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Monthly Newsletter of Vigyan Prasar

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VP News

Vigyan Prasar Activities in Tripura

For quite some time Vigyan Prasar has been trying to initiate various science popularisation activities in Tripura. For two years (July 1999-February 2001) Shri Sanjay Banerjee was working as Fellow of Vigyan Prasar. Shri Banerjee initiated a number on activities. A three-day workshop on science communication was organised by Vigyan Prasar at Agartala during March 22-24, 2000. The objective of the workshop was to assess the current status of popular science activities in Tripura and to identify the organisations/individuals engaged in science popularisation activities with whom Vigyan Prasar can join hands. As a follow up of the workshop Vigyan Prasar continued interacting with different organisations and individuals. As a result the following three activities have been initiated.

- A three month long (13 episodes) radio programme (jointly with AIR, Agartala) explaining scientific basis of miracles. It will be a weekly programme of half an hour duration. To finalise the topics of different episodes and to identify the script writers, a workshop was organised at Agartala on 30th June, 2001. The workshop was inaugurated by Prof. Mihir Kanti Dev Vice Principal, MBB College, Agartala and Chairman, Tripura State Pollution Control Board. Representatives from different drama groups of Agartala namely Natyabhumi, Roopam, CILPA, Patabhumi, Dakshini, Kabitalok, Cinedelve and Kabyalok attended the workshop. It is expected that the programme will go on air by the end of September 2001. A Committee of experts from Agartala will monitor the contents of the programme. Tripura Science Forum, a voluntary organisation engaged in science popularisation activities, has agreed to help Vigyan Prasar in monitoring the programmes.
- A 26-episode quiz programme jointly with Doordarshan Kendra, Agartala and Tripura Science Forum.
- Science pages in Newspapers.

Prof. M.K. Deb delivering his inaugural speech. Also seen Dr. S. Mahanti of VigyanPrasar

A section of the audience

Inside

... think scientifically, act scientifically ... think scientifically, act scientifically ... think scientifically, act...

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Clones – It's Human Beings Now

The term clone, in everyday usage, refers to a group of organisms that are genetically identical. Most such clones result from asexual reproduction, a process in which a new organism develops from only one parent. Thus, all the offspring of a single parent form a clone. An experimental technique developed involves destroying the nucleus of an egg cell of the species to be cloned. The nucleus is then removed from a body cell of an animal of the same species. This donor nucleus is injected into the egg cell. The egg, with its new nucleus, develops into an animal that has the same genetic make up as the donor. If a number of eggs receive transplants from the same donor, the resulting offspring form a clones. This technique was used to clone such amphibians as frogs and salamanders as early as 1950's. However, the source for body cells and the nuclei was an embryo consisting of only a few thousand cells, because at that stage of development an embryo's cells are relatively unspecialized. As an embryo develops into a completely developed organism consisting of billions of cells, its cells become increasingly specialized. Some cells become skin cells, while others become blood cells. Skin cells can normally make only more skin cells, and blood cells can normally make only blood cells. By contrast, each of the unspecialized cells of an early embryo is capable of producing an entire body. In 1996, however, researchers led by embryologist Ian Helmut of the Roslin Institute near Edinburgh, Scotland, found a way to do the seemingly impossible. Mammary-gland cells from an adult sheep were placed in a solution that essentially starved them of nutrients and caused them to stop growing for a few days. Then, they fused each mammary cell with an egg cell from which nucleus was removed. The resulting cells were allowed to grow into embryos, which were then transplanted into a surrogate mother ewe (female sheep) to complete their development. Nearly 300 attempts resulted in failure. Some eggs did not accept mammary cell nuclei, embryos that were produced died, and lambs that were born were abnormal and died. But, one lamb, apparently healthy, survived the procedure: Dolly, who was born in July 1996. Later, besides pigs and sheep, scientists in different parts of the world cloned other animals, including cows, pigs and mice.

Surely, it is only a matter of time before human cloning becomes a reality. Well, the day does not seem to be very far. Two maverick scientists have unveiled their plans to produce the first cloned human beings by the end of 2002. They declared their plans recently at a panel brought together by the U.S. National Academy of Sciences for a report exploring the use of human cloning in basic science and medicine, such as the creation of tissues for transplants. The group led by Severino Antinori, an Italian fertility specialist, and his colleague Panos Zavos of the Andrology Institute in Kentuky, formally announced that his team would begin creating cloned embryos within a month or so. They would treat 200 couples suffering from fertility problems starting in November 2001. This generated a heated debate on ethical and legal issues related to human cloning, But, safety emerged as the key issue.

Many scientists felt that human cloning would be a hasty step before mastering the techniques of animal cloning and solutions to the health problems often exhibited by the cloned animals, as it happened during the trials before Dolly's birth. Again, Ian Helmut gave examples of two animals, one sheep and one cow, that appeared healthy at birth, but later died from lung and immune system disorders respectively. These would have been nearly impossible to diagnosis in utero. Because of such and several other unresolved issues, many scientists feel that human cloning should be postponed until these questions were answered.

Would a human clone tend to have a diminished sense of individuality? Would cloing undermine basic elements of a loving nurturing family, such as the acceptance of each child as a unique individual? What would happen to a world that separated reproduction from love and other human relationships? Would society use cloning to modify the human race, say, for warfare or slavery? Would doctors use clones as sources of organs for organ transplants? True, these concerns are genuine, but, we have no answer to them as of now. Perhaps the strongest argument advanced in favour of human cloning is that cloning could provide the only avenue available to some infertile couples for producing children. In cases of fertile couples in which one member carries a gene for a disease, cloning using a cell from the other member could assure that the couple has a healthy child of its own. Further, a clone would not really be a duplicate, but, only a delayed identical twin because environmental factors would mould him or her into a unique individual.

This is where we have arrived at from the days of Darwin. Cloning technology like any other technology, has two facets. How do we ensure that human cloning technology turns out to be a blessing? How would it affect the Indian society? It is only a few years before human cloning becomes a part of our lives. How shall we cope with it then? Before deciding a course of action, it would be imperative to take people in confidence and involve them in the decision making process . This topic must, therefore, be dealt with as part of peoples' science movement. Let us talk to the people, initiate debates and then arrive at a consensus. Human clones are round the corner!

❑ *V.B. Kamble*

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Malaria – The Mosquito Connection

❑ V.B. Kamble

Deadly fevers – probably malaria – have been recorded since the beginning of the written word, that is, about 6000 – 5500 B.C. There are references to such types of fevers even in the vedic writings some 3500 – 4000 years ago. Even Hippocrates recorded such fevers some 2500 years ago. Malaria existed and still exists in many parts of the world. Malaria was widespread in India during the colonial period, that is, during the 19th and 20th centuries. According to some accounts, malaria was introduced in North America during the early 19th century by infected British soldiers who had returned from India. Despite the fact that there are no references to malaria in the "medical books" of the Mayans or the Aztecs – ancient civilizations in the central and south America, it seems likely that the European settlers and slavery brought malaria to the "New World" and the waiting anopheles mosquitoes (anopheles – "unprofitable" in Greek) within the last 500 years.

Ronald Ross

Quinine, a toxic plant alkaloid made from the bark of the cinchona tree in South America, was used to treat malaria more than 350 years ago. Jesuit missionaries in South America learnt of the anti-malarial properties of the bark of the cinchona tree and had introduced it into Europe by 1630s and into India by 1657. In the mid-1800s, the Dutch brought cinchona seeds from Peru and established cinchona plantations in Java (Indonesia) and soon had a virtual monopoly on quinine.

