



# Science Horizon

ODISHA BIGYAN ACADEMY

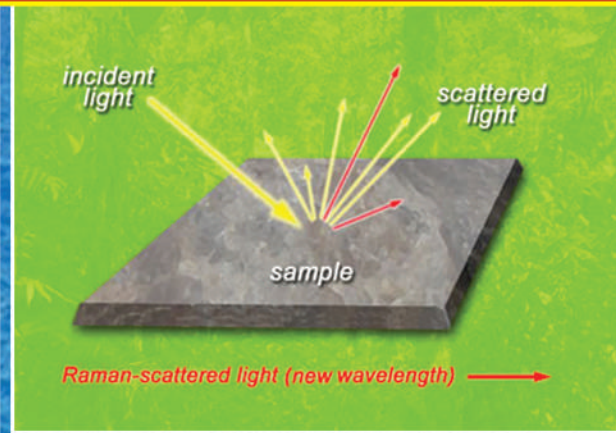
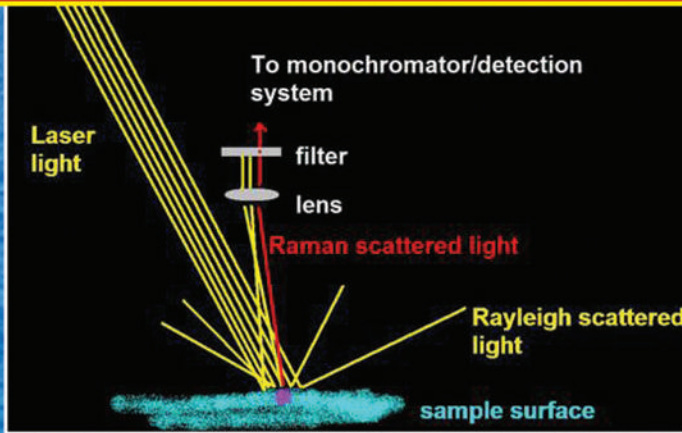
5TH YEAR

2ND ISSUE

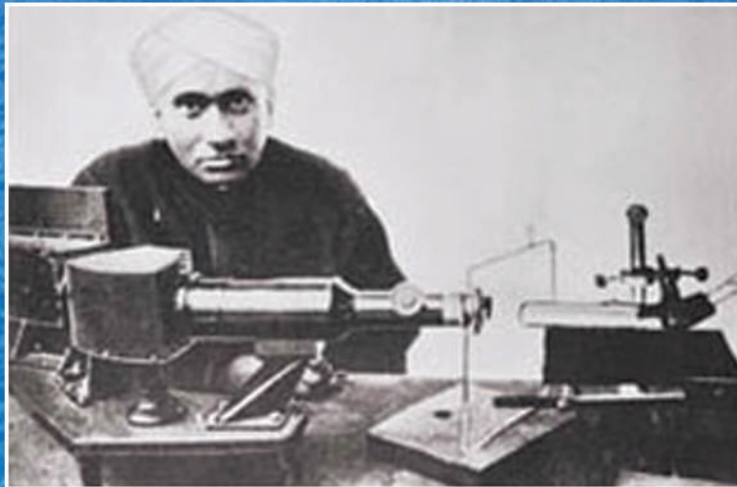
FEBRUARY 2015

Why the sky is blue

Dr C. V. Raman talks about science



## WHY IS THE OCEAN BLUE?





**PROF. B. K. BEHURA**

Arrival : 12.01.1922

Departure : 16.02.2015

Prof. Basant Kumar Behura, an eminent Zoologist of Odisha and Former Professor and Head of the Department of Zoology, Utkal University, Bhubaneswar left for his heavenly abode on 16.02.2015.

This sad demise is a great loss to our state and the country. Odisha Bigyan Academy pays homage to the great soul and prays the Almighty to provide eternal peace to the departed soul.

**Odisha Bigyan Academy, Bhubaneswar**

**‘SCIENCE HORIZON’ INVITES  
READERS VIEWS, OPINIONS AND SUGGESTIONS**

The Secretary, Odisha Bigyan Academy invites readers views, opinions and suggestions on the articles published / to be published in ‘Science Horizon’. Odisha Bigyan Academy would certainly value the opinions of its readers to make this science magazine useful and valuable to the community in general in creating scientific awareness. The views, opinions and suggestions should be sent to the Secretary, Odisha Bigyan Academy by the following address by post / in person along with softcopy through E-mail.

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FEBRUARY, 2015

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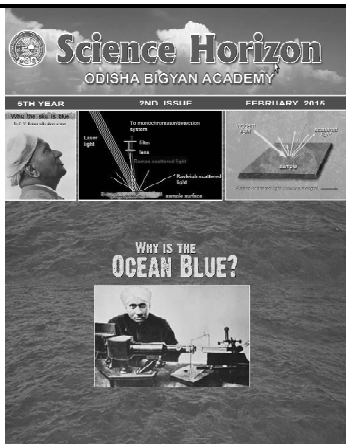
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## CONTENTS

Subject	Author	Page
1. Editorial : Science for the Benefit of Mankind	Prof. Tarani Charan Kara	2
2. Prof. B. K. Behura, An Eminent Zoologist	Dr. Prafulla Kumar Mohanty	3
3. Importance and Usefulness of Ants on this Earth	H. P. Patnaik P. K. Sadangi	6
4. Capuchin Monkeys : The New World Primates	Prof. Animesh Kumar Mohapatra Anirban Roy	11
5. Lethal Mutation	Dr. Dwijesh Kumar Panda	17
6. Jonas Salk - Father of Polio Vaccine	Professor Guru Prasad Mohanta	19
7. Glutathione, An Important Antioxidant	Dr. Debendra Nath Nayak	21
8. Depression : A Global Health Crisis	Dr. Debakanta Behera	24
9. Second-hand Smoking	Dr. Niraj K. Tripathy	26
10. Ozone Depletion - Causes and Consequences	Dr. Biswajit Rath Harekrushna Jena	29
11. Eco Friendly Pesticides	Sri Sanjeeb Kumar Das	34
12. Rhodiola Rosea - A Medicinal Herb of the High Altitude	Prof. Gopendra Kishore Roy	36
13. Bamboo : A Forest Wonder	Er. Ramesh Chandra Sahoo	38
14. Brown Manuring : A Tool for Sustainable Rice Cultivation	Dillip Ranjan Sarangi Biswanath Sadangi	40
15. Green Concrete an Eco-Friendly Product	Dr. Bishnu Prasad Behera	42
16. Megatons to Megawatts	Er. Mayadhar Swain	45
17. Quiz : Founders of Medical Science	Sri Himansu Sekhar Fatesingh	47

The Cover Page depicts : **Blue Sea & Raman Effect.**

Cover Design : **Sanatan Rout**

# EDITORIAL

## SCIENCE FOR THE BENEFIT OF MANKIND

From the dawn of human civilization to the present age, quantum leaps in human development and well-being were made possible only through explosion of novel ideas leading to breakthrough scientific and technological innovations in diverse fields such as infrastructure, agriculture, biotechnology, biomedical sciences, energy, communication, industry and transport among others enhancing the quality and comforts of human life.

Our country has had very rich traditions of Science & Technology (S&T). Science in India was always very closely intertwined with culture and philosophy. It was also tempered with very unusual wisdom. India's contributions to astronomy, mathematics, medicine etc. in the past have been truly amazing. The award of Nobel Prize to Dr. C. V. Raman in Physics in 1930 in recognition of his discovery "Raman Effect" on February 28, 1928, related to the scattering of light is a testimony of excellency in Indian Science.

Today, India has developed a strong capacity to design, fabricate, develop and test its own launch vehicle and satellites. It has moved from one sophisticated launch vehicle to the other more sophisticated ones such as from SVL to ASLV to PSLV to GSLV and has sent its own satellite to Mars (MOM) without any help from others. India has achieved international competitiveness in remote sensing and developed early cyclone warning system for the common mass. The real impact of Indian Space programme has been in terms of nation building through accelerated socio-economic development by impacting on problems ranging from education to drinking water. India's progress in space research has "reached the unreachables" living in remote and inaccessible areas of the country. We are witnessing a connectivity revolution today which has brought our vast nation together with the entire globe. Our transport and telecommunication infrastructure has been developed considerably reducing the 'time-space' among our people. Our health system has delivered to a majority of people by providing access to life saving medical technologies, and in eliminating or bringing under control a range of diseases such as small pox, polio, tuberculosis, sexually transmitted diseases and others. Nanomedicine, drug targeting and telemedicine have also become a reality today.

The contribution of S&T though considered vital in achieving sustainable human development, a large

part of its benefits has not yet reached the poor in the developing and even in developed nations. The gap between the rich and the poor is getting widened. On the other hand, S&T has been misused to create havoc for the community by creating weapons of mass destruction for warfare. Further, rising population growth and the resulting environmental degradation pose serious challenges for the living organisms in this earth. In India, like many other scientifically developed countries, the benefits of S&T are yet to reach the socially excluded and marginalized sections of the society. In terms of Human Development Index (HDI) as published by the UNDP in 2014, India ranks 135 among 187 countries across the world and is categorized among the "medium development" countries such as Egypt, South Africa, Philippines and Indonesia as against the neighbouring Sri Lanka having 73 rank in HDI. Our policy-planning and governance need to focus on exploiting the scientific knowledge and technological expertise to the fullest advantage of all sections of the society. If the S&T achievements are not shared equally amongst nations and the people of all the strata of society, then the technology would become a source of exclusion. It would create the spectre of a technological divide in which those with access achieve unprecedented levels of prosperity whilst the majority who are without it lose competitiveness and are marginalized from the world economy and its development. Therefore, our innovation and diffusion system should be so balanced as to serve the needs of big business and government as well as those of the great majority who depend on them for their bare necessities and livelihood.

The challenge can only be met with extensive and equitable application of S&T to five critical areas like water, energy, health, agriculture and biodiversity as identified by UN. While prioritizing innovation-intensive research activities, the outcomes in these areas need to be deeply focused for meeting the aspiration of common people and strengthening the economy of the nation. Here scientists and technocrats have a greater role to play keeping in mind the conviction of Alfred Nobel "Science for the benefit of Mankind" in order to put in place the technological applications that act as drivers of inclusive development and make sure that India secures a rightful place in terms of HDI along with top five nations in "high development" category including Norway, Australia, Switzerland, Netherlands and the USA in a few years of time from now.

*Prof. Tarani Charan Kara*  
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## PROF. B. K. BEHURA, AN EMINENT ZOOLOGIST

Dr. Prafulla Kumar Mohanty

### Service Career

Some individuals read science, some forcibly learn science, some try to get the science by heart and a very few love science, apply science, reply scientifically and lead their life through scientific approach. Professor Basanta Kumar Behura was one such personality of the last category who was the quintessence of scientific spirit and temper in his day to day life.

Prof. B. K. Behura was born in the year 1922 and passed away in 2015. During the period of his academic life, he had contributed significantly in the field of Zoology (Table-1).

**Table - 1 : Service Career of B. K. Behura**

Tenure	Nature of Post
1947-1957	Lecturer in Zoology
1948 (Jan.) -	Research at Edinburgh
1949 (Dec.)	University, Scotland
1949	Obtained Ph.D. Degree
1949-1950	Served at British Museum
1950-1957	Lecturer (first Odia Zoologist) in Odisha
1957-1960	Reader in Zoology
1960-1982	Professor of Zoology, Utkal University
1982-1984	Director, College Development Council (CDC), Utkal University
1985-1986	Visiting Professor, Meerut University
1986, 1987,	Visiting Professor,
1988, 1990	Dibrugarh University

### Dedicated Writer

During the service career, apart from teaching, Prof. Behura was actively engaged in writing popular science articles in various science magazines namely Science Reporter, Science Today, Bigyan Diganta etc. Besides these, he had also published some books pertaining to the animal world (Table-2).

**Table - 2 : List of popular science books in Odia**

Year of publication	Name of the book
1966	Frogs of Odisha
1967	Snakes of Odisha
1977	Dinosaurs
1981	Wildlife
1999	Man : A different Animal
1999	Bhitarkania : The Wonder Land of Odisha.
2008	Snakes
2010	Turtles of Odisha

### Serious Translator

Apart from the stated original creative books, he had translated some important books on animals (Table 3) in Odia language to cater to the need of the common people of Odisha.

**Table - 3 : Translated books in Odia**

Year of publication	Name of the book
1972	Wildlife (Protection) Act
1975 and 1979	Snakes of India, NBT
1980	Common Birds, NBT
1996	Biodiversity
To be published	Dinosaur

## Analytical Researcher

During professional teaching, Prof. Behura had guided and supervised some M.Sc. students in research leading to Ph.D. and D.Sc. degrees (Table-4). His field of research was animal kingdom and insect world especially aphids (very small insects) of the plants. he ensured perfection among his scholars and students in research activities.

**Table - 4 : Name of Ph.D. and D.Sc. students of Prof. Behera**

Year of award of Ph.D. & D.Sc. degree	Name of the Ph.D./ D.Sc. student
1974 Ph.D.	William Athony Zilka, USA
1974 Ph.D.	Murari Mohan Dash
1979 Ph.D.	Aditya Prasad Das
1980 Ph.D.	Lala Aswini Kumar Singh
1983 Ph.D.	Sudhakar Kar
1983 D.Sc.	Kalyani Bohidar
1984 Ph.D.	Dillip Kumar Roy
1985 Ph.D.	Bijoylaxmi Swain
1994 D.Sc.	Aditya Prasad Das
2001 Ph.D.	Narayan Chandra Satapathy
2001 Ph.D.	Debabrata Swain

He was also the Editor of the journal entitled "PRAKRUTI", published by the Utkal University. The editorial service was extended from 1962 to 1982, almost for two decades. Further, another journal namely 'PRANIKEE', published by the Zoological Society of Orissa," was his creation and edited by him since 1983. Although "Prakruti" is closed, "Pranikee" is continuing its publication by the Post-Graduate Department of Zoology, Utkal University through the assistance of the facilities of the department.

Prof. Behura had published more than 240 research papers in various national and international journals of repute including "NATURE". Quite for so many years, Prof. Behura also managed the Zoological Society of India and had been publishing the journal on behalf of the society. The most spectacular contribution in the field of his research is the discovery and reporting of a new species of insect which was scientifically named as "*Granthakita Cuttackae*".

