

ENVELOPE

A Newsletter by the Department of Biotechnology, TERI School of Advanced Studies, New Delhi

Knock! Knock! We have penned this letter down for you. From the moment we began the process of placing it in the envelope, our goal has been to communicate science effectively. We hope we are able to deliver quality science to your doorstep. Let's open this envelope together.

Issue: 1 | May 2023



Letter Drop

- Turning Plastics Biodegradable!
- The Reckoning of Chernobyl Tragedy with an Intent of Future
- Did you know that even plants have a way of shedding tears?

The Reader's Compendium

Deep Sea Angler Fish and Sexual Parasitism

Junk Mail

Manuscript

TERIPost

- DBT's Initiative Towards Biotechnological Solutions to Protect the Environment by Using Oilzapper

TERI SAS POST

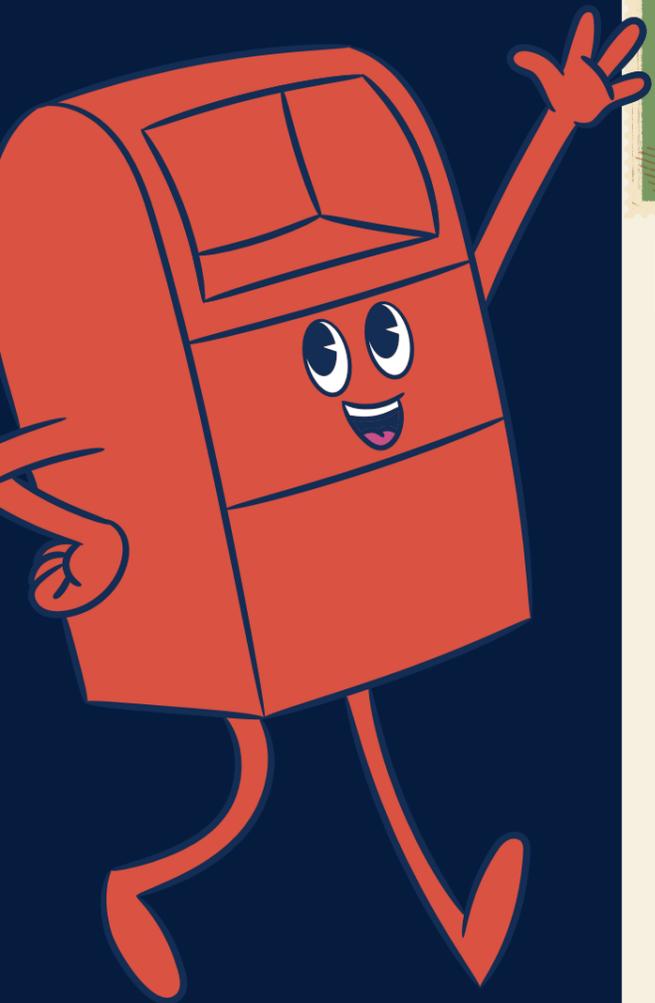
- The Importance of Collaboration and Adaptation in Biotechnology: An Interaction with Dr. Tripathi
- Activities in Campus



Have you ever mused over the happiness quotient of the plants in your garden? Do you ever speculate whether they shed tears or exhibit any visible signs of unhappiness when you accidentally forget to water them? Do you ever consider whether they exhibit any subtle behavioral changes when they feel neglected or undernourished? Turn to page 03 to find out more.



Have you ever come across the inspiring story of a barren land once devoid of value transformed into a flourishing paradise? Curious how this came to life? For more refer to page 07.



LETTER DROP

Flip your way through interesting scientific discoveries and breakthroughs via this newsletter.

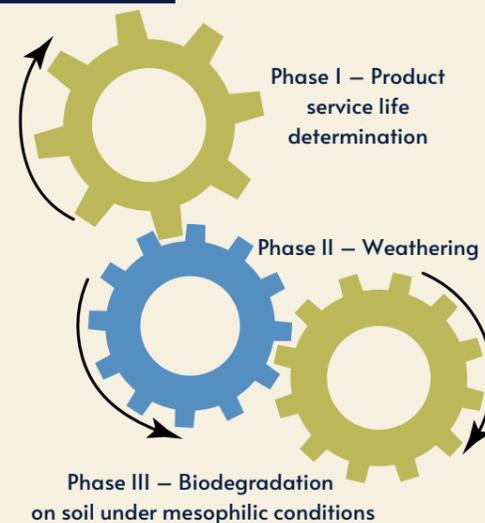
TURNING PLASTICS BIODEGRADABLE!

