



# Science Horizon

ODISHA BIGYAN ACADEMY

5TH YEAR

3RD ISSUE

MARCH 2015



# ACTIVITIES OF ODISHA BIGYAN ACADEMY

Interaction and Inspiration Programme from 10-13 February, 2015



## NATIONAL SCIENCE DAY - 2015





# Science Horizon

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MARCH, 2015

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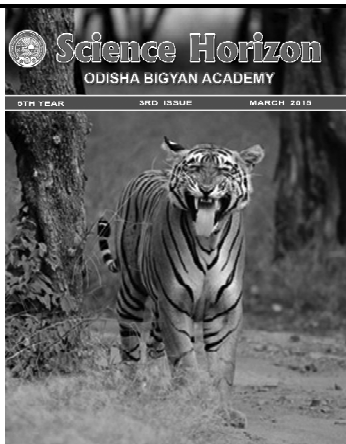
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The Cover Page depicts : **Endangered Tigers**

Cover Design : **Sanatan Rout**

# EDITORIAL

## WILDLIFE CONSERVATION : AN OVERVIEW

On the occasion of World Wildlife Day (3rd March) the U.N. has decided to raise awareness of endangered animals and plants and ways to fight against wildlife crime. The crime involves illegally selling and buying of animal body parts, as well as stealing or killing animals that are protected by laws. The global illegal trade of wildlife is second only to the illegal trade of drugs in value. It is proving a disaster, threatening biodiversity worldwide & pushing several species to the verge of extinction. The trade involves hundreds of millions of wild plants & animals from tens of thousands of species. Of late, India has become a conduit for illegal wildlife trade, threatening its megadiversity like never before. Wildlife trade is one of the most profitable illicit trades in the world, estimated at upto Rs. 10 billion annually. Illegal wildlife trade of elephant ivory, rhino horns and tiger bone, skin and other products, is widespread in many countries throughout the globe. Combating this crime is not only essential for conservation efforts and sustainable development, it also contributes to achieving peace and security in the society. It is high time that the country should learn from the recent episodes of vanishing tigers, elephants, one-horned rhinoceros from their respective reserves and took up the challenge to combat the menace of poaching as well as illegal wildlife trade. The country must act before it is too late. Apart from the above problems, threat to the survival of wildlife also arises from destruction, fragmentation and degradation of the habitats which are mainly man made. Therefore wildlife conservation has become increasingly important not only to ensure the protection of nature in its wilderness for the benefit of the present generation but also for the posterity. Wildlife has intrinsic values and contributions to the ecological, social, economic, genetic, scientific, educational, cultural, recreational and aesthetic aspects of sustainable development and human wellbeing. For these reasons global celebration of Wildlife Day has been urged.

The World Conservation strategy was developed in 1980 by the "International Union for Conservation of Nature & Natural Resources (IUCN) with advice, cooperation & financial assistance of the

United Nations Environment Programme (UNEP) and the World Wildlife Fund in collaboration with FAO and UNESCO. The strategy aims to provide an intellectual framework & practical guidance for conservation actions. The international NGO like World Wildlife Fund for Nature (WWF) & others are also involved in this work.

India being one of the 17 megabiodiversity countries of the world has an amazingly wide variety of animals endemic to the country. It is home to Bengal tiger, Indian lions, deer, pythons, wolves, foxes, bears, crocodiles, camels, wild dogs, monkeys, snakes, antelopes, Indian Bison and the Asiatic Elephant. The rich diverse wildlife of the region is preserved in 89 national parks, 18 Biosphere-reserves, 26 Wetlands and more than 400 Wildlife Sanctuaries across the country. Three of the world's 34 biodiversity hotspots (i.e. the Western Ghats, the Eastern Himalayas and Indo-Burma region) provide shelter to a number of rare and threatened animal species of the country. India contains 172 species (or 2.9% of the world's total numbers) of animals that are considered by IUCN to be globally threatened. These include 53 species of mammals, 69 species of birds, 23 species of reptiles and 3 species of amphibians.

Wildlife habitats and species around the world are facing serious crisis today. However, India is doing better than many other countries. India has launched an extensive protected area network of research institutions in which legislation, socioeconomic factors and wildlife research are playing a significant role. The Central Zoo authority of India plays a key role with Zoos in programmes related to the conservation & propagation of wild animals.

The success & failures of wildlife (biodiversity) conservation in India in the coming years will neither stem from how many wildlife sanctuaries and national parks we are able to maintain nor from the various laws we enact, but from the way the whole social, economic, administrative machinery functions. This system has many serious weaknesses today which must be corrected if we are to succeed. One should be optimistic that it would eventually be achieved to gain in strength. However, a long struggle is ahead of us.

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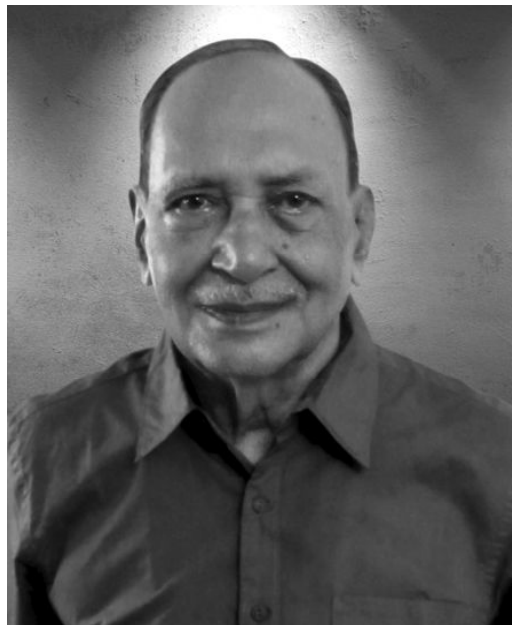
## MAJ. D. K. NANDA - AN EDUCATIONIST PAR EXCELLENCE

Prof. Amulya Kumar Panda

Major Dharendra Kumar Nanda was a person with a difference. He was a college teacher who taught Zoology and for some time, did research with the late, lamented Shanti Swaroop Bhatnagar awardee Professor M. S. Kanungo. He had an illustrious career as a teacher, as an NCC officer, as an educational administrator and an eminent educationist. Popularly known as 'Major Nanda' in all circles, he was indeed, a major in every sense of the term. Through his inimitable style of teaching and handling the practical classes he was a hot favourite with his students. He took every opportunity to spread the message of science amongst the students.

Born on the first day of January in 1932 at Balasore, he passed his I.Sc. from the second oldest college of the State - S. K. C. G. College, Parlakhemundi in 1948 and B.Sc. (Honours in Zoology) with distinction from Ravenshaw College - the oldest and biggest College of Odisha, in 1950. He then went for his M.Sc. (Zoology) to yet another great institution - Banaras Hindu University and got his degree in 1952. After this, he joined as Lecturer in Zoology at Khallikote College, Berhampur where he set up the Biology Department. This was a model department those days in the whole state.

In 1957 he joined the Orissa Education Service and was posted to Fakir Mohan College, Balasore. In 1970 he was promoted



Maj. D. K. Nanda (01.01.1932- 12.02.2015)

and he joined S.C.S. College, Puri as a Reader in Zoology. The credit of planning as well as supervising the construction of separate Botany and Zoology blocks in S.C.S. College, with state of the art facilities, goes to him. During his tenure, the Zoology Honours students of this College achieved academic excellence and every year got 5-6 places in the Top-Ten list. With a rare sense of commitment he diligently pursued his objective of complete personality development of his students through regular teaching-learning process as well as through extra and co-curricular activities like NCC, College Union, Drama, Games and Sports etc. Without possibly knowing that he was virtually a human resources development specialist, he precisely did that job throughout his career. As a teacher,

he might have worked in the colleges for a comparatively short period, but his contribution is incomparable. His 3 year stint as Principal, Gopabandhu Science College, Athagarh deserves special mention as he was instrumental not only in shifting the college to a new spacious and salubrious campus but in restoring the academic glory of the institution as well.

What is great about him was his conviction in everything he did. He was confident, never complacent nor was he ever conceited. With a positive attitude and an indomitable never-say-die spirit, he was a role model and a source of inspiration to his students and younger colleagues. He was an asset to every institution/organization where he worked. It is this attitude that determined his altitudes in his life.

Yet another remarkable achievement was the service he rendered as an officer in the National Cadet Corps (NCC). After undergoing Pre-Commission Training at Rajput Regiment Centre, Fategarh (UP) in 1955 he was a part-time NCC officer in colleges. Later he underwent a 6 month Advanced Training in NCC Academy, Purandhar. Impressed with his officer-like-qualities and outstanding Annual Confidential Reports the authorities chose him as a whole-time NCC officer. During this period he raised the Girls Battalion NCC in our state and was its Commanding Officer. A bright feather in his cap was his appointment as an Officer on Special Duty to the Chief of Army Staff-cum-Director General, NCC, General Choudhury.

In the sphere of education he worked in various capacities. As Secretary, Board of Secondary Education in 1980-81 he, for the first time, introduced computerization of marks and certificates. Later (1982-86) as the Vice President of the same organization he ensured flow of funds from the NCERT for extensive Teachers' Training Programmes covering several subject, planning and executing these programmes with rare aplomb. From 1986-89, as Deputy Secretary (Planning), Higher Education Department, he arranged to obtain adequate funds from Government of India for construction of Primary School buildings and many such development activities.

After retirement from Government service on superannuation, Utkal University chose to appoint him Director, College Development Council and he worked in that capacity upto 1992. It was indeed an eventful period for the University. The fact that as many as 150 Colleges were brought under the UGC cover as far as grant-flow is concerned and that 10 colleges were selected for grant of autonomy in the first phase bear ample testimony to his dynamism and vision. He was also successful in obtaining Ford Foundation grants for capacity building of students, teachers and non-teaching staff. Impressed with his contributions, Utkal University continued to utilize his services as long as possible and retained him, as Consultant, Examinations.

Similarly, the UGC, in recognition of his merit and achievements gave him a variety of assignments from time to time.

- Member, UGC Standing Committee on Autonomous Colleges;
- Member, CDC Drafting Committee;
- Members, Review Committee for Kerala University and Samblapur Univeristy;
- Convenor, Committee for Selection / Review of Autonomous Colleges of Tamilnadu and Madhya Pradesh;
- UGC Nominee in the Governing Body of Colleges in Tamilnadu, Madhya Pradesh and Odisha;
- Convenor, NAAC Peer Team, Mumbai;
- Member, NAAC Peer Team, Nagpur and Guahati.

The Government of Odisha too utilized his experience and appointed him the Chief Coordinator for training 150 Principals to face NAAC. He arranged NAAC Peer team visits to 150 colleges within 1½ years during 2005-06. By any consideration this is a rare feat. He was also associated with the Utkal University of Culture and functioned as Consultant, Academic for about 1½ years, during which he gave final shape to the Regulations etc. of the University.

In addition to all this, he, along with this writer, wrote and published a number of articles in the Odia dailies covering various aspects of Higher Education with view to sensitizing

the students, teachers, government and general public. In the process he attempted to arouse their interest and inspired them to strive for excellence individually as well as institutionally at the national level.



In recognition of his contributions to Science and Education he has been rated high by his superiors as evident from the entries in the Confidential Character Roll (CCR) and Annual Confidential Report (ACR). He has also been felicitated by a number of institutions and organisations. On 25th January 2015, Ravenshaw Zoology Alumni Association (RAZAA) felicitated him at his residence and that was the last such occasion.

In fact, 'Major Nanda' was a name synonymous with Higher Education in the State. Seldom does God endow people with such qualities and such accomplishments, as seen in him. He continued to dream about improvement in the system and worked towards this until he breathed his last on the 12th day of February, 2015. His departure for his heavenly abode has created a void that may be difficult to fill in the days to come.



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## WILDLIFE AS WISE LIFE

Dr. Prafulla Kumar Mohanty

### What is Wildlife ?

The term wild appears to be very common to us. Very often term wild is discussed which is associated with wild animal, wildness, wilderness, wild ass, wild birds, wild boar, wild cat, wild cherry, wild dog, wild duck, wild fire, wild fowl, wild goose, wild grape, wild honey, wild indigo, wild land, wild mare, wild silk, wild wood and wild life but what is wild/the term wild is derived from the old English wilde, the meaning of which is wild or Jungle. The following are the meaning of wild.

- (i) Being in a state of nature.
- (ii) Not tamed or cultivated
- (iii) Of an undomesticated or uncultivated kind.
- (iv) Uncivilized
- (v) Desolate

Accordingly, wildlife is undomesticated life and wild animals mean undomesticated animals. Broadly, free and undomesticated species of animals in general are wildlife. Wildlife resources are species of wildlife that have actual or potential economic value to people. wilderness is the area where the earth and its community of life have not been seriously disturbed by humans and where humans are only temporary visitors. Wildlife is one of the important natural resources like

(i) water resources, (ii) land resources, (iii) biological resources, (iv) minerals, (v) energy, (vi) ocean and (vii) human resources (Fig.1).

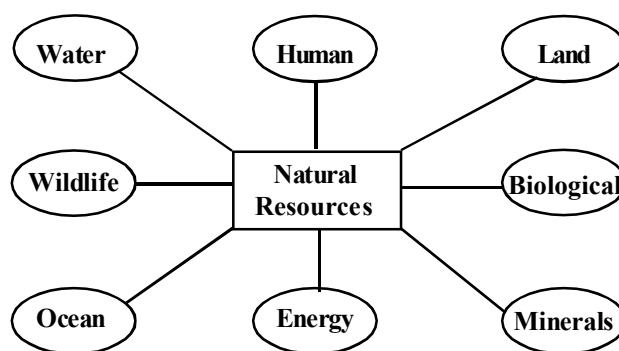


Fig. 1 : Major natural resources

### Wildlife : A Resources

Resource is source or possibility of help, or means of support, or means of occupying or amusing oneself or an expedient. In general, all means of satisfying human needs, at a given time and place are "resources". Obviously, resources are means for attaining individual and social welfare. There are four major categories of resources namely (i) continuous resources, (ii) renewable resources (flow resources), (iii) non-renewable resources (stock resources) and (iv) extrinsic resources (Fig. 2).

Wildlife is an important and vibrant living resource of our environment. This is considered as the biological resource because of the life. Due to various human (anthropogenic) activities, this resource is decreasing, depleting

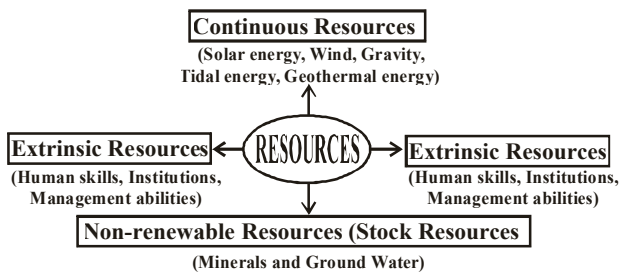


Fig. 2 : Major Categories of resources.

and degrading very fast. The significant human activities affecting or destroying the floral and faunal diversities are serious exploitation and pollution. This situation is leading to the extinction of species. In fact, we all fail to see certain plants and animals from our surrounding because of loss of natural population and extinction. In spite of various programme and efforts, our precious wildlife resource is getting depleted at an alarming rate because of commercial interest and myopic attitude towards nature.