Mal Aria

About a century ago, of the British Army in India, amounting to about 1,78,000 men, close upon 76,000 men were admitted into hospitals for malarial fever in the year 1897. In this single year, the mortality from fever among the civil population in India, amounted to a total of more than five millions. Today, malaria is considered to be one of the most important parasitic diseases worldwide. 40 per cent of the world's population lives in malaria endemic areas. 500 million clinical cases and about 3 million deaths are reported each year. In Africa, malaria deaths may account for 10 per cent of the overall annual mortality in children under 14. The worldwide distribution of malaria is shown in Figure 1 based on 1976 statistics. It reveals the presence of malaria in most of the world's developing regions and its notable absence in arid or mountainous areas where mosquitoes usually do not breed. Malaria parasites causing malaria are prevalent in regions lying roughly between latitudes 60° N and 40° N. It is widespread in tropical and temperate countries.

Till over a century ago, the popular view had been that malaria was caused by bad air (mal aria – Italian for bad air) or contaminated water. However, only in 1880, the first true sighting of the malarial parasite was made in Algeria by a French Army physician, Charles – Louis – Alphonse Laveran (1845-1922) while viewing blood slides of infected soldiers under a microscope. He showed that patients with malaria carried a protozoan parasite (called plasmodium), in their blood, and doctors began suspecting that mosquitoes spread the parasite causing the malarial infection. Laveran's discovery was, however, rejected by the medical community and it was not until 1886 that his discovery was accepted by Italian scientists, who were the

Fig. 1 : MALARIA, One of the world's most persistent diseases, affects 500 million people–many of whom suffer recurrent attacks–and kills 3 million each year. Almost all of the victims live in moist, tropical regions where disease-bearing mosquitoes breed freely. Attempts to control the spread of malaria by means of pesticides have not been successful, and in the 1970s there was a resurgence of the disease, carried by mosquitoes immune to the pesticides. This map, based on 1976 statistics, reveals the presence of malaria in most of the world's developing regions–and its notable absence in arid or mountainous areas where mosquitoes usually do not breed.

leaders in the field at the time. We may remark here that it was in 1882 that the mosquito transmission hypothesis was first made as a result of the association between the presence of mosquitoes and the occurrence of malaria – **a case of guilt by association**! By this discovery, the name of Laveran has forever become renowned in the history of malaria.

Charles Louis Alphonse Laveran

Camillo Golgl

The Mosquito Trail

In the early days, research about malaria was chiefly based on Laveran's discovery. It helped gain knowledge of the different forms of the malarial parasite in blood. It was found that it differed in the special forms of the disease. The relation between the parasite and the red blood corpuscles, in which it is chiefly to be found, was established. The Italian investigator Camillo Golgi (1843 – 1926) revealed the remarkable fact that the periodicity of the malarial attacks depended on the appearance of new generations of the parasite in the blood. Moreover allied parasites in the blood of several mammals and birds also were found.

The important question, previously mentioned, as to possibility of the malarial parasite living outside the body, and its way of obtaining entrance into the blood remained unanswered. Fore some reasons, among others owing to various facts that were known concerning other parasites of an animal nature, it was supposed that the malarial parasite in some way leaves the blood so as to exist in some form in nature, probably as a parasite of some other being. As nothing indicated that the parasite was to be found in the secretions or excretions, the supposition lay near at hand, that suctorial insects would assist in carrying the parasite to a place, where it had to pass the aforementioned part of its life-cycle. Attention was therefore directed to the mosquito, which was thus supposed to spread the malarial infection. The importance of the mosquito in this respect was proved. In this case, as in several others, tradition anticipated science; it is even said, that Negroes in the East-Africa use the same name for the mosquito and for malaria.

The mosquito theory of malaria was introduced to science by A.F.A. King in 1883. The theory, however, remained a conjecture without other evidence than some suggestions given by epidemiological observations. The attempts made in Italy around that time with the view of examining the theory experimentally, and, eventually, proving it to be true, gave results that seemed anything but encouraging; being far more likely to prevent the investigators from following this line.

A person of great merit concerning the solution of the problem was the English Investigator, Patrick Manson. It was a change in the appearance of the parasite, which was sometimes observed to occur, as the blood is shed, that Manson especially regarded as the first stage of its life outside the body. This phenomenon was afterwards shown by the American pathologist Mac Callum to imply an act of reproduction of the parasite. Manson was moreover guided by his experience regarding another parasite of the blood, a little worm, filaria, the transference of which from one part of its life-cycle to another he had found effected by the mosquito, and more particularly by special species of the mosquito. By his views set forth on malaria, and by exciting expectation that the solution of the malaria problem was to be found in the direction he indicated, Manson gave an impulse to the further testing of the mosquito-theory and at last to its being established. Manson, who lived in England, had no opportunity of taking up the experimental work of the problem. **The solution came from India**.

Malaria

How is it caused?

Malaria is a serious disease caused when a parasitic single celled organism, called plasmodium, enters the red blood cells. It is transmitted by several different species of mosquitoes of the genus anopheles that includes many that are carriers of the malarial parasite (plasmodium). The most severe form of malaria is caused by the parasite **plasmodium falciparum.** Generally, mosquitoes carrying malaria are found in tropical and sub-tropical climates.

Symptoms of malaria

After an incubation period of about 2 – 5 weeks, there is a sudden attack of shivering followed by a high fever of about 104^0F. This is often accompanied by headache and vomiting that lasts for several hours. These symptoms may occur at interval of 2 – 3 days, depending on the type of malaria. If the disease is not treated, the symptoms may recur at irregular intervals and even for many years.

How is malaria diagnosed and treated?

Though periodic bouts of shivering and high fever are symptomatic of malaria, only a blood examination can reveal the presence of malarial parasites. Initial treatment is with the drug chloroquine. Unfortunately, the parasite plasmodium falciparum is often resistant to chloroquine and many other drugs.

Anopheles : a vector of Malaria

Ronald Ross

It was at this juncture that Ronald Ross entered the arena. He was born in Almora, India, on May 13, 1857 — the year of the great Indian uprising — as the son of Sir C.C.G. Ross, a general in the English Army. Ross received an English dame and boarding school education. Subsequently he studied medicine at St. Bartholomew's Hospital, London, but with little enthusiasm. Although he had bowed to his father's wish that he not become an artist, his passionate interest in the arts took up much of his time. Ross published plays, short dramas, romances, fables, and poetry. He

MALARIA'S CONQUEROR and the mosquito he defeated are affectionately caricatured in a 1908 cartoon published by a newspaper in the British colony of Mauritius. The colony's hero was Sir Ronald Ross, a British Army surgeon, who had proved nine years earlier that malaria was transmitted by the bite of the Anopheles mosquito, and not by malaria (Italian for "bad air"). where malaria had spread with increasing ferocity for 40 years, Ross ordered that the mosquito-breeding swamps be drained, and thus halted the epidemic.

was married in 1889 to Rosa Bloxam and had two sons and two daughters. He was elected to the Royal Society in 1901 and knighted in 1911.

Apart from the arts, Ross had an abiding interest in mathematics, much of his self-education in the subject being undertaken while he was serving in the Indian Medical Service (1881-1888). Ross became more and more conscious of medical problems the longer he remained in India. Later he wrote: "I was neglecting my duty in the medical profession. I was doing my current work, it was true; but what had I attempted towards bettering mankind by trying to discover the causes of those diseases which are perhaps mankind's chief enemies?"

