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... the science information

Volume-04, No.-01 (2022)

Shri R.L.T. College of Science, Akola

*Info*SCIENCE

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Principal's Message and Editor's Words ...





I am proud exuberant to present the 1st issue of 4th volume of science magazine... *info*SCIENCE. It is comprised of informative scientific and research articles, reviews on different aspects and concepts of science and technology. I am sure that, readers will definitely get benefitted from it.

At this juncture, it gives me immense pleasure to pronounce that publishing the *info*SCIENCE is one of our best practices since the session 2018-19. I congratulate the editors of *info*SCIENCE, for their committed work and tireless efforts in bringing out this publication of *info*SCIENCE.

Dr. Vijay D. Nanoty
Principal, Shri R.L.T. College of Science, Akola

It's our privilege to publish the 1st issue of 4th volume of science magazine... *info*SCIENCE of Shri R.L.T. College of Science, Akola enriched with scientific and research articles of varied ideas and diverse views that are influential in the field of science and technology with substantially advance scientific understanding.

The goal of the coverage of *info*SCIENCE is to help readers and contributors make sense of the world of science. Its aim is to publish the scientific and research articles, reviews with matter of interest to teachers, researchers, students and other who concerned with the wide implications of science and technology.

The editorial board is sincerely grateful to our patrons, honorable executive members of the Berar General Education Society, Akola and the principal, advisors and authors for extending their everlasting cooperation to this scientific project and contributing valuable articles for publication in *info*SCIENCE. The board of editors strongly feels that everyone needs to contribute spontaneously in making the *info*SCIENCE more readable and informative. Best wishes to the readers and contributors of *info*SCIENCE.

Dr. Sushil M. Nagrale, **Dr. Pradip P. Deohate**
Dr. (Mrs.) Anjali A. Sangole and **Dr. Vinod D. Deotale**, Editors, *info*SCIENCE

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Volume-04, No.-01 (2022)

The Berar General Education Society's
NAAC Reaccredited 'A' Grade with CGPA 3.12

Shri R.L.T. College of Science, Akola

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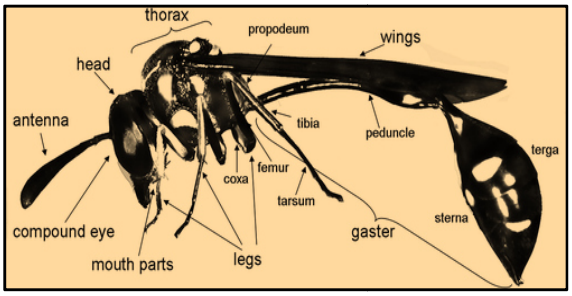
Research / Scientific Articles

Insect World - Diversity of Ichneumon Wasp

Dr. Sushil M. Nagrale
Department of Zoology, Shri Radhakisan Laxminarayan Toshniwal College of Science, Akola, 444 001, INDIA

Ichneumon wasps are one of the most diverse groups within the Hymenoptera with roughly 25,000 species currently described. Ichneumon wasps are also known as Ichneumonidae or Ichneumonoid. They are a family of parasitoid wasps. They attack the immature stages of complete metamorphic insects and spiders killing their hosts. They thus play an important role as regulators of insect populations, both in natural and semi-natural systems, making them promising agents for biological control.

Insect Ichneumons are belongs to the Class-Insecta, Order-Hymenoptera and Family-Ichneumonidae. They are commonly called Ichneumon wasps or Ichneumonids. Ichneumon wasps are one of the most diverse groups within Hymenoptera with roughly 25,000 species currently described.



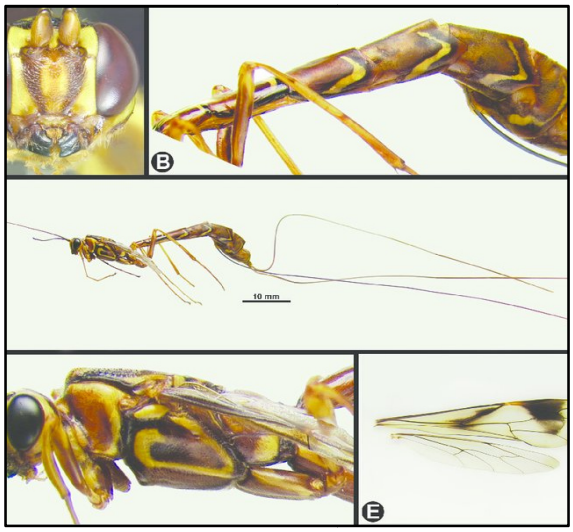
Ecological distribution

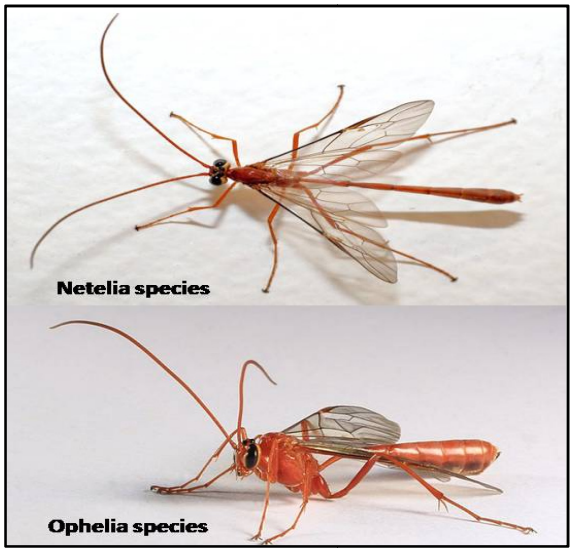
Ichneumon wasps are found on all continents except Antarctica. They all are terrestrial in habitat. They all are parasitoids (parasite the host). They are mostly occurs in temperate region and rarely in tropic region. Recently various new tropical species are discovered.

Morphological diversification

Adult Ichneumon are superficially resembles other wasps. They have a slender waist, two pairs of wings, a pair of large compound eyes on the side of the head and three ocelli on top of the head. Their size varies considerably from a few millimetres to seven centimetres. The Ichneumonids have more antennal segments than typical aculeate wasps. Ichneumonids typically possess 16 or more antennal segments, while most other wasps have 13 or fewer antennal segments.

Ichneumon females have an unmodified ovipositor which they use to lay eggs inside or on their host. Ichneumonids generally inject venom along with the egg, but only larger species (e.g. *Netelia and Ophion*) with relatively short ovipositors use the ovipositor in defence. Males do not possess stingers or ovipositors in either lineage.





Reproductive characters

A very few ichneumon species lay their eggs in the ground, but the majority of wasps inject eggs either directly into their hosts body or onto its surface. This may require penetration of substrate around the host. In wood-boring host larvae that live deep inside of tree trunks, requiring the ichneumon to drill its ovipositor through several centimetres of solid wood (e.g. *Megarhyssa* species).

After hatching, the ichneumon larva consumes it still living host. The most common hosts are larvae or pupae of Coleoptera - Beetles, Lepidoptera - Moths and Butterfly, Caterpillars and Hymenopterans grubs. Some species also parasitize spiders. Some Mesochorinae species are hyper-parasitoids by laying eggs inside the larvae of other Ichneumon.

The hosts of some species are agricultural pests, therefore ichneumons are sometimes valuable for biological pest control, but the host of most species are unknown.

Ichneumonids use both idiobiont and koinobiont strategies. Idiobionts paralyze their host and prevent it from moving or growing whereas koinobionts allow their host to continue to grow and develop. In both strategies, the host typically dies after some weeks, after which the ichneumon larva emerges and pupates.

Behaviours

Adult Ichneumonids feed on a diversity of foods, including plant sap and nectar. They spend much of their active time searching, either for hosts (by female ichneumon) or for emerging females (by male ichneumon). The parasitism pressure exerted by ichneumon can be tremendous, and they are often one of the major regulators of invertebrate populations. It is common for 10-20% or more of a host's population to be parasitized.

Taxonomic diversity

The taxonomy of the ichneumon is still poorly known. Family Ichneumonids is highly diverse, containing 24,000 more described species. Approximately 60,000 species are estimated to exist worldwide, though some estimates place this number at over 100,000.

They are under sampled. Studies of their diversity typically produce very high numbers of species which are represented by only a single individual.

There are high diversity and the majority of species being undiscovered. It has proven difficult to resolve the phylogeny of the Ichneumonids. Even the relationships between subfamilies are unclear. The DNA sequencing data is only available for a tiny fraction of the species, and detailed cladistic studies require.

The large number of species in Ichneumonidae may be due to the evolution of parasitoidism in hymenoptera,

which occurred approximately 247 million years ago.

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Honey and Health

Prof. Sonali N. Gawande and **Mr. Pawan D. Dharmode**
Department of Microbiology, Shri Radhakisan Laxminarayan Toshniwal College of Science, Akola, 444 001, INDIA

Honey has been used by humans since ancient times. Honey is the only insect-derived natural product and it has nutritional, cosmetic, therapeutic and industrial values. Honey is reviewed as a balanced diet and equally popular for male and female in all ages. Honey is the oldest wound healing agent known to humankind. Honey shows antibacterial, antiviral, anti-inflammatory and antioxidant properties. Investigations have indicated that honey has anticancer property and it is commonly used in traditional medicine to treat inflammation, cough and fever. Antioxidants present in honey such as flavonoids, polyphenolics, vitamin C and mono-phenolics may be associated with a reduced risk of cardiovascular failures. Honey has been suggested as potentially useful for various conditions of the gastrointestinal tract. Honey and ginger powder extract mixtures were found to have more antimicrobial effect than their individual use. Formulation of honey and tulsi extracts can be effectively used in major dental problem.

Honey is a natural product produced by honeybees from nectar of flowers. Honey has been used by humans since ancient times, 5500 years ago. Most ancient population, including the Greeks, Chinese, Egyptians, Romans, Mayans, Babylonians, consumed honey both for nutritional aims and for its medicinal properties. Honey is the only insect-derived natural product and it has nutritional, cosmetic, therapeutic and industrial values. Honey is reviewed as a balanced diet and equally popular for male and female in all ages. Honey possesses some special properties like no needs to refrigerate, it never spoils and it can also be stored unopened at room temperature in a dry place. The water activity (WA) of honey is between 0.56 and 0.62 and its value of pH is almost 3.9. Honey was utilized as a natural sweetener from ancient period since it has elevated level of fructose; surprisingly honey is 25% sweeter than table sugar. Moreover, the use of honey in beverages is also increasingly popular. Nowadays, information on the usage of honey for the cure of many human diseases can be found in general magazines, journals and natural products' leaflets and suggesting a wide variety of unknown activities. Evidence indicates that honey can exert several health beneficial effects including antioxidant, anti-inflammatory, antibacterial antidiabetic, respiratory, gastrointestinal, cardiovascular and nervous system protective effects. Although many investigations were done on honey, only a few are published. This study, which is a review of the current literature, highlights the therapeutic benefits of honey in the management of diseases.

Melghat is embarked as the ‘Heaven on Earth’. Melghat region is in the Amravati district of Maharashtra takes pride in its dense forest and rich biodiversity of medicinal plants. The region owed to its splendid biodiversity, provides a source for high nectar content and creates a perfect natural habitat to the honey bees. The major flora includes Amaltas, Kumbhi, Jamun, Behada, Shirish, Pangara and few other varieties of medicinal plants. Nectar collected by honey bees from these sources have been shown to imbibe the medicinal properties and came to be known as ‘Melghat Honey’. Honey primarily extracted by tribal population for centuries. Melghat honey helps in tackling the childhood malnutrition problem faced by the local

population. Also provides source of revenue for local tribal population and prevents occupational migration.

In insects the honey bee pollination has significant effect on the maintaining the biodiversity and affect the world food production. For the bee keeping the main thing is water and in the Melghat rivers are the main source of water. The climatic condition includes 1400 mm average rainfall, lowest temperature is about 6^0C, the highest 40^0C and average humidity 60%. These are the favorable condition for the bee flora and hence in the Melghat region there is chance to motivate the honey bee keeping. Melghat is rich in production of medicinal honey. Honey bee visit different variety of medicinal plants, by cross pollination collect the nectar and get the product of valuable honey which is having a tremendous medicinal value. The diversity in bee flora and honey bee species makes a valuable resource for apiculture. The population residing in this area is Tribes, Korku, Nihal, Gawalan and Gond etc.

The *Apis dorsata* called as 'Agya Madhmashi' in marathi are found in western ghats, Kokan and tribal pockets like Melghat and yielding highest honey. It mainly found in forested area such as Terai of Nepal. A nest of *A. dorsata* consisting of a single exposed hanging comb. The bottom of comb has a number of unoccupied hexagonal cells. Another species *Apis mellifera* (western honey bee) found everywhere except Antarctica. *A. mellifera* was first domesticated insects used for the production of Honey.

Medicinal properties of honey

Honey and wound - Honey is the oldest wound healing agent known to humankind. Honey shows antibacterial, antiviral, anti-inflammatory and antioxidant properties. Honey induces to release cytokines, which is what begins the tissue repair cascades. Furthermore, its active immune response to infection. Stimulation of other properties of the immune response by honey is also reported. Much evidence suggests the use of honey in the control and treatment of acute wounds and for mild to moderate superficial and partial thickness burns.

Honey and cancer - Current studies show that honey may exert anticancer effects through several mechanisms. Investigations have indicated that honey has anticancer property through its interference with multiple cell-signaling pathways, including inducing the apoptosis, antiproliferative, antimutagenic and anti-inflammatory pathways. Honey modifies the immune responses. Honey has been indicated to prevent cell proliferation, induce apoptosis, modify cell cycle progression and cause mitochondrial membrane depolarization in several types of cancer cell such as skin cancer cells (melanoma), adenocarcinoma epithelial cells, cervical cancer cells, endometrial cancer cells, liver cancer cells, colorectal cancer cells, prostate cancer cells, renal cell carcinoma, bladder cancer cells, human non-small cell lung cancer, bone cancer cells (osteosarcoma), leukemia and mouth cancer cells (oral squamous cell carcinoma). In addition, honey could be able to inhibit several forms of tumor in animal modeling including breast cancer, carcinoma, melanoma, colon carcinoma, hepatic cancer and bladder cancer.

Honey and asthma - Honey is commonly used in traditional medicine to treat inflammation, cough and fever. The ability

of honey to act in reducing asthma related symptoms or as a preventive agent to preclude the induction of asthma was showed. Chronic bronchitis and bronchial asthma were treated by oral honey consumption in animal modeling.

Honey and cardiovascular diseases - Antioxidants present in honey such as flavonoids, polyphenolics, vitamin C and mono-phenolics may be associated with a reduced risk of cardiovascular failures. In the coronary heart disease, the protective effects of flavonoids such as antioxidant, antithrombotic, anti-ischemic, vaso-relaxant reduce the risk of coronary heart disorders through three mechanisms as improving coronary vasodilatation, reducing the ability of platelets in the blood to clot and inhibiting low-density lipoproteins from oxidizing. Several investigations showed that certain honey polyphenols have a promising pharmacological function in reducing cardiovascular disorders.