### Historical Background on Wildlife

- (i) It is observed that there is a serious and continuous deliberation, discussion and calculation as to preservation, conservation and extinction of wildlife today. Man has been interested in the animals since the dawn of civilization. He killed them for food and clothing, observed them for amusement and joy and listened to various melodious notes of birds. For pleasure. So the idea of preservation of wildlife is never new to us. It has been an integral part of our religion and culture.
- (ii) The Vedas contain hymns in narrating, discussing and praising varieties of animals.

- (iii) Kautilya's "Artha Shastra" provides several penalties for killing, hunting or poaching, entrapping or molesting deer, bison, birds and other animals of the surrounding.
- (iv) Ashok's Fifth Pillar Edict proclaimed game and fisheries laws as early as the third century BC.
- (v) During the Medieval period, Mughal, emperors showed keen interest in animal life of the country. Game was protected and preserved in hunting reserves called "Shikar gaha".
- (vi) In all temples of India and Konark, Lingaraj and Jagannath temples of Odisha in particular, varieties of animals are seen either in the form of paintings or stone engraved form. This indicates the liking and attraction of artists and human beings during that period. This practice is also noticed today in one of the majestic modern temples of India including Akshar Dham of New Delhi.

### Important Wildlives of India

India is one of the four megadiversity nations of Asia. It is rich in biodiversity and possesses all the natural resources required for the sustenance of every kind of living organisms. In addition to the vast diversity of animals, our country is extremely rich in cultural diversity, geographical diversity and climatic diversity. Mega diversity countries

are a group of countries that are home to a wide variety of plants and animals. This category includes that have an extremely rich biodiversity. The World Conservation Monitoring Centre (WCMC), an agency of the United Nations Environment Programme (UNEP), had identified 17 megadiversity countries most of which are located in tropics. According to WCMC, the 17 megadiversity countries most of which are located in tropics. According to WCMC, the 17 megadiversity countries are Australia, Brazil, China, Columbia, Democratic Republic of the Congo, Ecuador, India, Indonesia, Madagascar, Malaysia, Mexico, Papua, New Guinea, Peru, Philippines, South Africa, United States and Venezuela. India is unique in having a varieties of wildlife (Table 1) which have made the earth colourful, attractive and vibrant.

### Why is Conservation Essential ?

Conservation without compensation is simply conversation. The wildlife helps us in many ways (Fig.3). These are as follows.

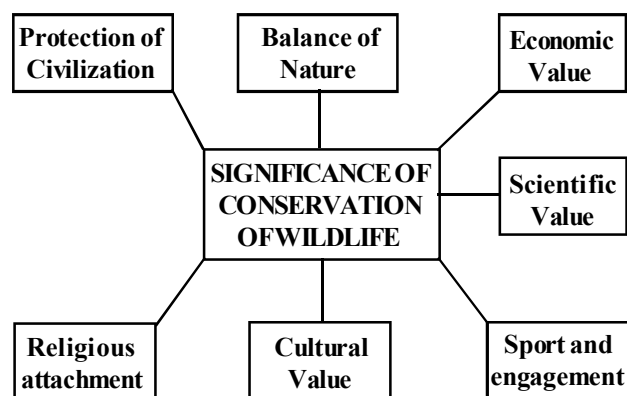


Fig. 3 : Importance of conservation of wildlife.

Table 1 : Some import wildlife of India

Sl. No.	Common Name	Scientific name of the animal
1	Asiatic elephant	<i>Elaphas maximus</i>
2	One harned rhino	<i>Rhinoceros unicornis</i>
3	Indian tiger	<i>Panthera tigris tigris</i>
4	Lion	<i>Panthera leo persica</i>
5	Indian panther	<i>Panthera pardus fusca</i>
6	Striped hyena	<i>Hyaens hyaena</i>
7	Sloth bear	<i>Melursus ursinus</i>
8	Nilgiri tangur	<i>Cercopithecus johni</i>
9	Rhesus monkey	<i>Macaca mulatta</i>
10	Hanuman monkey	<i>Semnopithecus entellus</i>
11	Indian wild boar	<i>Sus cristatus</i>
12	Mouse dear	<i>Tragulus meminha</i>
13	Spotted dear	<i>Axis axis</i>
14	Musk deer	<i>Moschus modschiferus</i>
15	Sambar (State animal of Odisha)	<i>Cervus unicolor</i>
16	Indian Bison	<i>Bos Gaurus</i>
17	Four horned antelope	<i>Tetracirus quadricornis</i>
18	Nilgai	<i>Boselaphus tragocamelus</i>
19	Pangolin	<i>Manis crassicaudata</i>
20	Wild buffalo	<i>Bubalus bubalis</i>
21	Estuarine crocodile	<i>Crocodylus porosus</i>
22	Muggar	<i>Crocodylus palustris</i>
23	Gharial	<i>Gavialis gangeticus</i>
24	King cobra	<i>Ophiophagus hannah</i>
25	Common Cobra	<i>Naja naja</i>
26	Monitor lizard	<i>Varanees</i>
27	Pea fowl	<i>Paro Cristatus</i>
28	Blue Jay (State bird of Odisha)	<i>Coracias benghalensis</i>
29	Egrets	<i>Egretta</i>
30	Quails	<i>Coturnix coturnix</i>

- (i) They maintain the "balance of the nature". The relationship between herbivores and carnivores are nicely balanced. The destruction of carnivores helps in increasing the herbivores which in turn affects the forest vegetation.
- (ii) Wildlife has significant economic value. The animal products like hides, horns, ivory, fur, teeth, oil etc. are a very good source of income.
- (iii) Wildlife plays a pivotal role in animal research. Various experiments and investigations in physiology, ecology, ethology, histology, anatomy, haematology and genetics of wild animals may divulge a wealth of information to us.
- (iv) Wildlife is a source of sport and enjoyment. It is an interesting and amazing experience to see pet and unpet animals, their behaviour and activities from close quarters.
- (v) Wildlife exhibits a great cultural value. The description of animals are seen in religions, culture, temples, vedas, mythologies and panchatantra.
- (vi) Wildlife is highly associated with Gods and Goddesses. Animals are carriers of many Gods and Goddesses for which people worship and conserve animals.
- (vii) wildlife protects our rich and strong civilization.

It is matter of serious concern that today wildlife is under serious threat due to various unwanted human activities (Fig.4). Human beings should be very careful for the animals around them. Otherwise the animals will face extinction and can only be seen as pictures in the book. Hence conservation should be a serious measure for future.

### Measures of Conservation

Wildlife is precious for our environment and life. They are an integral part of the nature. Therefore, they need to be conserved, preserved and protected by the following methods.

- (i) Protection by stringent laws
- (ii) Establishment of protected areas like Zoos, Parks, Sanctuaries, National Parks and Biosphere reserves.
- (iii) Restoration of original habitats.
- (iv) Providing better living conditions.
- (v) Educating public, common persons and students of schools, colleges and universities through awareness programmes.
- (vi) Observing various days pertaining to conservation of animals (wildlife week, world habitat day, Elephant Day, Pangolin Day, World Biodiversity Day, World Earth Day, World Forestry Day etc.)
- (vii) Collection of germplasm of existing species.

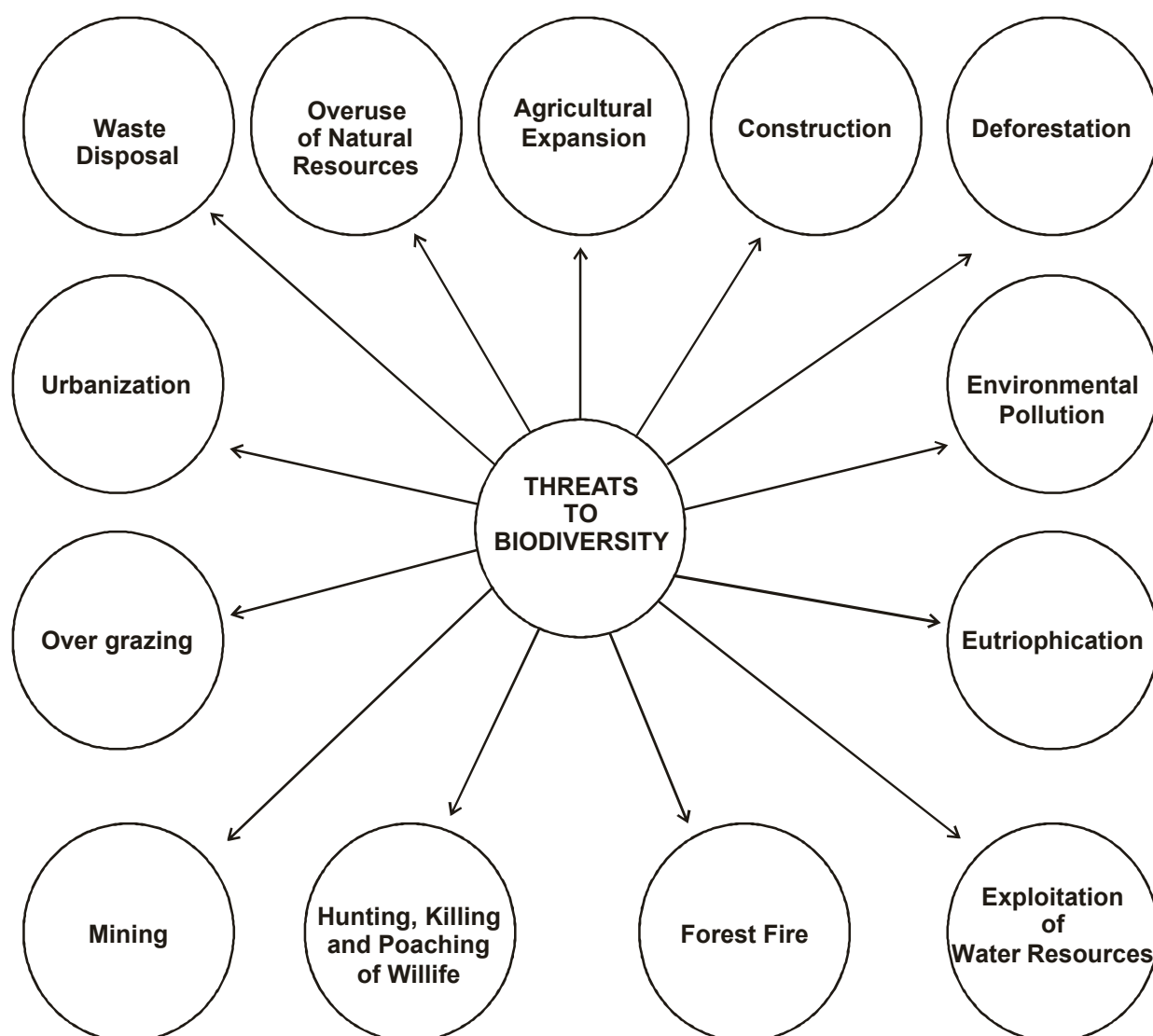


Fig. 4 : Threats to biodiversity due to human activities.

- (viii) Reduction of environmental pollution.
- (ix) Introduction of successful in situ (in site) and ex situ (off site) conservation measures.
- (x) Strengthening research on wildlife.
- (xi) Observing 4R rule (Reduce, Recycle, Refuse and Reuse).

### Conclusion

A planet without air, water and food is as like as human life with wildlife. Wildlives are

so beautiful creatures of our nature that JawaharLal Nehru (1974) said,

"Wildlife ? That is how we refer to the magnificent animals of our jungles and to the beautiful birds that brighten our "Lives."

So before being extinct, should we not think of them ? Should we not think of their natural habitat and population ?

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## RED DATA BOOK

**R. B. Mohanty<sup>1</sup>**  
**B. K. Tripathy<sup>2</sup>**

Man is said to have inhabited the earth for nearly 5.5 million of years. But he is not alone on this planet. The earth also houses another 10 to 100 million different species including plants, animals and micro-organisms, many of which are yet to be identified and scientifically studied. Moreover, man has depended on them for all his basic needs like food, clothing, shelter, medicine and other requirements. But in the 20th century with population explosion he became instrumental for the destruction of their habitats and the overexploitation of natural resources to such an extent that the existence of many species are threatened while some other species have undergone complete extinction. It is estimated that about 60,000 species of plants and 2000 species of animals are on the verge of extinction and approximately 27000 species get extinct every year due to the loss of their habitat. If this trend of depletion continues, one fourth of the world's total biodiversity may be wiped out by the year 2050.

After realizing the importance of different plant and animal species in an ecosystem and the role they play, conservation measures were accelerated in the last decade of the 20th century in different countries of the world. Explorations were carried out to ascertain the present status of different species and reports published from time to time.

There is an international body called IUCN which maintains the record of threatened species (a species i.e. liable to become extinct) for the purpose of conservation. The IUCN has headquarters at Morges, Switzerland and it has laid down five main conservation categories to highlight the present status of rare species for the purpose of their protection. The species to be protected and conserved are those that are (i) extinct, (ii) endangered, (iii) vulnerable, (iv) rare and (v) insufficiently known species. Using in IUCN guidelines, the world conservation monitoring centre (WCMC) has evaluated and described threats to about 60,000 plants and 200 animal species in its series of reports called the "Red Data Book". The "threatened species" include : endangered, vulnerable, and rare in IUCN categories. Additionally, in order to draw the attention to the threatened species which needs immediate measures for their conservation, IUCN also issue the list of the world's most threatened plants and animals. A rare flightless bird, Kagu in new Caledonia, a primitive Ox from Southeast Asia, the Orinoco River Crocodile who are on the verge of extinction also figured in the list. Plants like giant 'Rafflesia' of Sumatran rain forest and the African 'Violet' of central Tanzania are also the most threatened species. IUCN has estimated that about 10% of the world's vascular plant species i.e. around 20,000-25,000 species are under varying degrees of threat. Simultaneously, to include the information on threatened biological

species, IUCN is publishing Red Data Books on threatened species of animals and plants to highlight the latest status of species of our planet. The Red Data Book was first published in 1966. Since then the book is being regularly updated. The number of animals enlisted in this book is more than 3000 and that of plants is over 20,000. The book contains a list of 497 mammals, 1037 birds, 170 reptiles, 50 amphibians, 343 fishes and 1355 invertebrates. India has maximum number of threatened species in this data book. The number of threatened plants of India goes up to 474 while that of animals is more than 100 as per the list published in the Red Data Book. The organisms are classified as the threatened species on the basis of their distribution, abundance, quality of habitat, population number, biotic potential and potential values. IUCN has also compiled a list of endangered species of the world under the title, 'Blue Book' and a list of rare plants growing in protected areas like Botanical gardens under the title 'Green Book'.