In India, Ross succeeded in demonstrating the life cycle of the parasites of malaria in mosquitoes. Ross collected and identified various kinds of mosquitoes, dissected their guts and in August 1897 found his quarry in Anopheles mosquito that had just fed on a malaria patient. December 18, 1897 issue of the British Medical Journal reported that Dr. Ronald Ross discovered malaria cysts containing sporozoites (the same parasite Laveran had seen in the blood of his patients) in the stomach wall of anopheline mosquitoes that fed on a malaria patient. By July 1898, malaria transmission through the mosquito was established.

In 1899, Ronald Ross joined the Liverpool School of Tropical Medicine. He was immediately sent to West Africa to continue his investigations, and there he found the species of mosquitoes which convey the deadly African fever. In 1901, Ross was elected a Fellow of the Royal College of Surgeons of England and a Fellow of the Royal Society. In 1926, he assumed the post of Director in Chief of the Ross Institute and Hospital of Tropical Diseases and Hygiene, which had been created by the admirers of his work. During his active career, Ross' interest lay mainly in the initiations of the measures for the prevention of malaria in different countries of the world. He carried out surveys, initiated schemes, and established organisations for the prevention of malaria in several countries and places including the planting industries of India and Sri Lanka. Probably his greatest contribution was the development of mathematical models for the study of the epidemiology of malaria - that is, the causes, distribution and control of the diseases. Ronald Ross received the Nobel Prize for Physiology or Medicine in 1902 for his monumental work.Ronald Ross died in London on 16 September 1932 at the age of seventy five.

Mosquito Trail Continued

Unlike most of his colleagues in the Indian Medical Service, Ross was research-minded. In 1888, during his first furlough in England, he earned the newly established Diploma of Public Health and took a course in bacteriology. On returning to India, he studied malaria, initially believing that it was caused by intestinal auto-intoxication. During Ross's next furlough in England (1894) his successful, far-reaching malarial studies were initiated. This was due in large measure to the influence of Patrick Manson, for three reasons a key figure in Ross's contribution to the unravelling of the life history of the malarial parasite. First, Manson demonstrated convincingly to a skeptical Ross the correctness of Alphonse Laveran's pioneering observations of 1880: that the blood of malarial patients contained pigmented bodies of parasites. Second, Manson propounded a theory that mosquitoes transmitted malaria. Third, through an extensive exchange of correspondence with Ross, he helped to sustain the latter's researches in India during more than three years of difficulties that arose not only from problems of technique and of obtaining volunteer patients, but also from regimental duties and unsympathetic superiors.

Patrick Manson

In essence the problem Ross set himself — to prove Manson's hypothesis that mosquitoes transmitted malaria — was enormous, **for he had to contend with two variables : a variety of mosquitoes and a variety of parasites. The questions were which mosquito was the vector and which parasites were the malarial parasites (now known to be species of plasmodium, a protozoan involving two different**

Manson and his characteristic modesty

In 1890, Manson had set up a practice in London and was appointed Physician to the Seamen's Hospital, where he had access to many cases of tropical disease. He carried out prolonged observations on the "exflagellation" of malaria and, in a paper published in 1894, postulated that the process was a normal part of the life cycle of the parasite in the stomach of the mosquito. In the same year he met Ronald Ross, with whom, after showing him the malaria parasite, he spent long hours discussing the mosquito-malaria theory. Largely as a result of pressure on the India Office brought to bear by Manson, Ross was dispatched to India the following year to investigate the theory. Manson's advice was to "follow the flagellum", and Ross soon succeeded in observing exflagellation in the stomach of the mosquito. But the problem of following the parasite into the tissues of the mosquito, of which only one species is suitable for development, proved to be a Herculean task. Throughout the months of investigation that followed, Manson maintained a continuous correspondence with Ross. In August 1897 Ross dissected a new type of mosquito (Anopheles) that had fed on a malaria patient, and in it he found pigmented round bodies on the stomach wall. The pigmented bodies were sent to Manson, who confirmed their significance. Soon afterward Ross was removed to an area where human malaria was absent, and there he applied himself to the study of *Proteosoma*, a malaria parasite of sparrows. From this study he was able in 1898 to describe its complete life cycle in the mosquito. The discovery was announced by Manson at a meeting of the British Medical Association in Edinburgh. Ross fully acknowledged the part played by Manson; but Manson, with characteristic modesty, disclaimed any credit save that of having "discovered" Ross.

hosts in its life cycle. There are more than hundred species of plasmodium, but only four species have human as their natural host. See box)

The main points in Ross's contributions to the problem during 1895 – 1898 can be summarized as follows:

First, Ross demonstrated that volunteers who drank water contaminated with infected mosquitoes (including larvae) failed to contract the disease. This, along with his earlier doubts that aerial and water contamination provided a ready explanation for the epidemiology of malaria, did much to direct his attention to the possibility that transmission might be via mosquito bites (a point of view expressed by A.F.A.King in 1883). Ross apparently was ignorant of King's work until 1899; and in fact he met continual problems because of a shortage of scientific literature in India, above all in connection with identifying and classifying mosquitoes.

Giovanni Battista Grassi

Malaria Parasites

Malaria is caused by PLASMODIUM, a Protozoan involving two different hosts in its life cycle. There are more than hundred species of Plasmodium, but only four species have human as their natural vertebrate host. They are :

P. vivax:

i. Widely distributed.
ii. New generation of merozoites formed every 48 hours causing fever.
iii. Incubation period is 10 days.

P. ovale :

i. Found in West Africa and South America.
ii. Fever comes every 48 hours (due to the formation of new generation of merozoites)
iii. Incubation period is 14 days.

P. malariae :

i. Found in both tropics and temperate zones but not very widespread.
ii. Fever comes after every 72 hours.
iii. Incubation period varies from 27 – 37 days.

P. falciparum :

i. Common in tropics, including India.
ii. Most dangerous as it causes almost continuous fever but the course is shorter and without relapses.
iii. Incubation period is 10 days.

The arthropod hosts are females of certain species of Anopheles mosquito. There is no animal reservoir for any of these human parasites except possibly chimpanzees for *P. Malariae*. Malaria therefore cannot be acquired in uninhabited regions, for malaria to thrive there must be infected human beings and plenty of man-biting Anopheles, and easy contact between the two. *Plasmodium* also parasitizes lizards, birds and mammals but these differ from human malaria parasite.

Second, Ross's studies on the parasites in mosquitoes involved learning how to identify mosquitoes and to dissect their internal organs. From the beginning Ross was especially concerned with the "motile" parasitic filaments found in mosquito stomachs. The question was what happened to them. While he failed to recognize that the filaments were gametes (a point first appreciated by W. G. Mac Callum in 1897), Ross's supposition that they developed into another stage stood him in good stead, for it ensured that he spaced out his examination of individual mosquitoes from groups that had fed on malarial patients. Even so, it was not until 20 August 1897 that he observed in the stomach wall of a type of mosquito he had not hitherto encountered (a malarial vector *anopheles*, rather than the *Culex* and *Stegobium* he had been investigating for over two years) a cyst containing granules of blank pigment similar to the pigmented bodies initially observed by Laveran. 20 August 1897 was called "Mosquito Day" by Ross.

Third, owing to the administration of the Indian Medical Service, Ross was unable to continue his studies on this stimulating find, which he had immediately recognized, should lead him to unravel the complete life cycle. Some months later, however, he was able to study malaria in caged birds (Avian malaria) and to demonstrate the parasite life cycle, including stages in mosquito salivary glands. He also was able to demonstrate that mosquitoes could transmit malaria directly from infected to healthy birds.

Ross's discoveries into malaria were immediately followed by a series of important works. The Italian investigator, Grassi, in association with his colleagues, Bignami and Bastianelli, proved that the human malarial parasite not only in its early stage, already detected by Ross, but also in its further development undergoes the same evolution that Ross described for the growth of the avian malarial parasite in the body of the mosquito. Grassi also precisely indicated the species of mosquito that are of import for the malaria of man.