Basing on the devoted, dedicated and continuous research in the field of entomology, three species of animals are named after him. Out of three species, two are flat worms namely *Gameo behuri* and second one as *Urocleidus behuri*. The third animal was an insect (an aphid, a type of insect) whose biological name is *Dactynotus behuri*. These reflect the potential research ability of such renowned zoologist of Odisha.

## Scientific Excellence

Prof. Behura was so much dedicated, sincere, meticulous in the field of Zoology, that he had served different societies in various capacities and awarded prizes and medals (Table 5). He was the only zoologist of Odisha who was awarded the highest number of prizes and awards both from the Government of Odisha and non-government organizations. In his life time, he had realized the value of time and was engaged in writing, translating, reviewing, analysing and interpreting science articles on Zoology and environment. This, in fact, epells the class of academic excellence and attitude of percolating science to the society.

**Table 5 : Prizes and Awards of Prof. Behura**

Sl. No.	Year of award/ distinction	Name of the award, organisation etc.
1.	1978	Sectional President of the Section Zoology, Entomology and Fisheries of 69th Indian Science Congress Association (ISCA).
2.	1980	General President of 5th All India Zoological Congress, Bhopal.
3.	1985	General President of 7th All India Zoological Congress, Meerut.
4.	1978	Raja Jitendro Mallik Gold Medal by Zoological Society of India.
5.	1980	Sir Dorab Tata Gold Medal by Zoological Society of India.
6.	1981-1982	Popular Science Award by the Utkal University, Bhubaneswar, Odisha.
7.	1987	Samanta Chandra Sekhar Award by Odisha Bigyan Academy.
8.	1990	Nandighosh Award, Odisha.
9.	1998	Senior Scientist Award by Odisha Bigyan Academy.
10.	2000	Swami Satya Prakash Award by Arya Samaj.
11.	2000	Dr. Pranakrushna Parija Award by Pranakrushna Parija Memorial Trust, Cuttack.
12.	2000	Pranakrushna Parija Science Literature Award by Utkal Sahitya Samaj.
13.	2001	Bigyan-Gobinda Memorial Award, Cuttack.
14.	2002	Felicitated by Odisha Bigyan 'Prachar Samiti', Cuttack
15.	2003	Ray Saheb Banabihari Mohanty Award by Odisha Bigyan Prachar Samiti, Cuttack.
16.	2007-2008	Biju Pattanaik Award by the Govt. of Odisha.
17.	2013	Kalinga Samman.

### **A Person with Dignity and Divinity**

Prof. Behura was a multifaceted personality having all round academic qualities. He was an Academic Leader, Social Organizer, Disciplinarian, Teacher, Translator, Writer, Reviewer, Researcher, Administrator, Conservationist & Consultant all rolled into one.

The Post-Graduate Department of Zoology, Utkal University, Ravenshaw University and Zoology Department of

Government Colleges of Odisha are the creations of Prof. Behura. The growth and development of the Zoology has attained the existing height because of his vision, mission and passion towards the subject. The image and foot prints left by him will certainly be remembered by all the Zoologists of India and Odisha in particular.

Professor and Head, Post Graduate Development of Zoology,  
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## IMPORTANCE AND USEFULNESS OF ANTS ON THIS EARTH

H. P. Patnaik<sup>1</sup> and P. K. Sadangi<sup>2</sup>

Ants are very often crushed under our feet knowingly or unknowingly, but it is a fact that these tiny and elegant creatures share a place which cannot be compared with any form of life on this earth, the human dominated biosphere. Bert Holldobler, an ant specialist and Edward O. Wilson, a great biologist in their book - 'The ants', published in 1990 stated that "the neglect of ants in science and natural history is the shortcoming that should be remedied, for they represent the culmination of insect evolution in the same sense that human beings represent the summit of vertebrate evolution". Many researchers across the world have now realized to recognize the perspectives of ants in their natural eco-systems.

Ants, like other social insects take care of their own brood (the eggs and larvae) on a cooperative basis and therefore they are categorized as "eusocial insects". Since, ants tend to be very aggressive and have great ability to dominate themselves, their direct interactions with plants, other arthropods and insects become quite spectacular.

Food preference is extreme in ants exhibiting high variability in food selection. Some ants survive on plant exudates secreted from flowers and extra floral nectarines or derived as honey dew like secretion of homopterous insects. A few ant species cultivate fungus gardens to meet their food

requirements, some serve in the colony as scavengers and necrophagous (that eats dead or decaying animal flesh), while a majority of species serve as general predators on other insect groups exerting enormous pressure on other invertebrate populations in their habitats.

In general there are two categories of ants : one is designated as the introduced or tramp ants which were brought to new environments by human beings through trade or commerce. Usually, such type of ants occur in many places/habitats, such as human modified habitats quite away from their place of origin. These ants are polymorphic workers and rely on omnivorous diet. The second category of ants is termed as 'invasive ants' or introduced ants which penetrate the natural ecosystems and reduce the native ant diversity.

These small creatures have existed on the surface of the earth much before the arrival of human beings and originated 145 million years ago, for which they have every right to dominate the planet earth. Because of this, ants constitute a great part of animal biomass forming an important component of the ecosystem. Ants can invade any type of habitat from the Arctic Circle to the Equator, except Iceland, Greenland and Antarctica. There are about 9000 species of ants described from world-over representing 296 genera and 16 subfamilies The Indian



subcontinent records ant species under 8 subfamilies representing 600 species and 92 genera. In late 90's it was evidenced by the researchers that ants are potential bio-indicators among the terrestrial invertebrates.

Ants exhibit a greater resistance to pollutants in comparison to other invertebrates, especially to radioactivity and to industrial pollutants because of the fact that; only some 10% of ants remain outside their nest to be exposed to these negative effects and ants can change their patterns of activity at times when exposure to pollutants is less dangerous. However, the density of ant colonies and their sizes usually decrease with increasing levels of pollution.

Thus, studies on ants at the genus-level can provide useful information on environmental monitoring, conservation evaluation, and ecological research. In view of their diversity, abundance and hypersensitivity to environmental changes, ants are now being used for monitoring the health of ecosystems. Each ant species may have a unique response to the changes in climate.

Due to high diversity, high abundance, intricate relations and mutualistic behavior with both flora and fauna, ants qualify as excellent ecological indicators. Most of the ants have either a direct or an indirect relationship with vegetation. Some of these are highly specific to the habitat in which they occur and this depends on the benefits they avail for nesting, mating and food availability.

Ants influence the soil environment and concurrently affect the activity and abundance of soil microorganisms (fungi, bacteria, actinomycetes), nematodes and soil insects. Ultimately, soil abiotic and biotic changes generated by ants have an effect on the performance and diversity of vascular plants. Changes in ant community structure following disturbances have been found to reflect changes in many other invertebrate groups. Therefore, P. J. Folgarait, in his review article "Ant biodiversity and its relationship to ecosystem functioning" published in *Biodiversity and Conservation* during 1998, rightly opined that ants are useful organisms for ecological studies and are valuable biological indicators of environmental change. In Australia, ants have been used extensively as bio-indicators, particularly in relation to disturbances such as fire and grazing.

As ants invade new habitats very efficiently and reckoned as bio-indicators, they are now being used for biodiversity assessments and comparison of habitats and ecosystem. Therefore, in most terrestrial ecosystems ants are now said to play a major role. In agricultural ecosystems they serve as biological control agents and are increasingly appreciated as bio-indicator for environmental monitoring system.

The unique position of ants in the insect world was attributed to their relation to man - they are beneficial, harmful and competitors of man. The knowledge of biodiversity of ants

is useful for clear understanding of food web, which are important in the functioning of ecosystem. Most of the ants have multiple relationships with plants either for getting food from the plant or from the plant-dependent sucking pests or for protecting the plant from natural enemies.

### Role of Ants in Ecosystem

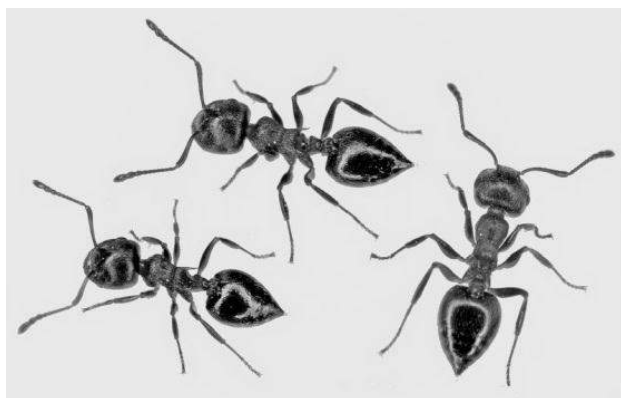
Ants have unique features and behavioral attributes that help them to render different services in an ecosystem and some of these are narrated below :

- (a) **Ants disperse seeds:** 'Myrmecochores' are the plant species, the seeds of which are dispersed by ants and about 3000 such plant species are known to exist across the world. These plants produce seeds that have lipid-rich appendages known as 'elaiosomes'. The mutualistic ants feed on such lipid rich portion leaving the remaining seed untouched which they disperse and bury in the soil benefitting the plants.
- (b) **Ants defend plants for food and shelter:** Certain ant species defend plants in exchange for food and shelter. Ant plants, or myrmecophytes, have natural hollows or cavities in thorns, stems, and even leaf petioles which shelter the ants. Trophobionts insect species like mealy bugs, aphids, treehoppers and scale insects produce bodily exudates which are rich in carbohydrates or amino acids.



Ants harvest these exudates and may protect the insects from predators or parasites. They may also even transport the insects to more favourable locations on the host plant.

- (c) **Ants Control Insect Pests in Agricultural Ecosystems:** Ants are biological control agents in agricultural ecosystems. Many predatory ant species have been found to significantly reduce agricultural pests and damage in annual and orchard crops. Solitary hunting is the most common method employed by predatory ants and in some cases recruitment of nest mates is done if necessary for transporting the prey. The published literature has emphasized seven genera of dominant predatory ants viz., *Oecophylla*, *Dolichoderus*, *Anoplolepis*, *Wasmannia* and *Azteca* in the tropics; *Solenopsis* in the tropics and subtropics; and *Formica* in temperate environments. However, the ants of leaf litter are mostly considered as specialized predators and are of interest to researchers.



The individuals of the genus, *Pheidole* also evidenced their role as efficient predator, because of their wide distribution, high species richness, and good adaptation to the physical conditions of the environment. *Pheidole* as a bio-control agent against *Anthonomus grandis* (Coleoptera: Curculionidae) has been demonstrated in cotton fields of Brazil. Similarly, in ephemeral, annual cropping agro-ecosystems, the above predatory ants are also reported as important natural enemies of lepidopteran pests of cauliflower and fruit fly larvae. Therefore, ants of this genus can contribute to regulate crop pest population and with other control methods ants' activity can reduce the cost of insecticides and thereby it can offer as an important tool in integrated pest management. The ants of the genus *Crematogaster* are also ecologically diverse which are found worldwide and are characterized by a distinctive heart shaped gaster (see figure). These ants are also known as

'cocktail ants' or 'acrobat ants'. Acrobat ants hunt both large and small prey which typically includes grasshoppers, termites, wasps and other small insects.

However, the impact of predatory ants in the natural control of insect pests and their potential as biological control agents in ephemeral annual vegetable cropping agro-ecosystem has so far not been explored critically. Some ant species like *Oecophylla smaragdina* and *Solenopsis* spp. though identified as potential biological control agents, but at times these ants act as pests. Therefore their utility as biological control agents need attention.

- (d) **Ants are ecosystem engineers:** Among soil dwellers, earthworms, termites and ants have been identified as the main soil engineers. Because of this attribute ecologists have considered ants as an important component of ecosystems. Ants play several important roles as soil turner, channelers of energy, pollinators, scavengers, biological control agents, and are important components of our food chain. Food storage and accumulation of feces, corpses and food remains by ants have been shown to rapidly and extensively change the soil conditions within the nest area by affecting: soil texture; chemical composition i.e., C, P, N and K content and microbial and microfaunal communities.

(e) **Ants as a source of human food and nutrition:** Many species of ants constitute a cheap, unconventional protein source in human nutrition. A variety of ant species are used as food by tribal people in many countries including India, Indonesia, Thailand, China, South and Central America, Australia and Africa. In India many families in the Kanara region of South India, parts of Nagaland, Chhattisgarh and parts of Odisha supplement their family income by harvesting and selling ant species. Mostly the mashed up workers of weaver ant, *O. smaragdina* are used as food by various tribes. The protein content of **O. smaragdina** ants is reported to be comparable to that of chicken eggs. Published reports evidenced that the extracts of ants of the genus *Polyrhachis* contained about 30-70% protein and more than 50 nutritional elements, including 26 kinds of amino acids. Ant colonies are populous, easily located and have a relatively high multiplication rate compared with vertebrate meat sources. Therefore, ants can be excellent nutritive substitutes for conventional vertebrate meat, with the additional advantage that they are less expensive and more abundantly available. In view of the above facts entomophagy is suggested to serve as a significant measure not only in obtaining inexpensive protein-rich foods, but also in avoiding mineral deficiencies.

(f) **Ants as a source of Pharmaceuticals:** 'Ethnoentomology' has revealed that apart from the consumptive value, some ant species are also remarkable for their medicinal value, predominantly in Asian and Latin American countries and to a lesser extent in Australia and Africa. In traditional entomotherapy ants are utilized as an alternative medicine in many parts of the world. Recent biochemical and pharmacological investigations are providing evidence regarding the medicinal significance of ant species. The well-developed immune system and anti-microbial chemicals that evolved in ants as a means of defense against pathogens are now being exploited for the treatment of human diseases.

The therapeutic uses of weaver ant, *O. smaragdina* have been widely documented and some of these are indicated as per the following;

- Ammonia-like fumes produced by rubbing weaver ants were inhaled by Tamil labourers in India to relieve symptoms of the common cold.
- The ants are useful in the treatment of cold and cough in Australia.
- Tribal people in Koraput District of Odisha eat the brood, reportedly to keep the body and mind cool in hot summer, and they also utilize workers caste of these ants as food so as to improve their eyesight.

- The weaver ants are also used for enhancement of immunity, treatment of gastric problems, asthma/cough, arthritis and cold in India.
- The natural silk fibers of the weaver ants can serve as a cell matrix for cell adhesion and thus have application in tissue engineering and wound healing.