In this context, the situation in India which is also one of the twelve mega-biodiversity centres of the world and with two biodiversity hotspots is in no way better. Based on the survey of about two thirds of the geographical area of the country. The ministry of forest and environment reported that India has about 45,000 plants and 77,000 animals species which are facing serious threat due to population explosion and its consequent effects. The Wildlife Institute of India, Zoological Survey of India (ZSI) and Botanical

Survey of India (BSI) are the three premier institutes publishing reports on the status of fauna as well as flora of our country from time to time. BSI, has published "The Indian Plant Red Data Book-1" with 125 data sheets of flowering plants for the first time in 1984 which is followed by several new publications in later years. Some pioneer workers like M.P. Nayar and A. R. K. Sastry have edited the "Red Data Book on Indian Plants" published by BSI in 1987, 1988 and in 1990 in several volumes highlighting around 195 endemic as well as the endangered flora of this sub-continent. The status survey of the endangered animal species was also carried out and the 'Red Data Book' on the fauna has been compiled by focusing on the present status of endemic mammals, birds, reptiles, amphibians and fishes of India.

The scientific exploration, survey, identification, cataloguing and publication of the list of endangered species in the form of "Red Data Book" is a tremendous task. But, it is the most essential primary step towards Biodiversity conservation.

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## ESTUARINE CROCODILE CONSERVATION PROGRAMME IN BHITARKANIKA, ODISHA : A SUCCESS

Dr. Sudhakar Kar

Since 1970s the population of the three crocodilian species in India as well as in Odisha is getting critically reduced due to combination of poaching and habitat loss. Piecemeal efforts were being made from 1960s onwards to save the crocodilian Fauna. On the request of Government of India, Dr. H.R. Bustard an FAO Expert, was appointed by UNDP/FAO to study on the prospects of crocodile rehabilitation in the river systems of India in 1974 and based on his report and guidance a Crocodile Conservation Project was launched in 1975 in different States of the country.

During 1976, survey of (i) Saltwater crocodiles (*Crocodylus porosus*) and (ii) Gharial crocodiles (*Gavialis gangeticus*) was conducted in the river systems of the Bhitarkanika area and in the river Mahanadi, respectively. The number of Salt-water crocodiles in Bhitarkanika area was estimated to be 96 including 34 adults. The number of Gharials in Mahanadi was estimated to be 8, including 4 adults. No detailed survey was, however, conducted for Mugger or Marsh crocodiles (*Crocodylis palustris*) at that time, although the species was known to occur at several places in the State. The breeding population of Mugger crocodiles known at that time were in the Balimela Dam of Koraput district and Ghodahad dam of Digapahandi area in Ganjam district.



**Bhitarkanika river with luxuriant mangrove vegetation at both the banks**

The Crocodile Project was started with the objectives of building the population and to make up the natural losses by death and predation through rear and release operations. That involved, collection of eggs from the nests as soon as those were laid down, incubation and hatching of those eggs in the hatcheries under regulated conditions of temperature and humidity, rearing the young juveniles, marking and release of the young crocodiles into the Nature i.e. into the protected areas, and assessment of the degree of success in restocking the protected areas with crocodiles released from the hatcheries. To accomplish these tasks, three separate research units were established at three locations like Tikarpara, Dangmal and Ramatirtha for the Gharial, Saltwater Crocodile and the Mugger, respectively. However, at the Nandankanan Biological Park, captive breeding programme for all the three crocodilian species were conducted.

## Management objectives

The broad strategies adopted for rehabilitation of crocodiles were to protect the three species of crocodilians in their natural habitats, to rebuild the population quickly through captive breeding (rear and release), and to build up trained personnels for the job. The broad objectives of activities under crocodile project were the following.

- (a) To protect the remaining population of crocodilians in their natural habitat by creating sanctuaries.
- (b) Quick rebuild of natural population through 'grow and release' or 'rear and release' technique involving the following phases of operation:
  - Collection of eggs from natural nests as soon as these were laid,
  - Incubation of those eggs under ideal temperature and humidity maintained in artificial hatcheries,
  - Hatching and rearing of the young crocodilians in ideal captive-husbandry conditions,
  - Marking and releasing of young crocodiles in protected areas, and
  - Protection of the released crocodiles and monitoring their movement pattern, survival, etc.
- (c) To promote captive breeding.
- (d) To take-up research to improve management.
- (e) To build up a level of trained personnel for better continuity of the project.
- (f) To involve the local people intimately for success of the conservation programme.

The "rear and rehabilitation" programme as well as the research activities on all the three crocodilian species have been taken up successfully for more than 39 years. Among all these three species, the Saltwater Crocodile Conservation and Research Programme at Dangmal in Bhitarkanika is most successful.

## Estuarine Crocodile Conservation and Research Project

At Dangmal in Bhitarkanika sanctuary (now a National Park), Estuarine crocodile eggs have been collected locally; and young crocodiles have been released in the creeks and the estuaries; and more than 2300 young captive reared crocodiles of about 3 feet length have been released in phases since 1977.

This operation has been a successful one and the crocodile population in the Bhitarkanika river system has gradually been built up. Above 75 released female Saltwater Crocodiles have bred successfully and are laying eggs in the wild. This is 13 times more in comparison to mid 70s to mid 80s so far as availability of the crocodile nests in the wild is concerned.



**Incubation and hatchling of eggs at Dangmal Project Hatchery (after about 75 days of incubation period the hatchlings emerge out)**



Captive reared young crocodiles (about 3 ft. length) are shifted carefully for release in the river systems away from human habitation

The annual census conducted in the river systems of Bhitarkanika wildlife sanctuary in Jan.2015 indicated that there are 1665 Saltwater crocodiles in Bhitarkanika area and the crocodile population is on increasing trend. The density of crocodile population in the Km. length of river / creek has increased from 0.87 to 12, during the last forty years.



One of the few large male crocodiles of about 18 ft. seen in Bhitarkanika river systems

### Results indicate the followings:

The census results indicate as follows:

- (i) Successful implementation of Saltwater Crocodile 'rear and rehabilitation' programme in Bhitarkanika sanctuary / National Park since 1975.

- (ii) There is marginal increase of crocodile population by 1.26% over Jan, 2014 census results.
- (iii) Breeding and egg laying of released crocodiles in the nature (about 70 crocodiles nests were located in different forest blocks of the sanctuary during 2015 nesting season).
- (iv) Kanika Range holds about 75.26% of the entire present crocodile population.
- (v) Bhitarkanika holds ten crocodiles of 16-18', six crocodiles of 18-20' and three crocodiles of about 20' length.
- (vi) The areas (main Bhitarkanika river from Khola to Pathasala, Thanapati creek, Mahinsamada creek, Suajore creek, Baunsagada creek, Kalibhanjadia, etc.) having higher concentration of crocodiles have:
  - (a) Good mangrove cover / fringing mangrove vegetations.
  - (b) a network of creeks and creek lets,
  - (c) stretches of undisturbed mud banks as favored basking/resting spots,
  - (d) less human disturbance (little or no illegal fishing activities), and
  - (e) hypo -saline condition of water in the creeks.
  - (f) depth of water (1.5m at the lowest tide).

Since the prime objective of the crocodile project is to rebuild their population in the wild, restocking the river systems of the

sanctuaries with captive reared crocodiles is an ongoing programme. The resident and released populations of crocodiles are periodically monitored and the trend of nesting is also assessed. Protection of crocodiles is a round-the-year activity. Major threats are from intruding fishermen using nylon set nets.

## Research

In-house research has been conducted to standardize 'the rear and release' technique. Studies have been carried out to determine the appropriate method of population assessment, egg collection, egg incubation, hatching, and husbandry of the young crocodiles and various aspects of behavioural biology of the three species of crocodiles and their habitat features.

The crocodile project that has since long come to a slow-pace in the State has contributed much to develop the know-how and spreading of awareness. Apart from producing a large number of crocodiles in a short span, the Crocodile Project has contributed in various ways to the entire approach of wildlife conservation, research and training.

Future of the crocodiles can be secured with adequate protection of their habitats and long term scientific management of the mangrove ecosystems.

## Acknowledgements

Dr. H.R. Bustard, Former Chief Technical Advisor to Government of India provided technical guidance and encouraged me throughout my study on crocodiles especially on *C. porosus* in Bhitarkanika. I am most

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## PLATYPUS: THE ANIMAL OF CONFUSIONS

\*Animesh Kumar Mohapatra

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### Introduction

Walking along the ecstatic sea shore of Eastern Australia, one can catch sight of an aberrant animal with peculiar morphological similarities with birds, reptiles and mammals. The animal, commonly designated as Platypus or duck billed platypus has captured the heart and mind of many zoologists since time immemorial. This duck-billed, beaver-tailed, otter footed animal is scientifically termed as *Ornithorhynchus anatinus*.

### Taxonomy and Etymology

In the year 1798, the Europeans encountered the platypus for the first time, when they gifted Captain John Hunter, the second Governor of New South Wales, with a sketch of that animal. English zoologist George Shaw anticipated that somebody had sewn a duck's beak onto the body of a beaver-like animal in his "Naturalist's Miscellany" book in 1799. The common name "platypus" is derived from Greek word "platypous" which means flat-footed. The scientific name

*Ornithorhynchus anatinus* drew its origin from Greek word "Orinthorhynchos" meaning bird snout and Latin word "anatinus" meaning duck-like.

The English dictionary does not agree with any plural of "platypus". Colloquially, the term "platypi" is used as plural which is technically erroneous. Early British settlers named the animal as "water mole", "duck mole" and "duckbill".

### The systematic classification

Kingdom	: Animalia
Phylum	: Chordata
Sub phylum	: Vertebrata
Class	: Mammalia
Subclass	: Prototheria
Order	: Monotremata
Family	: Ornithorhynchidae
Genus	: Ornithorhynchus
Species	: Anatinus

### Evolution

The oldest discovered fossil of the modern platypus, found 1,00,000 years ago, shows close analogy to extinct monotremes *Teinolophos* and *Steropodon*. Another fossil relative of the modern platypus, *Monotrematum sudamericanum*, has been

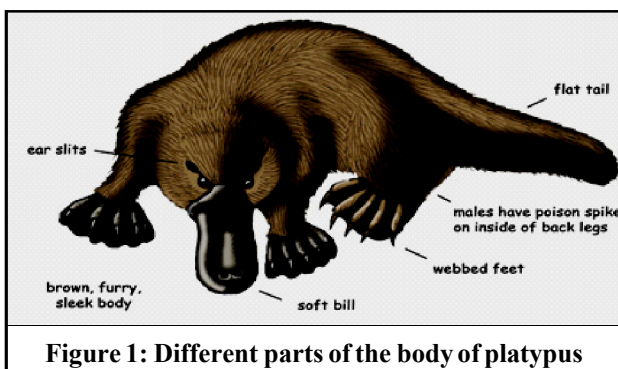


Figure 1: Different parts of the body of platypus

found in Argentina which infers the presence of monotremes in the super continent of Gondwana (Combination of South America and Australia joined via Antarctica).

Fossil evidence has depicted that the platypus has ancestral connections to animals that lived in cretaceous period ( million years ago). Two theories have been put forward to explain the way in which the platypus and other monotremes have evolved in relation to two other mammalian groups (Marsupials and placentals). The first theory (Theory B) proposes that relatives of the monotremes formed their own evolutionary branch that was distinct from the development of both marsupials' and placentals' relatives. The second theory (Theory A) was proposed by William Gregory which suggests marsupials separated from placentals causing them to evolve in a different way.

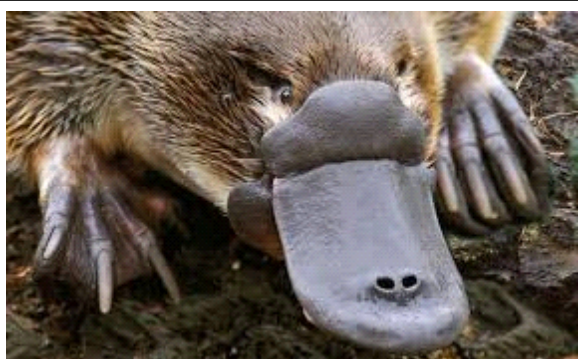


Figure 2: Bill of duck billed platypus

The platypus and other monotremes were poorly understood and their emergence is still a matter of diverse thoughts. Is it from a sauropsid lineage which includes reptiles and birds? Is it from a synapsid lineage which

mainly led to the modern platypus? Or is it derived independently from some virtual ancestral amniotes? These questions are still unanswered. Molecular clock and fossil dating validate platypuses diverted from echidnans (ant eater monotreme) around 19 to 48 million years ago.

### Habit and Habitat

The platypus is semi aquatic occurring in freshwater systems ranging from tropical rainforests to cold high altitudes of Australian subcontinent. More or less, platypus is restricted in Australia due to its favorable conditions. The animal is generally regarded as nocturnal and crepuscular with an excellent swimming instinct. It is very tedious to spot the platypus even on the surface of water due to the absence of external ear or pina in the animal. Uniquely among mammals, it propels itself when swimming by an alternate rowing motion of the forelimb. Although all four feet of the platypus are webbed, the hind limb do not assist in propulsion, but are used for steering in coalition with the tail. It is endothermic in nature, perpetuating the body temperature at about 32°C (90°F), lower than most of the mammals. It retires to a short, straight resting burrow, almost near the river bank, hidden under tangle of roots, when not in water. The average sleep time of this creature is said to be as long as 14 hours per day, mostly because it feeds on crustaceans, which provides a high level of calories to its body. Locality, human activity, ambient temperature, day length

regulates the activity pattern of platypus. The availability and concentration of this animal will be higher in presence of logs, twigs, and cobbled water substrate as that leads to an increased availability of micro invertebrate fauna the main food item of the animal

### **External features and adaptations**

The body weight of platypus varies from 0.7 to 2.4 kg, with females being smaller than males. The body and flat tail are well insulated to keep the animal warm, by a cover of dense, brown fur which act as waterproof sheilds platypus uses its tail for storage of fat and calorie reserve. The large, rubbery snout, which is a modification of upper jaw, has pitted tactile (sensory) organs and it shows a close resemblance with the bill of a duck externally. The snout, otherwise referred to as muzzle or beak, is moist and flexible having dorsal nostrils to capture worms and molluscs from the mud of river bed which can be stored in cheek pouches. Eyes and ears are located in grooves behind the beak which are covered by skin pouches while swimming. The webbing is more pronounced in front feet and is folded back while digging. Both the limbs are short, heavy and splayed away from the body. The webs are leathery extensions projecting beyond the claws for swimming walking and digging. Forelimbs are short and powerful having five digits with strong claws while hind limbs have smaller web with five digits. Webbed paws and short legs that protrude from the sides of body allow it to dive with ease. The insulated tail

covered with coarse hairs on the top and sparse hairs underneath assists the animal to propel and steer while swimming, enhancing its natural buoyancy. Roughly the size of a house cat, the animal with its streamlined and dorsoventrally flattened body, is perfectly adapted to aquatic life, fending by touch and smell. It is found that platypus uses almost 30% more energy when moving on land, compared to other terrestrial mammals of similar size.