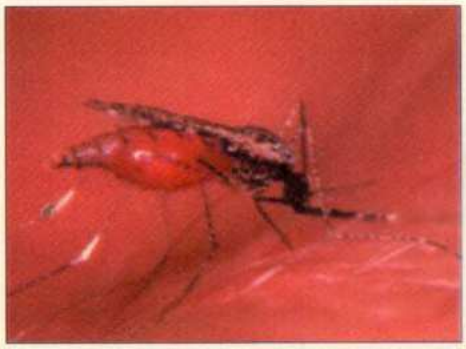


Fig. 2 : Anopheles – How she sits

Life Cycle of Plasmodium

Plasmodium spends its life cycle in two hosts — Man and Mosquito (anopheles). Man is the primary host in whom it causes the disease and harbours the adult stages of the parasite (see box).

Mosquito is the secondary or intermediate host. It is also known as the vector or the carrier of the disease as it carries the parasite (plasmodium) from an infected host to a fresh human host. Having two hosts, Plasmodium ensures continuance of its existence in the event of death of any one host. Therefore the complete life-cycle of the human malaria parasite embraces i) a period of development and infection in man, and ii) a period of development in the mosquito. **But in these two hosts the life cycle shows three phases.**

Schizogony - a cycle of growth and asexual multiplication in the liver cells and erythrocytes of man.

Gamogony - sexual cycle which begins in man and is completed in the stomach of anopheles.

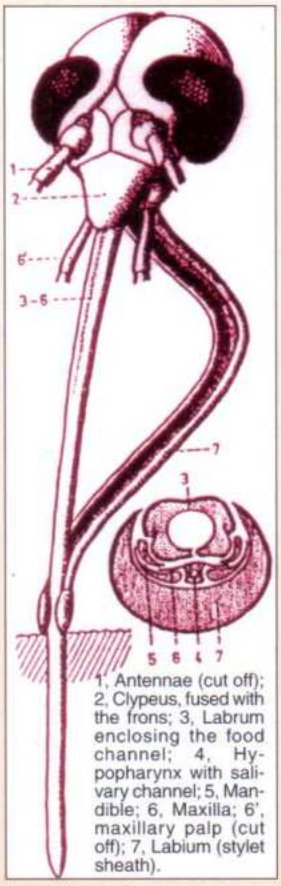
Sporogony -A cycle of asexual multiplication or sporogony in the stomach of anopheles.

Let us consider the three stages in some detail.

Schizogony

When an infected female Anopheles (Figure 2) bites man for its blood meal (Figure 3) it inoculates the malarial parasites into the human blood alongwith the saliva. This infective stage is a minute sickle shaped sporozoite which enter in thousands and remain in the blood for about half an hour. After that they enter the parenchymatous cells of the liver to escape from phagocytic white blood corpuscles and multiply in number. Basically schizogony is a phase of growth and multiple fission to form the merozoites. It is subdivided into the following phases:-

Sporozoites enter the liver cell, enlarge to form a schizont which divides to form about 1000 small spindle shaped merozoites called cryptozoites. They are immune to medicine and also to the resistance of the host. This is called the pre-erythrocytic phase.



1, Antennae (cut off); 2, Clypeus, fused with the frons; 3, Labrum enclosing the food channel; 4, Hypopharynx with salivary channel; 5, Mandible; 6, Maxilla; 6', maxillary palp (cut off); 7, Labium (stylet sheath).

Fig. 3 : Head of a mosquito in the act of biting, with schematic cross section through the proboscis

Cryptozoites (merozoites) enter new liver cells, grow into schizonts which again divide to form metacryptozoites (merozoites). This phase may continue in fresh liver cells or attack erythrocytes. Those which attack the erythrocytes are called metacrypto-merozoites. This is called the exo-erythrocytic phase.

On entering the RBC, the merozoites begin to feed on the corpuscles to form the adult stage or the trophozoite. The trophozoite grows further at the expense of the corpuscles to form the signet ring stage, amoeboid stage and schizont respectively. These are characterized by the presence of haemozoin granules and Schuffner's dots. The schizont ruptures to liberate the schizozoites (merozoites) and toxins which cause the periodic paroxysms (bouts of chills and fevers) and other symptoms as the cycle is repeated every 48 hours in new erythrocytes in case of P. Vivax – a species of plasmodium. This is called the Erythrocytic phase.

Sometimes during the post erythrocytic phase, some merozoites produced in erythrocytic schizogony reach the liver cells and undergo schizogonic development in liver cells.

Gamogony

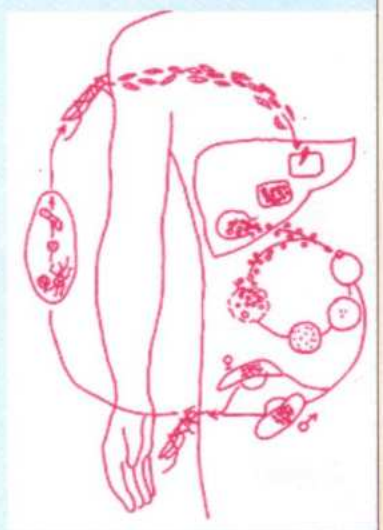
It is the sexual phase beginning in man but completed only in the female Anopheles. Some merozoites enlarge and produce pigment to form the gametocytes. Megagametocyte or female gametocyte is round with food laden cytoplasm and a small eccentric nucleus. Microgametocyte or male gametocyte have clear cytoplasm and a large central nucleus.

The gametocytes can develop further only in the body of a mosquito where suitable temperature is available.

When mosquito sucks the infected blood, the corpuscles are dissolved but the gametocytes are not digested. Microgametocytes undergo exflagellation i.e. the nucleus divides into 4-8 nuclei around which cytoplasm collects to form long flagellated structures called microgametes which break and begin to swim in the stomach of the mosquito.

In the megagametocyte the nucleus divides into two, one of which projects out as the polar body. Fertilization takes place to form zygote. Sexual cycle is completed in any kind of mosquito but further development is possible only in the female Anopheles.

Life cycle of plasmodium falciparum



The life cycle of all *Plasmodium* species is complex. Infection in humans begins with the bite of an infected female Anopheline mosquito. Sporozoites released from the salivary glands of the mosquito enter the bloodstream during feeding quickly invade liver cells (hepatocytes). Sporozoites are cleared from the circulation within 30 minutes. During the next 14 days in the case of *P. falciparum*, the liver-stage parasites differentiate and undergo asexual multiplication resulting in tens of thousands of Merozoites which burst from the hepatocyte. Individual merozoites invade red blood cells (erythrocytes) and undergo an additional round of multiplication producing 12-16 merozoites within a schizont. The length of this erythrocytic stage of the parasite life cycle depends on the parasite species. The clinical manifestations of malaria, fever and chills, are associated with the synchronous rupture of the infected erythrocyte. The released merozoites go on to invade additional erythrocytes. Not all of the merozoites divide into schizonts, some differentiate into sexual forms, male and female gametocytes. These gametocytes are taken up by a female anophylis mosquito during a blood meal. Within the mosquito midgut, the male gametocyte undergoes a rapid nuclear division, producing 8 flagellated microgamtes which fertilize the female macrogamete. The resulting ookinete traverses the mosquito gut wall and encysts on the exterior of the gut wall as a oocyst. Soon the oocyst ruptures, releasing hundreds of sporozoites into the mosquito body cavity where they eventually migrate to the mosquito salivary gland.