Recent research demonstrates that social insects including ants possess well developed immune systems and disease resistance ability. Ants secrete antibiotics externally by the metapleural glands to protect themselves against pathogenic fungi and bacteria. They also harbor the antibiotic-producing bacteria on special structures located on their cuticle. Thus, exploitation of such well-developed immune system and anti-microbial chemicals for the treatment of human diseases is felt essential. Therefore, this important taxon is reported to have enormous potential for providing future benefits to mankind as a source of pharmaceuticals for an increasing human population.

■

<sup>1</sup>Professor & Head, Department of Entomology, College of Agriculture;

<sup>2</sup>Associate Director of Research, RRTTS, Mahisapat, Dhenkanal, OUAT

## CAPUCHIN MONKEYS: THE NEW WORLD PRIMATES

Prof. Animesh Kumar Mohapatra  
Anirban Roy

### Introduction

"If humans descended from apes, how come there are still apes!" is one of the most frequently enquired questions when evolution is the topic of discussion. The apes and monkeys are the most prominent examples as the closest relatives of Homo sapiens and humans are primates themselves. Great scientist Stephen Hawking opined- "We are just an advanced breed of monkeys on a minor planet of a very average star. But we can understand the universe. That makes us something very special." Humans are the ultimate social product with an intelligence evolved from monkeys. Monkeys are of various types; about 225 different species of monkeys are recorded till date. Out of which, Capuchin monkeys are considered to be the most intelligent.

### Capuchin monkeys

The Capuchin monkeys are new world monkeys belonging to the subfamily Cebinae. They are considered to be the most intelligent and advanced monkeys among the New World



of monkeys and are extensively being used in various experiments to learn behavioral aspects.

### Natural habitat

Capuchin monkeys inhabit in low-lying forests, mountain forests and rain forests. The environment is suitable for them providing access to shelter and food. They are found in countries like Argentina, Brazil, Costa Rica, Honduras, Paraguay and Peru. Thus their range of inhabitation includes Central America and South America as far south as North America.

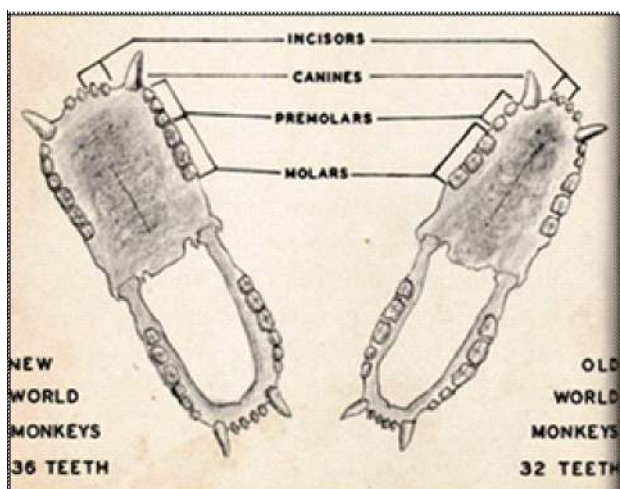
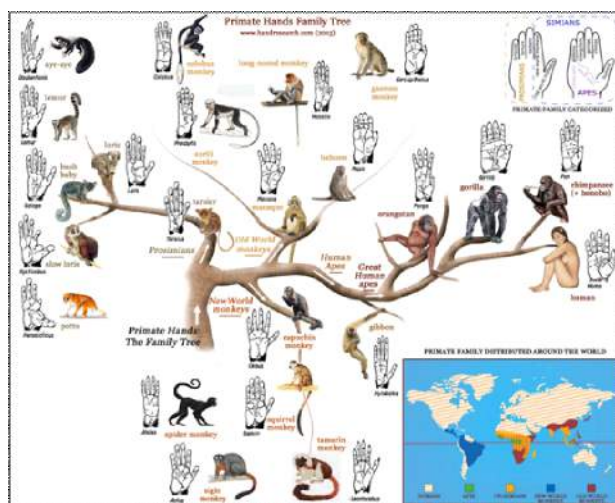
### Etymology, evolution and systematic classification

The word 'Capuchin' derives from a group of friars (group of evangelist counsels) who are named as 'Order of Friars Minor Capuchin', an offshoot from the Franciscans, who are seen wearing brown robes with large hoods covering their heads. On the contrary, the scientific name of the genus, Cebus, comes from the Greek word *kēbos* which means a long tailed monkey. The capuchins are new world

monkeys. The monkeys are broadly categorized as new world monkeys and old world monkey and marmosets. The new world monkeys differ from old world monkeys in having 36 teeth while old world monkeys have 32 teeth. The old world monkeys have narrow space between their nostrils, which open downwards and resembles with the apes and men. Thus, the new world monkeys with prehensile tail give evidence of a separate branch under the categorization of monkeys.

### Systematic position

Capuchin monkeys of Kingdom- Animalia, Phylum- Chordata, Class- Mammalia, Order- Primates, Family- Cebidae, Sub family- Cebinae and Genus- Cebus.



### Physical characteristics

Capuchins are black, brown, buff or whitish, but their exact colour and pattern varies with species. The length of their body



reaches up to 30cm to 56cm with tails as long as body. They are very agile with long limbs and long tail that assist the monkey in climbing trees and move through them. They are good jumpers and can jump a distance of as long as 9 feet from one tree to the other. They have big toes and thumbs for foraging food and holding the trees branches tightly.

### Paying Back to Nature

Capuchin monkeys use the forest for food during the day and as a home during the night. These monkeys are omnivorous, eat different fruits, weeds, seeds, insects



spiders, bird's eggs and small vertebrates. Forest serves as a lifeline for them. Their behavior is actually beneficial to the forest ecosystem. They help in seed dispersal, by spreading seeds they have consumed, either by dropping them or via faecal matter, helping new plants to grow.

### Social Structure and Types

Capuchins live in groups consisting of 10 to 40 members. Each groups consist of several females, males and their off springs. The groups are dominated by a single male who holds the fundamental rights to mate with the females of the group, though the white headed capuchins are headed by the alpha male



& alpha female. Communication of the group occurs by vocalization & mutual grooming. They are very cautious about the territory as they are territorial animals, protecting them from intruders. There are more than 5 types of capuchin monkeys, like black striped capuchin monkeys, kaapori capuchin monkeys, white head capuchin monkeys, large headed capuchin monkeys, brown capuchin monkey, golden tufted capuchin monkey, tufted capuchin monkeys and so on.

### Life History

Mature are capable of bearing young ones on every two years following a gestation



period of 160 to 180 days. The capuchin monkey depicts parental care when the young ones cling to their mother's chest, until they are larger, when they move to mother's back. Adult male capuchins are seldom involved in nurturing the siblings, Juveniles become mature, within four years for females & eight years for males. The average life span of these monkeys is 15 to 25 years.

### Sharp mind and Intelligence

The use of tools by primates is varied and includes hunting (mammals, invertebrates, and fish), collecting honey, processing food (nuts, fruits, vegetables and seeds), collecting water, weapons and shelter. The tufted capuchins are famous for their long term tool usage. In 1960, Iane Goodall observed a chimpanzee poking pieces of grass into a termite mound and then raising the grass to his mouth. After he left, Goodall approached the mound and repeated the behavior because she was unsure what the chimpanzee was doing. She found that the termites bit onto the grass with their jaws. The chimpanzee had been using the grass as a



tool to "fish" or "dip" for termites. Soon after her initial discovery of tool use, Goodall observed other chimpanzees picking up leafy twigs, stripping off the leaves and using the stem to fish for insects. This change of a leafy twig into a tool was a major discovery. Prior to this, scientists thought that only humans manufactured and used tools, and that this ability was what separated humans from other animals. In 1990, it was claimed the only primate to manufacture tools in the wild was the chimpanzee. However, since then, several primates have been reported as tool makers in the wild.

Capuchins rarely leave the safety of trees. If they have trouble in finding food during foraging, they will use tools to get it. Upon seeing macaws eating palm nuts, cracking them open with their beaks, these capuchins will segregate and choose a few of ripest fruits, nip off the tip of fruit and drink down the juice, then discard the rest of fruit with the nut inside. When the discarded fruits have hardened and become slightly brittle, these capuchins will collect them again and take them to a large flat boulder where they had previously gathered a few river stones up to a mile away. The stones, some weighing as much as the monkey, are used to crack open the fruit to get nut. Young capuchins observe the process but it takes nearly 8 years to master them. Even the stones are used to crack the shells of shellfish & crab by the capuchins, for eating them.



## Self Awareness

Capuchin monkeys react in a way when presented with a mirror to see their reflection that indicates an intermediate state between seeing the mirror as another individual and recognizing the image as self. This shows a remarkable difference between other animals and capuchin monkeys. The other animals react to the reflection as if encountering another animal that they don't recognize. A strange phenomenon was observed with the capuchin monkeys when they were provided with their reflection in the experiment, they reacted in three different ways:

- 1) Seeing an unfamiliar, same sex monkey on the other side of a clear barrier.
- 2) Seeing a familiar, same sex monkey on the other side of a clear barrier.
- 3) A mirror portraying a reflection of the monkey.



## Relationship with humans

For years Capuchin monkeys were the favorite monkeys of organ grinders (A street musician who plays a barrel organ) and are still one of the best pet monkeys. They are easily recognized as the "greyhound jockey" monkeys



and were used as service animals, thus, aptly referred to as "nature's butlers". Few organizations are known to train them to assist quadriplegics (patient with paralysis of all four limbs, usually as a result of injury to spine) as monkey helpers, somewhat similar to mobility assistance dogs. The monkeys are sympathetic which is proved when they help the quadriplegic by carrying out like microwaving food, washing their face and other such activities. In some regions they plunder crops and field and are seen as troublesome by nearby human populations.

## Behavior

Capuchins are usually calm. They have different calls for the definite purposes and are very interdependent of each other. When a monkey produces an alarm call, all other monkeys would take precautions; the entire response is based on trust. When a capuchin feels threatened, it will scream a lot. They usually swing and remain suspended from the branches of trees by their prehensile tail and produce sound to communicate. They micturate on their hands, and then rub their urine on their fur; to signal their sexual status.



### Why Capuchin monkeys are intelligent?

Cebus monkeys display unusually fast postnatal brain growth and motor skill development. The neonatal capuchin monkey brain, at approx. 29 to 34g, is a smaller proportion of the adult brain weight than is the brain of other primates except humans and great apes. It has also been reported that the cortical development in the brain usually occurs at an early stage. Brain development in 29 brown capuchin monkeys using high resolution MRI on brain volume, cortical grey and frontal lobe gray suggested non linear age related changes in total brain volume; cortical white matter volume and frontal white matter volume were detected from birth to 5 years. There are differences in corpus callosum between male and female

Capuchin. Males have a 10% smaller corpus callosum and brain ratio of males smaller than females of



same age. Corpus callosum of females showed significant age related changes while nothing is seen in males.

### Conclusion

Capuchin monkeys are the most intelligent new world monkeys. A researcher aptly suggested "You should really think of a capuchin as a bottomless stomach of want". Capuchin monkeys are slowly depleting due to destruction in natural habitat which should be checked to preserve this witty organism.

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## LETHAL MUTATION

**Dr. Dwijesh Kumar Panda**

Almost every species of animals has defects of one kind or another caused by mutations. Some of these mutations are lethal, some merely disadvantageous. In nature most departures from normal cannot survive long. Sometimes a mutation is so radical that nothing can be done to prolong the animal's life to maturity. This is what is known as lethal mutation. Often it kills the animal while it is in embryonic stage. Most lethal mutations are recessive, and are carried unsuspected by normal looking animals. Some mutations are dominant, their effects are visible.

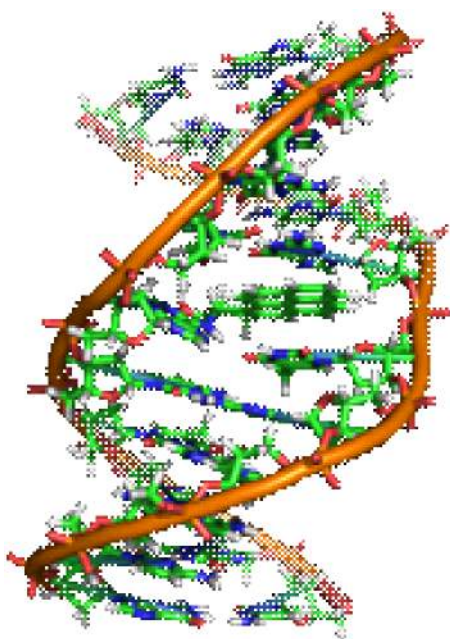
Lethal mutations exist in man. Babies with fatal congenital malformations are born in large numbers. Miscarriages and abortions of defective fetuses are more common. Some of these defects may be due to accidents or infections, but heredity plays a major role. The quickest way to expose lethal traits is by intense and continued inbreeding. In man such mating are generally illegal or taboo. But brother-sister mating in animals and self-pollination in plants are a standard laboratory practice. The outcome is generally detrimental-unless inbreeding has been customary in the species. When inbreeding begins, the heredity seems to be breaking down. All sorts of defects and weaknesses appear. The average life-span decreases. After a few generations the family becomes extinct.

Spontaneous mutations cause many common human diseases. Genetic diseases arise by spontaneous mutations in germ cells (eggs and sperm), which are transmitted to future generations. Sickle cell anemia is the result of this mutation. The erythrocytes of the patient become rigid and their transit through capillaries is blocked, causing severe pain and tissue damage. The red cells are resistant to the parasite causing malaria. Spontaneous mutation in somatic cells is an important mechanism in certain human diseases, including retinoblastoma. It is a retinal tumor of the eye in children. The cell proliferates in an uncontrolled manner, giving rise to retinal neoplasm.



**Lethal X-linked Rett syndrome**

Changes in DNA caused by mutation can cause errors in protein sequence, creating partially or completely non-functional proteins. Each cell, in order to function correctly, depends on thousands of protein molecules to function in the right places at the right time. When a mutation alters a protein molecule



**Covalent adduct between benzo[a]pyrene, the major mutagen in tobacco smoke, and DNA**

that plays a critical role in the body, a medical condition can result. A condition caused by mutations in one or more genes is called a genetic disorder. Some mutations alter a gene's DNA base sequence but do not change the function of the protein molecule made by the gene. If a mutation does change a protein molecule this will probably be harmful.