### **Electro-location**

It is an ability of an animal to detect an object by distortion of its electric field. Even the preys are located by detecting electric fields generated by muscular contractions. Monotremes are the only mammals (apart from one species of dolphin) to show a sense of electro location. Experimentally, the platypus's electro location is the most sensitive of any monotremes. The electro receptors (which detect electric signals) are confined in rostrocaudal rows in the skin of the bill, while mechanoreceptors (which detect touch) are uniformly distributed across the bill. The electro sensory areas of cerebral cortex are carried within the tactile somatosensory areas, suggesting a close association between the electric and tactile areas. Cortical cells receive input from both of them and dominates the somatotopic map of platypus brain. The platypus can dictate the direction of electric source by comparing differences in signal strength across the sheet of electro receptors. The distance of prey and its locomotion emits

both electrical signals and mechanical pressure signals which lead to cortical convergence of electro sensory and tactile inputs and the platypus uses the difference between arrival times of the two signals to sense the distance. The platypus, with its eyes and ears closed, moves its head sideways and the electro receptors detect tiny electrical currents generated by muscular contractions of its prey, enabling it to distinguish between animate and inanimate objects.

### **Venom in the Spur**

The cute and cuddly Australian animal proves very harmful to human experimenters when manhandled. Male platypus has a calcareous, sharp spur of about 12 millimeters long on each ankle. The spur, borne on both male and female platypuses, is composed of outer horny sheath and inner fibrous layer. Though the female spur is vestigial, male spur produces venom, particularly in breeding season. The venom is composed largely of deficin like proteins (DLPs), three of which are unique to the platypus, produced by the immune system of the platypus. The venom is produced in the crural glands of the male, which are kidney shaped alveolar glands joined by a walled duct to the spurs. The females are devoid of this crural gland which leads to rudimentary spur buds. Scientists described significant homology between DLPs and proteins present in the venom of snakes and other reptiles. The venomous cocktail is powerful enough to kill smaller animals such as dogs, however, it is not lethal to humans, but

the pain is so excruciating that the victim may be incapacitated by the attack. Swelling rapidly develops around the wound and gradually spreads through the affected body part. Pain develops into a long lasting hyperalgesia (temporary increased sensitivity to pain) which leads to edema (fluid filled swelling). It is often advised to pick up platypus by end half of the tail to avoid the spur in case it is a male. Unlike its reptile or mammalian counterparts, this venom is actually utilized for asserting dominance during mating season rather than to kill or immobilize prey or feed on other animal. The horny spur on inner side of tarsus (bone of ankle) is more developed than in case of Tachyglossus (Another Monotreme)

### **Genome of Platypus**

In 2014, researchers at the Australian National University reported that the platypus has ten sex chromosomes. Compared with two (XY) in most other male mammals, a male platypus is always XYXYXYXYXY and a female platypus is XXXXXXXXXXXX compared with two (XX) in most other female mammals. But sex chromosomes of Platypus show striking parallelism to the ZZ/ZW sex chromosomes found in birds. The platypus genome is also associated with both reptilian and mammalian genes in egg fertilization. More than 80% of the platypus' genes are common to the mammals. On the contrary, there appears no homology between the X-chromosomes of placental mammals and the platypus. Several groups have identified a gene called DMRTI on the X5 chromosome of platypus which

is perceived to be a sex determining factor in birds. Avian sex chromosomes ZZ (Male) and ZW (Female) possess DMRTI on the Z-chromosomes. Again, the species Platypus remained a significant misfit in any of the Darwinian scheme probing a mystery and a great deal of research is required to discover the mechanism of sex determination in platypus.

### Endoskeleton

The pectoral girdle is like that of a reptile partly changed to a mammal. It has separate clavicles and a median T-shaped interclavicle. Modern platypus young have three teeth in each of the maxillae (One premolar and two molar) and dentaries (three molars). Adults have heavily keratinized pads in their place. The jaw and jaw-opening muscles are distinctly different from mammals. The tiny bones that conduct sound in the middle ear are incorporated into the skull. However, there is no external ear or pinnae and the ear opening lies at the base of jaw. The animal has extra bones in the shoulder girdle with an interclavicle, which is absent in other mammals. On each side of the girdle, there is a coracoid, precoracoid and a scapula with spine. The interclavicle connects girdle to sternum. Vertebrae don't possess epiphyses except in the tail. Two vertebrae form a sacrum. It has a reptilian gait, with the legs on the sides of the body. The neck vertebrae have rudimentary ribs and the pectoral girdle contains epipubic bones extending from pelvis.

### Anatomical and physiological peculiarities

#### (a) Digestive system

Any species evolves by losing their ancestral traits and gaining new ones. But the platypus has not just retained ancestral reptilian characters, but it has totally forgone the use of an organ which most other species would find vital. The platypus has no stomach. Adult platypus does not even have teeth. They use rocks and gravels that gets adhered to their prey to grind up their food. The food retrieved from their cheek pouches goes to the oesophagus and reaches the intestine directly. There are still some unanswered questions like why have platypuses lost the stomach? If it is no stomach, then which organ helps in digestion? Stomach, being a part of gut, plays a major role in digestion by secreting enzymes like pepsins and strong acids to break down complex substances like proteins and fats. The glands secreting this enzyme and acids appeared about 450 million years ago and they represent an evolutionary innovation found exclusively in jawed vertebrates. Without the enzymes the stomach has turned out to be nothing more than an empty sac halfway down the digestive tract and was likely removed by natural selection. Nevertheless, the total deviation from normal vertebrates marks another evolutionary mystery surrounding the platypus.

Platypuses can consume food of their own body weight in 24 hours. It is a carnivore and feeds on annelid worms, insect larvae,

freshwater crustacea and shrimps. It mainly feeds during the night time with the help of electro receptors and mechanoreceptors present proximal to the bill. The bill serves to find and shift small prey from the substrate while larger prey is taken individually.

### (b) Circulatory system

Just like other mammals, platypus has a closed double circulatory system with heart and blood vessels (arteries and veins). Connolly et.al., (1999) have found a variety of information regarding the constitution of platypus blood as listed below:

- i) Compared to other animals, platypus shows higher packed red cell volumes, erythrocyte concentration and leukocyte count. The greater concentrations of erythrocytes are probably to cope up when faced with Hypoxia (reduction of oxygen level in body). Other serum and haematological biochemical values are relatives similar to other mammals.
- ii) The normal lymphocyte count in a wild platypus falls significantly within a few hours of capture.

### (c) Brain and nervous system

Nowak and Paradise (1983) observed that brain of platypus is small and is made up of two smooth cerebral hemispheres. They have similar five senses like that of human. Recent studies indicated that eyes of the platypus could possibly be similar to those of the pacific lampreys and Hagfish (Lower

Vertebrates) than to those of most vertebrates like tetra pods. It contains double cones, which most mammals donot have. They have binocular vision with the corneal surface of lens being flat and posterior surface steeply curved. The eyes are acute over long distance but because of their location, it is unable to see what is literally "under its nose." The bill's entire surface is covered with openings to sensitive nerve endings and serves as a vital sense organ. The platypus has no external ear lobe or pinnae which marks a difference from other mammalian characters. In the absence of teeth, the tongue is an organ of senses with the grinding pads; the nostrils are small openings that lead to Jacobson's organ (also called vomeronasal organ) located beneath the upper surface of the bill. The olfactory organ of the platypus's is not as developed as the echidnas.

### (d) Reproductive system and life history

The male reproductive system is similar to other mammals with an exception of penis being internal. The penis is a simple groove inside the cloaca which gets everted out during



Figure 3: Eggs of platypus.

mating. The testes are located within the body cavity and this condition is called testicond, found in elephants and shrews. The female platypus has two ovaries but the right one is vestigial. Rest structures are similar to that of the mammals. These animals exhibit a single breeding season (June-Oct); the female are likely to become sexually mature in their second year of life. After mating, the female constructs a deep burrow (20m or more long) which is blocked at intervals with plugs that acts as a safe guard against rising water or predators. The male takes no part in caring for its young and retreats to his burrow. The female softens the burrow with dead, wet leaves and fills the burrow with weeds to prepare a perfect bed for the young ones. It lays one to three small, leathery eggs (similar to reptiles). The egg develops in uterus for about 28 days, with only about 10 days of external incubation. After the eggs are laid, the females curl around them. There are three phases of incubation period, chiefly in the first phase, the embryo relies on the yolk sac for sustenance. The second phase experiences development of digits followed by last phase where the egg tooth appears.

The newly hatched young ones are blind and hairless and feed upon mother's milk. Although the platypus is said to possess mammary glands, it lacks nipples or teats. Instead, milk is released through pores in the skin from the milk pools present in grooves of the abdomen. After about five weeks of constant



Figure 4: Blind and hairless young ones of platypus.

milk suckling, the mother begins to spend more time away from the young. The young ones emerge from the burrow at around sixth week with small teeth which are gradually lost. Platypuses live up to approximately 20 years of age. The defensive organs like spleen, thymus, and gut-associated tissues are well developed. The lymphoid tissue of the platypus has necessary T and B lymphocytes to fight against foreign antigen. It has been recorded that when a platypus watches the sunrise, its pupils contract and when a platypus plunges out of ice cold water, it shivers. Both the instances show its response to stimuli.

### Is it a reptile?

Presence of cloaca, abdominal testes, single headed thoracic ribs, cervical ribs,

median T-shaped interclavicle, large coracoids and cleidoic eggs suggests the connecting link between platypus and reptiles. Cochlea of internal ear of platypus possess lagena similar to that of order squamata of the class Reptilia. The oviducts in female platypus separately opens into cloaca without uterus and vagina, thus supporting no uterine gestation as in female reptiles. Penis is simple retractile groove conducting only sperm which is again a striking similarity between platypus and reptilian males. The brain shows resemblance in having large anterior commissure without any corpus callosum joining the cerebral hemisphere for both the group of animals. Therefore, there is a pronounced affinity between platypus and the living reptiles.

### Is it a bird?

The avian affinity does have a common reptilian ancestry with the platypus. Shape of beak of platypus resembles ducks. Absence of teeth, presence of webs, presence of oil glands, and presence of obliterated sutures of skull are solid evidence of platypus being like a bird. With the tarsal spur like that of hens, platypus remains a species of controversy.

### Is it a mammal ?

Presence of hairs on the glandular skin, dicondylic skull, segmented sternum, 4-chambered heart, 4 optic lobes (corpora quadrigemina) and milk secreting glands suggests the common bond between mammals and platypus. A typical mammalian diaphragm

divides body cavity of platypus. Mammalian chondrocranium, seven cervical vertebrae, mammalian lobes of liver reflects their affinities with modern mammals. A slender caecum demarcates two intestines as in case of digestive system of mammals. With the presence of only left aortic arch and RBCs being circular and non-nucleated, platypus exhibits a stupendous similarity with mammals.

### Conclusion

Platypus - the animal with dissociative characters- indicates that they represent an early separate side line from main mammalian stock. This justifies their placement in separate subclass Prototheria from rest of the mammals. Peculiar blending of mammalian, avian and reptilian characters in a single animal makes it special in terms of zoological research. Loss of habitat, excessive pollution in water bodies, and lack of conservational strategies are held accountable for the decline of platypus population. More of attention should be harnessed to give this charismatic animal a long life.

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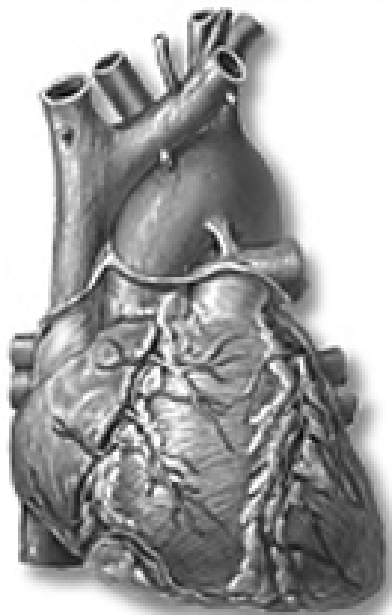
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## SOMETHING TO KNOW ABOUT HEART ATTACK

Dr. Kalyanee Dash

Life in 21st Century is marked with deadlines, stress and frustration. Associated with these risk factors, there are also lack of some good habits like doing regular exercises and taking healthy food. Due to these our younger generation are pushed to some risky conditions like - High Blood Pressure (Hypertension), High Blood Sugar (Diabetes), High Blood Cholesterol (Hyper lipidaemia) and obesity. Together, they cause one complex condition in our body known as metabolic syndrome.

Due to over stress of modern life, lack of exercise and changes in life style young people are suffering from Heart Attack and Brain Stroke. Since the frequency of Heart Attack is more than the Brain Stroke, we should know something regarding this.



HEART

### What is Heart Attack ?

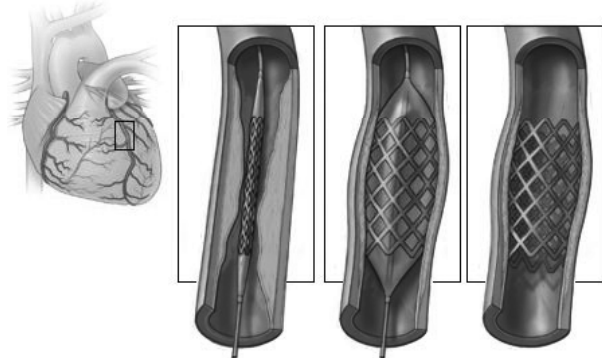
Our heart beats nonstop throughout the life. It requires good and proper nutrition and sufficient blood supply to the heart muscles. When blood supply to the heart is impaired or partially cut off, the cardiac muscles do not get sufficient nutrient and oxygen supply which leads to the damage and death of the heart muscles known as Cardiac Infraction. Unless blood flow is restored back quickly, recovery from a heart attack becomes impossible. For this, quick diagnosis, medical help and immediate treatment are necessary for our survival.

### Risk Factors of Heart Attack :

There are some major risk factors of heart attack which are neither under our own control nor we can avoid them. However, there are some risk factors which can be modified, treated and controlled by changing the life style or by medicines.

#### (A) Unavoidable risk factors :

- Age (82% of patients who die of coronary heart disease are 65 years or more).