Biotransformation technology is a process of utilizing biological systems to modify chemicals and create new products. It involves the use of enzymes, microorganisms, or cells to transform organic compounds into other forms that are useful for various industries such as pharmaceutical, food, and environmental. This technology offers a sustainable and efficient alternative to traditional chemical synthesis methods as it reduces the carbon footprint of the industries that use it and does not involve hazardous chemicals or high temperature reactions.

The Imperial College in London, UK, and a Britain-based startup, Polymaterial have harnessed this technology to develop plastics having a pre-determined lifespan during which they maintain the quality and appearance of traditional plastics. Once their lifespan expires, these plastics self-degrade into a wax-like substance which is then consumed by the microorganisms to give water, carbon dioxide and biomass. This entire process can take place in under a year and works in various types of climatic conditions including arid, tropical and temperate.

Several limitations outline this biotransformation technology despite its advantages. To begin with, the cost of enzyme production can be enormously high in some cases. Another limitation is the need for a specific microorganism or enzyme for each application, which can limit the range of products that can be produced.

In conclusion, biotransformation technology is a promising approach, and its application has the potential to revolutionize especially the food and healthcare industries as they contribute



a major proportion to plastic waste generation, by providing an environmentally friendly and economically viable method of plastic biodegradation.

References:
<https://www.polymateria.com/about-us/what-is-biotransformation/>

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RASHI GUPTA

THE RECKONING OF CHERNOBYL TRAGEDY WITH AN INTENT OF FUTURE

The Chernobyl nuclear disaster was a significant event that caused the largest uncontrolled release of radioactive materials into the environment. The accident led to the emission of two radionuclides, Iodine-131 and Caesium-137, into the air for about ten days. Despite the severity of the catastrophe, various plants, including soybeans, continue to grow and flourish in the radio-contaminated soil. This surprising phenomenon led researchers to investigate the effects of ionizing radiation on plants, which has been studied for over eight decades. The molecular assays of plants growing in the Chernobyl area revealed that the plants have adapted to the heavy metal stress, radiation damage, and increased levels of ionizing radiation by mobilizing seed storage proteins. These adaptations resulted in high levels of Caesium-137 in the beans, making them unsafe for consumption. However, this understanding of plant adaptation could have practical applications, such as developing strategies for non-food agricultural use of radio-contaminated areas, including biofuel production. Additionally, studying how plants react to ionizing radiation could be useful for growing plants during long space journeys to fulfill nutritional needs.



Image: insights into radio-contaminated beans as compared to normal beans

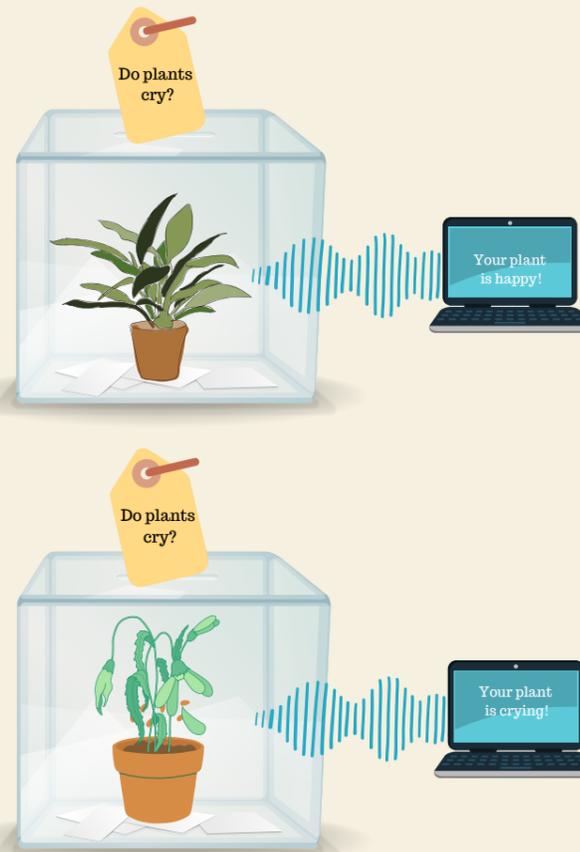
Rashi Gupta
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DID YOU KNOW THAT EVEN PLANTS HAVE A WAY OF SHEDDING TEARS?

When stressed or injured, plants produce "air borne sounds" that are equivalent to crying. A secret language so well guarded that only some animals, like mice, elephants, and bats can unravel the range of these ultrasonic "tears". These ultrasonic sounds are so high-pitched that we humans can't hear them, but they are there, telling a story of survival. These stressed plants produce up to 35 sounds in an hour, unlike well hydrated healthy plants which only produce one sound per hour.

