called a self loop), we can even have directed edges that go from one vertex to another and not the other way back. The degree of a vertex is the number of edges that are touching that vertex.

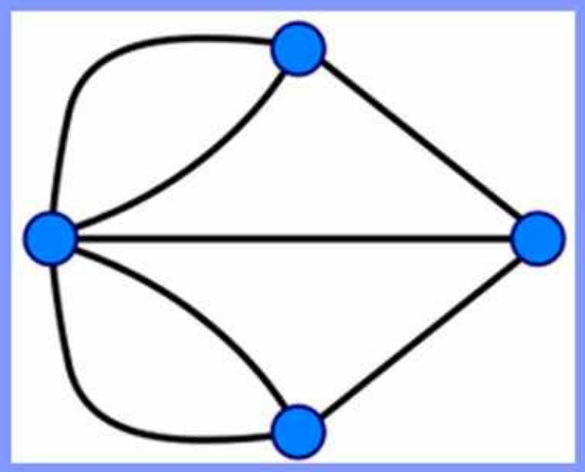
For example, in the above graph, vertex A has degree 4, and vertex G has degree 3. This is all the terminology that we need to tackle Euler's solution to the seven bridges problem.

Now in his search for the aforementioned route in the map of Königsberg, Euler quickly noticed that the path that a traveller took inside any of the four landmass was irrelevant, the only thing that mattered was the sequence in which the seven bridges were crossed, since the constraint was placed on them. This insight helped him simplify the map significantly. All that mattered now were the bridges, and which parts of the city they connected.



Euler represented the 4 parts of the city as 4 vertices, and the bridges as edges between them. In the above graph we denote this construction, with the left vertex representing the central island. The next observation was the most significant, that led to him concluding the non existence of such a walk

In terms of graph theory, we are required to start from any vertex on our graph, walk along the edges and stop at some vertex when we have covered each of the 7 edges exactly once. Now let us take a vertex that is neither our starting nor our stopping vertex. Then it must have an even degree, because we shall leave this vertex as many times as we enter it, and we cannot use an edge that we have already used before! So for such a vertex, the number of edges incident to it must be an even number. However, each of the vertices in the graph has an odd degree! (Three of them have degree 3 each and the vertex on the left has degree 5) Thus for such a walk to exist, no vertex can be a non-terminal vertex, meaning that such a walk cannot really exist with 4 vertices!



Euler thus showed that the existence of such a walk only depended on the degree of the vertices and nothing else. He also showed that for such a walk to exist the graph had to be connected, meaning that one could traverse between any two of its vertices along edges, and that that the graph should have either 0 or exactly 2 vertices of odd degree. In the latter case our starting vertex (with one net outgoing edge) and ending vertex (with one net incoming edge) would be different, and in the former the walk would start and end at the same vertex. Carl Hierholzer later proved that this result was not only necessary for such a walk to exist, but was sufficient as well, meaning that for any graph satisfying these criteria, there would always exist such a walk! We now call such a walk as an Eulerian path, in honour of the great mathematician.

Thus was born the field of graph theory, bringing one revolution after another with its applications. From modelling neural networks, understanding protein folding, optimizing traffic routes to designing the World Wide Web, it has been everywhere. Never did Euler judge the advances in technology his simple solution would bring along one day, and therein lies the beauty of human endeavour. What we drably dismiss as abstract, could very well assume form and define us tomorrow. After all, we are all slaves to our own brains!

Debmalya Bandyopadhyay is a third year undergraduate student pursuing Integrated BS-MS in Mathematics and Statistics from IISER Kolkata.

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The Thought Capsule

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Vision

What?

Cogito is a web-based bi-monthly, published on the IISER Kolkata website and available as a wall magazine on campus. The Oxford dictionary defines the word 'cogito' (latin: 'I think') as the principle, establishing the existence of a being, from the fact of its thinking or awareness. Cogito aims to encourage rational thinking among the scientific community of IISER Kolkata and hopes to spread awareness to the general public at large about scientific concepts. Our content contributors are from IISER Kolkata, but we intend to write and report about science done anywhere in the world.

Why?