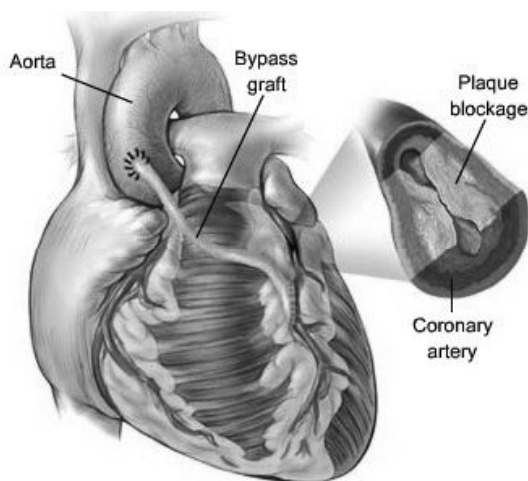
Cardiac Stent

- The risk of having heart attack is more in male than females.
- Heredity : Children of patients with heart disease are more prone to suffer from Heart attack.

**(B) Avoidable risk factors :**

These factors can be treated, modified and controlled by changing our life style, and by taking medicines.

- Smoking tobacco.
- High Blood cholesterol (more of LDL - Low Density cholesterol or Bad fat).
- High Blood Pressure (If not properly controlled) when High Blood Pressure and smoking coexist, the risk of Heart Attack increases.
- Low LDL (Bad fat) is good for our heart. A diet high in saturated fat raises our LDL level and the risk of Heart Attack.
- Low HDL (High Density fat or good fat) is bad for our heart. High HDL protects heart and it increases by exercise.



Coronary Art with byepass graft copy

Genetic factors, Type 2 Diabetes along with low HDL and high LDL cause Heart attack. If associated with High Blood Pressure the risk is still more.

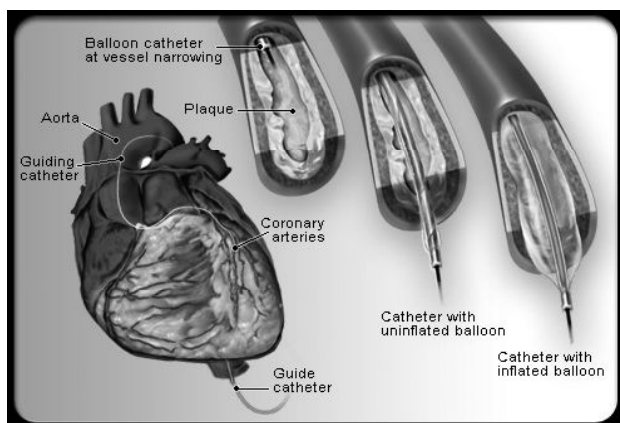
High Triglyceride (Most common type of fat in our body) with Low HDL and High LDL lead to building up of fatty deposits (plaques) inside the walls of Heart arteries (coronary arteries) known as Atherosclerosis and they cause Heart Attack.

**Mechanism of Heart Attack :**

High blood cholesterol leads to formation of fatty plaques inside the arteries of our body, most commonly inside coronary arteries (which supply blood to the heart muscles). It does not happen suddenly, but over a longer period. Gradually they break off from the arterial wall forming blood clots around them which block the blood flow through the coronary arteries

**Symptoms of Heart Attack :**

The most important symptom of heart attack are pain, heaviness, pressure and discomfort on the front part of chest. There may be shortness of breath, sweating, nausea and fainting attack. Other symptoms of heart attack are pain in the neck, Jaw or shoulder, cold sweating and chest pain which moves down the left arm. In female the symptoms of heart attack are little mild and mostly ignored. They get more of heart burn, acidity, nausea, vomiting, idigestion, back pain, neck pain and shortness of breath. Females get extreme

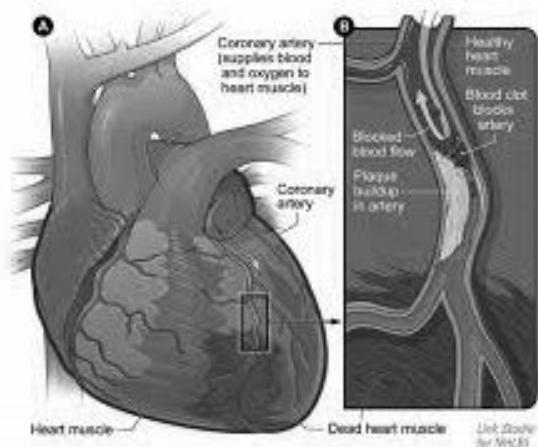


**Heart Disease Baloon Angioplasty copy**

tiredness, dizziness. At times flu like symptoms and sleep problems are observed in females about two weeks before a heart attack.

**What we will do ?**

When a person suffers from a heart attack, he can not take any quick steps for his treatment for which the family members, colleagues and any observer present near him should know something about heart attack so that they can take quick steps for his quick hospitalisation and treatment. This will help the chances of his survival. Therefore, if we come across someone who has such symptoms described above, we should take him immediately to a hospital.



**Imagescoronary Artery with Plaque copy**

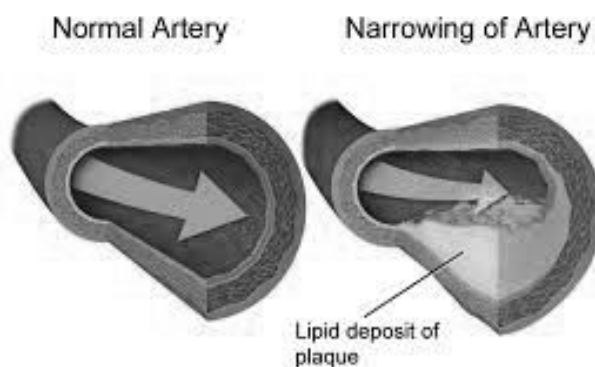
It is observed tht if a patient gets quick treatment within ninety (90) minutes of a heart attack he usually survives. When he is carried to the hospital, he is given one tablet of aspirin to chew and swallow by which the risk of blood clot formation is reduced. If the person is unconscious, Cardio-Pulmonary resussitation can enhance his survival chance.

**Diagnosis of Heart Attack :**

In the hospital one ECG (Electro Cardiography) is done by the attending physician and his condition is diagnosed. Bood tests are done to measure the proteins released from the heart muscles when they die due to choking of the coronary arteries by blood clots. His other conditions are diagnosed like Diabetes and High Blood Pressure.

**Treatment :**

In one well equipped hospital the cardiologist quickly tries to restore the blood flow to the patient's heart. Medicines are given to dissolve the blood clots inside the



**Coronary Artery Disease**

arteries. One procedure known as coronary Angiogram is done in which a thin tube with a balloon at the end is pushed through the artery of the patient. It opens up the blockage inside the coronary arteries by flattening plaque inside the arteries. Usually the doctors place a stent (a small, mesh tube) inside the coronary artery to keep the artery stay open.

### **Prevention of Heart Attack :**

When smoking is stopped, chances of a heart attack is immediately reduced by 1/3rd . Regular exercise and proper balanced diet help to prevent heart attack. Weekly 150 minutes of moderate exercise helps us to prevent heart attack. Plenty of fruits, vegetables and whole grains keep our heart healthy. Daily aspirin intake also prevents heart attack. Stress management by yoga and meditation are also helpful.

### **Life after Heart Attack :**

After one heart attack we can return home and after a few weeks can resume our normal activities. Cardiac rehabilitation helps quick recovery. One should follow a healthy life style to keep the heart free from further attack.

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## **DOES RAYLEIGH SCATTERING EXPLAIN THE BLUENESS OF SKY ?**

**Rajat Kumar Pradhan**

### **1. Introduction**

It is a well-accepted fact in the scientific community that Rayleigh scattering explains the blue colour of the clear day-time sky. One can look up any standard text book on optics or modern physics and verify that the authors very clearly state the same though on closer scrutiny it turns out to be a vague statement and is untenable without the necessary conditions stated. It is also an example of how something vague can attain the status of an established scientific fact though repeated assertion without much justification and because of lack of deeper analysis.

There are actually three reasons why the sky looks blue:

- (a) The intensity of the solar electromagnetic radiation spectrum peaks at (the green end of) the blue wavelengths of 4817 Angstrom corresponding to a blackbody temperature of 6000K, which is the surface temperature of the Sun. Therefore there are more blue photons than any other in the solar spectrum and hence they determine the dominant colour of the scattered light from the atmospheric scatterers.
- (b) The cones in the normal human eyes are more sensitive to the above blue

wavelengths than to any other colour. This may have occurred in the course of evolution as there was necessity to adapt to the dominant intensity of Sun at that wavelength for the most part of the day that was necessary for the survival.

- (c) The coherent forward scattered intensity of light by atmospheric scatterers goes as the inverse fourth power of the wavelength and this is known as Rayleigh scattering. Since for the visible range of the electromagnetic spectrum, blue has wavelength less than red, therefore it is scattered more by the atmospheric scatterers as we look in the direction of the Sun.

Of these three only the last one is habitually cited as the cause of the blueness of sky, although it is the weakest of the three factors. Now let's examine how far this can be justified.

## 2. Rayleigh Scattering

The inverse fourth power dependence implies that shortest wavelength will be most intense (see fig-1). The shortest wavelength for visible light is that of violet and not blue. Thus we should see a violet sky rather than a blue sky if Rayleigh scattering were the only reason. Obviously other factors are at work.

### Solar blackbody spectrum

Considering that the sun radiates as a blackbody at the surface temperature  $T_s=6000K$ . we get for the maximum intensity of the blackbody radiation curve a maximum at 481.7 nm which corresponds to the blue colour. This is the reason why the sun appears blue if looked at directly. Thus the presence of an overwhelming number of blue photons compared to other photons of wavelengths implies that in the scattered beams in all directions presence of blue will also be more intense than others (fig. -2).

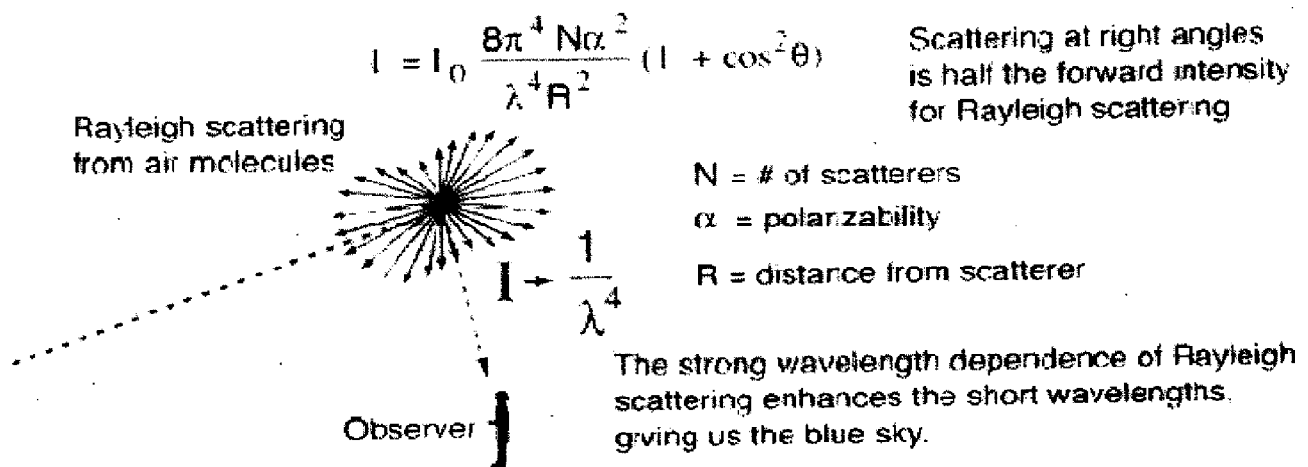


Fig. 1 : Rayleigh scattering of sunlight by atmospheric scatters

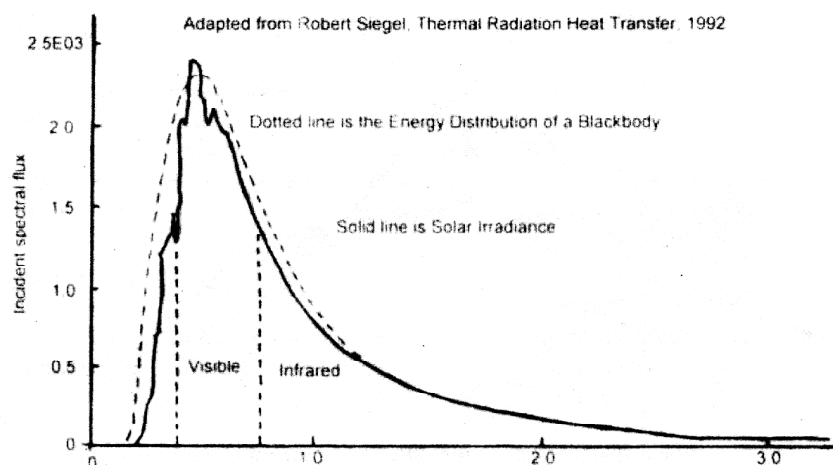


Fig. 2 : Solar energy spectral distribution peaks at around wavelength of 500 nm

Thus even though violet is the most scattered as per Rayleigh's formula, the incident intensity for blue being more than that for violet, the scattered intensity of blue overwhelms that of the most scattered violet.

#### 4. Color sensitivity of cones and light sensitivity of rods

From the physiology of human vision it is well known that the color sensitivity of the retinal cones in the human eye is a maximum for blue and thus will be able to catch fainter blue more effectively than any brighter shade of any other colour (fig. 3).

There are three types of color-sensitive cones in the retina of the human eye.

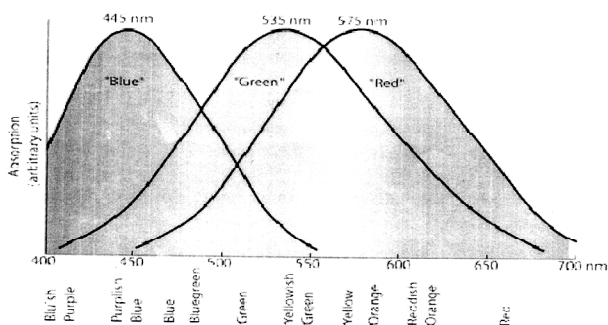


Fig. 3 : Spectral sensitivities of cones in the human eye

corresponding roughly to red, green, and blue sensitive detectors. Experiments have yielded response curves for three different kind of cones in the retina of the human eye. The "green" and "red" cones are mostly packed into the fovea centralis. By population, about 64% of the cones are red-sensitive, about 32% green sensitive, and about 2% are blue sensitive. The "blue" cones have the highest sensitivity and are mostly found outside the fovea. The shapes of the curves are obtained by measurement of the absorption by the cones, but the relative heights for the three types are set equal for lack of detailed data. There are fewer blue cones, but the blue sensitivity is comparable to the others.