Honey and gastrointestinal diseases - Honey has been suggested as potentially useful for various conditions of the gastrointestinal tract, such as periodontal and other oral disorders, dyspepsia and as part of oral rehydration therapy. *In vitro* studies propose that honey exerts bactericidal activity against *Helicobacter pylori*, although a clinical trial of manuka honey therapy to induce *Helicobacter* eradication failed to indicate a beneficial treatment. In addition, honey may be effective as a part of oral rehydration therapy. It shows therapeutic effects in the treatment of infants and children admitted into hospital with gastroenteritis.

Antimicrobial activity and different formulation of honey - The main factors for antimicrobial activity of honey are the enzymatic glucose oxidation reaction and some of its physical aspects, but the other factors that can show antimicrobial activity of honey include high osmotic pressure / low WA, low pH / acidic environment, low protein content, high carbon to nitrogen ratio, low redox potential due to the elevated level of reducing sugars, a viscosity that limits dissolved oxygen and other chemical agents / phytochemicals. Due to the properties of honey does not help in the growth of yeast and bacteria. The peroxidase is not at all origin of antibacterial level of honey, but many products with low antibacterial level were discovered in honey including terpenes, pinocembrin, benzyl alcohol, 3,5-dimethoxy-4-hydroxybenzoic acid (syringic acid), methyl-3,5-dimethoxy-4-hydroxybenzoate (methyl springate), 2-hydroxy-3-phenylpropionic acid, 2-hydroxybenzoic acid, 3,4,5-trimethoxybenzoic acid and 1,4dihydroxybenzene. Many investigations indicated that antibacterial activity of honey has minimum inhibitory concentration; therefore, honey has the minimum concentration necessary for complete inhibitory growth. Among the many types of honey, manuka honey has the highest level of non-peroxide activity. Investigations indicated that *Escherichia coli* and *Staphylococcus aureus* can be significantly prevented by manuka honey. It has been illustrated that antibacterial activity of honey is effective on many bacterial pathogens and fungi.

Formulation of honey and ginger - Honey and ginger powder extract mixtures were found to have more antimicrobial effect than the use of honeys or ginger extracts solutions individually. Use of honeys and ginger extracts mixtures for drug resistant

bacteria such as *staphylococcus aureus* (MRSA), *Escherichia coli* (R) and *Klebsiella pneumonia* (R) is recommended.

Formulation of honey and tulsi extracts - Formulation of honey and tulsi extracts can be effectively used in major dental problem. It can be used as herbal mouth rinses. The herbal mouth rinses containing tulsi and honey can be much effectively used in area where people cannot access to the chlorhexidine which is used as disinfectant and antiseptic.

Chemical Science of Revolutionary Scientist - Acharya P. C. Ray

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Acharya Prafulla Chandra Ray, is known as the father of modern chemistry in India. Prafulla Chandra was a synthetic inorganic chemist with active interest in thio-organic compounds. He was regarded as "Master of nitrites". He studied various Indian texts of Susruta, Charaka and explored the world of Indian science developed hundreds of years ago. His book, "A history of Hindu chemistry" is a critically acclaimed treatise on Rasashastra and Ayurveda. In 1894, he reported first ever synthesis of mercurous nitrite. Another major contribution was the synthesis of ammonium nitrite in pure form via double displacement between ammonium chloride and silver nitrite. He setup India's first pharmaceutical company, Bengal Chemicals, now known as the Bengal Chemicals and Pharmaceutical Works Ltd. (BCPWL). In the year 2011, which was also celebrated as the "International Year of Chemistry", the Royal Society, UK, honoured his work with the chemical landmark plaque "To commemorate the life and achievements of Acharya P. C. Ray, father of Indian chemistry, philanthropist and entrepreneur who founded modern chemistry teaching and research in India". This was the first ever landmark plaque awarded outside Europe. The plaque was installed on January 31, 2012 at his alma mater, Presidency College, Kolkata.

Acharya Prafulla Chandra Ray, a character defined by respect, indomitable courage and patriotism and most important, his commitment to the scientific integrity by using the best available local resources. He is known as the father of modern chemistry in India, who reached a high level of perfection in his times. Ray can easily be regarded as the first Indian who started the integration process of ancient Indian chemistry with modern sciences, a researcher who led Indians towards modern chemistry, founder of Indian Chemical Society and a Startup entrepreneur. He is the author of "A history of Hindu chemistry from the earliest times to the middle of sixteenths century" (1902).

He was born on August 2, 1861, in the village of Raruli-Katipara of Bengal. In his college life, chemistry became his dearest subject and he set up a laboratory at his home to experiment. Soon captivated by experimental science, Ray decided to make chemistry his career, as he recognized that his country's future would greatly depend on her progress in science. His passion for experimentation led him to set up a miniature chemistry laboratory at a classmate's lodgings and reproducing some demonstrations. Ray completed his B.Sc. in 1885 and at the age of 26, was awarded a D.Sc. in inorganic chemistry (1887). He was elected as the Vice-President of the Edinburgh University Chemical Society in 1887.

As a young Indian scientist, P. C. Ray applied for a job at Indian Educational Service (IES) but despite of his accomplishments and recommendation letters, he remained jobless for a year. During this period he stayed with his friend, Jagdish Chandra Bose and spent his time reading chemistry literature. In those times jobs were limited and mostly reserved for British. Such was the racial discrimination in British times that he was given only a temporary appointment at Presidency College as Assistant Professor at a meagre salary of Rs. 250, an absurdly low pay for someone with his qualifications. Ray disagreed but eventually accepted the job. He moved to the Rajabazar Science College, Kolkata as the first Palit Professor of chemistry in the year 1916 and continued his work with renewed vigour.

His research activities thrived in the laboratories of the university even though the facilities were inadequate.

As a student at the University of Edinburgh, he was impressed by the scientific knowledge of ancients in the western world. This generated immense curiosity in him to explore the extensive contribution of ancient India in the field of science and technology. He studied various Indian texts of Susruta, Charaka and explored the world of Indian science developed hundreds of years ago. Acharya Prafulla Chandra Ray's book, "A history of Hindu chemistry" is a critically acclaimed treatise on Rasashastra and Ayurveda. The first volume of the book was published in 1902 and the second in 1909. The book was strong enough to attract the attention of western world towards Indian alchemy and lead to the globalization of the fundamentals of Rasashastra.

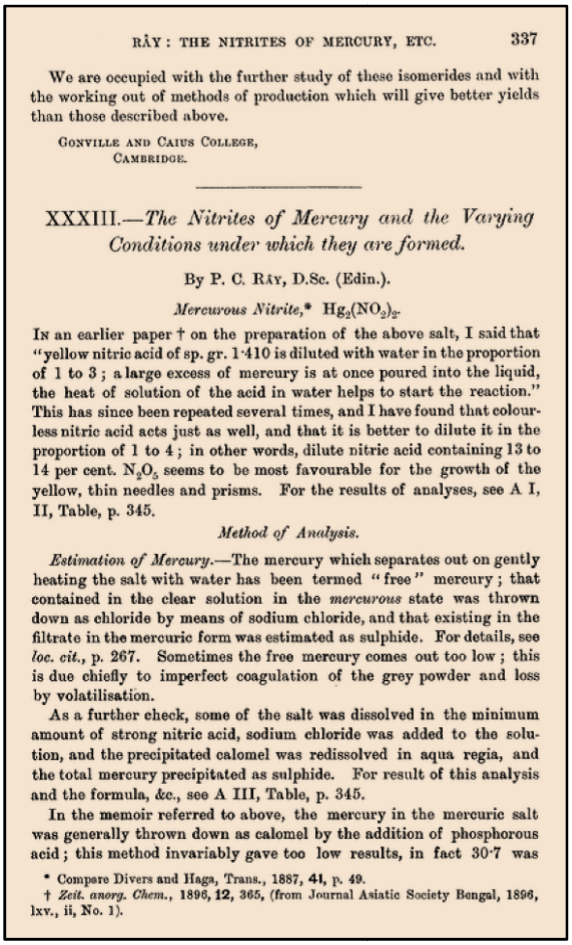
Prafulla Chandra was a synthetic inorganic chemist with active interest in organic molecules and reactions especially to the chemistry of thio-organic compounds. His initial work which made him famous was based on the chemistry of inorganic and organic nitrites, he was regarded as "Master of nitrites". He continued his work on related compounds and thereon shifted to the organic thio-compounds and their metal complexes. The metal which particularly fascinated him was mercury, may be because it has extensively important role in Indian medicine system of Ayurveda.

In 1894, P. C. Ray began analysis of certain rare Indian minerals in his quest to discover some new element to fill the gaps in Mendeleev's Periodic table. He soon reported the first ever synthesis of the previously unknown compound of mercurous nitrite, $Hg_2(NO_2)_2$, which he narrates in his autobiography as "The discovery of mercurous nitrite opened a new chapter in my life". This compound of mercury was a fascinating example of two relatively unstable ions combining to form a stable substance.

The formation of mercurous nitrite, $Hg_2(NO_2)_2$ was an accidental discovery, while he was trying to react excess mercury with cold dilute nitric acid to synthesize mercurous and mercuric nitrates, $Hg_2(NO_3)_2$ and $Hg(NO_3)_2$. During the course of reaction, he noticed the appearance of a yellow crystalline solid on the sides which on analysis revealed to be the unknown mercurous nitrite. The nitrite ion probably was the result of initial reduction of nitric acid by mercury. The pertinent point to be noted here is that stable mercury(I) complexes are very few in existence, even today, owing to the instability of mercury(I) towards disproportionation to mercury(II) and metallic mercury in solution.

This discovery was first published in the Journal of Asiatic Society of Bengal (1896) and immediately noticed by Nature magazine, which mentioned work in its issue of May 28, 1896, "A paper by Dr. P. C. Ray on mercurous nitrite, that is worthy of note". In further course of research, he published numerous significant research papers on nitrites and its related derivatives. This series of work by Ray and his students, led to laying the foundation of first research school of modern Chemistry in India.

Now with advances in analysis techniques, the compound has now been structurally analyzed using X-ray crystallography techniques (1985, 1986, 2011). The molecule is planar and centrosymmetric. The Hg atom is unsymmetrically bonded to nitrite ion through the two oxygen atoms, thereby forming a four membered chelate ring. The Hg-Hg bond length is 2.54 A^0 and the shorter and longer Hg-O distances are 2.20 A^0 and 2.61 A^0 respectively.



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We are occupied with the further study of these isomerides and with the working out of methods of production which will give better yields than those described above.

GONVILLE AND CAIUS COLLEGE,
CAMBRIDGE.

XXXIII.—*The Nitrites of Mercury and the Varying Conditions under which they are formed.*

By P. C. RAY, D.Sc. (Edin.).

*Mercurous Nitrite,** $Hg_2(NO_2)_2$.

IN an earlier paper † on the preparation of the above salt, I said that "yellow nitric acid of sp. gr. 1·410 is diluted with water in the proportion of 1 to 3; a large excess of mercury is at once poured into the liquid, the heat of solution of the acid in water helps to start the reaction." This has since been repeated several times, and I have found that colourless nitric acid acts just as well, and that it is better to dilute it in the proportion of 1 to 4; in other words, dilute nitric acid containing 13 to 14 per cent. N_2O_5 seems to be most favourable for the growth of the yellow, thin needles and prisms. For the results of analyses, see A I, II, Table, p. 345.

Method of Analysis.

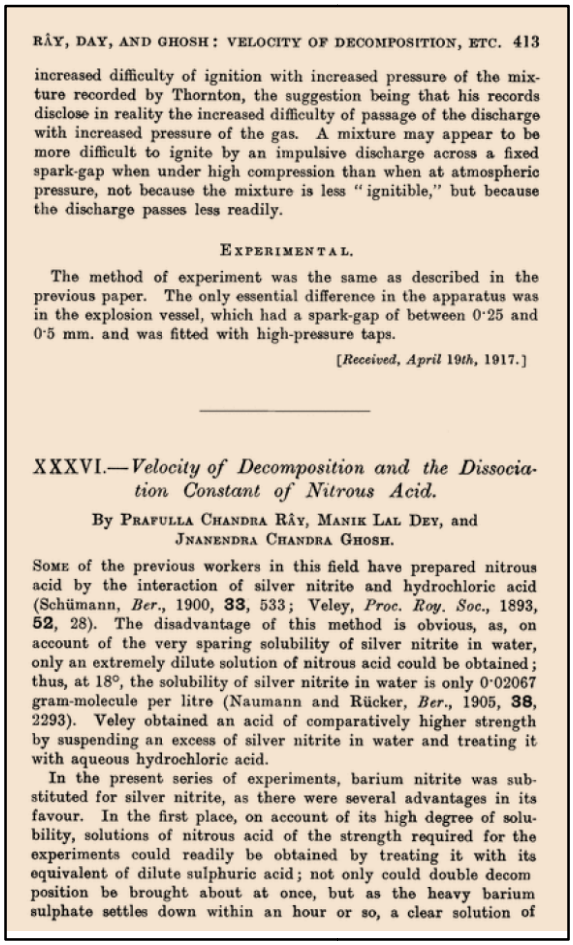
Estimation of Mercury.—The mercury which separates out on gently heating the salt with water has been termed "free" mercury; that contained in the clear solution in the *mercurous* state was thrown down as chloride by means of sodium chloride, and that existing in the filtrate in the mercuric form was estimated as sulphide. For details, see *loc. cit.*, p. 267. Sometimes the free mercury comes out too low; this is due chiefly to imperfect coagulation of the grey powder and loss by volatilisation.

As a further check, some of the salt was dissolved in the minimum amount of strong nitric acid, sodium chloride was added to the solution, and the precipitated calomel was redissolved in aqua regia, and the total mercury precipitated as sulphide. For result of this analysis and the formula, &c., see A III, Table, p. 345.

In the memoir referred to above, the mercury in the mercuric salt was generally thrown down as calomel by the addition of phosphorous acid; this method invariably gave too low results, in fact 30·7 was

* Compare Divers and Haga, Trans., 1887, **41**, p. 49.

† *Zeit. anorg. Chem.*, 1896, **12**, 365, (from Journal Asiatic Society Bengal, 1896, lxv., ii, No. 1).



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increased difficulty of ignition with increased pressure of the mixture recorded by Thornton, the suggestion being that his records disclose in reality the increased difficulty of passage of the discharge with increased pressure of the gas. A mixture may appear to be more difficult to ignite by an impulsive discharge across a fixed spark-gap when under high compression than when at atmospheric pressure, not because the mixture is less "ignitible," but because the discharge passes less readily.

EXPERIMENTAL.

The method of experiment was the same as described in the previous paper. The only essential difference in the apparatus was in the explosion vessel, which had a spark-gap of between 0·25 and 0·5 mm. and was fitted with high-pressure taps.

[*Received, April 19th*, 1917.]

XXXVI.—*Velocity of Decomposition and the Dissociation Constant of Nitrous Acid.*

By PRAFULLA CHANDRA RÂY, MANIK LAL DEY, and JNANENDRA CHANDRA GHOSH.

SOME of the previous workers in this field have prepared nitrous acid by the interaction of silver nitrite and hydrochloric acid (Schümann, *Ber.*, 1900, **33**, 533; Veley, *Proc. Roy. Soc.*, 1893, **52**, 28). The disadvantage of this method is obvious, as, on account of the very sparing solubility of silver nitrite in water, only an extremely dilute solution of nitrous acid could be obtained; thus, at 18°, the solubility of silver nitrite in water is only 0·02067 gram-molecule per litre (Naumann and Rücker, *Ber.*, 1905, **38**, 2293). Veley obtained an acid of comparatively higher strength by suspending an excess of silver nitrite in water and treating it with aqueous hydrochloric acid.