With the work of researchers at Tel-Aviv University, we now have a way to eavesdrop on these plant conversations. Lilach Hadany and her team placed tomato and tobacco plants in boxes fitted with microphones and they were able to detect the sounds of thirsty, stressed, and recently-cut plants. It's like a symphony of sounds, with each note telling us something new about the plant's state of being.

The most amazing thing is that plants don't have any organs that can produce sound, no vocal cords or lungs like animals do. Instead, as demonstrated by Hadany they use their vascular tissue, creating air bubbles that burst and pop



during periods of stress, producing those haunting cries. It's a marvel of nature, and we still have so much yet to unravel!

But this knowledge is not just fascinating, it can also be useful. By listening to these plant sounds, we can detect when they are in distress and provide them with the care they need. Crying can be used as a parameter for the detection of thirsty and stressed plants, which could help in monitoring plants in horticulture and farming. Moreover, Hadany's team devised a machine-learning model which was able to deduce whether a plant was recently cut or stressed by the sounds it made with up to 70% accuracy. We can save crops, boost harvests, and create a better world for both plants and animals alike.

So, the next time you hear a plant cry, don't be afraid to shed a tear with them. After all, we all share a common bond of struggle and survival, and it's that shared experience that makes life worth living.

Vaibhav Kothari
M.Sc. Biotechnology

TERI School of Advanced Studies

References: Khait, I. et al. Cell <https://doi.org/10.1016/j.cell.2023.03.009> (2023).

THE READER'S COMPENDIUM

ON THE ORIGIN OF SPECIES

If beautiful objects had been created solely for man's gratification, it ought to be shown that before man appeared there was less beauty on the face of the earth than since he came on stage. Were the beautiful volute and cone shells of the Eocene epoch, and gracefully sculptured ammonites of the secondary period, created so that man might ages afterwards admire them in their cabinet?"

To call 'Origin Of Species' a mere book on evolutionary science would be a blithe disregard to Mr Darwin's exceptional understanding of the fundamentals of life. Most of my February was spent understanding this 'argument' as he preferably calls it, and in my understanding, the book holds much more than just scientific insights.

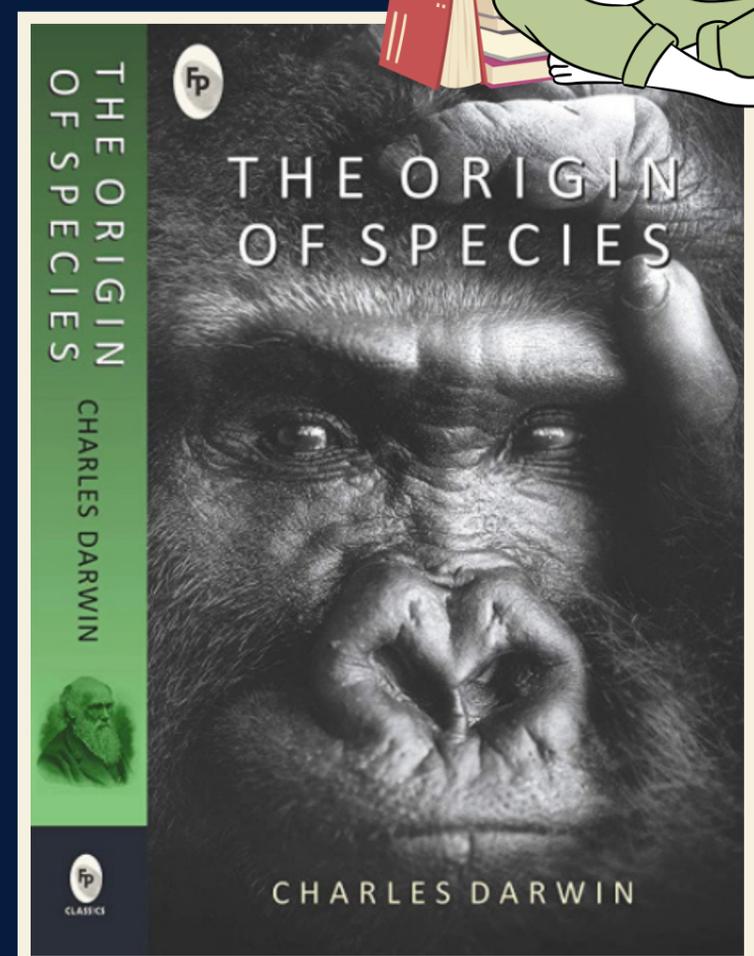
Origin Of Species contemplates a myriad of factors that create, support and destroy life - how and why do different species exist and modify? growing in different parts and its role in struggle for food and existence between individuals. Darwin very intelligibly puts forth the idea of natural selection vs selection done by man and explains- NATURE IN NO WAY FAVORS BEAUTY OF APPEARANCE, BUT BEAUTY OF PURPOSE A SPECIES BRINGS TO ITS ENVIRONMENT. Backed by wondrous examples, the book is not just full of theories but also, multiple queries and possible objections to the theory, which Darwin has tried to answer as much as he could.