The "blue" cones are thus very special and are identified by the peak of their light response curve at about 445 nm. Thus even though violet is scattered most by Rayleigh scattering formula, the eye detects the blue more efficiently than the violet. Thus the blue is more readily perceived and we see a blue sky.

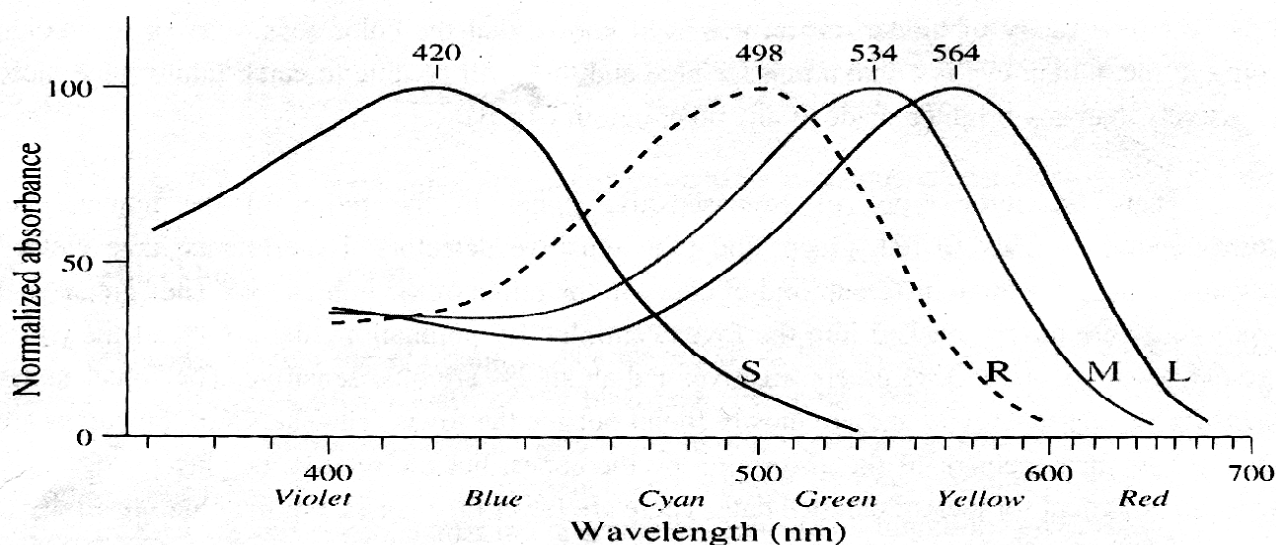


Fig. 4 : Sensitivity of rods to light intensity in comparison to cones

Further as shown in the fig-4 below the rod sensitivity to light intensity of different wavelengths shows that the rods are most sensitive to the green end of the blue wavelengths at 498nm (dotted curve). Thus because of the spectral absorbance distribution of the rods the blue will be perceived more readily than the others even if it is of low intensity.

So which one of these three reasons is to be taken as the primary reason for the blue colour of sky? It is clear that whichever we decide, it is certainly not going to be Rayleigh scattering alone. Even if Rayleigh scattering were not there and the formula had some other dependence we could still see a blue sky by a suitable conspiracy among the other two factors!

## 5. Conclusion

This little analysis of a very well-accepted scientific explanation shows that we should never accept a particular viewpoint or reasoning

or doctrine even if it be given by great scientists and universally accepted by all and sundry. because there may still be lacunae and loopholes in the arguments and there may be room for improvement and refinement. This is the true spirit of scientific enquiry and by this alone science progresses inch by inch towards perfection.

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## PHYTATE, A MAJOR 'ANTI-NUTRIENT' IN OUR DIET

Dr. Birendra Nath Nayak

Phytic acid has been considered as an anti-nutritional component in cereals, seeds and beans. Phytate (salt of phytic acid) is found in all plants because it stores phosphorus needed to support germination and growth. It is also a source of cation and myoinositol (a cell wall precursor). The phosphorus bound to phytate is not typically bioavailable to any non-ruminant animals and humans. The ruminant animals like cow, goat, sheep etc swallow and then regurgitate their food. This regurgitated food is known as 'cud' and is chewed a second time. Due to an enzyme Phytase located in their first stomach chamber, the rumen, these animals are able to separate and process the phosphorus in phytate. Humans and non-ruminant animals lack the enzyme to breakdown phytate. Therefore Humans should limit their intake of phytate as it has several harmful properties to the body. Research has traditionally focused on its structure that gives it the ability to bind minerals, proteins and starch so as to reduce their absorption by our body.

Phytate, the salt form of Phytic acid is also known as inositol hexaphosphate or IP6. It is a Phyto nutrient found in all plants especially in beans, seeds and nuts. Given in the table-1 is a list of percentage of phytate found in various common plants and products.

Discovered in 1903 phytic acid is a saturated cyclic acid having molecular formula  $C_6H_{18}O_{24}P_6$

The ring in the above formula (Fig. 1) is inositol (a B vitamin), attached to which are six phosphate groups. The presence of large number of phosphate groups points to its obvious role in plant tissues.

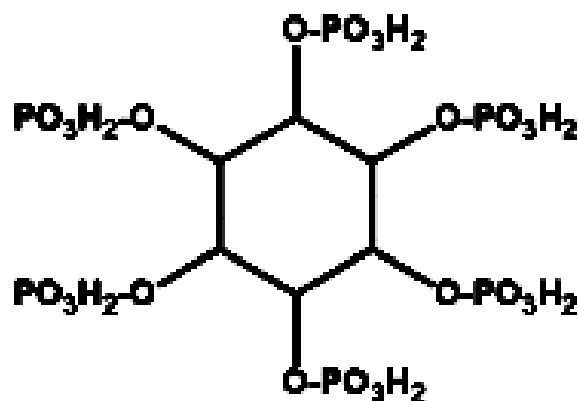


Fig. 1 : Phytic Acid

Phytic acid forms insoluble complexes with calcium, Zinc, iron and other nutrients and interfering with their absorption by the body. First phytic acid chelates strongly with minerals needed by the body say for example magnesium. The process of chelation creates bond between the acid and the mineral rendering it insoluble and therefore useless. It could be part of the reason why many people are deficient in magnesium and suffer from muscle cramping to PMS. Some scientists similarly believe the iron chelation is responsible for world wide epidemic of iron-

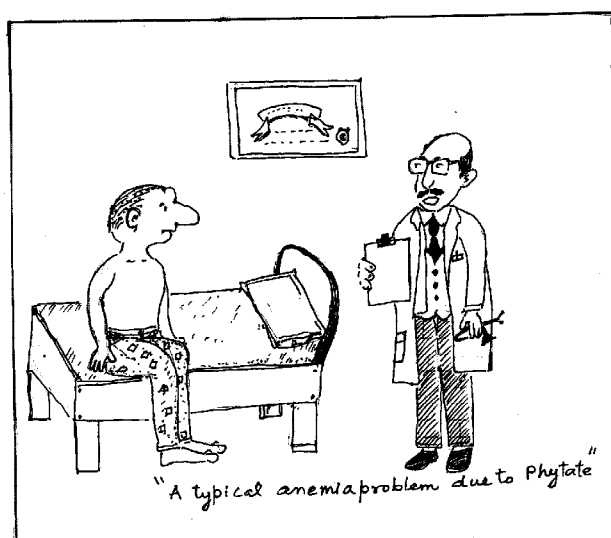
Table - 1 : Phytate content of different category of plants.

Category of plants	Common name	Taxonomic Name	Phytic acid/ Phytate g/100g dw
Cereals	Rice	Oryza.sativa, D. glaberrima	0.06-1.08
	Ricebran	-	2.56-8.7
	Maize	Zeamays	0.72-2.22
	Wheat	Triticumsp.	0.39-1.35
	Wheat bran	-	2.1-7.3
	Wheat germ	-	1.14 - 3.91
	Barley	Hordeum VuLgane	0.38-1.16
	Sorghum	Sorghum sp.	0.57-3.35
	Oat	Avena sativa	0.42-1.16
	Rye	Secale Cereale	0.54-1.46
	Millet	Penni setum sp.	0.18-1.67
	Trifede	Triticale secale	0.50-1.89
	Legumes	Kidney bean	Phaseolus Vulgaris
Broad bean		Vicia faba	0.51-1.77
Peas		Pisum sativum	0.22-1.22
Dry Cowpeas		Vigna Unguiculata	0.37-2.90
Chick Pea (Bengal Gram)		Cicer arietinum	0.28-1.60
Lentil		Lens Culinaris	0.27-1.51
Nuts	Peanuts	Arachis hypogea	0.17-4.47
	Almonds	Prunus dulcis	0.35-9.42
	Walnuts	Juglans regia	0.20-6.69
	Cashew nuts	Anacardium Occidentale	0.19-4.98
Oil seeds	Soybeans	Glycine max	1.0-2.22
	Soyconcentrate	-	10.7
	Tofu	-	0.1-2.90
	Linseed	Linum uritatissimum	2.15-3.69
	Seasame Seed	Sesum indicwm	1.44-5.36
	Sunflower Meal	Halianthus annuus	3.0-4.3

deficiency anemia. The deficiency of Zinc likewise influences the immune system as well as reproductive abilities. As a result, we have less access to the bone-building and nerve transmitting minerals so vital to us. Phytic acid also bonds with the basic vitamin niacin,

causing a condition known as 'Pellagra'. All these unwanted activities have rendered the notorious title 'anti-nutrient' to phytate.

The amount of phytate present in grains and nuts can be reduced by cooking, though even greater effects are seen if the food is



allowed to soak in an acid medium or sprout naturally. The practices of soaking, sprouting and fermenting have been known to ancient people. They knew it would give them a stomach ache if they did not.

It is especially important that the amount of phytate intake be limited in young children. Also care should be taken to restrict phytate to those persons who receive most of the mineral supply from food like wheat and grain. This can include vegetarians, or people living in poor countries where source of food supply is scarce.

Despite its potentially harmful effect, studies have shown several beneficial results from phytate consumption. The first is that Phytate acts as an antioxidant, which prevents the creation of free radicals that can damage cell. Second, the mineral binding properties of phytate allow it to combat colon cancer by reducing oxidative stress in the intestinal tract. Phytic acid has been shown to protect

against Parkinson's disease in an *invitro* environment. It is also used as food preservative.

The acid is also used in industrial applications, such as soil remediation for instance it can be used to immobilize inorganic contaminants like Uranium or nickel. It is also used medically as a chelation treatment for removal of uranium.

## Conclusion

In conclusion it can be said that nuts and seeds should not be rejected because of the Phytate alone. They are convenient, calorie and nutrient rich so we should take them but with a caution after removing most of the antinutrients by adequate soaking.

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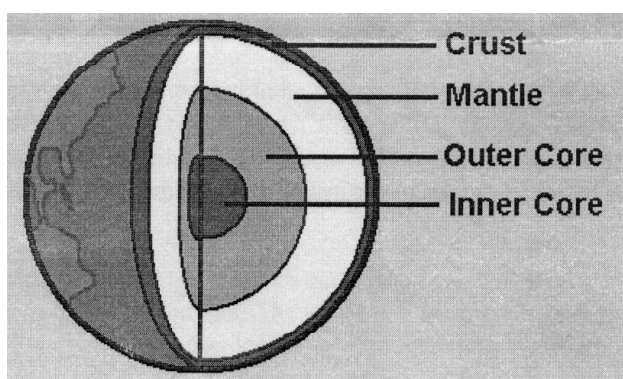
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## THE EARTH AND THE MOON

**Dr. Dwijesh Kumar Panda**

The Earth is a rocky globe, 12,800 km in diameter, orbiting the Sun, taking one year to complete the orbit. It is not a perfect sphere but is rather an oblate spheroid. The earth's polar diameter is 45 km less than its equatorial diameter. The earth is one of eight major planets that orbit the Sun. The Sun provides light and heat. All the planets go around the Sun in the same direction and all keep close to the same plane as they orbit. Three distinct zones exist within the earth. These are the core, the mantle and the crust. The core extends from the Earth's center and out to a radius of 3500 km. It consists of two parts: a fluid outer core and central solid core. The core is composed of iron, nickel and cobalt. Over the core, out to a radius of about 6370 km lays the mantle. It is mainly composed of silicates and is plastic in nature. Overlying the mantle, with an average thickness about 33 km, is the crust upon which we live. The temperature at the Earth's core is about 5000° C.



The surface of the Earth is mainly composed of sedimentary and volcanic rocks. The crust of the Earth resembles a huge broken eggshell with each of the pieces of shell floating on the mantle below it. These segments are called plates. Enormous forces are pent up at the boundaries between the crustal plates. Along these fault lines earthquakes are propagated when one plate slips against (or under, or over) another. Volcanoes are also active along fault lines. About two-thirds of the Earth's surface is covered with water. It is thought that life initially developed in the seas. The chalk and limestone deposits along our shores are remains of sea creatures that lived million years ago. The range of temperature on the surface of the Earth is moderated by the atmosphere, which has a blanketing effect. The temperature on the Earth range from -40° C at the Earth's frozen poles to around +40 C at the Equator.

The air of the atmosphere of the Earth is a mixture of different gases. Its composition by volume is nitrogen (78%), oxygen (21%), carbon dioxide and argon remaining 1%. The lower portion of the atmosphere is also quite rich in water vapor. Most of the mass of the air is concentrated in the first 10 km. The lowest region is the troposphere, which is the region of weather. All the cyclones and storms occur in this region. As the height above the ground increases so the temperature drops. Cirrus clouds extend up to a height of about 10 km. Beyond the troposphere is the stratosphere

lies at a height of 40 km. Above this lies the mesosphere. In this region the temperature falls to about -90 C at an altitude of 80 km.

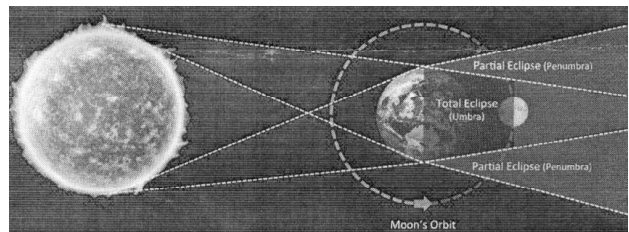
The division and measurement of time is tremendously important to mankind. The Royal Observatory at Greenwich adopted itself as the timekeeping Centre of the world. The Greenwich mean time is defined as when the mean Sun on the observer's meridian as seen from Greenwich the time was 12<sup>h</sup>00<sup>m</sup>00<sup>s</sup> GMT. In fact GMT became universally adopted for the purposes of astronomy and navigation that it became known as Universal Time (UT)

## The Moon

The moon is the Earth's only natural satellite. It is the one of the most splendid of the heavenly bodies to our naked eye. It has held the fascination of mankind for thousands of years. It has long been known that the tides were related to the position of the moon. Many superstitions are connected to the Moon. It is supposed to be unlucky to look at the crescent Moon. It is commonly held that insanity increases at the time of full Moon. Probably connected with this is the legend of lycanthropy. However, scientists tend to be rational people and have learned much about our cosmic neighbor, since Man first set foot on its surface.