In the present series of experiments, barium nitrite was substituted for silver nitrite, as there were several advantages in its favour. In the first place, on account of its high degree of solubility, solutions of nitrous acid of the strength required for the experiments could readily be obtained by treating it with its equivalent of dilute sulphuric acid; not only could double decomposition be brought about at once, but as the heavy barium sulphate settles down within an hour or so, a clear solution of

Another of his major contribution was the synthesis of ammonium nitrite in pure form via double displacement between ammonium chloride and silver nitrite. He also reported that on careful heating to 70^0C in moderate vacuum, a part of the ammonium nitrite goes through the process of sublimation via vaporization. He further worked upon it to determine the vapour density of ammonium nitrite and observed that his experimental density value agreed very well with the calculated structure, thereby showing that the salt existed in ion-pair form. In those times, only ammonium chloride salt was known to exhibit this property. In 1912, he presented this work at Chemical Society, United Kingdom before a distinguished audience including Noble Laureate William Ramsay. In its issue, the Nature magazine mentioned the work as "A further accomplishment in determining the vapour density of this very fugitive compound."

Since childhood, Prafulla Ray had observed the frequent famines and poverty in the country. Due to his knowledge of ancient Indian history, he was aware about the highly developed Indian industries existing before the arrival of British, who deliberately destroyed and crushed the native manufacturers to promote the British interest. Under an outsider and aggressive rule, gradually Indians had lost the inspiration and endeavour, to setup any new venture. With increasing unemployment levels in Bengal, he took up to himself to revive the industrial economy using the latest scientific knowledge and putting it to industrial use. With an initial investment of Rs. 700, he setup India's first pharmaceutical company, Bengal Chemicals, now known as the Bengal Chemicals and Pharmaceutical Works Ltd. (BCPWL). The company is now in prominence during the Covid-19 situation, as it has been licensed by Government of

India to produce the much needed hydroxychloroquine (HCQ).

In the year 2011, which was also celebrated as the "International Year of Chemistry", the Royal Society, UK, honoured his work with the chemical landmark plaque "To commemorate the life and achievements of Acharya P. C. Ray, father of Indian chemistry, philanthropist and entrepreneur who founded modern chemistry teaching and research in India". This was the first ever landmark plaque awarded outside Europe. The plaque was installed on January 31, 2012 at his alma mater, Presidency College, Kolkata.

As a teacher, Acharya Ray was an ideal person who was loved by his students. He believed in the philosophy of Sanskrit shloka, which he usually quoted, "Wish for victory everywhere except from your son and from your disciple". Prafulla Chandra Ray was a visionary ahead of his times, who understood the importance of amalgamation of the ancient and modern science.

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Review on the Development of Quantum Cutting Phosphors for Mercury-Free Fluorescent Lamps (MFFL)

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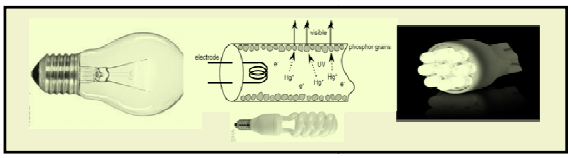
About 90% of global electricity generation is consumed for lighting which is more than that produced by hydro or nuclear stations and about the same as that produced from natural gas. In recent years there has been a growing interest in the development of efficient phosphors under vacuum ultraviolet (VUV) excitation. To obtain higher energy efficiency, a xenon-based fluorescent tube needs phosphors with visible quantum efficiency higher than 100%. This is possible with quantum cutting (QC). Quantum cutting provides a means to obtain two or more photons for each photon absorbed. It, therefore, serves as a down-converting mechanism with quantum efficiency greater than unity and it offers the prospect of providing improved energy efficiency in lighting devices. There are two methods to obtain quantum cutting, the first is photon cascade emission (PCE) and the second is cross-relaxation energy transfer (CRET), among which prominent and usual method is CRET.

Definition of the problem

Energy-efficient lighting is the need of the hour as nearly nineteen percent of global electricity generation is consumed for lighting which is more than that produced by hydro or nuclear stations and about the same as that produced from natural gas. Incandescent lamps, which were widely used earlier, suffer from a poor luminous efficiency as most of the energy is converted to heat and were replaced by light sources such as fluorescent tubes and compact fluorescent lamps (CFLs). Currently, the primary excitation of phosphors in fluorescent lamps is achieved by UV excitation from a mercury (Hg) discharge. While it generates electromagnetic radiation at about 70% efficiency, over 90% of the radiation occurs in the UV region at 254 nm. Conversion of UV light to visible light is accomplished by phosphors that introduce additional losses, predominantly due to the large energy difference between the exciting photon and the emitted photon; the resulting lamp energy efficiencies are at best 33%. Another disadvantage is all fluorescent lamps, CFLs contain mercury which complicates their disposal and adds substantial health risks and environmental issues during manufacturing[1].

Now day's replacement of the fluorescent lamps by environmentally benign light sources such as light-emitting diode (LEDs). The use of LEDs seems to be the most environmentally benign way of lightning. White light-emitting diodes (white-LEDs), which combine a blue- or a near-UV-LED with phosphors, paved the way for new mercury-less solid-state light sources. But white-light-emitting LEDs still suffer from a poor color rendering index (CRI)[2] and a comparatively low luminous intensity (especially when a good CRI is attempted). Following figure shows the history of lighting.



Reason behind the topic

Improvements in fluorescent lamps have been incremental with small improvements in efficiency through tailoring of the Hg discharge or optimization of the efficiency of phosphors that convert the UV into visible light. Major improvements will therefore require a conceptually new approach.

Plasma displays take advantage of a Xenon discharge (Xe) that emits vacuum

ultraviolet (VUV) photons in the 147-170 nm range to produce visible light. These have secured a sizable share of the commercial display market. To make these possible, new phosphors are required to optimize the efficiency of the display using VUV excitation. The larger energy of the VUV photons inherently limits the energy efficiency of a phosphor if only one visible photon is generated per VUV photon produced in the discharge. Here is the comparison between Hg and Xe discharge - Hg 254 nm (50% energy loss, 4.9 eV) and Xe 172 nm (70% energy loss, 7.2 eV).

Therefore, new phosphors with quantum efficiencies greater than 1 are required for this purpose. To make the Xe discharge-based fluorescent lamps more energy efficient than the currently used Hg-based tubes, quantum efficiencies above 150% must be achieved. A quantum-splitting phosphor would therefore serve this need. The discovery of such phosphors for VUV excitation would be advantageous, as it would lead toward the realization of highly efficient and environmentally benign lighting technology. Lamps having improved efficiency would decrease the energy consumption for lighting, a major part of the world energy budget, thereby reducing the costs of lighting and the consumption of fossil fuels that contribute to environmental problems. In addition, the replacement of Hg in a standard fluorescent lamp by a rare-gas (VUV) excitation source would eliminate environmental concerns regarding the disposal of Hg-based lamps[1].

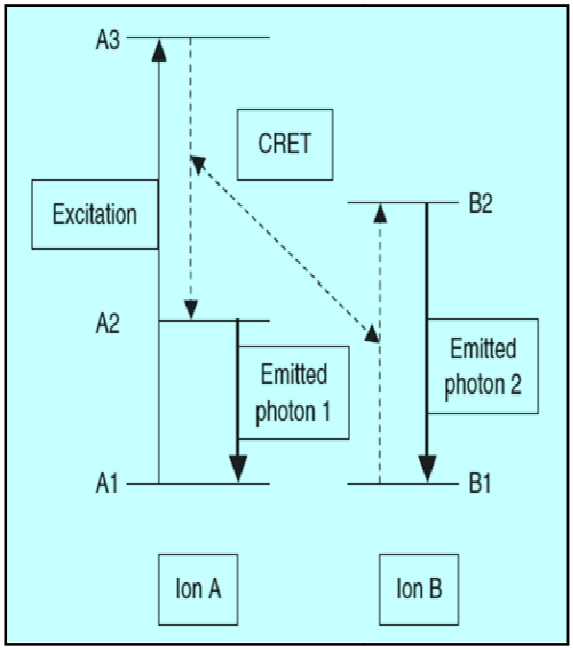
Ideas to overcome the drawbacks

To obtain higher energy efficiency than a mercury-based discharge lamp, a xenon-based fluorescent tube needs phosphors with visible quantum efficiency higher than 100%. This is possible with a so-called quantum cutting (QC) phosphor which upon VUV excitation emits two (visible) photons, for each VUV photon absorbed. Quantum cutting provides a means to obtain two or more photons for each photon absorbed. It, therefore, serves as a down-converting (DC) mechanism with quantum efficiency greater than unity and it offers the prospect of providing improved energy efficiency in lighting devices[4]. To obtain quantum-cutting phosphors with quantum efficiencies exceeding unity, the lanthanide ions are obvious candidates for this purpose due to their energy level structures that provide metastable levels from which quantum-cutting processes are possible. The VUV levels of many of the lanthanides have been recently measured, thereby providing the starting point from which new phosphors may be designed[1].

Mechanism of quantum cutting - Quantum cutting provides a means to obtain two or more photons for each photon absorbed. It, therefore, serves as a down-converting mechanism with quantum efficiency greater than unity and it offers the prospect of providing improved energy efficiency in lighting devices. There are two methods to obtaining quantum cutting, the first is photon cascade emission (PCE) and the second is cross-relaxation energy transfer (CRET). Among which prominent and usual method is CRET.

Cross-relaxation energy transfer (CRET) - An alternative scheme to develop an efficient quantum-cutting phosphor is to utilize a pair of ions that can share the initial excitation energy. The CRET process is illustrated in figure shown below, in which the initially excited ion (state A3) undergoes a nonradiative transition (A3→A2) to an intermediate excited state (A2) accompanied by an energy-conserving transition of a neighboring ion from its ground state (B1) to some excited state (B2). This would leave both ions in excited states, each of which could emit a visible photon. While this idea has been known for a long time and serves as one of the

main mechanisms for concentration quenching, it has been demonstrated by Meijerink's group as an efficient means of quantum splitting. They showed that for the Gd^{3+}-Eu^{3+} pair of ions, the internal quantum efficiency of 190% was possible, opening the way to serious consideration of this approach.



After ion A is initially excited, it undergoes a CRET with ion B such that ion A makes a transition A3→A2 while ion B makes a resonant transition B1→B2 (shown by the dashed lines). Both ions emit photons from their respective excited states A2 and B2. The mechanism for the CRET within the Gd-Eu pair has not been ascertained but exchange interactions likely dominate since Gd^{3+} is stoichiometric in the host; as a result, every Eu^{3+} ion is the nearest neighbor to Gd^{3+} with which it can undergo CRET. Rapid resonant energy migration among the Gd^{3+} ions ensures that the excitation will find a site adjacent to a Eu^{3+} ion[3,4].

Quantum splitting of the Gd^{3+}-Eu^{3+} couple has now been demonstrated in a large number of fluorides. The list, along with their estimated internal quantum efficiencies, includes GdF_3:Eu^{3+}(180%), BaF_2:1%Gd,1%Eu(194%), $NaGdF_4$:Eu^{3+}(160%), KGd_2F_7 and KGd_3F_{10}:Eu^{3+}(165%), $RbGd_3F_{10}$:Eu^{3+}(150%), $KGdF_4$:Eu^{3+}(175%) and $CsGd_2F_7$:Eu^{3+}(150%).The high efficiency of BaF_2:1%Gd,1%Eu is surprising, but it is well known that in BaF_2 the Ln^{3+} ions form clusters which may provide the required proximity for Gd^{3+} and Eu^{3+} ions[1].

Scope and limitations

In recent years there has been a growing interest in the development of efficient phosphors under vacuum ultraviolet (VUV) excitation. This is due to the industrial demand for the development of mercury-free fluorescent lamps and plasma display panels that use the VUV radiation from a noble gas discharge as the excitation source[5].

Recently, large-area PDPs have proven to be commercially successful as HDTVs. They operate based on a Xe discharge, which produces the VUV light for excitation of the red, green, and blue-emitting phosphors. Similar technology using a Xe discharge is envisioned for producing a fluorescent lamp that is free of Hg. To fulfill the requirements of quantum cutting, the host materials must possess a band gap larger than 3.0 eV and the excitation energy must be higher than 6 eV. The visible quantum cutting via down-conversion can be achieved for VUV radiation as an excitation source.

Implications

The QC phosphors via down-conversion have remarkable applications for developing high quantum-yield phosphors in mercury-free lamps and plasma display panels. If cost-effective techniques are developed and additionally the improvement in quantum efficiency is achieved then it will very much helpful to overcome energy consumed for lighting i.e. loss problem due to lighting.

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Cotton Pollen Grain Morphology

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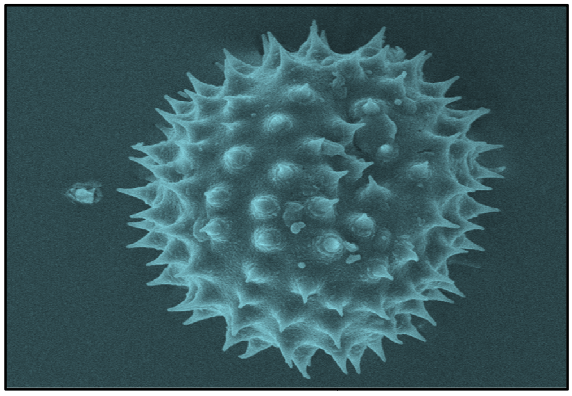
Pollen grains are reckoned to be a very conservative organ which facilitates the identification of plants at various taxonomic levels. Morphological characters of pollen grains or spores are embodies in the exine and are important criteria in consideration of inter-relationships of plants at various taxonomic levels. Pollen morphological entities for palynological investigations are polarity, symmetry, size and shape, exine stratification and exine ornamentation. Electron microscopic studies TEM and SEM have helped in tracing the pattern of development of pollen wall and in getting a correct picture of the nature and number of stratified layers and its fine structure.

Morphologically, pollen grains are reckoned to be a very conservative organ, facilitating the identification of plants at various taxonomic levels. The applications of pollen morphology are various, such as for the identification of plants, pollen spectrum found in atmosphere, honey or fissile bearing deposits. The ancient Assyrians have realized the functional importance of pollen grains as early as 717 BC. The potentialities of pollen and spore as a morphological entity in plants have gained more importance after the work of Hyde and Williams (1945), Erdtman (1955) and Nair (1960).