Sporogony

Those zygotes which penetrate the stomach wall undergo further development or else they elongate and pass out with the faeces as the ookinese or the dying stage. The zygote comes to lie below the outer epithelium where it becomes encysted to form the oocyst. The oocyst absorbs nourishment, grows about 5 times in size. It's nucleus divides repeatedly to form many nuclei and cytoplasm develops large vacuoles called zoitoblasts. Nuclei arrange themselves around the margin of vacuoles. Each

Nobel Prizes awarded for work on Malaria

Here is a list of Nobel Prizes awarded for work on Malaria or related topics.

1902	Ronald Ross	Great Britain	in Physiology Medicine for his work on malaria, by which he has shown how it enters the organism and thereby has laid the foundation for successful research on this disease and methods of combating it
1906	Camillo Golgi	Italy	in Physiology Medicine for their work on the structure of the nervous system
	Santiago Ramón y Cajal	Spain	-do-
1907	Charles Louis Alphonse Laveran	France	in Physiology Medicine for in recognition of his work on the role played by protozoa in causing disease

nucleus acquires some cytoplasm to form a slender spindle shaped sporozoite. Later the sporozoites break loose and form a tangled mass in the oocyst.

About 50 wart like oocysts are formed in the stomach of a single mosquito and each oocyst may have 10,000 sporozoites. The sexual phase takes about 10-21 days in the mosquito. When oocysts burst, sporozoites are liberated and reach the salivary glands of the mosquito. Thus the sporozoite is the infective stage which reaches fresh host when it bites a man. Four species of Plasmodium cause malaria in man but their life-histories are very much alike with minor differences (see Box).

A Return Engagement

In the heydays of the war on malaria - especially from the World War II through 1970s, widespread DDT spraying campaigns were organised including in India to stifle the annoying blood suckers. Larvicides and insecticides were used to kill mosquitoes before they could carry the parasite between the victims. In fact, once upon a time, malaria seemed destined for the history books, since it was supposedly caught in a pincer attack. But, **DDT played havoc with the environment – it killed the birds and beneficial insects as well as anopheles mosquitoes**. Further, a cheap, plant derived medicine chloroquine was available to kill parasites before they gained a foothold in their victims.

Then nature took over.

With a little help from modern ecological disturbances and tight government budgets:

Most important species of malaria vectors (i.e. agents - mosquitoes in this case) evolved resistance to one or more insecticides.

Malaria parasites in particular plasmodium falciparum, evolved resistance to chloroquine and then to several successor drugs.

Increases in travel and international trade moved drug-resistant parasites around the globe.

As mosquito-control efforts expanded, they grew more expensive, forcing some governments to abandon them.

The unfortunate result was a resurgence of malaria. There were major programs to control malaria, and they were quite successful. But the need to use more expensive insecticides over a broader range meant they were not sustainable.

Managing the scourge

Indeed, World Health Organisation (WHO) had initiated strategies for the global eradication of malaria in the mid-1950s. But, in 1960s, chloroquine resistant strains of plasmodium falciparum had arisen. **This was the result of over usage and probably under dosage of chloroquine**. At the time, there were no drugs to treat chloroquine-resistant malaria except the ancient, quinine. Quinine has now been completely synthesized, its synthetic analogue is called mefloquin. A "new" anti-malarial is a drug called Qinghaosu that is derived from the sweet wormwood (Qinghao) plant (genus Artemisia). It has been used in China for more than two thousand years to treat fevers associated with malaria. The drug has been shown to be effective in the treatment of the most deadly forms of falciparum malaria and has been effective against strains of plasmodium falciparum that are solidly resistant to chloroquine.

In 1967, WHO realized that the global eradication of malaria was impossible for a variety of reasons and the focus shifted to control of the deadly disease. Since the idea of eradicating mosquitoes was not realistic, the efforts were directed towards the reduction and management of their population below the threshold that would cause disease. (It may be remarked that besides malaria and filaria, the deadly dengue fever is also spread by mosquitoes belonging to a different species, viz. Aedes Aegyptes).

Only a combination of the following measures would help control the scourge of mosquitoes:

1. **Public Education** to explain to the people that some disease carrying mosquitoes breed in puddles of water, air coolers, tyres and other artificial containers, including flower pots around the house.
2. **Behavioural controls** like sleeping under mosquito nets - preferably soaked in insecticide.
3. **Chemical controls** with focussed use of less hazardous insecticides.
4. **Biological controls** through introducing organisms that eat or otherwise harm mosquitoes, or their larvae.

We have come a long way since Ronald Ross discovered malaria parasite in the gut of the female anopheles mosquito. Though the cause of malaria was discovered nearly a century ago by him, the scourge of the mosquito still persists. Mosquitoes are back with vengeance, and its guest plasmodium falciparum has not only developed resistance to quinine, but continues to develop strains resistant to even newer drugs. This war is continuing. We know how malaria is caused, but we have yet to develop strategies and means to control the spread of the disease. It is imperative that we channelise our efforts in controlling and managing the mosquito menace, just the way Ross did throughout his life.

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Fighting the War Once Again

The National Malaria Health Programme in the early 1950's was a vigorous national health effort. Combing the length and the breadth of the country, the health workers sprayed DDT and other insecticides so as to wipe out mosquitoes that bred in stagnant pools of water, and also distributed quinine pills house to house. In the 1960's, the war against malaria appeared to have been won. But, malaria returned with greater force – not just in India, but the world over. The war is being fought once again. 40 per cent of the world's population lives in malaria endemic areas, 500 million clinical cases and about 3 million deaths each year thanks plasmodium falciparum! Plasmodium has resurfaced in mutant strains that are resistant to quinine, and its more potent cousins, chloroquine and mefloquine. Other strains of the parasite, like plasmodium vivax hit at the brain and the central nervous system.

What could be the strategy then to wipe out malaria? One could attempt to attack the parasite by targetting some processes or metabolic paths crucial for its survival, or make a vaccine that can be inoculated into us developing immunity against it. Alternatively, spray insecticides to kill mosquitoes, and take steps not to allow stagnant pools of water to collect where mosquitoes breed. Thus, these are the broad strategies to fight malaria – hit at the parasite through drugs that disable it, develop a vaccine that offers us immunity against it, and target the mosquito which is the carrier of the parasite, by insecticide spray and removing its breeding grounds. Let us consider them briefly.

Some people are trying clever strategies on mosquitoes. These include genetically engineered mosquitoes in such a manner that they become unable to carry the parasite within, or shuffle the genes of the mosquito in such a manner that it would kill the rider within – called the transposon technology. There are also attempts to make the mosquitoes sterile by exposing them to raidation, and then unleash millions of these mosquitoes in the breeding grounds and let them mate. Over 5-6 generations, the population could be wiped out.

There are attempts to make vaccines against malaria, in our country as well as in other parts of the world. Each group looks at what it considers to be an essential component in the assembly of the parasite or body chemistry, and using this component as the antigen, and tries to make a vaccine that would produce the desired antibody. In our country, the work is on at ICGEB, New Delhi, and CDFD, Hyderabad. Since as of today, there is no malaria vaccine, we await the result from these labs with much hope.