If a mutation is present in a germ cell, it can give rise to offspring that carry the mutation in all of its cells. This is the case in hereditary diseases. A mutation can occur in a DNA within a germ cell. Humans carrying such germ line mutations may have an increased chance of cancer. Mutation may occur in a somatic cell of an organism. This can be a cause for the cell to become malignant, leading to cancer. A DNA damage can be a cause of an error when the DNA is replicated. This error in replication can lead to cause a gene mutation giving rise to genetic disorder. The process of

DNA damage repair is an important way in which the body protects itself from disease. Once a DNA is damaged, it will give rise to a mutation, which cannot be repaired.

Spontaneous changes in genes- mutations- do not occur frequently. The probability that a given gene will mutate to a defective form can increase a hundred-fold or more by so called mutagenic (mutation producing) agents. These include X-rays, neutrons and other ionizing radiations, ultraviolet radiation and mustard gas. Radiations are believed to cause mutations by literally "hitting" the genes causing ionization within them or causing internal rearrangements of the chemical bonds. The body is built by repeated division of the cells. Every cell of our body such as liver cell, brain cell, and kidney cell-carries chromosomes and genes from both parents.

The occurrence of a lethal condition in a family is a tragedy. It is a matter of concern with the accumulation of defective genes in the population. Such recessive defects may eventually accumulate to the point where eliminating them will be virtually impossible. The advances in science is expected to solve the problem of detecting the hidden recessives.

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## JONAS SALK - FATHER OF POLIO VACCINE

**Professor Guru Prasad Mohanta**

India is declared polio free and it is a great relief not only to the citizens of the country but also to the public health professionals. This is achieved through several years of persuasion for complete immunization under polio vaccination programme. The credit of first developing safe and effective polio vaccine goes to an American scientist, Jonas Salk. He was a medical scientist who refused to patent his invention of polio vaccine for the sake of humanity. He is reported to have forfeited an estimated seven billion US Dollars. But his interest was to save as many lives as possible and he became successful in achieving it. A great service to the mankind!



Polio virus enters the body through mouth and grows in the intestine. It causes symptoms like fever, fatigue, headache, vomiting, stiffness in the neck and pain in the limbs. In some cases the virus attacks the nervous system causing irreversible paralysis usually of legs. Usually 5 to 10% of the paralysed patients die. Polio was America's greatest fear after Atomic Bomb. In 1952, nearly 58,000 polio cases were reported. This was perceived as worst polio outbreak in America's history. At the peak of its devastation, Jonas introduced the vaccine. Jonas discovery was made known to the public on April 12, 1955 and he became an instant celebrity. Jonas Salk was hailed as 'miracle worker' and 12th April was like a National Holiday! Naturally polio was eliminated in US in 1979.

Born in New York City to a Russian - Jewish Parents in 1914, Jonas had his early education in a good school known as school for intellectually gifted students. His friends termed him as a perfectionist. As a child he was not interested specifically in Sciences but on humans and human side of nature. The basic interest in human beings led him to the discovery of polio vaccine that saved millions of innocent lives around the globe. He studied Medicine in New York University Medical School where he also worked as a technician and camp counsellor. Due to his interest on research, he took leave for a year to study biochemistry. His focus on microbiology

replaced the interest on practicing medicine and his desire to help mankind in general than to treat single patients, made him to choose research as a career.

Dr. Jonas while working in University of Pittsburgh School of Medicine received an invitation in 1948 to join the National Foundation for Infantile Paralysis to participate in the polio research project. The National foundation for Infantile Paralysis (now known as the March of Dimes Foundation) was established by President Franklin D. Roosevelt. Roosevelt himself was a polio victim. Several years of untiring hard work finally paid dividend. He could cultivate large quantity of virus in the test tubes using tissue culture techniques and developed vaccines. Following a successful testing in monkeys, he first field tested the vaccine in crippled children in school dedicated to the care and education of children with disabilities. Jubilant Salk on success of first field testing, continued testing on him, his wife and children. That showed his confidence level. After that Dr. Jonas initiated a nationwide clinical trial involving two million children and the vaccine was an instant success preventing polio.

Dr. Jonas life and research was not free from controversy and challenges. His work on influenza vaccine raised a serious ethical issue. He used to inject the experimental vaccine and then exposed the virus later to check the vaccine's efficacy. This testing was done in an

insane asylum without their knowledge and consent. The informed consent of field trial in human beings is the fundamental ethical requirement to biomedical research. Dr. Albert Sabin, another contemporary researcher, discovered a live polio vaccine. This raised controversy over usefulness of Salk's killed vaccine. Salk's killed vaccine was for injection and Sabin's live vaccine for oral administration. The live vaccine has a risk of causing polio in some cases. In one of the worst disasters, the live oral polio vaccine caused 56 cases of paralytic polio and five deaths in USA during 1955 due to production error. In India, oral polio vaccine (Sabin's vaccine) is used in immunization practice.

In 1960 Dr. Jonas established the Salk Institute for Biological Studies. This is now a centre for medical and scientific research. In the later part of his life, he devoted himself to searching for cures for AIDS and Cancer but without success. Salk died on June 23, 1995.

He received several awards and many honorary degrees. Some of them were : Congressional Gold Medal, Presidential Medal of Freedom, and a day named in his favour (May 6 as Jonas Salk Day). Dr. Jonas, trained as medical professional, chosen to do medical research instead of becoming a practicing physician, was hailed as one of the greatest medical researchers of the modern times!

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## GLUTATHIONE, AN IMPORTANT ANTIOXIDANT

Dr. Debendra Nath Nayak

In the present world to stay healthy is a big challenge. Every moment free radicals are busy attacking our bodies at the cellular level. By fighting free radical damage it is thought that we can age better and live longer and healthier lives. Apart from free radicals thousands of toxic chemicals are polluting our air, water and soil. All of us are paying heavy tax in terms of our health by eating processed, nutrient-depleted diet and absorbing high doses of electromagnetic radiation.

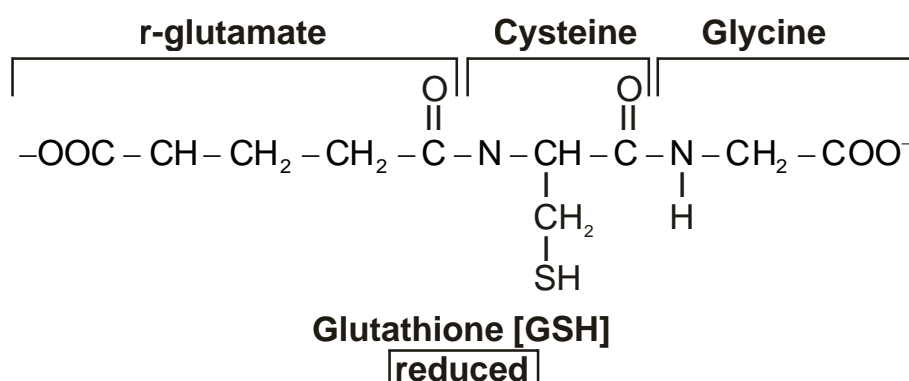
The situation however is not totally black as it appears to be. Nature has equipped all of us with basic version of the genetic detoxification software encoded in our genes which is good at ridding the body of toxins. The "mighty chemical" is called glutathione (GSH). It is an important antioxidant present in plants, animals, fungi and some bacteria preventing damage to important cellular components caused by reactive oxygen species such as free radicals and peroxides. It is one of the major endogenous antioxidants produced

by the cells, participating directly in the neutralization of free radicals and reactive oxygen species, as well as maintaining exogenous antioxidants such as Vitamin C and E in their reduced (active) forms.

It is known that the nitric oxide cycle which regulates various metabolic reactions such as DNA synthesis and its repair, protein synthesis, prostaglandin synthesis, aminoacid transport and enzyme activation is very critical for life. All these processes are affected by the level and action of glutathione in the body.

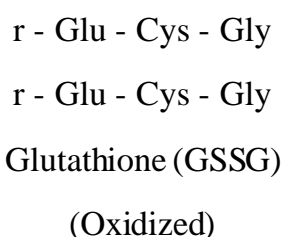
Besides it has a vital function in iron metabolism. Yeast cells depleted of or containing toxic levels of GSH show an intense iron starvation like response and impairment of the activity of extramitochondrial enzymes followed by death.

Chemically, glutathione is a simple molecule having molecular formula  $C_{10}H_{17}N_3O_6S$ . It is synthesized from 3 aminoacids, like cysteine, glycine and glutamic acid.

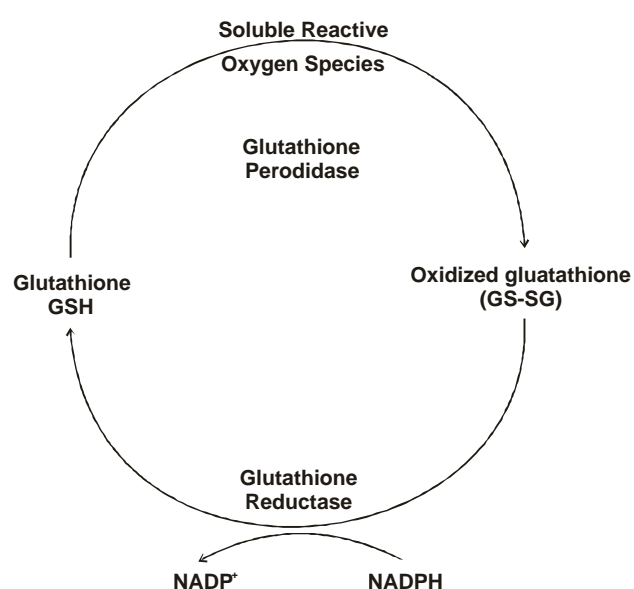


Thus glutathione is a tripeptide with a gammapeptide linkage between the carboxyl group of the glutamate side chain and amino group of cysteine (which is attached by a peptide linkage to glycine).

Thiol groups are reducing agents existing at a concentration of around 5 mM in animal cells. Glutathione reduces disulfide bonds formed within cytoplasmic proteins to cysteines by serving as an electron donor in the process, glutathione is converted to its oxidized form, glutathione disulfide (GSSG) also called L - (-) - glutathione.



Once oxidized, glutathione can be reduced back by glutathione reductase, using NADPH as an electron donor.



The ratio of reduced glutathione to oxidized glutathione within cells is often used as a measure of cellular toxicity.

The sulfhydryl group (SH) of cysteine serves as a proton donor and is responsible for its biological activity. Cysteine is the rate-limiting factor in cellular glutathione synthesis, since this amino acid is relatively rare in food. Even if all cells in the human body are capable of synthesizing glutathione, liver glutathione synthesis has been shown to be very important. In healthy cells and tissues more than 90% of the total glutathione is present in reduced form (GSH) and less than 10% exists in oxidized disulfide form (GSSG). An increased GSSG to GSH ratio of a tissue is considered as an indication of oxidative stress.

Being present within every cell, glutathione is known to be the primary defense molecule against free radical damages of the body. Unfortunately, the body's need for glutathione is sometime out paced by its ability to produce it. Glutathione is at its lowest level in the morning and should be replenished daily through healthy diet and supplementation. Even though our body produces its own glutathione but there are several factors like poor diet, pollution, toxins, medications, stress, trauma, aging, infections, radiation etc. which cause its depletion.

It is now known that glutathione deficiency is found in nearly all critical patients. These include people with chronic fatigue syndromes, heart disease, cancer, chronic infections, autoimmune disease, diabetes, Alzheimer's disease, arthrities, kidney problems, liver disease etc.



Our ability to produce and maintain a high level of glutathione is critical to recovery from nearly all chronic illness - and preventing diseases and maintaining optimal health and performances.

Glutathione is critical for one simple reason of its capacity to recycle antioxidants. The molecule pass from Vitamin C to Vit. E to lipoic acid and then finally to glutathione which cools off the free radicals and also recycles other antioxidants. After this happens, the body can 'reduce' or regenerate another protective glutathione molecule ready to start the process again.

However, problems occur when too much oxidative stress or too many toxins are to be tackled. Then the glutathione becomes depleted and one can no longer protect oneself against free radicals, infectious or cancer and toxins start accumulating. This leads to further sickness and soon we are in the downward spiral of chronic illness.

Glutathione is also the most critical and integral part of our detoxification system. De toxification or glutathione is the highest in liver and help to get rid of the toxins form the body produced or accumulated from smoking, intake of pesticides, heavy metals on food and water impurities. All these toxins stick to the glutathione, which then carries them into the bile and finally removed from the body through fecal matters.

Last but not least glutathione also helps us reach peak mental and physical function.

Research has shown that rained glutathione level decrease muscle damage, reduce recovery time, increase strength and endurance and shift metabolism from fat production to muscle development.

If one is sick or old or is just not in a peak shape, he/she is likely to have glutathione deficiency. It has been reported in the Lancet la medical Journal), that the highest glutathione levels is found in healthy young people, lower levels in healthy elderly, and it is still less in sick elderly and the lowest of all is reported in the hospitalized elderly people. However, the level of glutathione in the body can be maintained by food supplements (like garlic, onion, cabbage, cauliflower, grape, meat, sea food, egg etc.) and regular exercise.

So finally it can be said that glutathione is a powerful molecule present in our body to fight diseases and keep us healthy. By taking the above mentioned food and supplements one can enhance the glutathione level and enjoy a healthy life.

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## DEPRESSION : A GLOBAL HEALTH CRISIS

Dr. Debakanta Behera

Depression is a common mental illness in India. Worldwide more than 1 in 20 people suffer from depression. Yet the continuing stigma associated with it prevents it from being discussed, diagnosed and treated early. In a developing nation such as ours the scale of the infectious diseases takes priority at the cost of mental illnesses such as depression. Even though it affects all age groups, women are affected by it disproportionately. In many cases it is associated with childbirth commonly known as Post Natal depression causing huge distress to the entire family. In its most severe form, it can be fatal with 10 percent people suffering from depression killing themselves by committing suicide. There are more than 8 Lakh suicides occurring every year worldwide. According to the World Health Organisation (WHO), people with severe mental illness such as depression live at least 10 years less than those of the general population due to high risk behaviours such as heavy smoking, excessive alcohol use, suicide and neglect of physical illnesses such as diabetes, heart problems and cancer etc. globally depression is the main cause of the disability which affects quality of life and reduces productivity of working class population. Continuing stigma in the society associated with depression prevents people from discussing it and many face discrimination and isolation in the society. There is lack of understanding about depression as a real and serious illness in the society. This

is quite shocking, given the fact that depression can affect anyone of us.