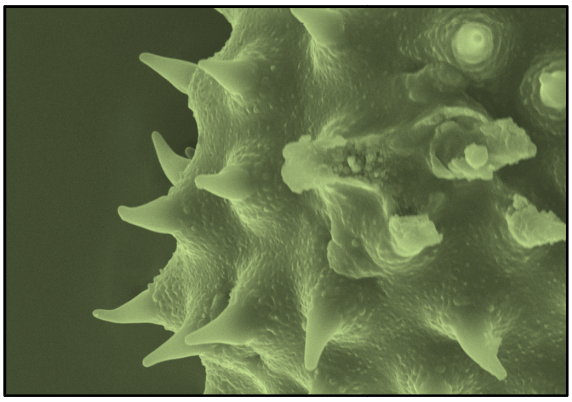
The morphological characters of pollen grains or spores are embodies in the exine and are important criteria in consideration of the taxonomy and inter-relationships of plants at various taxonomic levels. Moreover, knowledge of the exine morphology of various sporomorphs is of primary importance. Pollen grains and spores are reproductive propagules of diagnostic value of virtue of the characters embodies in the exine; Erdtman (1952). The pollen grain can also be useful tool in evolutionary consideration has been demonstrated by Wodehouse (1935). Erdtman (1952) provided a picture of differences of opinion in the field of terminology to be followed during pollen characterization. Pollen morphological entities for palynological investigations are polarity, symmetry, size and shape, exine stratification and exine ornamentation. Very recently Hesse *et al.* (2008) published a fully illustrated compendium of glossary terms and basic principles in palynology, which would found to be an indispensable tool for all palynologists.



The origin and development of pollen wall, together with the source and nature of the sporopollenin are of considerable attention and debate. Such developmental studies of the angiosperm pollen wall are of interest because they represents a complex of surface patterning even that is mainly controlled by the sporophyte rather than by the gametophyte; Heslop-Harrison (1971).

With the revolutionary development in optical technology leading to the introduction of electron microscopy, use of pollen and spores at micro-morphological levels have relevance in biodiversity studies at genetic levels; Ravikumar and Nair (1986). The electron microscopic studies TEM and SEM have helped a great deal in

tracing the pattern of development of pollen wall and also in getting a correct picture of the nature and number of stratified layers and its fine structure. The electron microphotographs of the surface replica of sexine provided the extra picture of ornamentation pattern.



Pollen grain, the male gametophyte of flowering plants, has two main concentric layers in the wall; the outer exine and inner intine. The morphological characteristics of the pollen grain are manifested in the exine. The stratification of exine along with number, position and character of aperture has been a subject of controversy. Pollen characters have been categorized into different groups namely, pollen unit, polarity, symmetry, shape, size, aperture and sporoderm (exine) stratification.

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Interesting Discoveries in Chemistry

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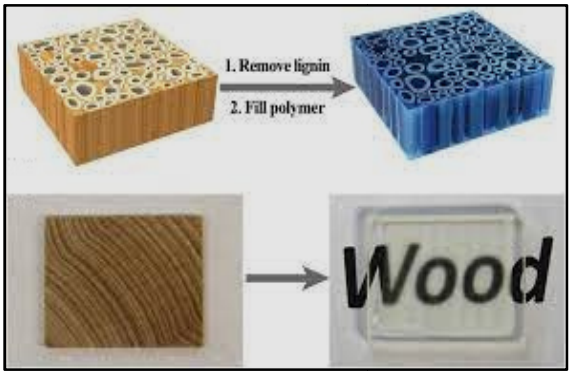
The interesting and exceptional discoveries in chemistry which will have an impact on our future and further development of science and technology summarized herein are making of transparent wood, synthesizing eco-ink for digital printing on porcelain, preparing magnetic polymers, transforming plastic into vanilla flavouring and developing the novel graphene based lubricant. Transparent wood may become a real revolution for the construction industry. The eco-ink is totally aqueous in nature which helps in reducing the toxicity as well as carbon footprint of the product. Magnetic polymers have enormous potential and the possibility of using them in many fields i.e. from diagnostic tools to touch screens and many more. Discovery of vanilla flavouring based on plastic is important, not only because of its increasing demand but more importantly for the sake of environmental benefits. Graphene based lubricant has the potential to become an alternative to traditionally used oil. It makes oil less toxic and easier to dispose off or recycle.

In chemistry, so many interesting and exceptional discoveries were made which will have an impact on our future and further development of science and technology. Some of these discoveries are summarized here.

Transparent wood

To make wood transparent, a new technique is discovered by the researchers of University of Maryland. Previously, so many attempts have been made to make the wood transparent by removing lignin using certain chemicals, succeeded too, but results in weakening of the wood.



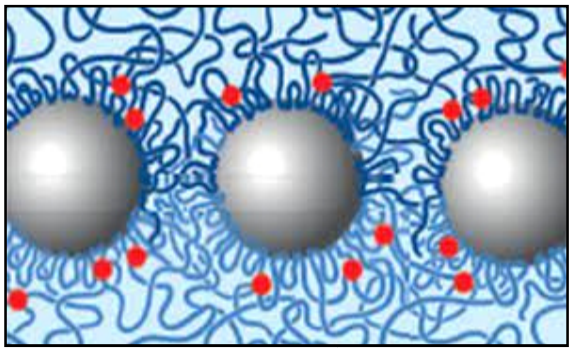
The method proposed by the researchers of University of Maryland involves an alteration of the lignin. The process starts with the removal of molecules responsible for giving colour to the wood. A specially prepared hydrogen peroxide agent is applied on surface of the wood and exposed to ultraviolet radiations. Then after, the wood becomes white in colour. It is cleaned thoroughly by soaking in ethanol and make the wood smooth and almost perfectly transparent by filling the pores with colourless epoxy. Overall process makes the wood 50 times stronger than other conventionally rendered transparent material and being able to transmit about 90% of light. It is stronger than the glass, light in weight and provides very good insulation. In future, the transparent wood may become a real revolution for the construction industry. It may completely change the image of buildings. The technologically advanced, transparent wood will provide an alternative to various types of displays. Even in harsh environmental conditions, where glass is often fails, these transparent wooden displays will prove themselves to be most durable and efficient one.

Eco-ink for digital printing on porcelain

So as to do the digital colouring of ceramic tiles and to obtain various colours along with different textures on porcelain like the fabrics or wood, the Italian company METCO has developed a special, sustainable ink called eco-ink. This ink is totally aqueous in nature without any type of organic solvents which helps in reducing the toxicity as well as carbon footprint of the product. Also, this ink can penetrate the surface of ceramic tile so there is no need of an additional protective layer. After applying the eco-ink, surface of the tiles becomes more durable. For the chemical and ceramic industries, this ink may be a true revolution in near future.

Magnetic polymers

Magnets are mostly found in the form of inflexible and hard metals. So there are many limitations for the use of magnets. That's why scientists have undertaken the project to create magnetic materials with mouldable behaviour. Under this, researchers have synthesized a powder having shredded magnetic materials and that was mixed with different types of polymers. To prepare a magnet from these components, advanced 3D printing was used which made it possible to give them much more complex shapes. The first prototypes produced showed the enormous potential of such materials and the possibility of using them in many fields i.e. from diagnostic tools to touch screens and many more like drugs, medicines, cosmetics etc. Synthesis of magnetic polymers will prove to be an important milestone in the development of science and technology.



Vanilla flavouring based on plastic

One of the biggest challenges of the present time is the problem of disposal of objects that made from plastic. The most interesting solution to this problem is given by the scientists of University of Edinburgh by transforming the plastic into vanilla flavouring. It involves the mutation of enzymes that are responsible for the decomposition of polymer i.e. polyethylene terephthalate from which the bottles are made. During decomposition terephthalic acid is produced, which is converted into vanillin. The taste and smell of this compound is almost like the vanilla. It is often used in the industries like food, pharmaceutical, cosmetics etc.

Currently, about 85% of vanillin is synthesised from chemicals that are derived from fossil fuels. Day by day, throughout the world there is an increasing demand vanillin. So, discovery of vanilla flavouring based on plastic is important, not only because of the increase in demand but more importantly for the sake of environmental benefits.

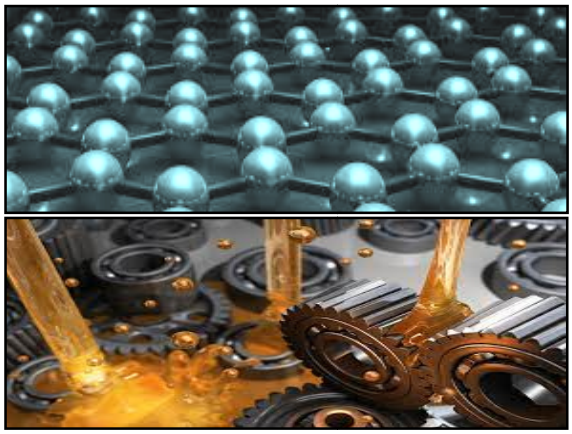
Eco-friendly plastic from salmon seed

Despite of number of advantages of plastic, it is also one of the main problems that are threatening our planet. That is why research for finding the greener alternatives is going on everywhere. Chinese scientists have developed a unique plastic like material having salmon seed as one of the main components. It was prepared by combining two strands of salmon DNA with a chemical derived from vegetable oil, so as to form a spongy gel like substance i.e. hydrogel which is freeze-dried, moisture is removed and moulded into various shapes.

Formation of this bio-plastic can emit upto 97% less carbondioxide than the preparation of traditional polystyrene plastic, also it is recyclable using DNA digesting enzymes. It can also be immersed in water so that it becomes a hydrogel again. For the future of plastic industry, such bio-plastic is an opportunity to decrease the pollution on our planet.

Graphene based lubricant

Novel graphene based lubricant which can be utilized in vehicles have been developed by Italian scientists. Addition of graphene increases the stability of oil, which in turn helps in reduction of friction between various parts of engine. Graphene has the potential to become an alternative to the oil which is used traditionally. It makes oil less toxic and easier to dispose off or recycle.



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Mobile Radiation and Human Health

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Mobile or cellular phones are now an integral part of the modern telecommunications. In today's digital world with the introduction of the 5G network, mobile radiation has become a common topic of discussion. We carry cell phones with us and are constantly exposed to electromagnetic radiation (EM). The research done in the field has confirmed that electromagnetic radiation is the main reason behind most modern-day lifestyle diseases like short-term memory loss, loss of concentration, stress, fatigue, sleep deprivation and compromised immunity.

Mobile radiation has become a common topic of discussion in today's digital world with the introduction of the 5G network. The more we use mobile phones, the more we are exposed to the harmful wifi radiation from all kinds of wireless devices including mobile phones, laptops, routers, smart TV etc.

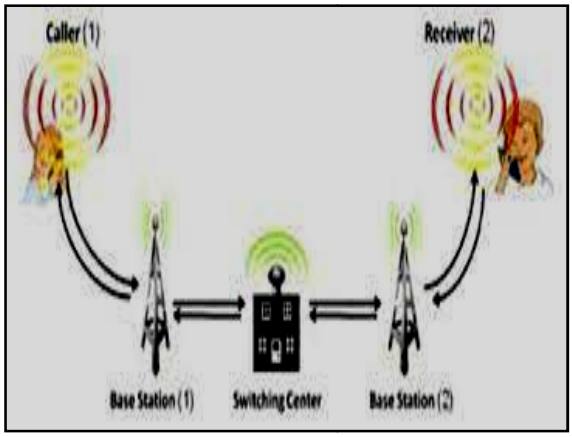
There are over 300,00,00,000 (three hundred crores) people in this world who use smart phones and in the next few years, the number is bound to grow by several hundred lacs. By 2021, it is expected that the number of Smartphone users will exceed the 380 crores mark. If we take India's case, Smartphone users will reach over 76 crores in the year 2021 according to the results of a survey published on Statista.

How the mobile phone system works?

The mobile phone system works like a two-way radio, and includes the individual handset and the base stations. Base station antennae are mounted high off the ground (on a tower or roof) to get the widest coverage. A mobile phone has a radio receiver and a transmitter. When you make a call, your phone uses radio frequency (RF) radiation via its antenna to 'talk' to a nearby base station. Once the base station has received your signal, your call is directed through the landline phone system. Mobile phone base stations emit relatively constant levels of RF radiation. The handsets emit levels of RF radiation that vary depending on three things -

- How long you use phone?
- How close you hold phone to your body?
- How close you are to the base station?

If the link to the base station is weak, the handset increases its radiation level to compensate.

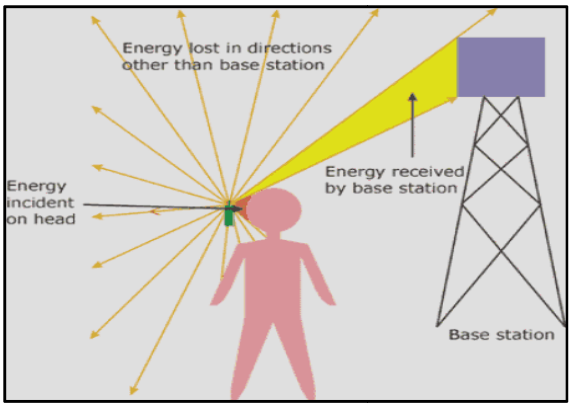


Mobile or cellular phones are now an integral part of the modern telecommunications. In many countries, over half the population use mobile phones and the market is growing rapidly. Cell phones emit low levels of non-ionizing radiation when in use. The type of radiation emitted by cell phones is also referred to as radio frequency (RF) energy. Mobile phones are low-powered radiofrequency transmitters, operating at frequencies between 450 and 2700 MHz with peak powers in the range of 0.1 to 2 watts. The handset only transmits power when it is turned on. The power falls off rapidly with increasing distance from the

handset. A person using a mobile phone 30-40 cm away from their body - for example when text messaging, accessing internet or using a “hands free” device - will therefore have a much lower exposure to radiofrequency fields than someone holding the handset against their head.

In addition to using "hands-free" devices, which keep mobile phones away from the head and body during phone calls, exposure is also reduced by limiting the number and length of calls. Using the phone in areas of good reception also decreases exposure as it allows the phone to transmit at reduced power. The use of commercial devices for reducing radio-frequency field exposure has not been shown to be effective.

There have been many studies throughout the world on RF (radio frequency) radiation and its effects on the body. There is a big difference between a biological effect - an effect on the body - and a health effect. For example, RF radiation from a mobile phone has the biological effect of raising the temperature in a localised area of the brain by a fraction of a degree. This biological effect doesn’t automatically carry any health risks. The human body is equipped to deal with very wide variations in temperature without experiencing harm. Radiation is a combination of electrical and magnetic energy that travels through space at the speed of light. It is also referred to as electromagnetic radiation (EMR).