The third front is the development of drugs against the parasite. In earlier times, drugs were identified and developed empirically. Native medical practice and folk tradition were of occasional help. This is how quinine was found to be useful. However, the malaria parasite lives on human blood and liver where it runs through its entire life cycle. It degrades the proteins of our red blood cell and lives on the digested soup. While doing so, it needs to watch out for the iron-containing component of the red cell hemoglobin, called heme, which can puncture holes in the parasite's cells and leak them to death. The parasite packages off the heme as safe garbage in a lump of a pigment called hemozoin. (It is this pigment that serves as the tell-tale sign of the presence of the parasite in our body). The continuous playing out of its life cycle between the tissues of the body makes the task of containing the parasite difficult. The drug we use should not be toxic to the liver, should not cause anemia or blood loss, and should target the parasite alone and not the surroundings of the zone that it colonizes. As it goes through its drama of devastation, it changes shape, size, the surface coat and the biochemical strategies of its survival. The researcher who wishes to devise an effective antimalarial drug needs to address this issue of multiple avatar or reincarnation of the pathogen.

As noted earlier, quinine had lost its effectiveness over the years in many parts of the world, since the plasmodium parasites have developed genetic strains or variants resistant to it. Better drugs of the quinine class have been developed over the last 50 years, notably chloroquine and mefloquine, by tinkering with the chemical structure of the parent quinine. Both have been widely effective and popular. Soon enough, chloroquine resistant strains of the parasite emerged, and some groups tried to attack this problem by devising a combination drug called Fansider (also called PM/SD). Strains resistant to this drug too emerged! Now three other drugs are suggested – one of them, called holopantrine, is effective against PM/SD resistant strains. In the meantime, two products coming out of Chinese medicines have proved useful – artemesinin, a plant product and the other being pyromaridine, but the action of the latter is unknown as of now.

Parasites breed fast and prolifically, these alongwith the feature adaptive mutations, makes the emergence of strains resistant to any newly introduced dru a frustrating reality. how does one overcome this difficulty and attempt to conquer disease of this kind? Namita Surolia of Jawahar Lal Nehru Centre for Advanced Scientific Research, Bangalore, and Avdesh of Indian Institute of Science, Bangalore (Namita's husband) argued that no matter what mutations or strains there may be – all of them must share some inescapable physological or biochemical features, mutations in which would be lethal and not let the parasites survive. It is these vital processes that should be identified and chosen as drug targets. Very recently, the couple has been able to identify one such target feature. Organisms like plasmodium parasites are not fully competent and self-sufficient in their fatty acid production which are important structural materials and energy sources for them. They rely symbiotically on organelles called apicoplasts residing in their cellular compartment; for some enzymes needed for the process. Now, these organelles could be thought of as drug targets. This is what Namita and Avdesh did in their quest for an effective anti-malarial drug. They reasoned that parasites cannot afford to bear any mutation in their apicoplast; it is too vital an organelle to become inefficient or disabled! Next, having realised that the apicoplast aids in making fatty acids for use by the parasites, they started looking for inhibitors of enzymes that catalyse the synthesis of fats and fatty acids. One such inhibitors is the antibiotic Triclosan. Incidentally, Triclosan is used as a broad spectrum/antimicrobial in pastes, mouth wash, shampoo and so forth.

Surelias tested the effect of Triclosan on the growth of P. falciparum and found that it arrested the growth of the parasite at concentrations as low as one milligram of the stuff in 3 litres of the medium! The discovery by the Surolia couple that Triclosan is an antimalarial drug has been well secured. However, they warn that Triclosan should be used judiciously, or in combination with other antimalarials, so as to avoid the problem of resistance currently seen with drugs like chloroquine. They also found that another antibiotic Cerulenin acts synergistically with Triclosan. Indeed, this discovery of Surolias could pave the way for developing more patent analogues of Triclosan for treating malaria.

– Based on an article by D. Balasubramanian

Malaria: Glossary

Important terms used in connection with Malaria are given below. The terms given do not necessarily appear in the present article.

Anopheles : A genus of mosquitoes in the family Culicidae; members are vectors of malaria, dengue, and filariasis.

Anopheline : Pertaining to mosquitoes of the genus *Anopheles* or a closely related genus.

Cinchona : The dried, alkaloid-containing bark of trees of the genus *Cinchona*.

Cinchonine : $C_{19}H_{22}N_2O$. A colourless, crystalline alkaloid that melts at about 245°C; extracted from cinchona bark, it is used as a substitute for quinine and as a spot reagent for bismuth.

Cyst : A normal or pathologic sac with a distinct wall, containing fluid or other material.

Cytoplasm : The protoplasm of an animal or plant cell external to the nucleus.

DDT : Common name for an insecticide; melting point 108.5°C, insoluble in water, very soluble in ethanol and acetone, colourless, and odorless; especially useful against agricultural pests, flies, lice, and mosquitoes. Also known as dichlorodiphenyltrichloroethane.

Dengue : An acute viral disease of man characterized by fever, rash, prostration, and lymphadenopathy; transmitted by the mosquito *Aedes aegypti*. Also known as breakbone fever; dandy fever.

Epidemiology : The study of the mass aspects of disease.

Filaria : A parasitic filamentous nematode belonging to the order Filaroidea.

Filariasis : A disease due to the presence of hairline nematodes (filariae) in humans, including *Wuchereria bancrofti, W. pacifica,* and *Onchocerca volvulus*.

Flagella : Relatively long, whiplike, centriole-based locomotor organelles on some motile cells (sing. Flagellum).

Flagellate : 1. Having flagella. 2. An organism that propels itself by means of flagella. 3. Resembling a flagellum.

Gamete : A mature germ cell.

Gamogony : Spore formation by multiple fission in sporozoans. Sexual reproduction.

Inoculation : Introduction of a disease agent into an animal or plant to produce a mild form of disease and render the individual immune. Introduction of microorganisms onto or into a culture medium.

Lymphadenopathy : Enlargement or disease of lymph-nodes.

Malaria : A group of human febrile diseases with a chronic relapsing course caused by hemosporidian blood parasites of the genus *Plasmodium*, transmitted by the bite of the *Anopheles* mosquito.

Malaria pigment : Dark-brown, amorphous, micro-crystalline and birefringent pigment found in parasitized erythrocytes, especially with malarial parasites, and in littoral phagocytes of spleen, liver, and bone marrow.

Merozoite : An ameboid trophozoite in some sporozoans produced from a schizont by schizogony.

Motile : Capable of spontaneous movement.

Oocyst : The encysted zygote of some sporozoa.

Organelle : A specialized subcellular structure, such as a mitochondrion, having a special function; a condensed system showing a high degree of internal order and definite limits of size and shape.

Parasite : An organism that lives in or on another organism of different species from which it derives nutrients and shelter.

Paroxysm : 1. A sudden attack, or the periodic crisis in the progress of a disease. 2. A spasm, convulsion, or seizure.

Pathogen : A disease-producing agent; usually refers to living organisms.

Pigment : Any colouring matter in plant or animal cells.

Plasmodium : A genus of protozoans in the family Plasmodiidae in which all the true malarial parasites are placed.

Protozoa : A diverse phylum of eukaryotic microorganisms; the structure varies from a simple uninucleate protoplast to colonial forms, the body is either naked or covered by a test, locomotion is by means of pseudopodia or cilia or flagella, there is a tendency towards universal symmetry in floating species and radial symmetry in sessile types, and nutrition may be phagotrophic or autotrophic or saprozoic.

Quinidine : $C_{20}H_{24}N_2O_2$. A crystalline alkaloid that melts at 171.5°C and that may be derived from the bark of cinchona; used as the salt in medicine. Also known as chinidine; β-quinine.

Quinine : $C_{20}H_{24}N_2O_2$. An alkaloid of cinchona, used principally as an antimalarial drug.

Schizogony : A sexual reproduction by multiple fission of a trophozoite; a characteristic of certain Sporozoa.

Schizont : A multinucleate cell in certain members of the Sporozoa that is produced from a trophozoite in a cell of the host, and that segments into merozoites.