Seldom do we come across a book this expansive which elevates us on an intellectual level, making us more aware. Written more than 160 years ago,

'Origin of species' makes a mark, giving:-

'One general law, leading to the advancement of all organic beings, namely - multiply, vary, let the strongest live and weakest die.'

Pragyee Thapliyal
M.Sc. Biotechnology
TERI School of Advanced Studies





DEEP SEA ANGLERFISH AND SEXUAL PARASITISM

LURING THE PREY

Deep-sea anglerfish, belonging to Clade Lophiiformes, are fascinating creatures found in the deep, dark waters of the ocean, where sunlight does not penetrate, organisms must generate their own light to illuminate their surroundings. Female deep-sea anglerfish use bioluminescence to generate light, which they use to lure their prey closer to them. The deep-sea anglerfish has an extension originating from the spines of its dorsal fin, which has numerous bioluminescent bacteria producing light. The terminal end of the extension and the entire dorsal spine glow with light, which attracts small fish, making it easier for the anglerfish to catch its prey.

DISCOVERING MALE DEEP-SEA ANGLERFISH

A TALE OF DISCOVERY

The discovery of male deep-sea anglerfish was a long-standing mystery for researchers. For decades, no male deep-sea anglerfish had ever been identified or found. It was not until the early 20th century that researchers discovered that the “missing males” had been misidentified as other fish species.

In 1922, an Icelandic biologist, Bjarni Saemundsson, discovered what he described as “a female Ceratioid with two of these smaller fish attached to her belly by their snouts.” Saemundsson believed that the smaller fish were the female’s offspring. However, he remained skeptical of the method of attachment of the larvae to the mother and passed the problem on to future researchers.

Two years later, in 1924, Charles Tate Regan, a researcher at the British Museum of Natural History, discovered a female Ceratoid attached to a smaller fish. He dissected both fish and found that the smaller fish was not the female’s offspring, but in fact, the MALE.

THE BREAKTHROUGH: AN UNCONVENTIONAL PATH IN LOVE

Regan and Norwegian zoologist Albert Eide Parr were the first to hypothesize the reason for the evolution of sexual dimorphism in Ceratoids. Regan suggested that while the female deep-sea anglerfish was giant, fierce, and luminous, the male Ceratioid grew to only a fraction of the size of the female and lacked the ability to lure its prey.

Instead, the males developed large, well-developed eyes and nostrils, which were adept enough to track a species-specific pheromone towards the female. Once the male found a suitable mate, it attached itself to the female’s belly using its sharp teeth, remaining there for the rest of its life.

Adapting to Sexual Parasitism (and to become one in Love):

Female anglerfish often have six or more males latching onto them permanently. The male fuses with the female, sharing a blood supply and receiving nutrition from her. The fusion also ensures that the male is always available to fertilize the female’s eggs. Over time, the male loses all organs that are not needed for his new life and becomes an appendage of the female, dependent on her for nutrition. Regan described the male anglerfish as a “merely an irremovable appendage of the female and entirely dependent on her for nutrition,” making them sexual parasites.

Not All Anglerfishes Are Sexual Parasites Though...

While the bizarre mating behavior does seem to be an important adaptation to keeping the mates close at hand, in seemingly vast, lonely and dark abyssal waters, there are other Anglerfishes, where the male does not exhibit extreme sexual dimorphism (i.e., morphological and size difference between males and females.) Such males encounter females only to mate for a short period of time and then drift away, freely swimming and hunting for their survival for the rest of their life.

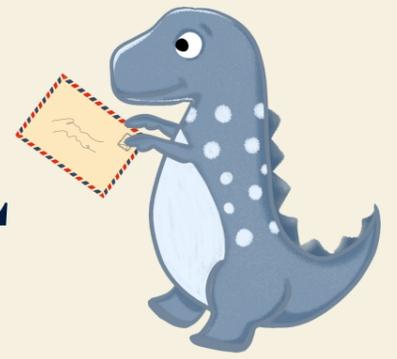
Such sexual dimorphism and parasitic behaviour are thus typical of deep-sea dwelling Anglerfishes only. Although they are found throughout the globe, the odd 160 species are still a rarity and swim around in darkness at a depth of 300-5000 metres. Such specimens are a marvel for the scientific community because very few species have been observed, let alone studied completely.