### How to know if you have Depression

The most common symptom of Depression is the lasting feelings of sadness and loss of interest in the things you used to enjoy before. Often you will feel very tearful, irritable and hopeless about your life and future. Many people feel guilty about their past deeds. You may blame and hate yourself. You can also suffer from anxiety, worry and apprehension.

There can be physical symptoms such as feeling constantly tired and exhausted. Many a times people suffer from aches and pains such as headache not explained by any other physical illness. Your sleep can be disturbed at night such as too little or too much, commonly known as Insomnia. You may suffer from poor or reduced appetite, lack of concentration and poor sex drive.

Depression can disrupt your quality of life and can cause strain in familial relationships. In its severe form you may feel life is no longer worth living and want to end your life. Suicide is not uncommon in Depression.

### What causes Depression

The exact cause of depression is not known. It can be triggered by stressful life situations such as bereavement (death of a family member) or a relationship breakdown. People suffering from a longstanding (chronic)

or a life threatening illness such as heart problems or cancer have a high risk of developing depression. Other physical problems such as under active thyroid (hypothyroidism) can also present as depression. Some people are more vulnerable to depression than others such as people with low self esteem and self confidence.

Depression can run in families and it is linked to chemical imbalance in the part of brain controlling mood and emotions. Alcohol and drugs such as cannabis used as a means to cope with stress can result in depression. Often women after giving birth feel depressed due to hormonal and physical changes (called as post partum blues) as well as due to added responsibilities to a new life. In its severe form it is called Post Natal Depression.

### **How to treat Depression**

Depression can be treated involving a combination of, self help, talking therapies (Psychological therapy) and medication. Depression can be mild or severe. In mild depression (when you are still able to do your daily activities such as going to school or work), talking through your feelings to a friend or a relative, exercise, meditation and yoga can be helpful. Talking therapies such as counselling, family therapy and Cognitive behaviour therapy (CBT) by a trained counsellor or a psychologist is helpful.

In severe depression however, medicines commonly known as antidepressants along with Talking therapy are helpful. There are different

kinds of antidepressants available (such as Fluoxetine, Sertraline and Venlafaxine) and they have to be prescribed by a doctor or a psychiatrist. Antidepressants are usually given for a few months and sometimes you need to take it for longer.

### **Prevention of Depression**

Exercise and a healthy diet can have a positive impact in preventing. It also helps to recover quickly from it. Being physically active can lift your mood and reduce your stress and improve your self esteem. It is important that people who suffer from depression should take their medication regularly as prescribed even after feeling better for few more months as advised by the doctor to prevent relapse from it.

### **Sharing the experience of Depression**

Sharing your experience of depression with someone close to you such as a friend and a relative who can listen sympathetically and support you, can be very helpful. There are some well informed and educational videos available in YouTube by international mental health charities (viz. MIND UK and depression Alliance) which will be very helpful and can be educational. In the current era of Internet Social media such as Facebook, Twitter and Google+, there are forums and supportive communities who support through peer discussion and information sharing about depression and its treatment. They try to improve awareness among public and reduce stigma associated with depression.

**Rukmini's Story, Aged 19**

"I was 19. I was studying in the second semester of a highly demanding Engineering college in the city. I have always been a top achiever in the class. After first semester assignments, I started feeling low, often teary eyed. I could not concentrate on my studies, and ashamed of myself. My friends noticed that I am tired all the time and irritable at times. I used to be happy and bubbly, but could not know why and stopped going to my music lessons which I used enjoy. I could not sleep properly at night. Increasingly I became dissatisfied with my life.

My mother noticed and started discussing with me about how I feel. Slowly I started to see how depressed I was. I was taken to a psychiatrist and following consultation given antidepressants and counselling. He also provided leaflets about depression which helped me to learn more about it. After few weeks things gradually started to change and I am feeling much better now".

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World Health Organisation: Depression Factsheet

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**SECOND-HAND SMOKING**

**Dr. Niraj K. Tripathy**

One does not smoke because he understands the dangers associated with smoking. But, one may be exposed inadvertently to second-hand smoke. Since second-hand smoke causes or contributes to various health problems, including heart disease, lung disease and various types of cancers, it is imperative to understand what it is and why it is so important.

Second-hand smoke is otherwise known as environmental tobacco smoke, involuntary smoke, and passive smoke. It is a mixture of the smoke given off by the burning end of a cigarette, pipe, or cigar, and the smoke exhaled by smokers, i.e., the combination of side stream smoke and mainstream smoke. The smoke given off by a burning tobacco product between puffs is called side stream smoke while the smoke exhaled by a smoker is called mainstream smoke (NTP, 2005). Small additional amounts are contributed from the tip of the cigarette, through the cigarette paper during a puff, and from the mouth end of the cigarette between puffs.

The physicochemical properties of mainstream (MS) and side stream smoke (SS) are qualitatively similar but quantitatively different. The quantitative property of second-hand tobacco smoke is different from that of mainstream smoke and side stream smoke because of its rapid dilution and dispersion into the indoor environment. The SS:MS ratios

are: nicotine, 7.1; carbon monoxide, 4.8; ammonia, 455; formaldehyde, 36.5; acrolein, 18.6; benzo [a] pyrene, 16.0; N'-nitrosonornicotine (NNN), 0.43; (methylnitrosamino)-1-(3-pyridyl)-1-butanone, 0.40 (IARC, 2004). Concentrations of individual constituents in second-hand tobacco smoke can vary with time and environmental conditions. The amount of smoke created by a tobacco product depends on the amount of tobacco available for burning. It is estimated that the amount of second-hand smoke emitted by smoking one large cigar is similar to that emitted by smoking an entire pack of cigarettes.

Out of more than 7,000 chemicals that have been identified in second-hand tobacco smoke, at least 250 are known to be harmful and, at least 69 are carcinogenic to man. Some of them include arsenic, benzene, beryllium, cadmium, chromium, nickel, polonium-210, 1.3-butadiene, ethylene oxide, vinyl chloride, toluene, etc. Second-hand smoke has been classified as a known human carcinogen by the IARC (IARC, 2004). Many factors such as the type of tobacco, the chemicals added to it, the way the tobacco product is smoked, and the material in which the tobacco is wrapped for cigarettes and cigars determine the nature of chemicals in second-hand smoke (NTP, 2005).

People can be exposed to second-hand smoke in homes, cars, workplaces, public places, such as bars, restaurants, and places meant for recreation. The source of most second hand smoke is from cigarettes, followed by pipes, cigars, and other tobacco

products. Second-hand smoke exposure can be measured by testing indoor air for nicotine or other chemicals in tobacco smoke. Exposure to second-hand smoke can also be tested by measuring the level of cotinine (a by-product of the breakdown of nicotine) in the non-smokers' blood, saliva, or urine (NTP, 2005).

For children, in the age group of 13-15, the home environment may be a significant source of exposure to second-hand smoke, while other sources may be schools and public transportation. Four out of every ten children (approximating to 700 million children globally) have at least one parent who smokes, predisposing them to be exposed to second-hand tobacco smoke at home (WHO, 2010). In India, 21.9 % of children are exposed at home and 36.6% outside homes. Country-level estimates on second-hand tobacco smoke exposure at home and in public places among youth are available in the WHO Reports on the global tobacco epidemic (WHO, 2011). Almost half of the youth are exposed to second-hand tobacco smoke in public places. Again, for most women, the home environment is the primary source of second-hand tobacco smoke, which may be enhanced by their exposure at the workplaces. About one third of adults worldwide are regularly exposed to second-hand tobacco smoke (IARC, 2012).

More than 50 epidemiological studies since 1981 have concluded the association between second-hand tobacco smoke and lung cancer as well as cancers in the nasal sinus, larynx and pharynx among the non-smokers. According to NCI (2003), approximately 3,000

lung cancer deaths occur each year among adult non-smokers in the United States as a result of exposure to second-hand smoke. It is estimated that living with a smoker increases a non-smoker's chances of developing lung cancer by 20 to 30 percent. Lee et al. (2009) have shown the association of parental tobacco smoking with the risk for lymphatic and haematopoietic cancers and brain tumours in children. Second-hand tobacco smoke might have a stronger effect on breast cancer than active smoking (Collishaw et al., 2009).

Some of the health problems associated with the pregnant woman being exposed to second-hand smoke are miscarriage and premature birth. Women exposed to second-hand smoke for 6-8 hours a day as children and as adults have a greater chance of having difficulty in conceiving and suffering more miscarriages and an increased risk of failed embryo implantation. Second-hand smoke poses additional risks for children, whose mothers are especially exposed to second-hand smoke during pregnancy, include low birth weight, childhood asthma, infections in the middle ear, bronchitis, pneumonia, learning or behavioral deficiencies, negative effects on the immune system, and Sudden Infant Death Syndrome (SIDS). Second-hand tobacco smoke exposure raises adolescents' risk of metabolic syndrome, a disorder associated with excessive belly fat that increases one's chances of heart disease, stroke, and type II diabetes (Weitzman, 2005). Second-hand smoke also causes chronic coughing, phlegm and wheezing, as well as eye

and nose irritation. It may lead to premature death in non-smoking adults and children when they are constantly exposed. It irritates the respiratory passages and has immediate harmful effects on a person's heart and blood vessels and may increase the risk of heart disease and stroke with hardening of the arteries.

There is no safe level of exposure to second-hand smoke. Even low levels can be harmful. The only way to fully protect non-smokers from second-hand smoke is to completely eliminate smoking in indoor spaces, cleaning the air, and ventilating buildings. The World Health Organization's Framework Convention on Tobacco Control (WHO FCTC) is a multilateral treaty with legally binding obligations for its 174 Parties according to which supply and demand reduction measures are available to countries to counter the tobacco epidemic. Article 8 of the Treaty specifically addresses the need for protection from second-hand tobacco smoke and to meet the highest standards of protection from its menace and to provide a clear timeline for Parties to adopt appropriate measures within five years of entry into Force of the WHO FCTC. Many countries including India have passed several laws restricting smoking in public places. Smoking is banned in airline flights, buses, trains, all Government owned offices, schools, colleges, cinema halls, hospitals, airports, bus terminals, parks, restaurants and bars as well as private workplaces.

In order to be on the safer side, one has to quit smoking although it is very difficult as

it is highly addictive. Further, do not smoke or allow anyone to smoke in your home and vehicle. Insist that smoking restrictions are strictly enforced at your work place and other public places where it is banned and try to walk away from smokers.

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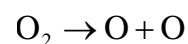
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## OZONE DEPLETION- CAUSES AND CONSEQUENCES

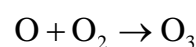
**Dr. Biswajit Rath<sup>1</sup>  
Harekrushna Jena<sup>2</sup>**

The Earth's atmosphere is divided into several layers. The lowest layer, the troposphere, extends from the Earth's surface to about 10 kilometers (km) in altitude. Virtually all life activities including that of humans occur in the troposphere. The next layer is the stratosphere which continues from 10 km to about 50 km vertically. Most of the commercially operated airline traffics occur in the lower part of the stratosphere. The ozone layer is mainly found in the lower portion of the stratosphere from approximately 20 to 30 kms above the Earth surface when its thickness varies seasonally and geographically. This Ozone layer provides a protecting shield against the harmful solar ultraviolet radiation reaching the earth. Even minor problems of ozone depletion can have major effects. Every time even a small amount of the ozone layer is lost, more ultraviolet light from the Sun can reach the Earth.

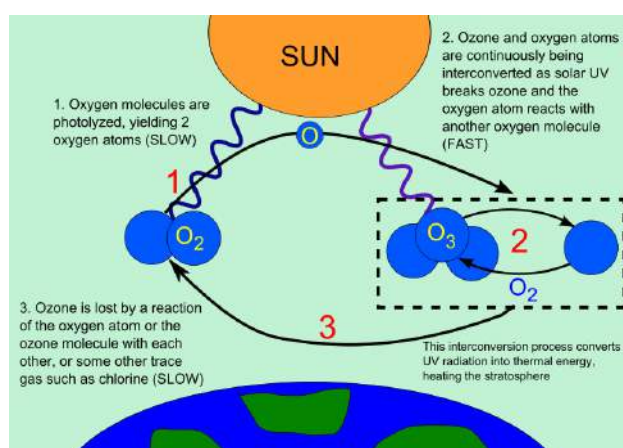
Ozone is a molecule containing three oxygen atoms. The high energy ultra-violet rays of the sunlight causes an oxygen molecule to split into two oxygen atoms:



In the second step one of the oxygen atom joins with another oxygen molecule to form a molecule of ozone ( $\text{O}_3$ ) (Fig.1) :



However, Ozone may be destroyed by combining with a lone oxygen atom to get



**Fig.1 : Ozone formation pathway**

back to molecular oxygen again. Ultra-violet light is required for the formation of ozone in the stratosphere, and then the ozone absorbs the ultra-violet light and stops it reaching deeper into the earth's atmosphere. Normal oxygen, which we breathe, has two oxygen atoms and is colorless and odorless. The properties of ozone layer was first explored in detail by the British meteorologist G. M. B. Dobson, who developed a simple spectrophotometer (the Dobson meter) that could be used to measure stratospheric ozone from the ground. The concentration of ozone in the atmosphere is measured in "Dobson Units" in honor of Dobson.

Ozone is much less common than normal oxygen. Out of each 10 million air molecules, about 2 million are normal oxygen, but only 3 are ozone. However, even the small amount of ozone plays a key role in the atmospheric chemistry. The ozone layer absorbs 97-99% of UV rays from about 200 nm to 315 nm wavelengths with a maximal absorption at about 250 nm. Ozone molecules are constantly formed and destroyed in the stratosphere. The total amount of  $O_3$  in the atmosphere, however, remains relatively stable.

## Ozone Depletion:

The ozone layer can be depleted by free radical catalysts such as : nitric oxide (NO), nitrous oxide ( $N_2O$ ), hydroxyl (OH), atomic chlorine (Cl), and atomic bromine (Br). The concentrations of chlorine and bromine in the atmosphere have increased markedly in recent years due to the release of large quantities of man made organohalogen compounds, especially chlorofluorocarbons (CFCs) and bromofluorocarbons. Chlorine molecules arising from various other sources like : large fires and certain types of marine organisms, swimming pools, industrial plants, sea salt and volcanoes do not reach the stratosphere because the Chlorine compounds from these sources readily combine with water and are removed from the troposphere as acid rain.