Spore : A uni- or multicellular, asexual, reproductive or resting body that is resistant to unfavourable environmental conditions and produces a new vegetative individual when the environment is favourable.

Sporogony : Reproduction of means of spores. Propagative reproduction involving formation, by sexual processes, and subsequent division of a zygote.

Sporozoa : A subphylum of parasitic Protozoa, typically producing spores during the asexual stages of the life cycle.

Sporozoite : A motile, infective stage of certain sporozoans, which is the result of sexual reproduction and which gives rise to an asexual cycle in the new host.

Trophozoite : A vegetative protozoan; used especially of a parasite.

Zygote : 1. An organism produced by the union of two gametes. 2. The fertilized ovum before cleavage.

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Intellectual Property Rights
(Part-IV : Glossary and Sources)

❑ *Subodh Mahanti*

In the first three parts of the article we have briefly covered general aspects of intellectual property rights, patent system, industrial designs, trademarks and international and regional conventions treaties. In this part we have included a list of IPR-related terms with definitions and some sources including relevant websites.

Abandonment : Dropping of an invention, a part of an invention (e.g. certain features or claims), an application or a patent.

Appeal : Legal remedy against decisions by patent examiners or courts

Applicant : Natural or legal entity in the name of which a patent application is filed e.g. an organisation or the inventor.

Assignee : Inventor(s) who legally transfer his or her or their rights (in part or whole) to the invention to another person or organisation.

Biopiracy : It means exploitation of existing genetic resources and gaining control on them through wrongfully granted patents.

Bioprospecting : The use of genetic resource as permitted by the Convention of Biodiversity through rightful material transfe agreement is known as bioprospecting.

Breeder's Privilege: Permits use of one protected variety to breed another new variety without authorisation of the original plant breeder.

Cautionary Letter : The owner of a patent can send an admonition/cautionary letter to a third party if he/she/it has realised that his/her/its patent rights are infringed.

Claim : An invention claim defines for what protection is being sought. It has a decisive impact on the material scope of a patent. Besides the main claim there may be subordinate claims.

Compulsory license : In case of insufficient working or practice of an invention the patent owner may be forced in some states to grant (subject to certain conditions) license to another who intends to make use of the invention.

Counterfeiting : It means the imitation of a product. The counterfeit is not only identical in the generic sense of the term as a bag might be but it also gives the impression of being the genuine product originating from the genuine manufacturer or trader.

Cross license : Mutual license, for example in case of selection invention.

Defendant : The person(s) being sued for infringement constitutes the "defendant".

Dependency : A patent 'A' is dependent on another patent 'B', if use of the subject of patent 'A' would infringe patent 'B'.

Dependent License : Compulsory license for the owner of younger patent, which is dependent on an elder patent for example in case of selection invention. Such license may be subject to the certain conditions.

Design or Industrial Design : As per WIPO guidelines a design or industrial design "covers any composition of lines or colours or any three dimensional form, provided that such composition or form gives a special appearance to a product of industry or handicraft and can serve as a patent."

Disclaimer : Express waiver of a part of a subject matter which is within the scope of the original patent.

Design Patent : A design patent covers the appearance of an object - new, original, ornamental and unobvious designs for articles of manufacture.

Disclosure : Illustrative description of an invention given in the patent application in such a way that a person skilled in the art would be able to understand it.

Discovery : The discovery implies only a perception, not its use. A discovery as such is not patentable.

Distinctive Signs : A sign is distinctive for the goods to which it is to be applied when it is recognised by those to whom it is addressed as identifying goods from a particular trade source, or is capable of being so recognised.

European Patent Application : Application for a European patent. The patent examination is made centrally for all designated countries by the European Patent Office which also gives out a uniform application number and a uniform filing date etc.

European Patent Convention : Multilateral treaty that provides the granting of European Patents. The treaty was signed on October 5, 1973 and it came into effect on October 7, 1977. Member states of the treaty are : States of the European Union plus Switzerland, Cyprus, Lechtenstein and Monaco.

European Patent Office : Supernational patent office which grants patents under the European Patent Convention.

European Patent : A patent granted by the European patent office. The European patent has in the designated states for which it is granted the same effect as a national patent .

Examination : Check of the field subject matter of the

invention with regard to patentability especially novelty and inventiveness.

Examiner : A person having necessary qualification appointed by the patent office to examine an application in the examination (granting) procedure to decide on the patentability.

Expiry : End of the legal term of a proprietary right.

Example : Specific illustration of an invention by describing an experiment that was carried out. It is an important part of the disclosure supporting patentability.

Farmer's right : It entitles a farmer to use farm-saved seeds for growing subsequent crops on his/her own land or on leased land or for traditional exchanges in the village community.

Filing : Submissions of an application at a patent office.

Filing Date : Official date of filing of the patent application at the respective patent office.

Final Rejection : Refusal of a patent office to grant a patent for procedural reasons or if the subject of invention is unpatentable. The applicant has the right to file an appeal in High Court.

Geographical Indications : TRIPS Agreement defines geographical indications as "indications which identify a good as originating in a territory of a member, or a region or locality in that territory, where a given quality, reputation or other characteristic of a good is essentially attributable to its geographical origin."

Grace Period : In patent laws of a few countries a specific period is provided before the filing of a patent application.

License of Right: A patent may be endorsed with the words "license of right" three years after it is sealed. In such cases any person may obtain as a matter of right a license without having to establish a case for a compulsory license.

Industrial Applicability : A purely theoretical invention is not patentable. It must be of a kind which can be applied for practical purpose. If the invention is intended to be product or a part of a product then the intended product must be capable of being made in practice. And if the invention is intended to be a process or part of a process then the intended process must be capable of being carried out in practice.

Infringement of patent : Illegal use of a patented invention.

Infringement Suit : Suit of a patent owner in High Court against the unauthorised user of an invention protected by patent.

Intellectual Property : Intellectual Property means the property in intellectual creations, particularly technological invention and literary and artistic works.

Interlocutory Injunction : It means that as part of an infringement proceeding the plaintiff may pray for "interim relief" to restrain the defendant from continuing the act of infringement till the case is completely heard and disposed.

International Patent Application : A patent application filed under the Patent Co-operation Treaty (PCT). The application may be filed at the so-called receiving office and it will remain valid for those States party to the treaty that are wished by the applicant.

International Search Authority : There are several International Search Authorities that are listed by WIPO viz., Australian Patent Office, The Austrian Patent Office, The Chinese Patent Office, The European Patent Office, The Japanese Patent Office, The Korean Industrial Property Office, The Russian Agency for Patents and Trademarks, The Spanish Patent and Trademark Office. The Swedish Patent Office and the US patent and Trademark Office.

International Preliminary Examination Authority (IPEA): These are the patent offices that have been authorised by WIPO to function as IPEA to conduct a preliminary examination of the PCT applications. All the International Search Authorities, except 'The Spanish Patent and Trademark Office, are also IPEAS.

Inventor : A person who first made the invention and filed a patent application for the same.

Lapsed Patent : To keep a patent in force the patentee needs to pay a yearly fee. In case the patentee fails to pay the renewal fee within the prescribed period the patent in question is considered lapsed.

License : A legal permit given by a patentee to one or more persons to make, use or exercise the patent owned by patentee.

Licensing Agreements : One of the most important activities of enterprises in connection with industrial property concerns the conclusion of license agreement in the framework of industrial expansion or marketing projects. Most transfer of technology agreements, joint ventures, franchise agreements and other strategic alliances included some sort of license or authorisation to use protected invention, design or distinctive signs. Confidential known-how and trade secrets are often included in such agreements.