About the image: The image displays a pair of deep-sea anglerfish, which are drifting slowly in the dark waters. Upon observing the image more closely, one can notice a small male of the same species attached to the female’s abdomen, which is significantly larger in size.

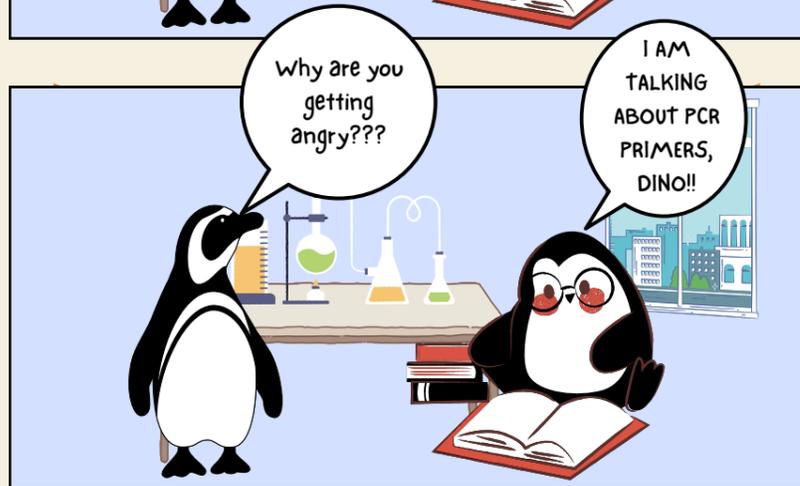
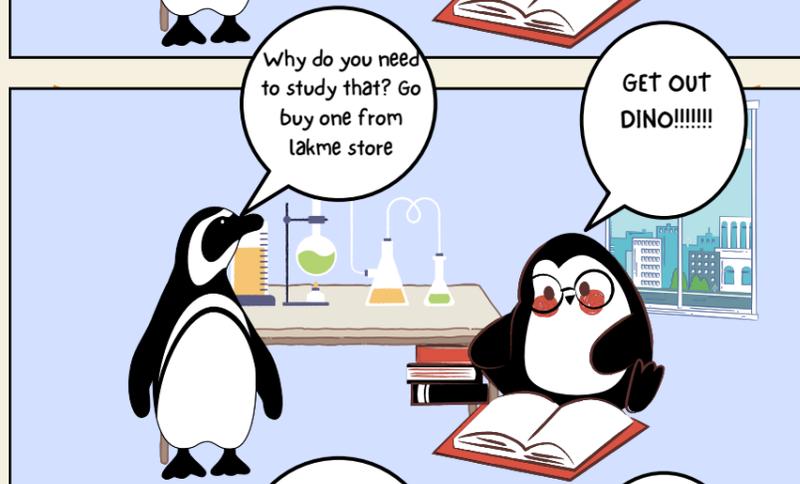
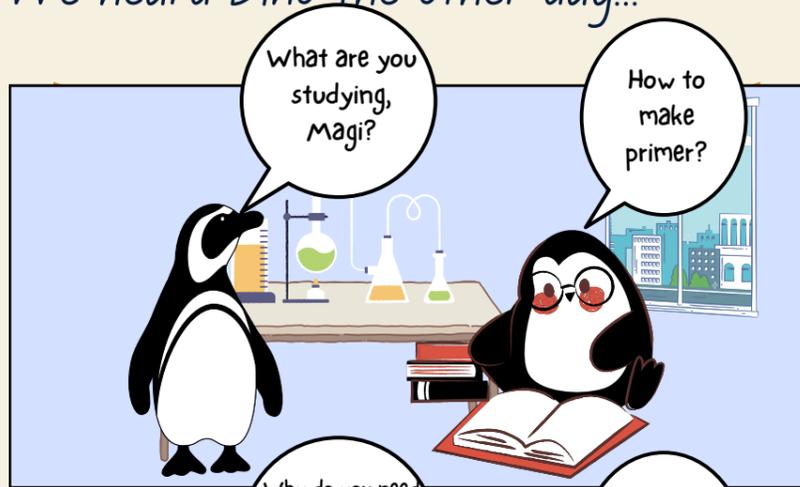
References and further readings:

1. The Horrors of Anglerfish Mating by Matt Soniak, 2014, Mental Floss. Available at – <https://www.mentalfloss.com/article/57800/horrors-anglerfish-mating>
2. The Bizarre Love life of the Anglerfish by Emily Osterloff, Natural History Museum. Available at – <https://www.nhm.ac.uk/discover/bizarre-love-life-of-the-anglerfish.html>
3. A light in the darkness, Understanding Evolution. Available at – https://evolution.berkeley.edu/evolibrary/article/fishtree_05 Swann, J. B., Holland, S. J., Petersen, M., Pietsch, T. W., & Boehm, T. (2020). The immunogenetics of sexual parasitism. *Science*, 369(6511), 1608-1615.

JUNK MAIL



We heard Dino the other day...



Ritika Kalra
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TERI School of Advanced Studies



Did you know there exists a species of fungus which has more than 17,000 sexes. This diversity is observed in **Trichoptum** mushrooms.



Did you know there's a protein in the human body called **Pikachurin** named after a famous character from Pokémon franchise.



Did you know DNA can be used to store data. In a single gram of DNA, 700 TB of data can be stored.

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YOU MIGHT LIKE TO READ THIS!



New genetic research has provided insights into the evolution of woolly mammoths. The study reveals that certain traits, including their fluffy coats, were encoded in their genes and became more prominent as the animals adapted to the harsh Siberian climate.



These deep-sea "potatoes" could be the future of mining for renewable energy.

MANUSCRIPT

rDNA: A CONTROVERSY IN THE MUGGLE WORLD: INTO THE PAST THROUGH DUMBLEDORE'S PENSIEVE, WHEN? AND WHERE?

An abstract to rekindle our minds.

It was 1973 at Gordon Research Conference on Nucleic Acids, among the excited scientists talking about the newly discovered technique to combine the hereditary material of the animals and the bacteria (to be put in a very laymen terms) sat some of the participants of the conference worried about the potential risks it is going to pose to the humans and the environment. "There was a possibility that harmless microbes could be unintentionally changed into human pathogens through the introduction of antibiotic resistance, which was part of the technique; through the production of dangerous toxins, which was a possible outcome; or through the transformation into cancer-causing agents of materials that previously were benign." A chaotic concoction of the participants urging for a noteworthy deliberation on these larger issues was assembled and upon their demands a conference to settle the issues was organized under the supervision of Paul Berg a lead investigator and a distinguished researcher. Massachusetts Institute of Technology, April 17, 1974 to alert the larger community and to describe the actions and the group's motivations a letter was drafted:

J. Roblin
 Give a copy to:

Joe Sambrook
Mike Botchan
Phil Sharp
Carol Muller
Doris Baltimore
Paul Berg
Hans Kornberg *Dave Zipser*
Who else? *Ray*
 Bob
 Carl DeLoe
 Rich Roberts

Distributed June 14, 1974

OFFICE MEMORANDUM • STANFORD UNIVERSITY • OFFICE MEMORANDUM • STANFORD UNIVERSITY • OFFICE MEMORANDUM

Date: August 13, 1974

To : Signators of Biohazard Letter
 Maxine Singer, Herman Lewis

FROM : Paul Berg *Paul*

SUBJECT:

Our letter on Recombinant DNA Molecules called for an "International" Conference at which the issues we raised would be discussed by people concerned with these problems and from which we might obtain an agreed upon statement or policy.

The conference is scheduled for February 24-27, 1975, at the Asilomar Conference Center in Pacific Grove, California. I assume that each of you will attend the conference and participate in some way in the program.

Baltimore, Roblin and I and recent invitees Maxine Singer (accepted) and Hans Kornberg (not yet replied) have undertaken the planning of the conference; my secretary, Ann Ferrell, will be coordinating the administrative details of the meeting.

Funds for the meeting have been promised by the NIH but very likely NSF, NAS and EMBO (and possibly others) will also provide funds. Consequently we should be able to bring all of the people needed to make this an interesting and productive meeting.

Our preliminary plan is to organize several working groups with 1 or 5 people, each to plan a scientific and discussion session dealing with a particular problem: (1) natural history of *E. coli* in animal and human populations; (2) plasmids and their genetic determinants; (3) opportunities and concerns associated with hybrids containing animal virus (both oncogenic or non-oncogenic) DNA; (4) opportunities and concerns associated with hybrids containing animal cell DNAs; (5) (tentatively) other autonomously replicating interspecies hybrids, e.g., plant and fungi DNA; (6) (tentatively) the techniques of constructing hybrid DNA molecules (e.g., restriction enzymes, other) and useful vectors (e.g., plasmids, and phages); (7) summing up, putting forth propositions for conference consensus and future plans.