The CFCs and other widely-used chemicals produce roughly 84% of the chlorine in the stratosphere, while natural sources contribute only 16%. In contrast, CFCs are very stable and do not react with other elements in the atmosphere. Thus, there is no natural process to remove the CFCs from the lower strata of the atmosphere. Over the period of time, winds drive the CFCs into the stratosphere. These highly stable compounds are capable of surviving in the stratosphere, where Cl and Br radicals are liberated by the action of ultraviolet light. In the presence of ultraviolet light these gases release Cl and Br radicals (atoms) which then react with the  $O_3$  and start destroying ozone in the ozone layer



leading to ozone depletion. Each radical (Cl/Br) is then free to initiate and catalyze a chain reaction capable of breaking down over 100,000 ozone molecules.

The breakdown of ozone in the stratosphere results in a reduction of the absorption of ultraviolet radiation. Consequently, the unabsorbed ultraviolet radiation reaches the Earth's surface. Ozone levels over the northern hemisphere have been dropping by 4% per decade. The average concentration of ozone in the atmosphere is about 300 Dobson Units. The ozone hole is considered to be formed when the concentration of ozone drops below 220 Dobson Units.

**Ozone hole form over Antarctica :**

During the Antarctic winter something special happens to the Antarctic weather. During the extreme cold of winter, with no sun for six months, strong polar winds blowing around the continent form the "polar vortex" which isolates the air over Antarctica from the rest of the world. The polar vortex traps and chills the air to temperature below -80° Celsius. The ice in these polar stratospheric clouds provides surfaces for the chemical reactions that destroy the ozone. This needs light to kick-start the reactions. In spring the

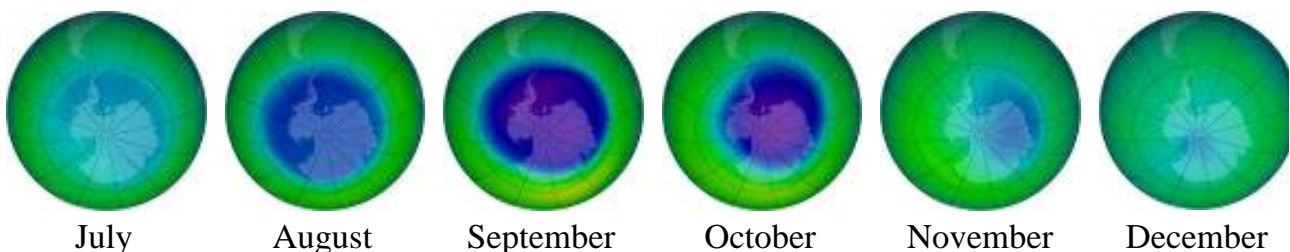
sun rises above the horizon and provides energy which starts the photochemical reactions. The clouds melt and the trapped compounds (chlorine and chlorine monoxide from the CFCs) are released. Ozone in the lower stratosphere is destroyed and the ozone hole appears (Fig. 2).

By the end of spring at warmer December, temperatures break up the vortex and destroy the clouds. Sunlight starts creating ozone again and the hole begins to repair. A similar hole appears in the Arctic during spring, but it is smaller because of warmer temperatures.

Polar stratospheric cloud is present at about 80,000 feet altitude. These are the highest flying clouds and occur only in polar region where the temperature in the upper atmosphere dips below minus 100°F. They are sometimes called "nacreous clouds" as they are coloured like the nacre of mother of pearl with coloured bands that move with the position of the cloud and the observer (Fig.3).

**Health effects of Ozone and UV exposure due to Ozone Depletion:**

There is a great deal of evidence to show that ground level ozone can harm lungs function and irritate the respiratory system. Exposure



**Fig.2 : The ozone hole builds up over the winter months, peaking at around September and breaking up again by December**



Fig.3. Nacreous clouds over antarctica

to ozone and the pollutants that produce it is linked to premature death, asthma, bronchitis, heart attack, and other cardiopulmonary problems. Long-term exposure to ozone has been shown to increase risk of death from respiratory illness.

UV rays that comes from the sun are of three types : UV-A (400-315 nm), UV-B (315-280 nm) and UV-C (280-100 nm). They differ in their biological activity and the extent to which they can penetrate the skin. The harmful effects from exposure to ultraviolet (UV) radiation can be classified as acute or chronic. The acute effects of UV-A and UV-B exposure are both short-lived and reversible. These effects include mainly sunburn (or erythema) and tanning (or pigment darkening). The chronic effects of UV exposure can be much more serious, even life threatening, and include premature aging of the skin, suppression of the immune system, damage to the eyes, and skin cancer

### Sunburn (Erythema):

Sunburn (or erythema) is redness of the skin, which is due to increased blood flow in

the skin caused by dilatation of the superficial blood vessels in the dermis as a result of exposure to UV radiation. High UV doses may also results in edema, pain, blistering, and peeling of the skin a few days following exposure. UV-B radiation is believed to be mainly responsible for sunburn as it is more erythmogenic by a factor of 1,000, however since there is more UV-A radiation reaching the earth's surface, UV-A contributes 15-20% to the sunburn reaction in the summer months. Risk factors for sunburn include fair skin, red or blond hair, blue eyes, and freckles. For people with fair skin, it takes only 15-30 minutes in midday sun to induce erythema. In terms of areas of the body that are more susceptible to sunburn, the face, neck, and trunk are two to four times more sensitive than the limbs. In addition, children and the elderly are believed to be more sensitive to UV radiation and may burn more easily. Sunburn reaches its maximum redness eight to 12 hours after exposure and fades within one to two days.

### Tanning:

Tanning refers to delayed pigmentation of the skin, or melanin pigmentation. Tanning results from an increase in the number of functions melanocytes (pigment cells) resulting in increased activity of the enzyme tyrosinase. This leads to the formation of new melanin and an increase in the number of melanin granules throughout the epidermis. However, there is another mechanism that may provide more protection for subsequent

exposures. In addition to tanning and sunburn, thickening (or hyperplastic) of the epidermis also occurs and is thought to be a significant component of a mild sunburn reaction. A single moderate exposure to UV-B radiation is sufficient to induce 3-fold thickening in the stratum corneum that lasts one to two months. This thickening is likely to be more important than tanning for providing endogenous photoprotection.

### **Premature Aging of the Skin:**

One of the chronic effects resulting from repeated exposure to UV radiation is premature aging of the skin, which encompasses a number of clinical signs that reflect structural changes in the dermis. These clinical signs include dryness, wrinkles, accentuated skin furrows, sagging, loss of elasticity, and mottled pigmentation, and are the result of degenerative changes in elastin and collagen. The degenerative changes accumulate over time and are largely irreversible. It is believed that as much as 80% of premature aging of the skin may occur within the first 20 years of life. UV-A radiation has been found to be an important contributor to premature aging of the skin. Whereas UV-B is 1,000 to 10,000 times more efficient than UV-A in terms of induction of sunburn and nonmelanoma skin cancer, respectively, with premature aging of the skin.

### **Suppression of the Immune System:**

Suppression of the immune system resulting from exposure to UV radiation is believed to be an important contributor to the development of nonmelanoma skin cancers.

Put simply, UV radiation induces a state of relative immunosuppression that prevents tumor rejection. This is mainly accomplished by interfering with the normal surveillance function of antigen-presenting Langerhans cells in the epidermis, which are responsible for T-lymphocyte activation in response to foreign antigens. The number of Langerhans cells and their characteristics are altered from exposure to UV radiation while similar cells that are responsible for the selective induction of suppressor lymphocyte pathways are resistant to UV damage. This creates an imbalance in the local T-cell function and a shift from helper to suppressor pathways, which ultimately favors tumorigenesis and progression. Grossman and Leffell conclude that the immunosuppressive effects of UV may be as important as the carcinogenic effects of UV radiation in the establishment and progressive growth of UV-induced skin tumors.

### **Damage to the Eyes:**

UV rays can also damage the eyes leading to Corneal damage, cataracts, and macular degeneration which ultimately leads to blindness. Melanoma, a type of skin cancer, can also develop within the eye. The Melanomas originate in the uveal melanocytes, which are found in the iris, ciliary body, and choroids of the eye.

### **Skin Cancer :**

Skin cancer is the most common type of cancer occurring in the world. There are different types of skin cancer such as the nonmelanoma skin cancers, basal cell

carcinoma (BCC) and squamous cell carcinoma (SCC), and melanoma. Exposure to UV radiation is thought to be an important factor in each of these cancers as it induces DNA damage, however the types of exposure necessary to cause the different types of skin cancer may vary. For the nonmelanoma skin cancers, cumulative sun exposure is believed to be important, whereas for melanoma the intermittent exposure hypothesis has been postulated. This hypothesis proposes that infrequent intense exposure of unacclimatized skin to sunlight is related to the increasing incidence of melanoma and is more important than chronic sun exposure. The incidence of all types of skin cancer is increasing.

### Conclusion :

According to an estimate of the U.S. Environmental Protection Agency (EPA), 60 million Americans born by the year 2075 will get skin cancer because of ozone depletion. About one million of these people will die. In addition to cancer, some research shows that a decreased ozone layer will increase rates of malaria and other infectious diseases and 17 million more cases of cataracts patients. So if we make awareness among people we can save ozone layer from depletion, ecosystem imbalance, and other health effects caused due to UV light.

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## ECO FRIENDLY PESTICIDES

Sri Sanjeeb Kumar Das

### Introduction

Pesticides are chemical compounds used in controlling pests of various kinds which cause great harm to human life. Most of the pesticides are organo-chlorine and organo-phosphorous in nature. Organo-phosphorous insecticides are much more toxic to vertebrates than Organo-chlorines and these neuro toxicants inhibit vital enzymes like Cholinesterase of the nervous system of the pests.

### Chemical Pesticides and Residual Effects

Pesticides are one of the major instruments of Green Revolution, by playing a vital role against insect pests and plant diseases. However, indiscriminate use of pesticides have resulted in the development of complex problems of the environment in many forms like soil and water pollution. Agricultural residues containing pesticides, fertilizers etc. move downward with percolating water and join the aquifers and ground water slowly causing the contamination of the ground water system.

While spraying the pesticide on crop plants, the residues are deposited on the plants. The same pesticide can enter into the body of poultry, domestic animals and human beings through fodder and food. Experimental studies have shown that eggs, milk, food grains and vegetables commonly used by human beings are contaminated with pesticides and ultimately affect human beings by developing new diseases.

Therefore, in recent days one of the major thrusts of agricultural research has been to reduce the requirement of chemical pesticides without affecting crop yield, by

adopting various biological measures, suitable scientific crop management techniques and use of eco-friendly pesticides.

### Need of Biopesticides

The scenario therefore inevitably demands the development of some new methods and the use of natural products derived from plants is one such method. Because plant products are biodegradable, ecologically safe and have significant toxicity on target species. There are some plants which contain alkaloids and isoflavonoids which act as insecticides. Alkaloids such as **nicotine** from tobacco, **rotenone** from *Derris elliptica* and **Pyrethrins** and **Clinerins** from Pyrethrum are good plant pesticides.

### Pesticidal Action and Significance

Most Plant insecticides act as contact poisons which enters into the body of insect pests through their cuticular openings (Pore). The plant *Milletla pachycarpa* contains two insectidal compounds known as **rotenone** and **saponine** which act as contact and stomach poisons. The plants belonging to the **solanaceae (Potato family)** are also insecticidal plants. They contain alkaloids called solanaceou alkaloids. Plants like ***Ricinus communis*** (Castor), ***Ocimum bacilicum*** (Common basil), ***Haplopyton*** (Cockroach plant), and several others also have insecticidal properties. which work against many domestic and agricultural pests.

The pesticidal effect of Neem was well known to India since ancient times. **Azadirachtin** and other **limonoids** like **meliantiol** and **salanin** extracted from the leaves, bark and seeds of neem are quite effective against a large number of insect

pests. Azadirachtin repels insects, inhibits their feeding (**Antifeedant**), pattern and affects hormonal balance in insects. **Salanin** a neem product on the other hand, is much more effective than the synthetic chemical **Diethyl toluamide**, widely used as an insect repellent.

The powerful toxic principle present in the oil extract of **custard apple** seed is **Anonaceous-acetogenins**. The leaf extract of custard apple is also reported to have all the bioactive compounds, contained in the seed extract and both are almost equally effective against pests. The root and leaf extract of ***Catharanthus roseus*** has antifeedant properties. The whole herb of ***Tridax procumbens*** has **insecticidal action** and hence it can be used to control mosquitoes houseflies and cockroaches.

The extracts of the seed of ***Acacia nilotica***, ***Citrellus colocynthus***, ***Madhuca longifolia*** affect the fertility of female mosquitoes. The products of Pongemia, Neem, Castor, Mahagani seeds and Mohua oil are good sources of toxic principles having **anti termite** properties.

### Conclusion

To ensure a pollution free environment for our future generation it is our duty to make everybody aware of using pollution free chemicals and accordingly environment management is also very important to prevent further degradation of nature and ecological imbalance.

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## RHODIOLA ROSEA - A MEDICINAL HERB OF THE HIGH ALTITUDE

Prof. Gopendra Kishore Roy

Rhodiola rosea or simply 'Rhodiola' also called 'Arctic root' or 'Golden root' is a wonder herb that grows generally at high altitudes (1800-4000 metre) in the arctic regions of Europe, Asia and Alaska. Mentioned as a medicinal plant by Greek physician Dioscorides in the first century, the herb was used in Iceland, France, Russia and Greece. In 1755, rhodiola rosea was included in the Swedish pharmacopoeia. In 1961, G.V. Krylov- a Russian botanist led an expedition to the cedar taiga in the Altai mountains of southern Siberia and located the 'golden root.' Over the years, there has been investigations on the beneficial root extract of the plant in keeping with the mention of it in the ancient literature as a herbal medicine for various ailments.

### Historical link

As a traditional folk medicine rhodiola has been in use to increase physical endurance, work productivity, longevity, resistance to high altitude sickness and to treat fatigue, depression, anaemia, impotence, infections and nervous system disorders. In Russia and Scandinavia, it is in use for centuries to cope with the Siberian cold climate and the stressful life. The plant has been in use in the traditional Chinese medicine to prevent altitude sickness.