The Moon is a brilliant object in the night sky. It does not actually emit any light of its own. It shines purely by reflecting light from the Sun. The moon is a hard, rocky body,

is over a quarter of the diameter of the Earth. This has led many astronomers to consider the Earth and Moon as a double planet system. The other planetary satellites in the Solar System have diameters much smaller than that of their parent bodies. The Moon was formed as the Earth collided with another large body perhaps a large asteroid. Much of the debris thrown up then gathered into an orbit around the Earth and eventually coalesced to form the Moon.



The Moon is illuminated by the Sun varies over a 29.5 day cycle. This cycle is known as synodic period of the Moon. The Earth casts a vast, cone-shaped shadow in space. A lunar eclipse occurs when the Moon wanders into this shadow. First the moon enters the region of partial shadow, or penumbra. It is known as penumbra I eclipse. If the Moon enters the full shadow, or umbra, then the direct sunlight will be cut off and eclipse is said to be total. If only part of the Moon enters the umbra then the eclipse is said to be partial. Even at a total lunar eclipse, the Moon does not usually completely vanish from the view. Sunlight is refracted and scattered by the Earth's atmosphere, bathing the eclipsed Moon in a reddish glow. During a total lunar eclipse the umbra takes about an hour to leave the Moon. About two lunar eclipses arc

visible per year from somewhere on the Earth's surface. A total eclipse of the Moon occurs every few years.

Neil Armstrong became the first man to set foot upon the Moon in the Apollo 11 on 20 July 1969. It was one giant leap for mankind. The Apollo series was to go beyond number 17, but a combination of financial cutbacks and public indifference caused the programme to come to a premature end. The Moon is the easiest of the celestial bodies to observe. It graces our evening skies for two consecutive weeks every month. It is very close to us on the astronomical scale. Around the time of full Moon the lunar surface is dazzlingly bright and seems to be a mass of streaks, spots and blotches. The lunar craters are now accepted that meteorite impacts have caused most of them. Numerous faults due to horizontal and vertical slippages are seen on the lunar surface. Low swellings or blisters are also seen on the lunar surface. It is thought that these domes are produced by ancient volcanic upswellings and some are seen to be topped by small craterlets.

The Apollo astronauts have revealed traces of hydrogen, helium, neon and argon, but with incredibly low densities. These gases are thought to be transient and to result from captured solar wind. The temperature on the lunar surface varies greatly, because of the absence of a blanketing atmosphere. The

equatorial "noon" temperature reaches  $100^{\circ}\text{C}$ , whilst at night falling to  $-150^{\circ}\text{C}$ ! During the lunar eclipses, the surface temperature falls very rapidly once the sunlight has been removed. This indicates that the surface material has a very low coefficient of thermal conductivity. The fact is confirmed by the samples brought back from the *Apollo* missions. The rapid temperature changes might be expected to erode rocks and crumble the top soil.

It is said that while Newton was sitting in his garden one day he chanced to see an apple fall from a tree. On reflection, he realized that the same force that pulled the apple to the ground was responsible for keeping the Moon in the orbit about the Earth. He thought it likely that the same sort of force operated between the planets and the Sun, keeping the planets in the orbits. Newton's universal law of gravitation states:

"The force of attraction between any two bodies is directly proportional to the product of their masses and inversely proportional to the square of the distance separating them."

**References:**

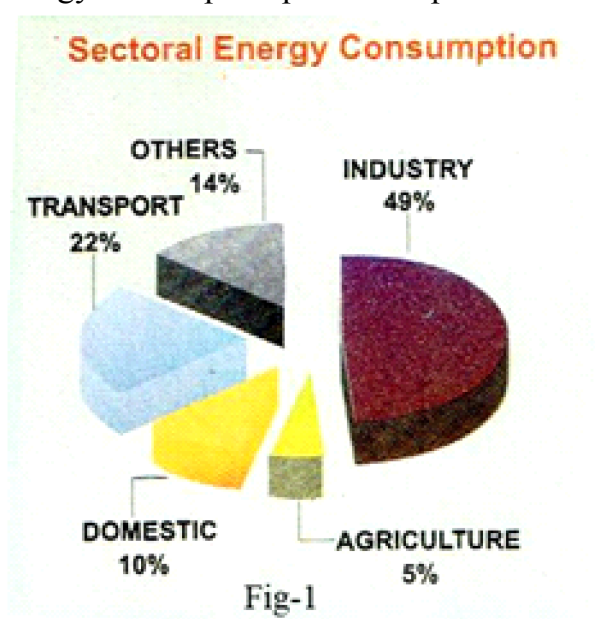
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## PRINCIPLES OF ENERGY MANAGEMENT

Er. Ramesh Chandra Sahoo

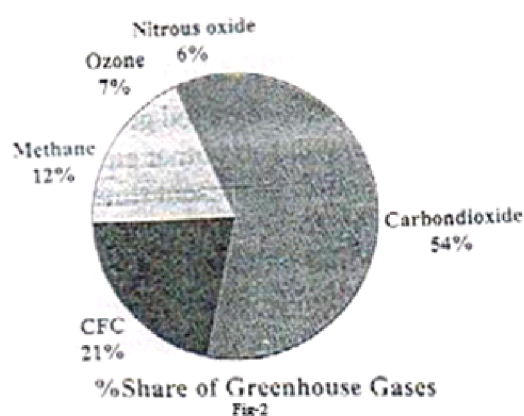
Energy is one of the major inputs for economic development of any country. It assumes critical importance in case of developing countries in view of ever increasing energy needs, requiring huge investment to meet them. As such, management of energy becomes essential in saving energy. Consequently, quite a substantial amount of money is saved in these cash starved countries. In case of India, importance of Management of Energy assumes far more significance than other developing countries for two simple reasons: requirement is huge, potential of saving is also huge. Industrial sector here consumes about 49% of India's total commercial energy, Iron and Steel being the largest consumer. Other energy intensive industries are Aluminum, Cement, Fertilizer, Pulp and Paper, Power plants, Sugar and Textiles. Energy consumption per unit of production is



much higher in India even in comparison with some other developing countries. Studies have revealed energy saving potential can be up to, as high as, 20% in Industrial sector.

### Global Warming and Climate Change

Energy wastage in the industry leads to environment damage by polluting the atmosphere. Some industrial exhausts are  $\text{SO}_2$ ,  $\text{NO}_2$ ,  $\text{CO}$ , CFC and toxic gases. Increasing use of fossil fuel gives rise to  $\text{CO}_2$  emission. It leads to green house effect and global warming. Its composition is shown in Fig-2.



The increasing use of energy has attracted global attention due to its associated climatic impacts. These are Ozone layer depletion, Land degradation, Air and Water pollution, Rise of sea level and Loss of bio diversity. To save these calamities energy conservation through management is a successful tool. Therefore the knowledge of energy management and audit are essential for industry owners and managers.

## 1. Energy Management and Audit

The fundamental goal of energy management is to produce goods and provide services with the least cost and least environmental effect. Its principles are -

- i. Procurement at the lowest possible rate from original source.
- ii. Manage energy use at highest efficiency, at every stage i.e. transport, distribution and consumption.
- iii. Recycling or reuse by waste recovery process.
- iv. Select low investment with appropriate technology to meet economic production and sustain environment.
- v. Make use of waste, generated within the plant to reduce energy bills.

These can be achieved by employing trained energy managers to conduct in house energy audit. External energy audit as mandatory, should also be conducted by certified energy auditors in the industries own benefit.

## 2. Material & Energy Balance

Materials and Energy Balance are essential for industrial process management. Its purpose is to assess the input, conversion efficiency, output and losses. It is a powerful tool for establishing the basis for improvement and potential savings. Various components of inputs, outputs and waste are illustrated below.

These balances are also useful for ongoing projects right from the design stage. This can

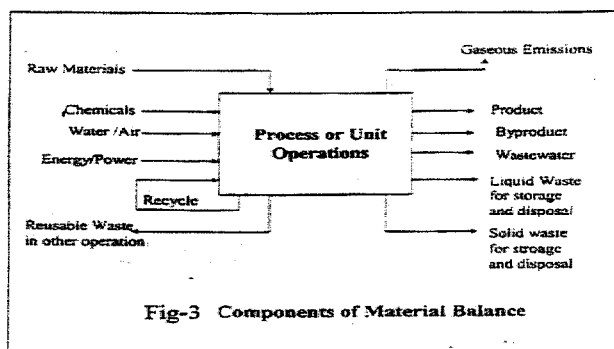


Fig-3 Components of Material Balance

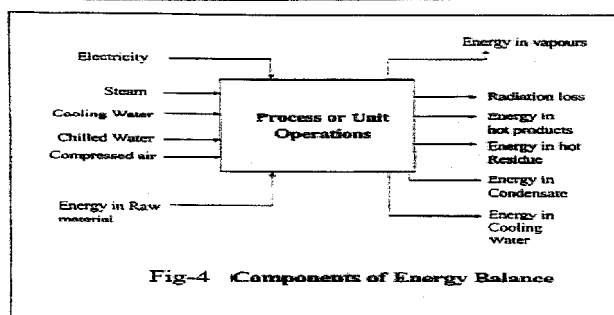


Fig-4 Components of Energy Balance

control cost of production and environment pollution. Inefficient use of raw materials and energy in production process are reflected as wastes.

## 3. Energy Action Planning

In industries, which do not have energy efficient ethics, efficient communication down words from senior management is very vital. Senior executives must demonstrate their commitment to the goal of successful management through words and actions as well. They should actively participate in the organization planning and management campaigns. It is important to translate the goal and objectives into action plan for successful implementation. Necessary identification of specific terms are -

- What needs to be done.
- Who will do it.
- When it will be carried out and completed.
- What should be the budget?

To be effective, the tasks must be feasible and clearly defined. Right people are to be identified and assigned to carry out the tasks. They should conduct a field force analysis to identify positive and negative forces to reduce energy demand per unit of production or services.

**Positive forces**

High price of energy, availability of energy efficient technology, tax on energy consumption, top management commitment, Energy as a high component of production cost.

**Negative Forces**

Absence of Energy Policy, Lack of Awareness, Insufficient Skill & Knowledge, Competing Corporate Priorities, Insufficient Financial Resources.

Employees can be simulated by the energy management team through awareness and training. Keeping a watch on energy use at every step of production/service can successfully result on reduction of cost. An employee giving the best result should be awarded. This would develop a competitive spirit among the employees.

**4 Financial Management**

In the process of Energy Management, at some stage, investment would be required. It would be prudent to adopt a systematic approach for merit rating, without assessing its fiscal gain. The proposed measure should have other benefits such as enhanced productivity, improved product quality, healthful environment besides energy saving.

The cost involved should be captured in totality i.e. Direct Project Cost, Additional Operation and Maintenance Cost, Training Cost. Then only the investment analysis can be carried out. The basic criteria for financial investment appraisal include - Payback period (PBP), Return on Investment (ROI), Internal Rate of Return (IRR), Net Present Value and Cash Flow. These measures enable financial planning of the Energy Management project. It enables the company to incorporate energy efficiency projects into their system.

**5. Project Planning**

There are variety of basic planning techniques. All monitor costs against resource budget. These are-

**Gnat Chart** - Gantt chart is used for scheduling the tasks and tracking the progress of the project. Gantt's scheduling tool takes the form of a horizontal bar graph on a time scale, a basic sample is shown below.

Task	Duration	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2 month	■	■										
2	2 month			■	■								
3	2 month					■	■						
4	2 month							■	■				
5	2 month									■	■		
6	2 month											■	■

**Figur-5. Gnat Chart Format**

The horizontal axis of the Gnat chart is a time scale, expressed either in absolute time or with reference to the beginning of the project. The time resolution depends on the project, whereas the time unit typically is in week or month. Row of bars in the chart show the beginning and ending dates of the individual tasks in the project.

In the above example, each task is shown to begin when the task preceding is completed. However, the bar may overlap in cases where a task can begin before the completion of another, and there may be several task performed in parallel. For such cases, the Gantt chart is quite useful for communicating the timing of the various tasks.

For larger project, the task can be broken into sub-tasks having their own Gantt charts to maintain readability.

### Critical Path Method- CPM

CPM provides the following benefit:

- Graphical view of the project.
- Interrelationship among various task / activities.
- Predicts the time required to complete the project.
- Show which activities are critical to maintain the schedule and which are not.
- CPM models the activities and events of a project as a network. Activities are depicted as nodes on the network. Events that signify the beginning or ending of activities are depicted as arcs of lines between the nodes.

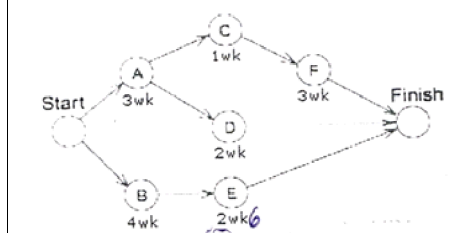


Figure 6 : CPM DIAGRAM

### Steps in CPM project Planning

- Specify the individual activities.
- Determine the sequence/interrelationships of those activities.
- Draw a network diagram.
- Estimate the completion time for each activity.
- Identify the critical path (longest path through the network). Update the CPM diagram as the project progresses.

The critical path can be identified by determining the following four parameters for each of the activity.

- ES- earliest start time : the earliest time at which the activity can start given that its precedent activities must be completed first.
- EF- earliest finish time : equal to the earliest start time for the activity plus the time required to complete.
- LF- latest finish time : the latest time at which the activity can be completed without delay the activity.
- LS- latest start time : equal to the latest finish time minus the time required to complete the activity.

The slack time for an activity is the time between its earliest and latest start time, or between its earliest and latest finish time. Slack is the amount of time that an activity can be delayed past its earliest start or earliest finish without delaying the project.

The critical path is the path for the project network in which none of the activities have slack time, that is, the path for which  $ES=LS$  and  $EF=LF$  for all activities in the path. A delay in the critical path delays the project. Similarly, to accelerate the project, it is necessary to reduce the total time required for the activities in the critical path.

### Program Evaluation and Review technique (PERT)

Complex project require a series of activities, some of which must be performed sequentially and others that can be performed in parallel with other activities. This collection of series and parallel task can be modeled as a network.

CPM is a deterministic method that uses a fixed time estimate for each activity. While CPM is easy to understand and use, it does not consider the time variation that can have a great impact on the completion time of a complex project. The program Evaluation and Review Technique (PERT) is a network model that allows for randomness in activity completion times.