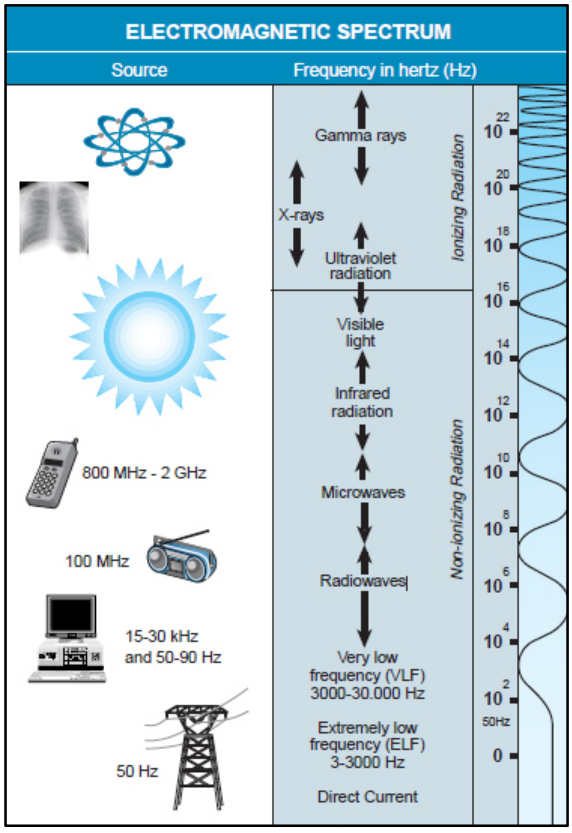


There are mainly two types of radiations -

Ionising radiation (IR) - It is capable of causing changes in atoms or molecules in the body that can result in tissue damage such as cancer. Examples of IR include x-rays and gamma rays

Non-ionising radiation (NIR) – It doesn’t cause these changes, but can prompt molecules to vibrate. This can lead to rises in temperature, as well as other effects. Examples of NIR include ultraviolet radiation in sunlight, visible light, light bulbs, infrared radiation, microwave energy and radiofrequency energy.

Mobile phones work on the connectivity through wireless satellite signals like wifi as well as Bluetooth technology. Smartphone’s have all these connectivity features by default and that’s why all cell phones emit electromagnetic waves, low-frequency non-ionizing radiation.



The electromagnetic frequency or radiation from a device is used for connectivity with other devices in order to make calls and access the internet. We

carry cell phones with us and are constantly exposed to electromagnetic radiation. The answer to why is mobile phone radiation harmful lies in the fact that the radiation from wireless gadgets is of a different nature as compared to the natural frequency of the human body. The waveform from wireless devices is constant in nature while the waveform from the human body is random in nature.

It is not the amount of radiation from a device that harms us, it is the nature of radiation that is dangerous as it is not compatible to the human body. The research done in the field has confirmed that electromagnetic radiation is the main reason behind most modern-day lifestyle diseases like short-term memory loss, loss of concentration, stress, fatigue, sleep deprivation and compromised immunity.

How mobile radiations are harmful to us?

Apart from all the researches and clinical tests that have confirmed the impact of EM radiation on human health, some of the common side effects of radiation exposure are mentioned below.

Higher stress and fatigue - Adults are experiencing higher stress nowadays and this can also lead to increase cholesterol, blood sugar, risk of cardiovascular.

Poor sleep quality - Anxiety disorder is commonly found in people having poor sleep quality and in the long run, this can trigger mania and bipolar depression.

Headache - Constant headache leads to migraines, irritation, lower productivity, and creativity at the workplace**.**

Weakened immunity - Being constantly surrounded by radiations weekends our immune system and due to which we are prone to always catch a cold, our tummy is often upset, wounds are slow to heal and feel tired all the time.

Fertility issues - High radiation can destroy some or all of the eggs in the woman's ovaries and can result in infertility or early menopause.

Short-term memory loss - In a tech-enabled lifestyle, we are surrounded by many radiation sources and mobile phone radiation occupies a great share of it which affects our memory and causes confusion or decreased alertness.

The above-mentioned are some of the health problems that resulted from excessive use of mobile phones. Many of us have been experiencing one or more such issues due to exposure to cell phone radiation.

As in the past few months of the Covid-19 pandemic, this year, we have seen kids using mobile phones for online classes due to the closing of schools in lockdown and the likewise reports of issues caused to children's health since the screen time has greatly increased. Kids taking school classes online have been complaining about constant headaches, irritation, fatigue and stress.

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Utilization of Sericulture Waste for Improvement of Socio-Economic Welfare in India

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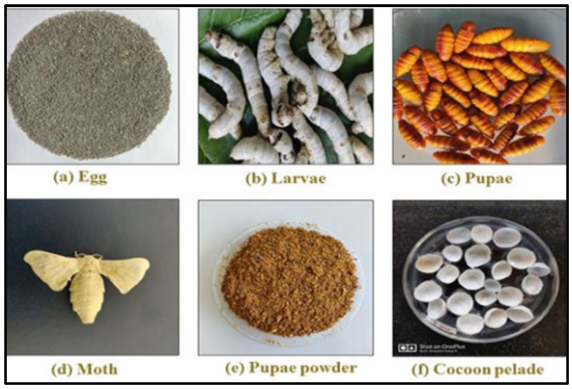
Sericulture is an agro-based industry in a developing country like India. By-products and sericulture waste products are used in pharmaceutical, cosmetic, paper, agriculture and food industries. In addition to the production of silk, industry can produce a number of by-products from mulberry and silkworm. The major waste generated during silkworm rearing includes excess of harvested leaves, unfed leaves, larval litter and exuvia of the moulted larvae. Silkworm larval litter can be utilized as an excellent organic fertilizer. Leftover leaf from silkworm litter is separated and used as animal feed for cows, sheep, pigs, buffaloes and poultry. Silkworm litter forms an ideal raw material for use in biogas plants along with cow dung in the production of biogas. Secondary chemicals contained in the mulberry leaf in litter can be extracted and used in the pharmaceutical industry. Silk products are used in cosmetics, producing nutritive material for skin and hair care products.

Sericulture is an agro-based industry in a developing country like India, where there are lot of resources and labour. The industry is advantageous for the benefit of poor people in providing opportunities for the improvement of the rural livelihood. Sericulture involves large scale of interdependent technologies from which useful by-products will be evolved. The by-products and sericulture waste products are used in pharmaceutical, cosmetic, paper, agriculture and food industries. In addition to the production of silk, industry can produce a number of by-products from mulberry and silkworm. You all know that, like all other agro-based industries, silk industry also generates a lot of waste. Waste originates at different stages of silk production in varying degrees, but, the overall waste-output ratio appears to be somewhat high here. If the waste obtained is re-cycled back, it adds to the sericulture economy.

What is a by-product?

Generally, any waste is a by-product. But, in mulberry cultivation or silkworm rearing or reeling, a number of by-products reduce the net cost of production and enhance the economic gains to producers. It also gives birth to a variety of enchanting products to the consumers. As all these wastes have a market and can be put to use, they are called by-products.



By-products of silkworm rearing

Sufficient waste is generated during silkworm rearing which has got an immense scope for direct or indirect use in agriculture (Seri-business manual - A users' guide, farm sector, 2003). The major waste generated during rearing includes excess of harvested leaves (accounting for 10-20%), unfed leaves (20-30%), larval litter (60% of ingested food) and exuvia of the moulted larvae. Apart from these, weak, diseased or unhealthy worms, rejected worms and dead larvae also constitute wastes.

Entrepreneurial opportunities in sericulture

Litter as compost

Silkworm larval litter (excreta of larvae and leftover mulberry leaves) can be utilized as an excellent organic fertilizer.

The litter contains nitrogen, phosphoric acid and potash. As direct application of fresh litter to the field is less effective and often causes spread of silkworm diseases, it is recommended to use it as compost. In case, the leftover leaf is used as feed for animals, farm yard manure can be obtained and this retains the original amount of nutrients and can be used as good manure. So, the use of litter through feeding of animals is more economical than direct application as manure. The manurial value of bio-digested cow dung plus litter slurry is higher when compared to cow dung compost. The details are presented in following table.

Type of Manure	N (%)	P (%)	K (%)
Cow dung	1.65	0.70	0.67
Silkworm larval litter	2.67	0.92	1.36
Cow dung + Silkworm larval litter	2.01	0.93	1.04
Silkworm larval litter + Old slurry	2.56	0.95	1.07
Cow dung + Silkworm larval litter + Old slurry	2.18	0.97	1.12

Kalimuthu and Rajasekaran (1992) studied the possible utility of silkworm litter as an alternative and also supplemented with cow dung and old slurry for biogas production. When silkworm litter is used for bio-gas production, the fermentation proceeds rather rapidly (Shivappa Shetty et al., 1978) and also maximum quantity of gas produced when silkworm litter was mixed with other organic wastes (Rajasekaran and Oblisami, 1981).

Silkworm litter as animal feed

Leftover leaf from silkworm litter is separated and used as animal feed for cows, sheep, pigs, buffaloes and poultry. It is particularly effective for rearing sheep. Also, the dung collected by rearing sheep on silkworm litter has a high value as agricultural manures (Zhang et al., 2014). Chicks fed on them lay more and larger eggs because of the higher protein content. Some of the studies have revealed that the growth hormone can be extracted from the silkworm litter. It can also be used in making of plastic materials, paints and pencil covers, as well as activated carbon of excellent quality. Recently, it has been found that chlorophyll can be extracted from the silkworm litter by using a suitable solvent and this is used in medicines and cosmetics.

Silkworm litter as feed for biogas plant

Silkworm litter forms an ideal raw material for use in biogas plants along with cow dung in the production of biogas. This also helps in the destruction of microorganisms present in the litter which are pathogenic to both mulberry and silkworms. Leaf and litter can be separated with a sieve like device called a leaf-litter separator. Silkworm litter as cattle feed and excreta for bio-gas production and also used as organic manure. Pupae for extraction of oil, amino acids and vitamins, as a poultry and fish feed and used as manure. The silk worm moths are used in the preparation of poultry feed and to prepare medicine for sterility.

Silkworm litter usage in pharmaceutical industry

Secondary chemicals contained in the mulberry leaf in litter can be extracted and used in the pharmaceutical industry. The following are some of the chemicals extractable from litter.

Chlorophyll and related compounds - It is estimated that 20 tones of silkworm excrement can produce one tone of chlorophyll or 30 kg of sodium, iron chlorophyll in and that too, with less expenditure than the conventional process of manufacturing from dried alfalfa leaves. Chlorophyll containing products are used in

medicine and cosmetics in China and Japan. The chlorophyll is used as a colouring matter in soaps, food waxes and toothpastes. It is also used as a deodorant, healing agent and a medicine to check bleeding of teeth and gums (Nazimet et al., 2017). Other useful leaf compounds that can be extracted from the silkworm litter are carotene and phytol, which have useful applications in pharmaceutical industry. The Zhejiang Academy of Traditional Chinese Medicine claims to have developed Gan xue bao, a medicine for hepatitis and leukemia made from chlorophyll extracted from silkworm excrement. Also, the medicine developed from silkworm excrement has an efficacy rate of 95.6% for cancer patients suffering from loss of white blood cells caused by chemotherapy and radiotherapy.

Carbohydrate compounds - The Chinese have also developed techniques for reducing fructose, pectin and polymers from silkworm litter. Sri Ram Institute of India has evolved methods for isolating chitin and chitosan from silkworm exuvia, useful for the dissolution of poorly soluble drugs. Triacontanol, a plant growth promoter produced by the insects as an exocrine compound is found in the litter. Triacontanol is used as a growth promoter for mulberry field.

Dead larvae as suturing material

The silk glands from matured larvae are drawn out into a fine filament called silk gut, used as absorbable suturing materials in surgery. It is possible to use dead larvae as the source of surgical guts. This could be done by treating silk glands with acetic acid and then drawing them into a fine filament. But, to date, no record of any country producing suturing guts from dead silkworms of the rearing bed.

Silkworm faeces

Paste chlorophyll, pectin, phytol, carotene and triacontanol, solanesol etc., extracted from silkworm faeces are used in the treatment of various diseases such as hepatitis, acute pancreatitis, chronic nephritis, stomach and gastric disorders, leukocytopenia, blood cholesterol etc. Phytol is used in the preparation of vitamin E and K and carotene in vitamin A. Faeces are taken as a medication or a nutritional supplement by diabetic patients.

Silkworms in cosmetics

Silk proteins and amino acids provide intense moisture to the skin. Silk products are used in cosmetics such as a skin care product using ‘sericin’ and bath gel. Silk amino acids are used to prevent dehydration and are mostly found in eye rejuvenation gels and creams. They are also used for producing nutritive material for skin and hair care products.

Conclusion

Sericulture industry is having the tremendous uses of various products and by products in preparation of compost, human medicinal use, handicrafts and in cosmetics. Silk industry, as an agro-based, provides considerable opportunities to improve rural livelihoods. The silkworm B. mori is a potential economic insect whose impact needs proper attention and exploitation for the betterment of mankind. Proper utilization of sericulture and silk waste adds a value of up to 40% to the silk industry. Sericulture waste upon enrichment can be converted to high value manures and can effectively be used as useful organic manure in an integrated system for sustaining soil organic status. Silk proteins perform a lot of biological activities, such as antioxidation and pharmacological functions like anti-cancer, anti-inflammatory and antimicrobial activities. The functional aspects of sericulture will be further developed and finally reborn into a real biotechnology based sericulture in the future which is bound to add value to industry as a whole. Further investigations are needed to explore the bioactive properties and to

improve the need of silk products for socio-economic welfare.

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The Internet of Things ... IoT

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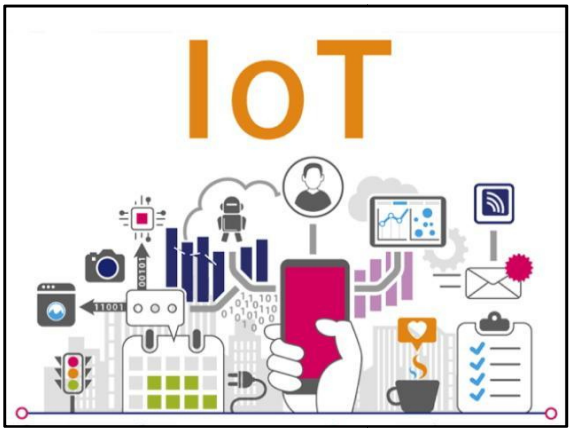
Internet of things (IoT) is the continuing development of the internet that allows everyday objects embedded with electronic devices to send and receive data over internet. These everyday objects include smart phones, watches, wearable devices, air conditioner etc. IoT is evolving and is being experimented with and used in tons of different ways than you can ever imagine. Future of IoT has the potential to be limitless. The potential is not just in enabling billions of devices simultaneously but leveraging the huge volumes of actionable data which can automate diverse business processes.

Internet of things (IoT) is the continuing development of the internet that allows everyday objects embedded with electronic devices to send and receive data over internet. These everyday objects include smart phones, watches, wearable devices, air conditioner etc. IoT promises many exciting innovations. There are maximum chances that, you are already surrounded by the first wave of IoT technology. Your smartphone can monitor and share your location, your smartwatch counts and share how many steps you took today and your web connected car can track and share your driving habits. Recent innovations are just tip of the iceberg as we grapple with a new world where everything has a sensor and every action is recorded. Where will these monitoring tools show up next? What information will they record? How will that information be used?



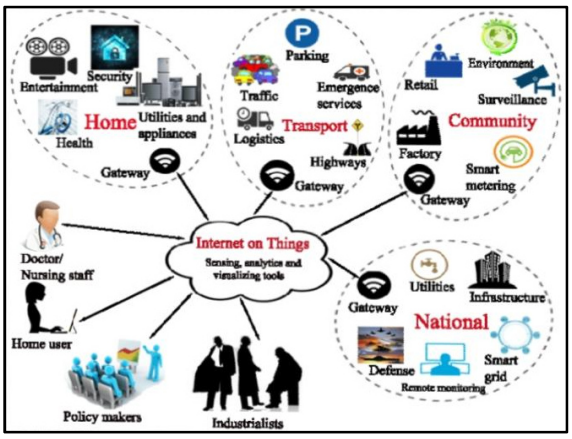
In future, most of the items will likely include a chip that uniquely identifies that item and shares that data to applications running on the internet. Want to know if the Hidesign bag is real or a copy? Using the embedded in the bag and connecting through Hidesign's phone app, you will be able to verify that you are buying the genuine article. Where you just about to throw that delicate cashmere sweater into the washing machine on the hot cycle, not to worry, your smart washer or dryer will be able to read the sweater's chip and inform you that you could accidentally shrink your favourite sweater.