### Present use

Rightly named as 'golden root', it is the extract from the rhodiola root which has been in use for multifarious medicinal purposes. The aerial portion of the herb is consumed as food in some parts of the world, sometimes as a component of the salads.

In keeping with its use in traditional medicine in different parts of the world, research investigations have authenticated to many of the beneficial effects of this wonder herb. Evidences of the diverse health benefits of the herb, based on more than thirty years of scientific research including previously 'top secret' Soviet studies have been made public to the world.

A number of chemical compounds, which include anti-oxidants, anti-fatigue and anti-depression agents have been identified in the rhodiola extract.

Rhodiola is being used for increasing energy, stamina, strength and mental capability and is considered an 'adaptogen', meaning thereby that it acts in non-specific ways to increase resistance to stress without disturbing normal biological functions. It is also used for improving athletic performance shortening recovery time after long work outs and for

heart disorders like irregular heart beats and high cholesterol. Other uses include:

- (i) Treating cancer and tuberculosis (practised by the physicians of Mongolia)
- (ii) Preventing cold and flu
- (iii) Anti-ageing process
- (iv) Strengthening the nervous system
- (v) Enhancing immunity

A 'miraculous cure': Some years back, a lady named Patricia Gerberg suffered from an unexplained and incapacitating decline in her physical and mental energy and was ultimately discovered of undiagnosed 'Lyme disease'. She was given rhodiola rosea which could replenish energy stores at the cellular level and within ten days of use could feel better. Of late, it has been established that the symptoms found in the above case corroborates to a tick-borne infectious disease caused by species of bacteria belonging to the genus *Borrelia*. The disease affects multiple body systems and is treated by antibiotics. The disease is named after the town Lyme, Connecticut, U.S. where a number of cases were identified in 1975.

### **Indian efforts**

Locally called 'solo' in Ladakh, the leaves are edible. The medicinal properties of rhodiola herb were more or less unknown till the scientists of the Leh-based Defence Institute of High Altitude Research (DIHAR) took a

systematic study of the plant more than a decade back. According to R.B.Srivastava, the director of DIHAR, while adaptogenic qualities of rhodiola can help the soldiers adjust to low pressure and low oxygen environment, the plant has also been found to possess anti-depressant and appetizer properties which is of specific relevance in case of altitude living. The Institute has developed herbal adaptogenic appetizers and herbal adaptogenic performance enhancers that can improve performance in high altitude conditions, which have been highly appreciated by the Indian Army. While Russian investigators established its impact on athletes and thereafter on cosmonauts, the findings of DIHAR reveal the potential of rhodiola for anti-ageing, tissue regeneration, protecting neurons during lack of oxygen, protection from radioactivity and cognitive improvement. The Institute has started a two-acre plantation of rhodiola in its premises.

With versatile and multifarious therapeutic values and as specific treatment-aid for altitude-related ailments, rhodiola-the wonder drug in the cold and high Himalayas has led Indian scientists to wonder if it is going to be the end of the quest for 'Sanjeevani'-the mythical herb that had given fatally-injured Lakshman (younger brother of Lord Rama) a renewed life in the Rama-Ravana battle of the epic Ramayana.

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## **BAMBOO : A FOREST WONDER**

**Er. Ramesh Chandra Sahoo**

Bamboo is a forest product. It is known as the tallest grass in the world. Plantations are found both in deep jungles and social forest. It is used both by the rich and poor alike. The rich use it for decorative furnitures and show case items where as the poor use it as their cheap construction material in thatched and low quality houses. It has got a huge potential to bring about a revolution as a bio-energy resource. Therefore, considering its importance, awareness building is necessary among the common people.

Bamboo has a good number of charms as a forest tree.

- It's growth of 1-1.5 mtrs per day in its tender stage is fastest in the plant kingdom.
- It has more than 5000 applications which include domestic, industrial, energy and carbon sequestration.
- Its forest colleague timber does not match with it in longevity, softness, versatility and economy.
- Bamboo plantation produces large amount of biomass and 30% more oxygen than a hardwood forest of similar size.
- It can bend but seldom, breaks in storms and cyclones. Protection ability of Bamboo surpasses all other variety of trees and bushes.

- Tensile strength is superior to mild steel, weight-to-strength ratio is better than graphite, strongest contender of all other known variety of biomass on earth.

But it is yet to get its proper place in forestation activities in India. Number of plantations are dwindling down due to heavy consumption, natural calamities including forest fire. Awareness is yet to develop for its replenishment, mainly among the rural poor, who are its real beneficiaries. In all plantation activities to fight global warming and pollution, stress has been put on wood based trees forgetting bamboo. But in honest comparison bamboo should overtake other trees.

All parts of a bamboo plant can be used profitably for different purposes. Root for sapling, trunk for construction, lighter parts for board fabrication and furniture. Top portion of the tree being tapered is used for fiber extraction for end use in household utilities. Remaining portion is used for fencing and other sundries. Dry leaves are generally used for cooking, room heating, biomass briquettes and carbon powder etc.

Recently research organizations are working for its use in producer gas, a much sought after industrial energy. Average bamboo consumption is 1.14kg per one unit of energy with a dual fuel engine with diesel replacement of 77%. It produces the most efficient blue flame. Its ash content is only 6% which is comparable to any other solid fuel for producer gas.



Selective harvesting from the bamboo bush is another advantage of this forest product. Annual harvesting of only 15 to 20% of matured stock can be effected without damaging its productivity and environment. Its carbon sink per hectare is similar to other wood species like eucalyptus and teak. Its carbon dioxide sequestrate rating is nearly 12 tonne per hectare of plantation.

Bamboo has another edge over other forest products as regards to poverty alleviation. Unlike the tree crop plantation, bamboo is highly suitable for cultivation specifically for pro-poor development. It very often grown in small plots of marginal lands managed by poor people. It is possible to group many small plots under one project to qualify for carbon trading as small scale forest project. Gift of a bamboo bush has religious impact in China. They believe it brings good luck to people and environment.

### **Massage and medicine**

It is the use of hollow bamboo canes that are warmed or used at room temperature in general massage. They are used as a tool in all modalities of massage. The treatment is currently gaining popularity in spas and salons and by beauty therapists. They can be used in a various treatment process in their own right or in conjunction with hot stones. Bamboo cupping jars were used in Traditional Chinese medicine.

Growing of Bamboo in Odisha can be attempted as small forestation projects in primary schools to educate students from the very early stage. Saplings may be supplied to the schools free of cost by social forestry division. Students can be guided to develop a bush each either on their own land or village waste land. It would meet fuel requirement of midday meals, besides cleaning the environment by removal of wastages. Next step is to produce bamboo briquettes with local available binding materials. It may promote small industries in the village while educating the students with its technology. These briquettes have a calorific value of 5500 to 7500 kcal/kg. Further step is to be taken for anaerobic digestion of bamboo plantation waste. The process products are cooking gas and solid and liquid fertilizer of superior quality. Excess gas, if available, can be used for electricity generation to meet the requirements of the same school. Such effort would make the schools independent in energy consumption related to fuel and electricity.

Our country is now implementing several missions for energy security and pollution control. The emphasis should be given in educating students from the early stage to deliver the mission objectives at their ripe age. Schools should be made into training grounds for the technologies. Bamboo plantations should be initiated at the earliest.

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## **BROWN MANURING : A TOOL FOR SUSTAINABLE RICE CULTIVATION**

**\*Dillip Ranjan Sarangi & \*\*Biswanath Sadangi**

Rice is the staple crop of Odisha. It is cultivated in most of the cultivated area (4.41 m ha) in our state yielding 6.94 million tonnes of rice for our consumption. But, the average production of rice in our state 1572 kg/ha is very meager when compared with that of our national average 2118 kg/ha. This low yield of rice can be due to various reasons like imbalanced nutrient application, improper cultivation practices and ignorance about micronutrient application. As farmers solely depend on farm manure and chemical fertilizers for rice cultivation, the imbalance supply of nutrients take place. Lack of adequate knowledge and limited facility for soil testing in the state also results in fertilizer application without any scientific basis. The major nutrients in excess in the soil or deficient in them are not clearly known. The use of single nutrient fertilizers adds to the misery. There is also increasing advocacy for use of green manure and natural nutrients for preventing the harmful effects of chemical fertilizers.

Recently, Dr M.S. Swaminathan, the "Father of Green Revolution in India" called for "*Evergreen Revolution*" by use of organic



nutrients for farm production and maintaining the soil fertility and sustainability. This has generated a lot of attention for the integration of nutrients from organic, inorganic and biological sources. But, it is still far from practice. In practice, farmers either use very less organic manure or no manure in rice cultivation. The practice gradually reduces soil fertility and productivity. In our state many farmers cultivate rice in their fields one after another mostly in irrigated lands. This method of cultivation reduces the soil pH leading to higher soil acidity.

### **Green Manuring**

For improving crop production, nitrogen, phosphorus and potassium are the most important elements. Nitrogen is needed for growth and metabolic activities. Usually nitrogen is supplied through chemical fertilizer urea and farm manure. Green manuring is being used in many parts of India to supply nitrogen in its organic form. For this, different species of plants having specific microbes in their root nodules that fix atmospheric nitrogen are used e.g. *Sesbania* spp. In Dhaincha (*Sesbania* spp.) plant root nodules *Rhizobium* species of bacteria reside and fix nitrogen found abundantly in the air. These plants are grown before rice cultivation and when

ploughed after 45 days of growth the nitrogen mixes in the soil and available to the rice plants planted afterwards. This method is very effective where monsoon is predictable and assured irrigation facility is available. But, in India and more typically in Odisha green manuring has varying degree of adoption due to untimely monsoon setting and lack of assured irrigation facility in addition to lack of knowledge about its benefits.

### **Brown manuring**

Brown manuring is similar to green manuring, except the fact that rice and *Sesbania* spp. are both grown together and when these dhaincha plants overtake the rice plants in height at about 25 days of co-culture, a weedicide 2, 4-D is applied to kill these *Sesbania* plants. After 4-5 days of spraying *Sesbania* plants will appear brown and then start dying. As it is a selective herbicide, it kills only *Sesbania* plants and not the rice plants. This is called knocking down effect. Brown manuring is usually recommended for the rice which is directly seeded, but not when transplanting is done. If the rice is broadcasted then at the time of *beusaning* dead *sesbania* plant parts will be incorporated in soil, whereas, in case of line sowing at the time of weeding it mixes in the soil supplying the nitrogen and other nutrients to rice.

### **Social Feasibility of the Technology:**

- The technology is more suitable for risk prone agro-ecosystems in which direct seeding of rice is done.

- As most of the Indian rice growers are resource poor, the technology can add more benefit with very marginal input cost.

### **Benefits :**

- Brown manuring increases the soil organic carbon content, thereby supplying required nitrogen for the rice plants. Thus, a part of nitrogenous fertilizer (upto 25%) can be replaced by brown manuring.
- It also increases the rice yield as shown in our experiments, thereby improving the economical benefit of the farmers.
- It also improves the soil health parameters like organic carbon content and earthworm population of the soil.
- Brown manuring reduces the weed population in the early stage due to its high growth rate and competition with the weeds.

### **Conclusion**

As there is a rising trend in chemical fertilizer cost, brown manuring can be used as an alternative approach for higher production and thereby more benefit for the farmers. As the brown manuring practice is eco-friendly and improves the overall soil health, it should be widely advocated by the extension agencies to realize its benefits for the farming community of the nation.

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# GREEN CONCRETE AN ECO-FRIENDLY PRODUCT

Dr. Bishnu Prasad Behera

## Introduction

"Green concrete" is a revolutionary concept in the history of concrete industry. This was first invented in Denmark in the year 1998 by Dr. W. G. Concrete. Green concrete requires less energy for its production and produces less CO<sub>2</sub> than the normal concrete. It is a type of concrete which resembles conventional concrete but requires minimum amount of energy in production and causes least harm to the environment. It is environment friendly. Concrete is one of the most consumed entity after water and accounts for around 5% of the world's total CO<sub>2</sub> emission. Green concrete follows reduce, reuse, and recycle techniques or any two processes in its production technology. The major objectives behind green concrete 1) are to reduce green house gas emission, 2) to reduce the use of waste materials in production leading to sustainable development without destruction of natural resources.

Usually concrete is a mixture of cement, sand, aggregates and water. Most of these materials can be recycled, or supplemented with other recycled materials to make as good



Fig. 1 : Principles of green concrete preparation

or in some cases better concrete. In the industry, green concrete can be prepared by using recycled materials in the concrete mix. With the help of a new advanced concrete crushing equipment, old concrete blocks can be crushed and the resultant aggregates could be used in new concrete mixes. Supplementary cementitious materials like fly ash and slags are replacing some of the cement content in the mix reducing the overall need to produce green concrete.

Green buildings and bridges (Fig. 2) constructed from using green concrete mixes i.e. using recycled materials are known to be as strong as the concrete mixes that use all new ingredients. Thus the use of recycled water, crushed concrete aggregates and supplementary cementitious materials like fly ash and slag greatly reduce carbon foot print and provide alternate sustainable building material for the industries.

## Features of green concrete

- Optimizes use of available recycled materials.
- Better performance
- Enhanced cohesion, workability and consistency
- Reduced shrinkage and creep

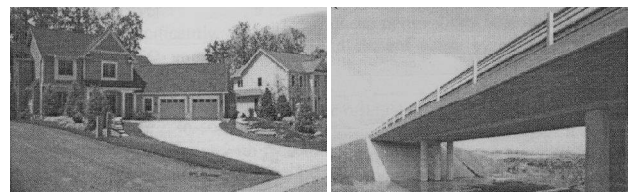


Fig. 2 : Green buildings Fig. 3 : Green concrete bridge

- Durability, better service life
- Reduced carbon footprint
- No increase in cost
- LEED India certification

### **Cement and CO<sub>2</sub> emissions**

Portland cement, an essential component of concrete, is the cementing material that binds the concrete together. However, in recent decades, the process of production of cement has been known to be a major source of green house gas emission. Worldwide production of Portland cement accounts for 5% of the man made CO<sub>2</sub> generation. The green house gas is most attributed as the source of global warming. The CO<sub>2</sub> generation is due to decarbonation from lime stone, klin fuel combustion and cement transportation by vehicles. It has been reported that production of one ton of cement releases about one ton of CO<sub>2</sub> into the atmosphere. Hence the use of cementitious materials like fly ash and slag are advisable for their use in green concrete production as they are eco-friendly to the environment.