PERT uses three time estimate-optimistic, pessimistic and most likely, which help in establishing the probability of completing a project within a specified time and take calculated risk before commencing a project. It has the potential to reduce both the time and cost required to complete a project.

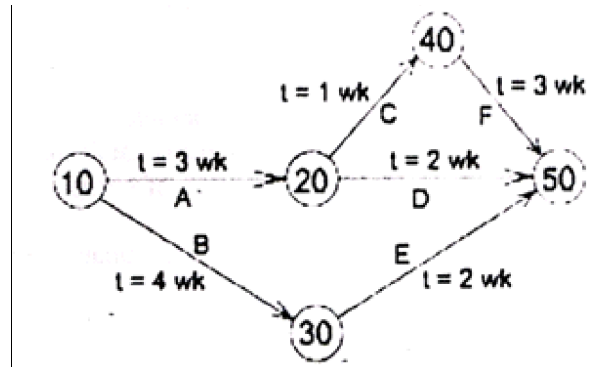


Fig-7 PERT Chart

### The Network Diagram

In a project an activity is a task that must be performed and an event is a milestone making the completion of one or more activities. Before an activity can begin, all of its predecessor activities must be completed. Project network models represent activities and milestones by arcs and nodes.

The milestones generally are numbered so that ending node of an activity has a higher number than the beginning node. Incrementing the numbers of 10 allows for new ones to be inserted without modifying the numbering of the entire diagram. The activities in the above diagram are labeled with letters along with expected time required to complete the activity.

### PERT planning involves the following steps:

- Identify the specific activities and milestones.
- Determine the interdependencies and proper sequence of the activities.
- Construct a network diagram.

- Estimate the time (three time estimates, if probabilities are to be computed) required for each activity.
- Determine the critical path.
- Update the PERT chart as the project progresses.

### Benefits of PERT

PERT is useful because it provides the following information:

- Expected project completion time.
- Probability of completion before a specified date.
- The critical path activities that directly impact the completion time.
- The activities that have slack time and that can lend resources to critical path activities.
- Activities start and end dates.

### PERT/CPM Technique:

At present, concept of PERT and CPM are amalgamated by taking best form both techniques. It is therefore called PERT/CPM technique.

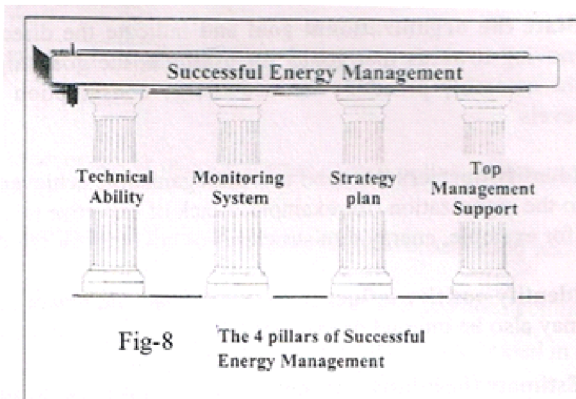
## 6. Energy Monitoring and Targeting

Energy Monitoring and targeting is primarily a management technique. It uses energy information as a basis to eliminate waste and improve the existing operating methods. The principle is 'you cannot manage what you do not measure'. It essentially combines the principle of energy use and

statistics. Monitoring indicates the existing pattern of consumption. Targeting identifies desirable level of energy conservation. All sources of energy like electricity, fuel, steam, refrigerant, compressed air, water and effluent are controllable resources. Their consumption on regular basis are collected through data logger. Once this information is available targets can be set and remedial measures implemented. Elements for this system are - Recording, Analyzing, Comparing, Target Setting, Monitoring, Reporting, Controlling, Checking, Allocating, and Determining, Highlighting problems in equipments or systems.

### Conclusion

Four vital elements for a successful energy management are shown in the following figure. Top management support is the key ingredient for success. They must be refreshed on present available facilities for energy management and conservation. There are short term, medium term and long term strategies for the purpose. Government of India through its enactment of Energy Conservation act 2001 and Electricity act 2003 have fixed guide lines



and support structure for management. With the advent of modern technology and e-management it is much easier to achieve a target oriented operation. A number of energy economy products & processes are awaiting to play their role. Even a small fraction of energy conservation by bulk consumers could reduce the present energy crisis of the country to quite an extent. The consumers would also be financially gainer through credits for Certified Energy Reduction (CERs). Professional investors can earn profits from Clean Development Mechanism (CDMs) projects and can finance other similar projects as well. Through various international frameworks and protocols, whole world is making this effort through partnership and co-operation. In India, we can have significant results only when bulk consumers at the operating end take it with all sincerity and seriousness and involve themselves whole heartedly.

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## CLEAN ENERGY FOR BETTER TOMORROW

Dr. Devananda Beura

### Introduction

Energy in different forms is indispensable for diverse activities in life. The modern life doesn't spend a single minute without requiring energy for various purposes. At every step of life right from cooking to transportation, lighting, cooling, heating and even entertainment, energy is needed and is spent also. Therefore Energy is directly linked to well-being and prosperity of the human being across the globe. The world population, which has reached about seven billion use energy at each moment to make the lives easier, richer, more comfortable, more productive, safer and healthier. The rising energy demand is perhaps the biggest challenge for man in future to sustainably continue all his wellbeing. Looking at the gross estimates of energy demand and economic growth by 2040, the world has to use energy more efficiently and shift toward lower-carbon fuels.

The present day global energy demand is met upto 80% with Fossil fuels. Coal, petroleum, and natural gas are the common fossil fuels that contain high percentages of carbon. Fossil fuels are formed from the fossilized remains of dead organisms by exposure to heat and pressure in the Earth's crust over millions of years. The global energy

demand in 2035 is projected to rise by 40% out of which fossil fuels would still be contributing 75%. The consumption of coal, petroleum and gas in the power plants, industry, buildings and transport sectors is set to rise in future. Environmental concerns regarding high carbon content of fossil fuels have compelled to adopt a significant increase in lower-carbon options, but practically these are yet to be realized widely enough to meet current or future demand for energy. The global share of power generation from non-fossil sources in the past two decades has decreased from 37% (in 1990) to 33% (in 2010); in contrast, the share of coal-fired power generation has risen from 37% to 42%. On one hand, if fossil fuels will continue to provide the majority of global energy needs for the foreseeable future, question arises whether such non-renewable energy source will remain forever to be sufficient to meet the demand. Infact the world energy demand can not be met indefinitely with the fast depleting fossil fuels together with its high risk environmental impacts. Hence, we have to shift for the energy of low carbon option, the so called clean energy. That means, we have to go for the renewable energy sources to reduce the adverse impacts on the environment.

### **Clean Energy**

The common understanding of clean energy is that it can be exploited and used without direct damage to the biosphere. The reason for clean energy being environment

friendly is that it is available without disruption of continuing natural processes. For example, energy from solar radiation is available naturally without human involvement. Similar is the case with wind, moving water and geothermal energy. Of course technological interference is required to convert such energy for human use. But such technologies may be self operative like photovoltaic cells, windmills and waterwheels, which can often be put to use without interrupting the balance of local ecosystems. All these sources of clean energy are also known as renewable energy sources, which can be replenished without technological assistance. Renewable energy is energy derived from natural resources that replenish themselves over a period of time without depleting the Earth's resources. These resources also have the benefit of being abundant, available in some capacity nearly everywhere, and they cause little, if any, environmental damage. Nuclear and biofuels are some other forms of energy frequently considered as clean and renewable. We claim and acknowledge biofuels are renewable as they are derived from biomass. The reason is that plant life is constantly being replaced on a natural basis, regardless of how it is used for human purposes. So far as nuclear power is concerned, it is proclaimed as pro-environmental as nuclear reactors do not emit greenhouse gases. But the mining and enrichment of nuclear fuel are not free from significant greenhouse gas emissions. Though in true sense nuclear sources are not renewable, but such sources can be replenished through complicated, expensive, and dangerous technology.

## Why Clean Energy

The energy scenario speaks differently for the countries of different economic status so far as the demand is concerned. Energy demand will grow close to 60 percent in the developing countries as five-sixths of the world's population attempts to improve their standards of living. But the developed countries will maintain nearly same energy demand as they are on the optimum side. For them the population growth and the demand for energy as well may not bring any difference in future. Growth in electricity demand will remain the biggest driver of energy needs. By 2040 the electricity generation will account for 40 percent of global energy use. The present day power generation of the world is predominantly thermal i.e. produced from coal, gas and oil. Hydroelectricity and nuclear power contribute significantly less amount. The non-hydro renewable energy resources like geothermal, solar, wind and biomass bear less than 1% of the total electricity generation. Electricity production is a major source of greenhouse gases that cause lots of harm to the various components of the environment. Electricity generation from coal, nuclear, and other non-renewable power plants is the leading cause of industrial air pollution. Producing energy from these resources takes a severe toll on our environment, polluting our air, land, and water. The by-products of electricity generation from fossil fuels and their harmful impacts are given in the following table-1.

The most important purpose of using clean, renewable energy is to reduce the adverse impact on the environment. Electricity, the major form of energy can be produced by renewable energy sources with fewer environmental impacts replacing the fossil fuels. By that way it is possible to make electricity without producing carbon dioxide (CO<sub>2</sub>), the leading cause of global climate change. Clean energy also reduces harmful smog, toxic buildups in our air and water, and the impacts caused by mining, industries and gas extraction. Energy from the sun, wind, and thermal energy stored in the Earth's crust are non-exhaustible and shall be made available for infinite period. Renewable energy providing reliable power supplies and fuel diversification enhance energy security. Substituting the traditional energy sources with renewable energy can help to conserve the natural resources.

It is well known that ecological damage resulting from current economic activity is due largely to use of fossil fuel. There is worldwide awareness among intellectuals, planners, policy makers, scientists and other sensible people that it is high time to annul the damaging side-effects of fossil fuel. Most efficient way of getting the solution is to replace fossil fuel with so-called "clean energy," which can delink development from degradation of environment.

## Conclusion

During the ancient time, till fossil fuels were used, people were using the traditional fuel, which were all renewable. In that

<b>By-products of electricity generation</b>	<b>Impacts</b>
<b>Sulfur dioxide (SO<sub>2</sub>)</b>	Causes acid rain, sulfur dioxide triggers asthma attacks in people and contributes to the formation of fine particles, also detrimental to respiratory health.
<b>Nitrogen oxides (NO<sub>x</sub>)</b>	Reacting with sunlight creates ground level ozone and smog. High levels of NO <sub>x</sub> increase susceptibility to respiratory infections, especially among children.
<b>Ozone (O<sub>3</sub>)</b>	It occurs naturally in the upper atmosphere, where it is beneficial. However, ozone in the lower atmosphere creates the urban haze which we call smog. Automobiles and electricity generation are top contributors to ground level ozone. breathing ozone can lead to shortness of breath, lung inflammation, asthma attacks, and for children who grow up in areas with high ozone pollution, greater risk of lifelong lung disease.
<b>Particulate matter</b>	It is a type of air pollution more commonly referred to as soot. Exposure to particulate matter is especially harmful to people with lung disease (e.g. asthma, bronchitis, emphysema) and heart disease.
<b>Carbon dioxide (CO<sub>2</sub>)</b>	It is a greenhouse gas that contributes to global climate change. Long-term effects associated with fossil fuel burning could be even more alarming than air pollution-related deaths today. In the future, tropical diseases could thrive as the earth's climate warms, and deaths due to extreme weather conditions could increase.
<b>Mercury</b>	It is a highly toxic metal that is released from coal-fired power plants. Mercury accumulates in the fat cells of fish and other animals. When humans eat the fish, they are exposed to mercury. Mercury causes permanent damage to the liver and central nervous system, causing loss of motor function, slurred speech, tunnel vision, and loss of hearing. Because mercury accumulates in biological organisms it is constantly being recycled in the environment as it moves up the food chain

connection after learning the use of fire, the oldest renewable energy the ancient man could use, was from traditional biomass. Wind power might be the second oldest renewable energy, which was used to drive ships over water. As such solar radiation was very common renewable energy used for drying of things. In

due course with the march of civilisation towards modernity, people came to know the use of fossil fuels, adhered to it and reached the height of its use. Now when the fossil fuels are rapidly depleting and environmental degradation is getting triggered up fast, there is no alternate way but to adopt the clean energy.

As it is well known, the use of fossil fuels raises serious environmental problems. About 21.3 billion tonnes of carbon dioxide (CO<sub>2</sub>) are produced from the burning of fossil fuels. Only about half of that amount can be absorbed by natural processes. Therefore the remaining 10.65 billion tonnes of atmospheric carbon dioxide per year is the net increase of its amount in the atmosphere. It is one of the greenhouse gases that contributes a lot to global warming. A global movement towards the generation of renewable energy is therefore under way to help reduce global greenhouse gas emissions.

While talking of the clean sources of energy, we have to go for the renewable energy technologies. It has a much lower environmental impact than conventional energy technologies. Renewable energy is non-exhaustible in nature and nurtures the overall development locally at the point of installation. They derive their energy from the sun directly or indirectly like hydro and wind power. It is expected that such source may be capable of supplying energy to man for almost another 1 billion years. After that the heat of the sun may increase to make the surface of the earth too hot for liquid water to exist.

Renewable energy provides 21.7% of electricity generation worldwide as of 2013. Renewable power generators are spread across many countries, and wind power alone already provides a significant share of electricity in some areas: for example, 14% in the U.S. state of Iowa, 40% in the northern German state of Schleswig-Holstein, and 49% in Denmark. Some countries get most of their power from renewable sources, such as Iceland (100%),

Norway (98%), Brazil (86%), Austria (62%), New Zealand (65%), and Sweden (54%).

The worldwide renewable energy capacity has grown at the rates of 10-60% annually from 2004. Landmark development in this regard is seen during 2009. More wind power capacity was added during 2009 with than any other renewable technology. In 2010, among the newly built power generation capacities, renewable power has constituted as much as one third of the total. As per the estimation of the International Energy Agency in 2011, solar power generators may produce most of the world's electricity within 50 years, which will reduce the emissions of greenhouse gases to a greater extent. Rest of the energy needs may be met with wind, hydropower and biomass plants.

The amount of green energy investments throughout the world is rapidly increasing. In 2010 nearly US \$243 billion was invested in wind farms, solar power, electric cars, and other alternative technologies worldwide, representing a 30 percent increase from 2009 and nearly five times the money invested in 2004. In clean energy investment sector, China came first by an investment of \$51.1 billion in 2010 followed by Brazil. India is also in a rising trend of investing for clean energy. It may step up to the third position over the next 10 years having being said the investment growth may touch 369 percent. Such scenario of worldwide effort to adopt the clean energy technology clearly indicates a pro-environmental journey for better tomorrow.

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