Your clothes aren't the only items that will be marked with a chip. The food you purchased will also be uniquely identified. Your refrigerator will be able to read those chips to tell what food you are eating, how frequently, which food are in danger of spoiling and which foods need to be replenished.

IoT will extend beyond the home. As you drive to the grocery store to pick up the milk your refrigerator ordered, cameras on billboards along the road identify the make and model of your interests.

Applications of IoT

- ✓ Smart homes
- ✓ Smart city
- ✓ Self-driven cars
- ✓ IoT retail shops
- ✓ Farming
- ✓ Wearables
- ✓ Smart grids
- ✓ Industrial internet
- ✓ Telehealth
- ✓ Smart supply-chain management



Scope of IoT

IoT is evolving and is being experimented with and used in tons of different ways than you can ever imagine. Some IoT examples can be smart breweries, smart coffee machines, smart parking facilities, smart supply-chain mechanisms etc.

Future of IoT

Future of IoT has the potential to be limitless. Advances to the industrial internet will be accelerated through increased network agility, integrated artificial intelligence (AI) and the capacity to deploy, automate, orchestrate and secure diverse use cases at hyperscale. The potential is not just in enabling billions of devices simultaneously but leveraging the huge volumes of actionable data which can automate diverse business processes. As networks and IoT platforms evolve to overcome these challenges, through increased capacity and AI, service providers will edge furthermore into IT and web scale markets - opening entire new streams of revenue.

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Nuclear Power - The Key to Least-Cost Zero Carbon Emissions

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To achieve zero carbon emissions, nuclear power generation has an important role in countries having low wind resources and thus it will help the world to a large extent in near future. Renewable energy sources i.e. wind and solar are considerably significant to reduce the carbon emissions but availability of wind and sun has a natural variation across geographic regions for day to day, which creates complications for the reduction of total carbon emissions. For most of the nations, under strict greenhouse gas emission controls, reliable nuclear power generation has a large potential value in the electricity grid and it can be the key to least-cost zero carbon emissions.

There is too much carbon pollution into the atmosphere because of several human activities which is affecting the carbon cycle globally, causing warming and changing the patterns of precipitation.

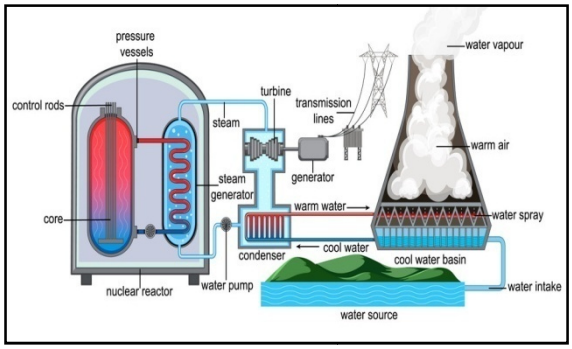
Several environmental studies on climate change have suggested that, to minimize the catastrophic climate impacts, it is much essential that humanity work to keep global mean temperature increase under 1.5^0C relative to pre-industrial levels. For this it is too much important and necessary that carbon emissions from across the energy system would have to reach zero as early as possible.

We all know that, renewable energy sources i.e. wind and solar are considerably significant to reduce the carbon emissions, but availability of wind and sun has a natural variation across geographic regions for day to day which creates complications for the reduction of total carbon emissions.

Power generation from natural gas can fulfil the gaps in the energy provided by wind and solar. But in a zero emission electricity system, it is required to provide electricity when there is no shining of the sun and also the blowing of wind.

It was observed that, by ramping up the wind and solar power harvesting installations, 80% of carbon emissions can be controlled. However, in order to 100% reduction in carbon emissions, it requires remarkable infrastructure changes in energy storage, transmission capabilities and energy generating infrastructure.

Recently, to examine the utility of nuclear power as an alternative to serve the need of providing low cost energy and replacing the natural gas as a backup energy, investigation of the wind and solar resources of various countries was done. During this investigation, it was suggested that, in countries like United States which is having the good geographic conditions and better climate for generation of large wind power, deployment of nuclear power is not needed but in countries like Brazil where lesser wind resources are available, nuclear power can be utilized strategically.



For most of the nations, under strict greenhouse gas emission controls, reliable nuclear power generation has a large potential value in the electricity grid. Places with poor wind sources can benefit from nuclear earlier in the path to zero emissions, whereas places with very good wind resources would only need to get rid of the last traces of carbon emissions.

In near future, nearly everywhere, nuclear power generation can be the key to least-cost zero carbon emissions.

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Black Wheat - A Better Food Supplement

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Black wheat is one of the coloured wheat which is gaining importance among the health conscious people because of its varied health benefits and biological properties. Morphologically it is similar to that white wheat in all aspects except its grain colour and nutritional composition. Black wheat is gluten free cereal which is rich in vitamin B, protein, dietary fibre and other nutrients like phosphorous, potassium, calcium, magnesium, manganese, selenium and copper. The polysaccharide and protein content of black wheat seeds are higher than that found in common wheat. It has been estimated that on an average, 100 g of black wheat provide 71 g carbohydrates, 13 g protein, 10 g fibre and 3.4 g fat. Black wheat has emerged as a better food supplement. It has an ability to combat and address global and national challenge of the malnutrition.

The coloured wheat has gained attention among the farmers in recent years. One of that is black wheat which is gaining importance among the health conscious people because of its varied health benefits and biological properties. Morphologically black wheat is similar to that white wheat in all aspects except the grain colour and nutritional composition. Black wheat is rich in anthocyanin that imparts colour to grains, protein dietary fibre, iron and zinc contents.

From centuries, wheat is one of the oldest cereals cultivated and consumed in the world. Superseded by rice, wheat ranks second in area and production. It is the second most stable crop covering an area of 29.8 mha in India. Zinc and iron are most deficient micronutrients in India. Zinc fortified coloured wheat has good prospect to fight against one of the major challenging issue i.e. malnutrition which is the major problem in all age group of people especially among children. It occurs because of inadequate intake of proteins, vitamins, energy and micro-nutrients which impairs the quality of life resulting from poor health.

Improvement in the nutritional value of common wheat grain, amber in colour can address the major challenge i.e. malnutrition. Normal common wheat with the supplemental anthocyanin, a phenolic compound content results in coloured purple, blue and black wheat which has been developed by National Agri-food Biotechnology Institute (NABI), Mohali, Punjab after seven years of research. It has got permission for human consumption by Food Safety and Standards Authority of India (FSSAI).

Bio-fortified black wheat has immense biological values and can become health improving food supplement. To some extent, it can help in eradication of a major, universal problem of malnutrition. The black wheat variety 'Nabi-MG' is rich in zinc and iron content compared to normal wheat, thus indicating double bio-fortified lines which are expected to have significant effect on human health. It is gluten free cereal, rich in vitamin B, protein, dietary fibre and other nutrients like phosphorous, potassium, calcium, selenium, magnesium,

manganese and copper. Polysaccharide and protein content of black wheat seeds are higher than that found in the normal common wheat.

Black wheat has highest anthocyanin content among all coloured wheat. It has around 60% more iron concentration and more nutritious than common varieties of wheat. Anthocyanin is naturally occurring water soluble pigment which gives red, orange, black, blue and purple colour to the majority of fruits and vegetables depending upon different concentration of anthocyanin. Anthocyanin is an antioxidant which removes the free radicals from the body before they are able to react with the cellular components and alter their function or structure. Higher anthocyanin content is associated with the better development and accumulation of micronutrient. Whole meal prepared from black wheat has 17.71% protein content and richer in anthocyanin content followed by blue and purple coloured wheat is quite is uncommon. It has been estimated that on an average, 100 g black wheat provide 71 g carbohydrate, 13 g protein, 10 g fibre and 3.4 g fat.

Black wheat has been developed through the normal plant breeding i.e. a technique to change genetic pattern of plant to increase its utility for humans. It is not developed through genetic engineering. It is not harmful to our body at all. For this work, exotic germplasm procured from Japan was crossed with a normal high yielding and disease resistance wheat cultivar. After selection, black wheat was developed in India at NABI, Mohali under the leadership of scientist Dr. Monika Garg after seven years of research in different seasons and regions to check its overall adaptability and yield potential to India's environmental conditions.

Farmers have stared cultivating black wheat in several states of India including Punjab, Haryana, Uttar Pradesh, Maharashtra, Madhya Pradesh, Bihar and Chhattisgarh. Total area under black wheat cultivation is about 1000 acres. At present, Madhya Pradesh is leading producer of common as well as black wheat. Despite of lower availability and productivity of black wheat than common wheat it is able to fetch higher price in the market because of its varied nutraceutical properties.

Black wheat has emerged as a better food supplement. Its chapatti is a better option for people allergic to wheat, suffering from digestive disorders. It helps reducing obesity as consuming chapatti made of black wheat, as staple diet doesn't cause hunger. It helps in regulating blood glucose homeostasis, lowering serum cholesterol etc. It was found that black wheat consumption helps in rejuvenating the affected cancer cells, reduces proliferation of cancer and inhibits tumour formation. Unsaturated fatty acid present in black wheat prevent the chances of increased occurrences of diabetes, cardiovascular and cardiac disease. It is a better supplement which delays aging, can control the high blood pressure and cholesterol levels.

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Recyclization of Chemistry Laboratory Waste Water - Today's Need

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Laboratory waste, particularly of chemistry laboratory involves several toxic organic and inorganic materials and hazardous chemicals including mineral acids and heavy metals. These acids, alkalis and other chemicals come out with waste water and if disposed directly to environment without neutralization, it not only degrades the underground water quality but also deteriorates the soil quality drastically when exposed for prolonged period of time. Heavy metals can be absorbed by living organisms. Once they enter the food chain, large concentrations of heavy metals may accumulate in the human body. If the metals are ingested beyond the permitted concentration, they can cause serious health disorders. Therefore, it is necessary to treat metal contaminated waste water prior to its discharge to the environment. It is important to make sense of waste water treatment and recycling in laboratories of colleges and other educational and research institutions.

Due to this pandemic condition of Covid-19, only for few days we went in college and get less chance to perform the chemistry practical in laboratory. While doing practical not only in college but also in school time, I observed that after performing the experiments we through the chemical in basin and wash all the glassware in that basin. So, question arise in my mind that where this water does goes. I come to know that this water is disposed in ground without doing any treatment on it. Means this chemical contaminated water gets mixed in ground water, which may cause soil erosion as well as contamination of ground water also.

It is well known fact that laboratory waste, particularly of chemistry laboratory involves several toxic organic and inorganic materials and hazardous chemicals including mineral acids like hydrochloric acid, sulphuric acid, nitric acid and heavy metals. These acids, alkalis and other chemicals come out with waste water and if disposed directly to environment without neutralization, it not only degrades the underground water quality but also deteriorates the soil quality drastically when exposed for prolonged period of time. It is important to make sense of waste water treatment and recycling in laboratories of colleges and other educational and research institutions.

Due to the discharge of large amount of metal contaminated waste water, because of their high solubility in the aquatic environments, heavy metals can be absorbed by living organisms. Once they enter the food chain, large concentrations of heavy metals may accumulate in the human body. If the metals are ingested beyond the permitted concentration, they can cause serious health disorders. Therefore, it is necessary to treat metal contaminated waste water prior to its discharge to the environment.

We all know that water scarcity in India is an ongoing water crisis that affects millions of people every year. India has only 4% of world's fresh water and population of India is over 1.3 billion. Many factors are responsible for shortage of water in India. This scarcity of water makes the government and non-government organization to take serious action on these problems. In spite of this it is

observed that million tons of water is going to be waste by various people's activities. To overcome all these problems there is need of recyclization of waste water.

When water supplies are limited and poorly managed, both ecosystems and people suffer. Efficient and effective water management is necessary. WWF works with partners to advance the science of water conservation. It's our duty to work with governments, businesses and local communities to ensure that there are sufficient in-stream flows for people and other freshwater species and promote methods for sustainable water use.

So, it is observed that wastage of chemistry laboratory waste water is a serious problem. Many restrictions are made but it is observed that all are invalid. Wastewater treatment facilities apply biological, chemical, and physical principles under controlled conditions to remove contaminants from large volumes of water. To design such waste water treatment or recyclization plant is really a big task. If all the laboratories contain such plants, water released from these plants has minimal negative effects on the environment and public health, thus permitting the use of waterways for recreation, which I think is a need of today.

Easier and Efficient Selective Oxidation of Carbon-Hydrogen Bonds Using Oxygen with Reusable Catalyst

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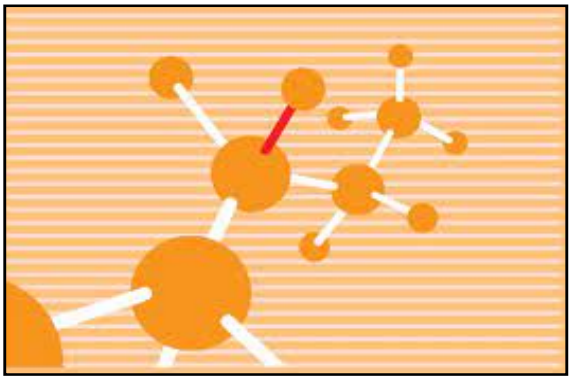
Tokyo Institute of Technology's team of scientists, lead by Dr. Keigo Kamata, was found a promising catalyst for oxidative C-H functionalization. They investigated the catalyst murdochite-type Mg_6MnO_8, a rock salt structure of magnesium oxide with 1/8th of the Mg^{2+} ions replaced with Mn^{4+} ions and another 8th ions replaced with vacancies orderly occupying alternating layers. The team prepared Mg_6MnO_8 nanoparticles with very high surface area using a cost effective sol-gel method aided by malic acid. The specific surface area of their Mg_6MnO_8 catalyst was 104 m²/g, which is about seven times more than Mg_6MnO_8 synthesized using methods reported earlier. The Mg_6MnO_8 nanoparticles could be easily recovered by filtration and could be reused without any noticeable loss in the catalytic activity.

Selective cleavage and oxidation of C-H bonds is called as the oxidative C-H functionalization. In pharmaceutical and agrochemical industries, it is an important step in the production of many solvents, polymers, surfactants and intermediate compounds.



In this process, generally, everyone want to use oxygen as the only oxidant to avoid use of more expensive and environmentally toxic substances like hydrogen peroxide, chlorine, nitric acid etc. Use of oxygen as the oxidant however creates some unsettled problems.

There is some progress in the field of recoverable and reusable catalysts but most of the heterogeneous reactions required high temperatures, more oxygen pressures or the use of toxic material. Successively, this wipes out the scope of potential applications, scalability and efficiency of these catalysts.