### **Use of fly ash**

Fly ashes are the mineral residue, obtained from the combustion of powered coal in thermal power generating plants. Fly ash consists mostly of silicon dioxide, aluminum oxide and iron oxide. It is pozzolanic in nature. Fly ash can replace up to 50% of the Portland cement required in the manufacturing of concrete. Fly ash can be used to improve workability and consistency of concrete. Due to its slower rate of hydration, fly ash can lower the heat of hydration and is therefore

important in mass concrete structures, like large foundations, bridges, dams and piers. High fly ash concrete exhibits less bleeding and shrinkage than straight cement mixes.

### **Use of slag**

Slag is the byproduct produced during the smelting of ores to purify metals. In nature, metal ores are usually found in impure state often oxidized and mixed with silicates or other metals. During smelting, when the ores are exposed to high temperature, the impurities normally attached to the metal get separated from the molten metal and can be removed as slag. Ground granulated slag reacts with water to produce cement like properties. It could therefore be used in the production of concrete, in combination with Portland cement, as a part of the blended cement. Concrete containing ground granulated slag develops strength over a longer period, leading to reduced permeability with better durability properties. Most significantly, slag, decreases portland cement usage by as much as 50%, thereby diminishing CO<sub>2</sub> emissions.

### **Production of green concrete**

Green cement can be prepared by using fly ash, micro silica in large amount, stone dust, marble sludge power, quarry rock dust.

### **Suitability of Green concrete in structures**

Green concrete is suitable in reducing the dead weight of a structure. It also reduces crane age load, allow handling, lifting flexibility with lighter weight. It has good thermal and fire resistance, sound insulation

capacity than traditional granite rocks. It improves damping resistance of the buildings. The speed of construction can be enhanced, with the use of green concrete so that overall construction period is shortened. It has greater strength and durability than conventional concrete. The heat of hydration of green concrete is significantly lower than the traditional concrete. This results in a lower temperature rise in large concrete pours, which is an advantage for green concrete.

### Advantages of Green Concrete

Some of the advantages of the green concrete are, the emission of CO<sub>2</sub> which can be reduced by 30% in the concrete industries. It is best suited for controlling environmental pollution. Green concrete requires less maintenance and repair. It has good thermal resistance and fire resistance capacity. The compressive strength behavior of green concrete with water cement ratio is similar to conventional concrete. The flexural strength of green concrete is almost equal to that of conventional concrete. It also reduces the overall consumption of cement. By using fly ash, its workability increases and reduces extra load on landfills and mitigates the wastages of aggregates. As most of the recyclable materials are used in the manufacturing of green concrete, it leads to sustainable development.

### Scope in India

Green concrete is a revolutionary concept in the history of concrete industry. As green concrete is made from concrete wastes, the green building concept is catching

up very fast both at the global level as well as in India too. There is an increased need for green building materials and product in industries. Use of green concrete can help us to reduce a lot of wastage of several products. Various non-biodegradable products can also be used and thus avoiding the issues of their disposal.

### Conclusion

Green concrete is very effective in reducing energy consumption due to its solar reflectivity and high thermal mass. It reduces world's total CO<sub>2</sub> emission by 1.5-2%. So the use of green concrete will not only reduce the emission of CO<sub>2</sub> into the environment but also be cost effective in future. Green concrete is also very often cheap to produce, as the waste products are used as a partial substitute for cement, production. Further charges for the disposal of waste are avoided, energy consumption in production is lower, and durability is greater. Waste can be used as a resource to produce new products and the environment is protected.

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## MEGATONS TO MEGAWATTS

Er. Mayadhar Swain

The "megatons to megawatts program" was a good effort for the benefit of the humans. Megaton and megawatt are both units of energy. But while one has become the symbol of destruction, the other is the example of peaceful use of energy. The capacity of atomic bomb is expressed in megatons of TNT and the unit of electrical power is megawatt. The bomb dropped on Hiroshima of Japan has the power of 20 kilotons TNT. Modern bombs have the power in megatons. One megaton is equal to 1000 kilotons. The capacity of a power generating station is expressed in megawatts. For example, the capacity of Indravati Hydroelectric Project (Odisha) is 600 Megawatt and the capacity of Tarapur Nuclear Power Plant (Maharashtra) is 1400 Megawatt. The "megatons to megawatts program" was to utilize the uranium of atom bombs to generate electrical energy.

The story of nuclear energy goes back to the World War II. Although Albert Einstein, in his special theory of relativity, has formulated the mass-energy equation ( $E = mc^2$ ) in 1905, it was in 1938 that Otto Hahn, Lise Meitner, and Fritz Strassmann discovered the method for splitting Uranium to get nuclear energy.

Nuclear power can be used for both destructive and peaceful purposes. But the irony of fate is that it was first developed and used for destructive purpose. After Japan bombarded Pearl Harbour port of USA on the morning of December 7, 1941, USA joined

the war and took the lead on Allied side. It manufactured the atom bomb under Manhattan project. The first atom bomb named Little Boy was dropped on Hiroshima city of Japan on August 6, 1945 and the second bomb named Fat Man was dropped on Nagasaki of Japan on August 9, 1945. In both the cities almost two lakh people died and more than that were wounded.

After the war, nuclear reactors were established to produce electricity from Uranium. The first nuclear power plant was established in USA in 1951. Gradually, the technology was used in many more countries.

After World War II, conflict developed between USA and Soviet Union. Each country had its own block of other nations and each feared that the other would attack on it. It was termed as Cold War. As a result, both USA and Soviet Union stockpiled thousands of atom bombs.

Soviet Union was disintegrated on December 26, 1991 under severe economic conditions. Then the big country Russia was no longer to match with USA in terms of power and economic growth. The so called Cold War was over after disintegration of the Soviet Union. But the newly independent republics had more than 2400 nuclear weapons. After the Cold War, there was no need of piling of nuclear weapons. Further, Russia was struggling to get itself stable both economically and politically. So it wanted to dismantle a few thousand atom bombs and sell the nuclear fuel. The nuclear weapons usually contain a substantial amount of valuable

Uranium that can be utilized in commercial nuclear power plants to generate electricity. But the Russians had little cash to do it safely. Again care had to be taken so that it did not fall into wrong hands. Hence, it was important to carry out the program keeping the non-proliferation objective in mind.

Uranium-235 is used as a fissionable material to extract nuclear energy. Natural Uranium contains about 0.72 percent of Uranium-235 and 99.27 percent of Uranium-238. The commercial power plant reactors use Uranium with about 3 percent to 5 percent of Uranium-235. Hence, the natural Uranium is enriched via suitable processes to get this value. Enrichment to levels of 20 percent or greater produces highly enriched Uranium which is used in nuclear weapons.

For using the highly enriched Uranium-235 available in Russian atomic bombs for commercial reactors, the uranium has to be down-blended or diluted so that the amount of Uranium-235 becomes lower enough to be suitable for commercial reactors. For safe down-blending of enriched Uranium available in nuclear bombs, right technology and cash were required.

Dr. Thomas Neff, a physicist of the Massachusetts Institute of Technology, USA proposed a scheme for utilizing the uranium of nuclear weapons in commercial reactors. He published an article in the editorial page of the New York Times on October 24, 1991. This proposal turned out to be "Megatons to Megawatts program". Dr. Neff warned that if

USA would not buy the material, agents in the former Soviet Union might get it and buy to highest bidders with probable proliferation to non-nuclear countries. He estimated that a typical nuclear warhead might yield nuclear fuel worth \$200,000 and 10,000 warheads would fetch \$ 2 billion.

After this, USA negotiated with Russia to purchase the uranium of warheads. Both countries initiated this 20-year agreement in Moscow on August 28, 1992 when George W. Bush was the president of USA. Later President Clinton signed the agreement in 1993.

Under the program, both USA and Russia got benefitted. Russia down-blended 500 tons of enriched Uranium into 15,259 tons of reactor-grade Uranium over a period of 20 years and shipped these to USA. USA paid to Russia the charges to down-blend the highly enriched Uranium. USA also gave back to Russia a similar quantity of natural Uranium.

Russia got a rich bonanza of about \$ 13 billion. USA was happy to get Uranium from 20,000 warheads of Russia and fuelled its nuclear power reactors which provided 10 percent of electricity produced in USA over the past 20 years.

The historic project was concluded on December 31, 2013 and is considered as the most successful nuclear non-proliferation program.

■

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## QUIZ

### FOUNDERS OF MEDICAL SCIENCE

**Sri Himansu Sekhar Fatesingh**

1. Who is considered as the father of modern medicine ?  
 (a) Aristotle (b) Hippocrates  
 (c) Charaka (d) Galen
2. Who is regarded as the father of plastic and cosmetic surgery ?  
 (a) Galen (b) Imhotep  
 (c) Aristotle (d) Sushruta
3. Who is remembered as the founder of microscopic anatomy ?  
 (a) Claude Bernard (b) Marcello Malpighi  
 (c) Karl Landsteiner (d) William Harvey
4. He is described as the father of physiology.  
 (a) Claude Bernard (b) Leeuwenhoek  
 (c) Imhotep (d) Galen
5. Who is credited as the father of modern human anatomy ?  
 (a) Hippocrates (b) Georges Cuvier  
 (c) Vesalius (d) Luigi Galvani
6. Who is often respected as father of modern dentistry ?  
 (a) Niels Finsen (b) Pierre Fauchard  
 (c) Alexis Carrel (d) Robert Barany
7. He is usually acknowledged as the father of vaccination.  
 (a) Emil Behring (b) Ronald Ross  
 (c) August Krogh (d) Edward Jenner
8. Who is regarded as the founder of homeopathy ?  
 (a) Hippocrates (b) Samuel Hahnemann  
 (c) Carl Linnaeus (d) Phillip Miller
9. He is considered to be the father of audiology.  
 (a) Raymond Carhart (b) Carl Linnaeus  
 (c) Niels Finsen (d) Charles Laveran
10. Who is regarded as the father of emergency medicine ?  
 (a) Niels Finsen (b) Karl Landsteiner  
 (c) Thomas Morgan (d) Peter Safar
11. The credit of "the father gynaecology" goes to -  
 (a) J. Marion Sims (b) Alfred Binet  
 (c) Charles Sherrington (d) Thomas Morgan
12. The title of 'father of experimental psychology' is given to  
 (a) Gustav Fechner (b) Alfred Binet  
 (c) Wilhelm Wundt (d) Gerhard Domagk
13. He has been widely accepted as the founder modern nursing ?  
 (a) Ignaz Semmelweis  
 (b) Rosalind Franklin  
 (c) Corneille Heymans  
 (d) Florence Nightingale
14. Who is given with the title 'the father of psychoanalysis' ?  
 (a) Sigmund Freud (b) Carl G. Jung  
 (c) Nikolas Tinbergen (d) Ivan Pavlov

15. He is acknowledged as the father of radiation therapy.  
 (a) Marie Curie (b) Hassan K. Awwad  
 (c) Pierre Curie (d) Emil Fisher
16. he is considered as the father of antiseptic medicines ?  
 (a) Louis Pasteur (b) Hans Spermann  
 (c) Joseph Lister (d) James Simpson
17. Who is often regarded as the father of chemotherapy ?  
 (a) Paul Ehrlich  
 (b) Hermann Muller  
 (c) Alexander Flemming  
 (d) Jonas Salk
18. Who is acknowledged as the father of bacteriology ?  
 (a) Robert Koch (b) Alexander Flemming  
 (c) Louis Pasteur (d) Ronald Ross
19. Who is regarded as the father of molecular biology ?  
 (a) G.N. Ramachandra (b) Max Theiler  
 (c) Linus Pauling (d) Otto Warburg
20. The title of "father of pediatrics" is given to -  
 (a) Karl Landsteiner  
 (b) Elie Metchnikoff  
 (c) Sir Frederic Hopkins  
 (d) Muhammad ibn Zafariya Razi
21. He has been described as the father of medical ultrasound.  
 (a) George Minot (b) John J. Wild  
 (c) Willem Einthoven (d) Hugo Theorell
22. Who is considered as the father of test tube baby ?  
 (a) Max Theiler (b) George Beadle  
 (c) William Bateson (d) Sir Alec Jeffreys
23. He is regarded as the founder of gene therapy.  
 (a) Hugo de Vries  
 (b) William French Anderson  
 (c) William Bateson  
 (d) Sir Alec Jeffreys
24. Who is described as the father of artificial organs ?  
 (a) Willem Johan Kolff  
 (b) Thomas Straz  
 (c) Jules Bordet  
 (d) Konard Bloch
25. Who is credited as the founder of nephrology ?  
 (a) Julius Axelrod  
 (b) George Palade  
 (c) Michael E. DeBakey  
 (d) John P. Merrill

**ANSWER**

01. (b) 02. (d) 03. (b) 04. (a) 05. (c)  
 06. (b) 07. (d) 08. (b) 09. (a) 10. (d)  
 11. (a) 12. (c) 13. (d) 14. (a) 15. (b)  
 16. (c) 17. (a) 18. (a) 19. (c) 20. (d)  
 21. (b) 22. (c) 23. (b) 24. (a) 25. (d)

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2. The authors desirous of writing and contributing articles to the magazine should first assimilate the ideas of the theme and present it in simple language and popular style.
3. The authors are requested to write clearly on one side of A/4 size paper. The relevant pictures in 4cm X 6 cm size are welcome. Photo copies of manuscripts are not accepted for consideration.
4. Each article will be ordinarily of two to three printed pages in A/4 size papers.
5. The article shall be profusely illustrated with pictures.
6. At the end of the article the author should give the references and suggestions for further reading.
7. The reference of books, journals, sources, ideas and essential points collected by the writer should be mentioned in the bibliography. This will enhance the quality and fidelity of the writing and give the reader an opportunity for making further studies.
8. Matter translated from other languages and illustrations should indicate the original sources otherwise those would not be accepted. The articles which are not published, can not be returned to the authors.
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10. The writers should present difficult concepts of science through stories of everyday life, heart-rendering songs, pictures, satirical cartoons or attractive dramas.
11. All units in the articles should be given in the metric system.
12. The title of the article should be brief and attractive. Moreover, subtitles may be given in long articles. The writings should be coherent and cohesive.
13. There should not be repetition of specific words. While ensuring the contemporary spirit of the writing, it should reflect some valuable lesson for the society. It is also necessary to avoid mistakes in spelling, language use and factual details.
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