Despite unbelievable scientific progress in the last few decades, there are reasons to believe that our society is yet to develop a basic scientific temper. The proof lies not only in the rampant abuse of nature and natural resources, but also in the pervasiveness of pseudoscience, myths and superstitions. So, it is indeed a challenging time for science in India and an exciting time to be a scientist. Cogito is our effort to ensure that the science we do should not be locked behind laboratory doors or restricted to the reach of the scientific community. We believe it to be of utmost importance to be able to communicate science, effectively, to the masses. Also, since research is public-funded, the scientific community should enable public benefit from research. Such enablement commands scientists to engage with the society, as communicators of the fruit of their work. People need to know why they should care about research, how it can affect their lives, and that science is a way of life. We hope that Cogito will be one such medium, to realise this goal.

Where?

Cogito is solely web-based at present. However, it is available as a wall magazine in the IISER Kolkata campus on poster boards located - in front of the research complex (RC), inside the teaching and research complex (TRC), inside the lecture hall complex (LHC), in front of the NSCB canteen and at the library entrance. You can read our published pieces on the website or at the wall magazine locations. Our wall magazine includes a QR code, scanning which, will directly take you to our website.

When?

Cogito has been envisioned as a bi-monthly (one issue in two months) magazine. We will consider shifting it to a monthly magazine, depending on content flow. We hope that the IISER Kolkata community will extend their cooperation in this regard and regularly help us in creating content.

How?

We accept content submission perennially and perpetually. We welcome anything and everything that communicates science - articles, news, opinion pieces, artwork, photographs, sci-toons, book-reviews, interviews. If you would like to write about a certain talk/event/conference at IISER Kolkata, send us a short report with a photograph on the same day and we will put it up on our website.

Words of Encouragementand Wisdom

"I love the fact that IISER Kolkata is bringing out a magazine, where you will talk to senior researchers, give their views out and put it out on the web and as a wall magazine. I think it's a very welcome step. It should be encouraged. Being on the web should not be something discouraging for you. The way forward is to be on the web. Web presence is what is going to matter in times to come. Having a print version may or may not be useful, but being on the web is most important. Talk to people, but also talk to students. There are lots of students who have amazing ideas. Listen to them. Bring their stories out. Somebody who's won a major national award, is a role model. But I think more important is to listen to young voices, because their ideas and vision will shape India in the 21st century. Bring their ideas and views out; and trust me, and trust me, you can make a tremendous difference, by simply pursuing this in a rigorous and an interactive manner."

Pallava Bagla, Science

"I hope your journey in science comm is one of wonder and awe. I believe, through you as messengers, Cogito will serve as a space for showcasing what the scientific community at IISER Kolkata and elsewhere in the world, has been up to- one imagines scintillating discoveries, failures, milestones, notes from the field, their work with communities and solutions to global challenges they are working on. I look forward to seeing cartoons, illustrations and multimedia in Cogito which promises to take us through the exciting lives of the scientists and the students. I do hope, at some stage, a section of Cogito content can be translated into the vernacular for the benefit of the community at large.

Sahana Ghosh, Mongabay India

"More often than not, the science done in institutions across India stays locked up in their ivory towers, inaccessible and intelligible by the masses. In such an environment, Cogito is a much-welcomed initiative towards making science accessible. I'm looking forward to seeing the science stories coming out of IISER Kolkata. Good luck!"

Pratik Pawar, Freelancer

More on our website!

Courtship behaviour is associated with mating behaviour, where an individual tries to impress the partner by either display or offerings or nest decoration etc. Here a Red billed Chaugh is offering food to the female as courtship.The one which is offering food is the male here and the receiver is the female. Not all species show sexual dimorphism. This is one such example.

On the Cover

Cooperation is a well known behavioural trait throughout the animal kingdom where generally group living organisms cooperate with each other while performing certain tasks to gain fitness. Here a Blood Pheasant couple is feeding in a cooperative manner. While the female is feeding, the male keeps an eye on the surroundings to watch out for predators and vice versa. The brightly coloured bird with white and red is the male and the brown one behind is the female. This is a nice example of sexual dimorphism where different sexes look different.

A Pig-tailed Macaque baby is feeding here on ripe berries. Feeding is a very crucial behaviour and is essential for nutrition and thus fitness. Fitness is a term associated with evolution. To define it simply one can say it is the amount of gene one can transfer to the next generation through its progeny or offsprings. As the offsprings has certain relatedness with the parents, the parents' genes are transferred to the progeny and when the offsprings reproduce it is transferred to the next progeny. This way the parent genes aquire fitness. There are two components to it. One fecundity : the number of offsprings produced, and second survivality : number of offsprings which lived until they

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