Counter to this background, Tokyo Institute of Technology's team of scientists, lead by Dr. Keigo Kamata, was found a promising catalyst for the oxidative C-H functionalization. In their research paper published in the journal "ACS Applied Materials and Interfaces", they concluded that isolated manganese species fixed in a crystalline matrix could constitute a high performance heterogeneous catalyst even at mild reaction conditions, based on previous knowledge.

They investigated the catalyst murdochite-type Mg_6MnO_8, a rock salt structure of magnesium oxide with 1/8th of the Mg^{2+} ions replaced with Mn^{4+} ions and another 8th replaced with vacancies orderly occupying alternating layers. The team prepared Mg_6MnO_8 nanoparticles with very high surface area using a cost effective sol-gel method aided by malic acid. The specific surface area of their Mg_6MnO_8 catalyst was 104 m²/g, which is about seven times more than Mg_6MnO_8 synthesized by methods reported earlier.

Through number of experiments, the scientists also demonstrated that their Mg_6MnO_8 nanoparticles could efficiently catalyze the selective oxidation of C-H bonds of various alkylarene compounds even at mild reaction conditions and atmospheric pressure. The yield of the final

product was also more as compared to that obtained using existing Mn based catalysts. Also, the Mg_6MnO_8 nanoparticles could be easily recovered by filtration and could be reused without any noticeable loss in the catalytic activity after performing multiple cycles of reaction.

The team of scientists sought to understand why their proposed catalyst performed so well through a series of kinetic and mechanistic studies. They concluded that the isolation of redox sites (Mn species) in a crystalline base matrix (MgO) was a particularly important feature to achieve oxidative C-H functionalization using oxygen at mild conditions. Dr. Keigo Kamata, satisfied with the results and findings, speculates that their approach constitutes a promising strategy for the development of a highly efficient heterogeneous oxidation system with wide substrate scopes.

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Developments in the Field of Biotechnology

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Biotechnology is the technology that utilizes biological systems, living organisms or parts of this to develope or creates different products. Term biotechnology was coined by Hungarian agricultural engineer Karoly Ereky in 1919. Gene-splicing is the most dramatic of the new biotechnology techniques. There are various branches of biotechnology which includes medicinal biotechnology, agricultural biotechnology and industrial biotechnology. Biotechnology has applications in four major industrial areas including medical, crop production and agriculture, industrial uses of crops and other products and environmental uses. Some major biotechnology innovations are biosensors, 3D bioprinting, bioplastics, bioenergy, gene editing and virtual and augmented reality.

Introduction to biotechnology

Biotechnology is the technology that utilizes biological systems, living organisms or parts of this to develope or creates different products. Brewing and baking bread are examples of processes that fall within the concept of biotechnology to produce the desired product. Here the living organism used is the yeast.

Karoly Ereky was a Hungarian agricultural engineer. Term biotechnology was coined by him in 1919. He is regarded by some as the father of biotechnology.

At the beginning of the eighteenth century, developments in biotechnology tended to bring industry and agriculture together. After that, one some basic processes of biotechnology such as fermentation were refined to develope paint solvents for the emerging automobile industry and acetone from starch.

Modern era of biotechnology

Gene-splicing is the most dramatic of the new biotechnology techniques. It involves chemically snipping out the genes that tell a cell to produce some substance and inserting them into another cell, which then becomes a miniature factory producing the substance. There are various branches of biotechnology dealing with various research factors unlike medicines, agriculture, industrial biotechnology etc. Some of the examples are given below.

Medicinal biotechnology

Synthetic insulin, synthetic growth hormone and diagnostic tests to detect various diseases are just some examples of how biotechnology is impacting medicine. Biotechnology has also proved helpful in environmental cleanup, refining industrial processes and in agricultural production. From the Ebola vaccine to mapping human DNA to agricultural impacts, medical biotechnology is making number of advancements and helping millions of people. Some of most recent uses of biotechnology are work in the genetic testing, drug treatments and artificial tissue growth.

Agricultural biotechnology

Agricultural biotechnology is also known as agritech. It is an area of agricultural science involving the use of scientific tools and techniques, including genetic engineering, molecular markers, molecular diagnostics, vaccines and tissue culture, to modify living organisms - plants, animals and microorganisms.

Industrial biotechnology

Developments in areas like physics, chemistry, engineering, computational and material sciences greatly impact progress in the biotechnology. Genetic engineering, biotechnology, toxicology, molecular biology and other related sciences have also made it possible to create a new generation of biological weapons (BW).

Applications of biotechnology

Biotechnology has applications in four major industrial areas, including health care (medical), crop production and agriculture, non-food (industrial) uses of crops and other products (biodegradable plastics, vegetable oil, biofuels etc.) and environmental uses.

- ✓ Nutrient supplementation
- ✓ Abiotic stress resistance
- ✓ Industrial biotechnology
- ✓ Strength fibers
- ✓ Biofuels
- ✓ Healthcare
- ✓ Food processing
- ✓ Fuel from waste

Branches in biotechnology

- ✓ Synthetic DNA
- ✓ Development of vaccines
- ✓ Testing and tracing for COVID-19
- ✓ 4D printing and tissue engineering
- ✓ Gene editing
- ✓ Gene sequencing
- ✓ Quantum microscope
- ✓ Biosensors

Fields in biotechnology

- ✓ Medical scientist
- ✓ Biotechnological technician
- ✓ Epidemiologist
- ✓ Microbiologist
- ✓ Medical and clinical lab technologist
- ✓ Bio manufacturing specialist
- ✓ R and D scientist

Biotechnology innovations

- ✓ Biosensors
- ✓ 3D Bioprinting
- ✓ Bioplastics
- ✓ Bioenergy
- ✓ Gene editing
- ✓ Virtual and augmented reality

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Recycling of Plastic

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Around us everywhere there is use of plastic. PET is a popular thermoplastic used to produce low pressure products, clothing fibers and soft drink bottles. PVC is another thermoplastic used for preparing wires, pipes, bottles and cling films. Thermoplastic HDPE is softer and more flexible compared to PVC. It is used to produce gallons and pipes. LDPE is used to make plastic bags. Recycling of these plastic is very much necessary because almost all the plastic is non-biodegradable and thus builds-up in the environment, where it can cause harm. However, the fact is that you cannot recycle all types of plastic. Plastic materials that you don't recycle get destroyed or disposed of in landfills. There are two methods of recycling plastic. First one is traditional recycling which involves melting plastics and processing them into new plastic products. Second type is advanced recycling in which effect of chemicals breaks down plastic material by pyrolysis, chemical recycling, gasification and converts plastic waste to valuable liquids that can become new petrochemicals.

Plastic is all around us. From soda bottles, grocery bags to your ID card, we see and use plastic every day. Many of these plastics come from materials like petrochemicals. The plastic around us has advantages but also create so many problems. Plastic can cause litter and pollution in the environment. These effects can put human beings and the environment in danger. Also, if you do not correctly manage plastic, making new ones can be a waste of resources. It is thus reasonable to reuse and reprocess plastic to prevent waste.

Recycling of plastic is very much necessary because almost all the plastic is non-biodegradable and thus builds-up in the environment, where it can cause harm. For example, approximately 8 million tons of waste plastic enter the earth's oceans every year, causing damage to the aquatic ecosystem and forming large ocean garbage patches. Presently, almost all recycling is performed by remelting and reforming the used plastic into new items; so-called mechanical recycling. This can cause polymer degradation at a chemical level and also requires that waste be sorted by both colour and polymer type before being reprocessed, which is complicated and expensive. Failures in this can lead to material with inconsistent properties, which is unappealing to the industry.

PET - Polyethylene terephthalate (PET) is a popular thermoplastic. This material is thin and is perfect for producing low pressure products. Clothing fibers and soft drink bottles are popular products made from it.

PVC - Polyvinyl chloride (PVC) is another thermoplastic. It is also one of the commonly used plastic materials around the world. PVC is used to produce wires, pipes, bottles and cling films.

HDPE - High density polyethylene (HDPE) is also a thermoplastic. It is softer and more flexible compared to PVC. HDPE is used to produce gallons and pipes.

LDPE - Low density polyethylene (LPDE) is the opposite of HDPE. It is used to make plastic bags. Sometimes, it is not easy to recycle this material. Instead of recycling, you can clean and reuse them for other uses or purposes.

However, the fact is that you cannot recycle all types of plastic. This is because plastic products come from different types of materials and it is uneconomical to recycle some of these materials. Usually, this is either due to the long process or high cost and sometimes, the ineffectiveness of the existing recycling process. For instance, if you put these materials in recycling equipment, they may cause the equipment to stop or break. See also interesting facts about aluminum recycling. Are you wondering what plastic type fall under this category? Here you go.

PS - It is a polymer. The products that come from this plastic include plastic cutlery and yogurt containers

PP - It is also a polymer. Manufacturers frequently use it to make plastic boxes, plastic furniture and plastic jar lids. In most cases, recycling companies will reject it for recycling.

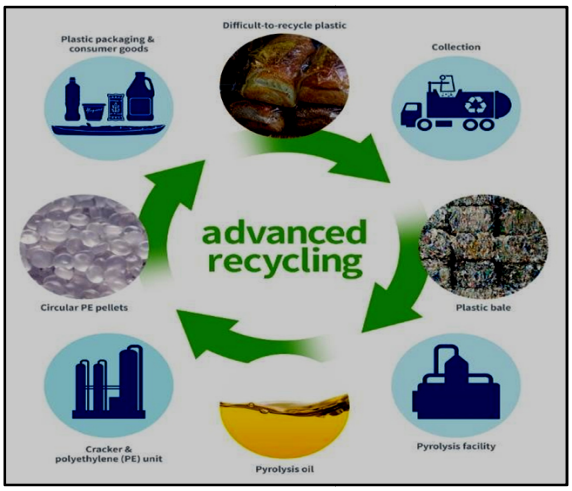
So, from all we have said, recycling plastic depends on the type of material. Plastic materials that you don't recycle get destroyed or disposed of in landfills. Nevertheless, recycling is the best choice for plastic materials. There are different types of plastics and this makes it impossible to recycle all plastics in the same way. However, there are two methods of recycling plastic.

Traditional recycling

This method is the most widespread recycling method. Another word for the traditional recycling is the mechanical recycling. This method is suitable for recycling the thermoplastic materials. The traditional recycling method involves melting plastics and processing them into new plastic products. After recyclers melt plastic, they make them into new products through a process called injection molding.

Advanced recycling

This is a process through which the effect of chemicals breaks down plastic material. This method consists of three other techniques which include pyrolysis, chemical recycling and gasification.



Step-1 : Collection of waste plastic - The first step to plastic recycling is gathering waste plastic products. While this process may seem like an easy task, it is not entirely so. At this stage, employees or volunteers go around and collect waste plastic from homes, offices and public places. Certain areas have collection sites where people can dispose of their plastics. Some recyclers put recycling bin around public locations, residential areas and industrial zones to ease collection. People can dump their plastic.

Step-2 : Sorting of plastic into categories - After collection, recyclers send the plastic they have gathered to facilities, where they separate the plastics according to types. As you already know, plastics differ in size, color, thickness and use. In this process, recycling machines sort plastics based on the properties of the material. Often, color and the resin content in the plastic are the basis by which recyclers sort plastics.

Step-3 : Washing of plastic to remove impurities - After sorting plastics, recyclers wash the materials to remove impurities. These impurities in plastic include paper labels, dirt and particles. Washing plastic also removes glue and additional chemicals that plastic materials may. Washing is essential because failure to remove impurities may damage the new product. Moreover, the contaminants contained in plastic products are not plastic materials and may not be recyclable.

Step-4 : Shredding and resizing of plastic - This process comes immediately after washing plastics. It is impossible to recycle plastic in its already developed state. There is a need to resize the plastic material to a form that can be recycled. In this fourth process, materials will be put into shredders to reduce the plastic into fragments. A plastic material cut into tiny pieces is more comfortable to process than when it is in its original form. Shredding also makes it possible to reprocess plastic to other materials aside.

Step-5 : Identification and separation of plastic - After resizing has been completed, the next process is to identify and separate plastic materials. In this process, plastic particles undergo testing procedures. The reason for testing plastics is to identify the class and the quality of plastic. The plastic materials are then separated based on their features for further processing. There are several features tested in this process. One of these qualities is density.

Benefits of plastic recycling

Now you might be wondering why recycling is a great choice. After all, the process looks cumbersome and you must justify it based on its benefits. Well, the fact is that, it comes with various benefits and these benefits are why you should encourage recycling.

✓ Plastic recycling reduces the amount of trash that ends up in the oceans.
✓ Plastic recycling creates new jobs.
✓ Plastic recycling creates additional revenue for the government and private organizations.
✓ Recycling plastic reduces the release of carbon dioxide and harmful gases into the environment.
✓ Plastic recycling conserves the space used as landfills. It makes it possible to use those landfills for other purposes.
✓ Recycling saves petroleum that producers may use to make new plastics.
✓ Plastic recycling lessens the energy that manufacturers consume in creating new products. Plastic recycling prevents global warming.
✓ Plastic recycling reduces the emergence of all forms of pollution.
✓ Plastic recycling provides income for volunteers who collect plastic waste.
✓ Plastic recycling helps reduce activities like deforestation that happen when making new plastic.
✓ Encourages a sustainable lifestyle among people.

Advanced recycling, sometimes referred to as chemical recycling, converts plastic waste to valuable liquids that can become new petrochemicals. This approach complements traditional recycling by converting a range of materials, including many difficult-to-recycle plastics, into important building blocks for new chemicals. Because of the potential to repeatedly recycle post-use plastics into new materials, polymers produced through advanced recycling are often referred to as circular polymers.

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A Cognitive Map - Navigation of Bats Using Spatial Cognition

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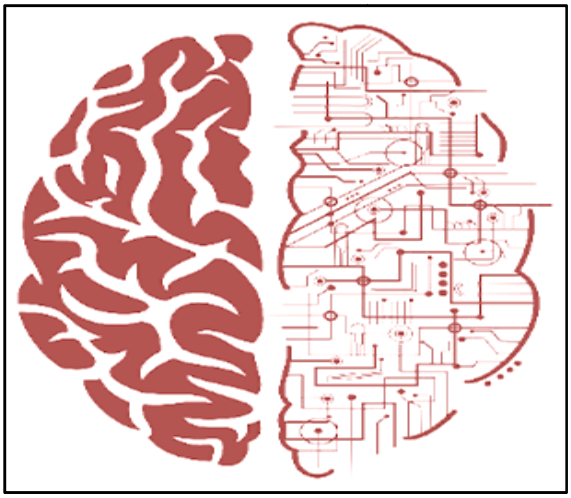
A cognitive map is also called as a conceptual or mental map. It is a type of mental representation of a portion of the physical environment and relative locations of points within it, which serves an individual to acquire, code, store, recall and decode information about relative locations and attributes of phenomena in their everyday or metaphorical spatial environment. The animals having a cognitive map are able to assess landmarks, compass information and then do the calculation of their travel path to any location within mapped area. A cognitive map can allow an animal to navigate from its current position to an undetected goal. Egyptian fruit bats are considered as world champions of navigation. Like humans, these bats create a visual cognitive map of the space surrounding them by making the use of various conspicuous landmarks.