Work group leaders for session 1 (M. Swartz), 2(R. Novick), 3(A. Shatkin), 4(Don Brown) and 7(the planning group) have been identified and they are already organizing their "teams". The others are still in the tentative stage. There will be a meeting of the planning group and the already agreed upon work group leaders at the MIT Cancer Center in Cambridge on Tuesday, September 10th, to discuss the progress so far. Suggestions or comments from any of the original signators of the Science-Nature letter would be deeply appreciated.

PB:af
 Enc.

Credit: Paul Berg Letter - Nature. Wellcome Collection. In copyright

In the history of rDNA, letters by Paul Berg to the Scientific communities and the science journals reflect the obstacles in terms of concerns pertaining to harmful effects of rDNA technology and iterative efforts made to rethink the technology and express the limits where genetic engineering might go astray.

Reference:

•Weiner C. (1999). Is self-regulation enough today?: Evaluating the recombinant DNA controversy. Health matrix (Cleveland, Ohio : 1991), 9(2), 289-302.



TERIPOST

Reporting to you the advancements straight from The Energy and Resource Institute, New Delhi
~ Team Envelope.

DBT'S INITIATIVE TOWARDS BIOTECHNOLOGICAL SOLUTIONS TO PROTECT THE ENVIRONMENT BY USING OILZAPPER

The Department of Biotechnology, Government of India, took the lead and started a programme on Petroleum Biotechnology in 1992, under which various projects got sanctioned. Under DBT sponsored project, TERI began to work on selecting indigenous microbes to clean up oil spills. After seven years of extensive efforts, TERI chose a consortium of microbes designated as "Oilzapper", which could degrade various types of crude oils under laboratory and field conditions. TERI obtained a patent (No. 168/DL/2000) on Bioremediation of oil spills and oily sludge contaminated sites.

For the large-scale product application, a Joint Venture named ONGC TERI Biotech Ltd (OTBL) was created between ONGC and TERI on March 26, 2007 under the Companies Act, 1956, with an Authorized Capital of 1 crore divided into 10 lakh equity shares of 10 each. The share of ONGC in this partnership is 49.98%, and that of TERI is 48.02% (Website : www.otbl.co.in). OTBL generated more than 320 crore as revenue from 2007 onwards. OTBL has also paid Tax (Service Tax, GST, and Income tax) of approximately 80 crore to the Government and OTBL also generated large number of employment opportunities (directly and indirectly).

Numerous lakes and rivers in different parts of India have so far been treated with Oilzapper, which has thus been instrumental in restoring the environment and livelihood of many farmers whose land was damaged due to oil spill. It is indeed an excellent example of harnessing science for the well-being of humankind. Many of those whose livelihood depends on fisheries also lose their jobs because of oil slicks in rivers and lakes. Water in many lakes situated in different parts of India was treated with Oilzapper, which was thus instrumental in restoring the livelihood of many people.



Oilzapper product facility "Fermentation Technology Research Institute" inaugurated by the Hon'ble Minister of State (Independent Charge), Ministry of Science and Technology, Government of India)



Oilzapper product



Before Bioremediation



After Bioremediation

BIOREMEDIATION OF OIL SPILL SITE BY OILZAPPER APPLICATION

In the past, for oil spills in farmers' fields, ONGC & Oil Companies used to pay huge monetary compensation to farmers for loss of land fertility and for loss of crop, at times multiple crops. The farmers were also losing a source of their livelihood for several crop seasons. However, with the introduction of 'OILZAPPER' technology, payment of monetary compensation has become history. In case of oil spill in farmer's field, OTBL moves in quickly, removes the oil contaminated soils and immediately replaces the same with fresh fertile soil. While the farmers immediately get back their fertile land for cultivation, there is no loss of livelihood for them and also ONGC saves enormous financial resources for having not to pay huge compensation to the farmers.

Currently, OTBL is providing bioremediation services on a large scale using Oilzapper.

The users of Oilzapper are all major oil companies in India and abroad, such as ONGC, IOCL, BPCL, OIL India Limited, Numligarh Refinery, Bharat Petroleum Corporation Ltd, Tata Power, Reliance Industries, BG Exploration and Production India Ltd, Mangalore Refinery & Petrochemicals Ltd. (MRPL), Canadian Nexen Petroleum Yemen, Kuwait Oil Company (KOC), Kuwait, and Abu Dhabi National Oil Company (ADNOC).

The technology has also been used in Yemen, Petromashila and for mega project in oil field of Kuwait Oil Company (KOC) in Kuwait to treat large oil-contaminated area.

TERI also completed a project on the clean up of the oil spill in 4 sq. km area in Kuwait (Middle East) with a project value of US\$40 million.

TERI treated 217,000 m³ soil through application of Oilzapper.

TERI SAS POST

Presenting to you updates from the Department of Biotechnology,
TERI School of Advanced Studies in a nutshell
~ Team Envelope.



THE IMPORTANCE OF COLLABORATION AND ADAPTATION IN BIOTECHNOLOGY : AN INTERACTION WITH DR. TRIPATHI



In our recent interaction, Dr. Shashi Bhushan Tripathi, Professor at the Department of Biotechnology at TERI School of Advanced Studies, emphasized the crucial role of collaborations within the field of biotechnology.

Dr. Tripathi firmly believes that solitary work is no longer effective and that collaborations are now an indispensable requirement. During our conversation, Dr. Tripathi highlighted the challenges faced by researchers when dealing with certain species that require specialized environments that may not be readily available. However, by pooling together resources, expertise, and funding through collaborative efforts, partners can overcome these limitations and achieve mutual benefits.

Dr. Tripathi also stressed the importance of bridging the gap between theoretical research and practical implementation. Scientific literature often contains technical terms and concepts that are difficult to implement in real-world scenarios. Collaborations can help address this challenge by bringing together researchers with different expertise and perspectives to facilitate the implementation of research findings and ensure their impact on solving real-world problems.

Sustainability is another key area of focus for Dr. Tripathi. He defines sustainability as the conservation of resources for future generations and believes that biologists can contribute to this by developing breeds and varieties that exhibit resistance against diseases and adaptability to future challenges. By focusing on adaptation rather than mitigation, biologists can ensure sustainable practices in biotechnology.

Overall, Dr. Tripathi's insights emphasize the crucial role that collaborations play in overcoming resource constraints, bridging the gap between theoretical research and practical implementation, and contributing to sustainability within the field of biotechnology.



TERI SAS students and faculty, Department of Biotechnology at TERI SAS Stall organised at World Sustainability Development Summit 2023, February 2023.

BIOTIKOS
DEPARTMENT OF BIOTECHNOLOGY
TERI SCHOOL OF ADVANCED STUDIES, NEW DELHI

presents
a webinar on

DIATOM BIOREFINERY
by
Dr. Archana Tiwari
Professor at Amity University, Noida, India. Her key research interests include Phycoprospecting Diatoms for wastewater remediation and high-value products.

18th February 2023 | 4:00pm
Platform: Microsoft Teams

To register tap on link or scan the QR
<https://forms.office.com/r/3pFvzHpMAR>

For queries: biotikos@terisas.ac.in [biotikos_terisas](https://www.instagram.com/biotikos_terisas)

BIOTIKOS
DEPARTMENT OF BIOTECHNOLOGY
TERI SCHOOL OF ADVANCED STUDIES, NEW DELHI

presents
a webinar on

**Role of Microbiome in Maintaining
Human Health, Environment &
Global Peace**
by
Prof. Rup Lal
Professor Rup Lal is an eminent and highly experienced INSA senior scientist who is known for his seminal work in the field of microbial metagenomics. He is currently serving as a senior ambassador of the Indian region for ISME (International Society For Microbial Ecology), FEMS (The Netherland and Federation of European Microbiological Societies) and is widely recognized as a distinguished authority in his field. With an exceptional academic record and deep passion for research, he holds a prominent position at Acharya Narayan Dev College, Delhi University.

29th April 2023 | 3:00pm
Platform: Microsoft Teams
To register tap on link or scan the QR
<https://forms.office.com/r/ODKTnBbpFj>

For Queries: biotikos@terisas.ac.in [biotikos_terisas](https://www.instagram.com/biotikos_terisas) [BiotikosTeriSAS](https://www.facebook.com/BiotikosTeriSAS) [Biotikos TERI SAS](https://www.linkedin.com/company/Biotikos-TERI-SAS)

Dr. Archana Tiwari opened the first instalment of the Biotikos Lecture Series of 2023 with a lecture on Diatom Biorefinery on February 18th. The lecture series was followed by a lecture on the Role of the Microbiome in Maintaining Human Health, Environment & Global Peace by Prof. Rup Lal on 29th April, organized by students from the Department of Biotechnology at TERI SAS.



TERI SAS students and Faculty visit to Krishi Vigyan Mela at IARI PUSA campus on 3 March, 2023.

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