A cognitive map is a type of mental representation of a portion of the physical environment and relative locations of points within it, which serves an individual to acquire, code, store, recall and decode information about relative locations and attributes of phenomena in their everyday or metaphorical spatial environment. It is also called as a conceptual or mental map.



Edward Tolman has introduced this concept in 1948 to explain the behaviour of rats that appeared to learn the spatial layout of a maze. Then after, this concept was applied to other animals and also to the humans.

A cognitive map, the term coined by Edward Tolman, is the landmark or an internal representation or an image of external environmental feature. According to him, individuals acquire the large numbers of cues i.e. signals from the environment and could use these to build a mental image of an environment i.e. a cognitive map.

A cognitive map serves construction and accumulation of spatial knowledge, allowing the 'mind's eye' to visualize images in order to reduce the cognitive load, enhance recalling and learning of information. This type of spatial thinking can also be used as a metaphor for the non-spatial tasks, where people performing non-spatial tasks involving memory and imaging use the spatial knowledge to aid in processing the task.

Simply, a cognitive map is a mental representation of the layout of one's environment where they are able to form a mental representation of an environment that they have been in or are currently in, e.g. when someone asks you for the directions to your home, you are able to form an image of the roads, turns, landmarks, along the way to your home from his starting point in your mind. This type of representation is a cognitive map, the knowledge of an individual about the spatial and environmental relations of geographic space. These are usually termed 'idiosyncratic' and 'common' respectively. They refer to personalized spatial information needed for episodic activities, e.g. one's home location, a private place for reflection, a particular view or scene or for more general social information, e.g.

local landmarks, named ethnic districts, squares, highways, town or city.

Those animals, which use a cognitive map can 'visualize' the landscape and solve the problems of orientation by referring to these map. The animals having a cognitive map are able to assess landmarks, compass information and then do the calculation of their travel path to any location within mapped area. A cognitive map can allow an animal to navigate from its current position to an undetected goal.

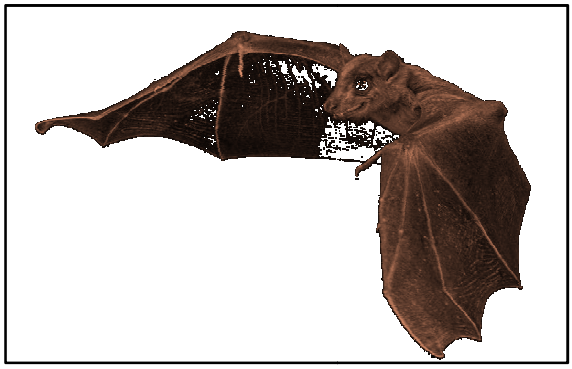
As the sun sets, number of Egyptian fruit bats leaves their cave and flies out, one by one, into the night. Trees bearing ripe fleshy fruits are their goal. Before returning home to their cave, they must consume more than double of their own body weight each night. How do they manage to do it efficiently?

Animals adopt different type of navigational strategies for finding food or other resources. One is simply to search the resource randomly and once located, then go straight back home using so-called path integration - an internal 'recording' of one's motion to then calculate the way back home. Some ants use this type of strategy. For fruit bats, random search is not the most efficient. Once found a fruit tree, never changes location and continues to bear fruit for days or weeks.

The easiest strategy is probably beaconing. It is the ability to sense a target by seeing, smelling etc. from the current location of animal's to then move towards it. If targets are beyond detection range, animals can use piloting, following a series of landmarks until the target is found. It has been shown in homing pigeons. A piloting animal would most likely zigzag and spend more time and energy than it would by moving along a straight path. In this way, only limited number of targets can be memorized and reached. The navigation strategy which is much more flexible and still cognitively demanding is to use the spatial memory to locate objects or places. The memorized positions of the target and landscape features, relative to the animal's current position, constitute an internal 'cognitive map' from which one can compute a direction. When such a map is in mind, previously visited targets beyond detection range become easy to reach efficiently, usually a straight line. This ability is best exemplified by shortcutting i.e. taking a novel route between any two previously visited locations.

Egyptian fruit bats

Egyptian fruit bats are considered as world champions of navigation. Like humans, these bats create a visual cognitive map of the space surrounding them by making the use of various conspicuous landmarks. In just few hours, they fly so many kilometres and come back to the starting point. These bats navigate space around them like the city's human inhabitants. To navigate over the short distances, these bats use their sonar while for longer distances, use their vision. Like humans, bats at some stage get from one point to another via direct new routes, not previously taken.



When these bats leave their home, they already know where they want to go and how to reach that destination. The bats remain loyal to a few trees for weeks and when visiting a new tree, they fly straight towards it. These bats may take new shortcuts for flying directly to the location which they previously reached

from other places. These shortcuts are very straight and indistinguishable from other non-shortcut track. These bats have very good long term memory of the locations of many different individual fruit trees and ability to calculate their relative positions within the landscape. It enables them to take the shortest and most efficient routes.

The presence of a cognitive map is essential to our ability to navigate through areas we know, because it facilitates the use of spatial knowledge to derive new routes. When we visually recognise places, like our living room or office, we identify and localise various objects that make up the scene. A cognitive map is a miraculous phenomenon of one's mind.

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Environmental Effects of Pesticides

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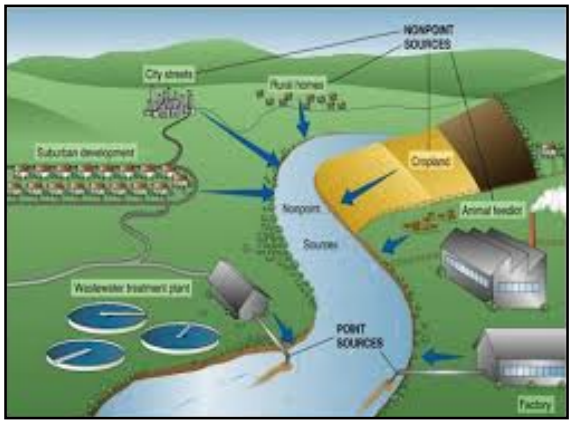
Pesticides are chemical or biological agents that are specially designed to kill or retard the growth of pests. Insecticides, herbicides, defoliants, desiccants, avicides, fungicides, nematicides, rodenticides etc. are some common pesticides that are in use since long time. As pesticides are toxic chemicals prepared kill pest species, can also affect non-target species like plants, animals and human beings. More than 95% of the sprayed insecticides and herbicides reach the destination other than their target species. Globally more than 60% of global agricultural land is at high risk of pesticide pollution. Ecological effects of pesticides extend beyond individual organisms and can extend to ecosystems. The effects of pesticides on human health depend on the toxicity of the chemical and duration of exposure. Children are more susceptible and sensitive to pesticides. For better future non-chemical pest management technologies along with technologies that reduce pesticide use need to be implemented.

Pesticides are chemical or biological agents which are used to control pests, weeds, insects etc. These agents are specially designed to kill or retard the growth of pests. It includes insecticides, herbicides, defoliants, desiccants, avicides, fungicides, nematicides, rodenticides etc. Pesticides are included in a broad range of organic micro pollutants that have ecological impacts.

One of the main drivers of the negative impact of modern industrial agriculture on the environment is the unintended consequence of pesticides. As pesticides are toxic chemicals prepared to kill pest species, can also affect non-target species like plants, animals and human beings. Negative effects of pesticides are not just in the area of application but cover the large area. More than 95% of the sprayed insecticides and herbicides reach the destination other than their target species, because they are spread across entire agricultural fields. Other chemicals that used for agricultural use like fertilizers can also have negative effects on the environment.

It was found that, globally more than 60% of global agricultural land is at high risk of pesticide pollution. Pesticides can contribute to air pollution. Pesticide drift occurs when pesticides suspended in the air as particles are carried by wind to other areas. Ecological effects of pesticides extend beyond individual organisms and can extend to ecosystems. The impact on living beings also affects the non-living environment and humans indirectly. Pesticides have some direct harmful effect on plant.



Pesticides can kill bees and are strongly implicated in pollinator decline; the loss of species that pollinate plants, including through the mechanism of colony collapse disorder in which worker bees from a beehive or western honey bee

colony abruptly disappear. Application of pesticides to crops that are in bloom can kill honeybees, which act as pollinators.

Pesticides can enter the human body through inhalation of aerosols, dust and vapours that contain pesticides, through oral exposure by consuming food or water and through skin exposure by direct contact. Pesticides secrete into soils and groundwater which can end up in drinking water. Pesticide spray can drift and pollute the air.

The effects of pesticides on human health depend on the toxicity of the chemical and duration of exposure. Children are more susceptible and sensitive to pesticides because they are still developing and have a weaker immune system than adults. Children may be more exposed due to their closer proximity to the ground and tendency to put unfamiliar objects in their mouth. Pesticides tracked into the home from family members increase the risk of exposure. Toxic residue in food may contribute to a child's exposure. Exposure effects can range from mild skin irritation to birth defects, tumors, genetic changes, blood and nerve disorders, endocrine disruption, coma or death.

For better future non-chemical pest management technologies along with technologies that reduce pesticide use need to be implemented. The use of these technologies with multidisciplinary approach for assessing the risks and benefits of pest control can help to make the agriculture environmentally better. For farmers, it will also improve the productivity and profitability of agriculture.

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Turmeric - Nature's Precious Gift

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Turmeric (Curcuma longa) is a well known indigenous herbal medicine. It is used in traditional medicine as a household remedy for various diseases like biliary disorders, anorexia, cough, rheumatism diabetic wounds, hepatic disorders, sinusitis etc. It has properties like antioxidant, anti-migraine, antimicrobial, anti-tumor, anti-inflammatory etc. It is recognized and used all over the world in many different ways. In India it is used in the curry, in Japan it is served in tea, in Thailand it is part of the composition of cosmetics, in China it is used as a dye, in Malaysia as an antiseptic, in Pakistan as an anti-inflammatory agent, in US it is used as a preservative and colouring agent in mustard sauce, cheese, butter, fries etc. Turmeric consists of a group of three curcuminoids - curcumin (77%), demetossicurcumin (17%) and bisdemeto-ssicurcumina (3%) as well as volatile oils like tumerone, atlantone and zingiberone, sugars, proteins and resins.

In India, China and other countries in Southeast Asia Turmeric are extensively used as a spice, food preservative and colouring material. It is used in traditional medicine as a household remedy for various diseases like biliary disorders, anorexia, cough, rheumatism diabetic wounds, hepatic disorders, sinusitis etc.

Curcumin is a phenolic compound isolated as a yellow pigment from turmeric (Curcuma longa). It is derived from the rhizome of the plant, perennial member of the Zingiberaceae family, cultivated in India and other parts of Southeast Asia. Phenolic compounds are natural phytochemicals derived mainly from phenylalanine and less frequently from tyrosine and are widely present in food and nutraceutical. The medicinal potential of turmeric is known for thousands of years. In Asian countries, it is traditionally used as a medical herb because of its properties like antioxidant, anti-migraine, antimicrobial, anti-tumor, anti-inflammatory etc. Because of multiple potentialities of turmeric, it is recognized and used all over the world in many different ways. In India the turmeric containing curcumin is used in the curry, in Japan it is served in tea, in Thailand it is part of the composition of cosmetics, in China it is used as a dye, in Malaysia as an antiseptic, in Pakistan it is used as an anti-inflammatory agent, in the United States it is observed in mustard sauce, cheese, butter, fries etc. as a preservative and colouring agent. Curcumin is available in different types of formulations i.e. capsules, tablets, ointments, energy drinks, soaps, cosmetics etc.

Curcumin has a large variety of strong biological activities and properties. Scientific research has confirmed the numerous pharmacological effects of curcumin and established its ability to act as a potential therapeutic agent against several chronic diseases.

Components of turmeric

Turmeric consists of a group of three curcuminoids - curcumin (77%), demetossicurcumin (17%) and bisdemeto-ssicurcumina (3%) as well as volatile oils like tumerone, atlantone and zingiberone, sugars, proteins and resins. Curcuminoids is recognized as safe and tolerable substances, even at doses of between 4 and 8 mg per day by the US FDA. Curcumin is the main component of turmeric; it is also known as diferuloylmethane. It is a yellow-orange crystalline solid. Its molecule consists of two 4-hydroxy-3-methoxy-phenyl bound to α,β-diketone unsaturated carbon bridge. Curcumin undergoes the keto-enol tautomerism with keto and enol forms; when dissolved, the enol form predominates over keto. Curcumin is quite unstable compound. It degrades very fastly from neutral to alkaline solutions.

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Parsley - A Beautiful Herb with Unique Medicinal Values

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Parsley (Petroselinum Crispum) is a biennial aromatic plant belongs to the family Apiaceae. Parsley is a leafy herb. It grows up to roughly one foot in height like a small shrub. Parsley is rich in the nutrients and minerals that are required for the good health. Parsley contains the vitamins A, B, C and K along with minerals K, Fe and Cu. Parsley is cultivated as an annual and harvested for not just the leaves and stems, but also for the root which has stronger flavour as well as medicinal properties. It has medical properties like antifungal, anti-inflammatory, antioxidant and antiseptic.

Parsley (Petroselinum crispum) is an annual culinary herb widely grown in Europe and Western Asia. It is a biennial aromatic plant belongs to the family Apiaceae. In Mediterranean, the medicinal herb has been widely used for more than 2000 years, firstly by ancient Greeks in religious rites until Hippocrates introduced it as a diuretic. Romans were brought parsley to Central Europe and around 795 CE, by the law of Charles the Great, its cultivation in this area become obligatory. In addition to medical purpose, today parsley is used as a spice around the world, generally in omelets, salads, sauces, soups, for making herb butter and also as an accompaniment to various other dishes.

Parsley is a leafy herb. It grows up to roughly one foot in height like a small shrub. It has faint green colour stems having multiple pairs of closely ruffled leaves growing at the ends. The variety curly is more fragile than other common flat-leafed variety, which makes it easy to shred or finely chop the herb for culinary purposes. Parsley has a fresh, green aroma and flavour of combination of citrus, clove, and nutmeg, having a unique taste. It flowers in its second year, with circular clusters of white flowers setting a top thin stems. Parsley is available year-round.

Nutritional content

Though ever being relegated to garnish status, parsley is rich in the nutrients and minerals that are required for the good health. Parsley contains the vitamins A, B, C and K along with minerals K, Fe and Cu. It is also a good source of folate. It contains volatile, essential oils having the compounds like limonene, eugenol and myristicin which give the herb its unique aroma and medicinal properties like antifungal, antioxidant, antiseptic and anti-inflammatory. It contains flavonoids, apigenin and luteolin that boost the antioxidant and the anti-inflammatory properties of parsley. Parsley can be used as a digestive aid and pallet cleanser. It is used in medicines, cosmetics, traditional / ethno-botanical use, for cooking and making essential oil.

Half a tablespoon of dried parsley contains about 6.0 µg of lycopene, 10.7 µg of α-carotene, 82.9 µg of lutein plus zeaxanthin and 80.7 µg of β-carotene. Dried parsley can contain about 45 mg/gram apigenin. The apigenin content of fresh parsley is reportedly 215.5 mg/100 grams, which is much higher than the next highest food source Green celery hearts providing 19.1 mg/100 grams.

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Photo Gallery

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