Most-Favoured-Nation Principle (MFN) : The TRIPS Agreement contains a principle, the most-favoured-nation principle, which has not traditionally been provided for in the context of intellectual property rights at least on the multilateral level. The Principle provides that any advantage, favour, privilege or immunity granted by a Member to the nationals of any other country (whether a Member or not) shall be accorded immediately and unconditionally to the nationals of all other Members, with certain specified exemptions.

Novelty : Obligatory criteria of patentability that is the subject matter of an invention must be new or else not patentable. It must be emphasised that novelty is not something which can be proved or established, only its absence can be proved. An invention is new if (before

Some of the abbreviations that one may encounter while going through IPR literature.

ARIPO	:	The African Intellectual Property Organisation
CBD	:	Convention of Biodiversity
CIS	:	Commonwealth Independent States
CGPDT	:	Controller General of Patents, Designs and Trademark, Mumbai
COICA	:	Co-ordinating Body of Indigenous Organisation of the Amazon Basin
CPC	:	Community Patent Convention
CSIR	:	Council of Scientific and Industrial Research, New Delhi
DSIR	:	Department of Scientific and Industrial Research, New Delhi
DBT	:	Department of Biotechnology, New Delhi
DST	:	Department of Science & Technology, New Delhi
EAPC	:	The Eurasian Patent Convention
EPO	:	European Patent Office
EPC	:	European Patent Convention
FAO	:	Food and Agriculture Organisation
GATT	:	General Agreement on Tariff and Trade
GRIPS	:	Group Intellectual Property Services
ICAR	:	Indian Council of Agricultural Research, New Delhi
ICMR	:	Indian Council of Medical Reserach, New Delhi
IPC	:	International Patent Classification
IPR	:	Intellectual Property Rights
ISA	:	International Search Authority
IPEA	:	International Preliminary Examination Authority
ITA	:	Information Transfer Agreement
ICTA	:	The International Centre for Technology Assesment, Washington, DC
IPMD	:	Intellectual Property Management Division, CSIR, New Delhi
JPO	:	The Japanese Patent Office
KIPO	:	Korean Industrial Property Office
MTA	:	Material Transfer Agreement
NAFTA	:	The North American Free Trade Agreement
NRDC	:	National Research and Development Council, New Delhi
OAPI	:	The Organisation Africaine de la Proprite Intellectualle
PCT	:	Patent Cooperation Treaty
PGI	:	Patent Globalisation Index
PGR	:	Plant Genetic Resources
PIC	:	Prior Informed Consent
RFSTE	:	Research Foundation for Science, Technology and Ecology, New Delhi
TRIPS	:	Trade Related Intellectual Property Rights
TLT	:	Trademark Law Treaty
TIFAC	:	Technology Information, Forecasting and Assessment Council, New Delhi
TKDL	:	Traditional Knowledge Digital Library
TKRC	:	Traditional Knowledge Resource Classification
UPOV	:	Union of Protection of Plant Varieties
USPTO	:	United States Patent and Trademark Office
UNCTAD	:	United Nations Conference on Trade and Development
WTO	:	World Trade Organisation
WIPO	:	World Intellectual Property Organisation

the priority date) it has not been available to the public either by oral or written description by prior use or in any other way.

Nullity : It means invalidity of a patent after grant. If invalidity covers only a part of a patent that is called partial nullity. Reasons listed completely in a patent law due to which a patent is liable to be invalidated are known as reasons for nullity.

Nullity Action : Law suit for stating nullity (invalidity) of a patent before a court or patent office.

Patent : A patent is a property right granted by the State to a patentee, excluding others, for a fixed period, from using the patented invention without the consent of the patentee.

Patent Agent : A patent agent is someone who is qualified to act for another to obtain industrial property rights. In India a would-be patent agent has to clear the examination for patent agents which is conducted by the Patent office. In most countries the term 'patent attorney" is synonymous with "patent agent" but in a few countries for example in the USA the former term means someone who is legally qualified in general law and who has additionally passed examination set by the United Sates Patent and Trademark office (USPTO) in order to be qualified to act before it, whereas the latter term is reserved for those who are not qualified lawyers but who have passed the "registration" examination set by the USPTO.

Patentable Subject Matter : In order to be eligible for patent protection an invention must fall within the scope of patentable subject matter. Patentable subject matter is established by statute and is normally defined in terms of the exception to patentability.

Patent Categories : Patent for invention can be grouped into two main categories, namely:

a) Patent for products e.g. chemical compounds, devices etc.

b) Patents for processes (methods) such as process for manufacture or methods of use.

Patent Globalisation Index : The concept of Patent Globalisation Index (PGI) is viewed as a measure of globalisation of patent activity. It is the effective number of corresponding patent application filings in various countries per 'first patent filings' of an invention.

Patentee : The owner of a patent as shown in the Registrar of patents maintained by the Patent Head Office. In India the Patent Head Office is situated at Kolkata.

Patent information : Patent documents provide three different types of interrelated information namely

* technical information
* legal information
* commercial information

Patent laws demand that the inventor disclose the invention clearly and completely so that a person skilled in the art may carry out the invention. At least one mode has to be described and whenever possible drawings to be added for better understanding. In some countries the inventor is required to describe the best known mode for the invention. Patent documents bear the name and address of the inventor and the applicant. This helps to identify who worked on the technology in question and where the invention was made and their interrelations can be ascertained. A patent document is more them a technical publication. A patent or a published patent application has a legal dimension. The legal information conveyed by patent documents is of particular importance for the business policy of any enterprise. A patent document also gives information on the direction

of a competitor's R&D activity. A continuous survey of patent activity can offer certain commercial information.

Patent office : A government or international administrative body which is authorised to receive or examine patent application and grant patents. Indian Patent Office has its headquarters at Kolkata and it functions under Controller General of Patents. Designs and Trademarks (CGPTT). It has three branch offices at Mumbai, Chenai and New Delhi.

Patent Publication: Advertisement/notification of the patent; patent publication is different from publication of the patent application.

Patent Specification : Publication of the patent invention usually edited in printed form by the patent offices.

Phonogram : Phonogram means an exclusively aural fixation (that is it does not include for example, the sound tracks of films or video cassettes), whatever be its form (disc, tape or other).

Pipeline protection : A provision under the GATT in which countries that have no provision for product patent are required to create an intermediate provision of exclusive marketing rights for five years based on product patent granted in any of the member states.

Plaintiff : The patentee or his assignee can file a suit in the High Court for infringement of his patent. They constitute the "plaintiff

Prior Art : Knowledge that is available in the public domain. This becomes very important for the assessment of novelty and inventive step. Prior art may be in the form of lectures, broadcasts, newsletters, magazines, research journal, books, patent specification, instances of public use etc.

Priority Application : First deposition (filing) of a patent application at a patent office for a certain subject matter.

Product Patent : A product patent provides exclusive rights to the product manufactured by any process.

Process Patent : A process patent only protects one process and the product can be manufactured by an alternative process. Process patent provides scope for innovation to develop alternative process.

Protection of Equivalents : The fact that infringement is not only the execution of the literal teaching of a patent claim by a third party but also execution of modifications thereof, for the person having ordinary skill in the art, had been readily accessible at the beginning of the infringing action, the so-called equivalents such as chlorine (Cl) subsistent instead of bromine (Br) in the claim.

Priority Date : The date on which the first patent application is made in India or in other country among the countries notified as "convention countries " by the Government. Many patent related issues are decided based on the Priority Date.

Reference : Written publication (e.g. patent specification, books etc), cited by the patent examiner for denying the existence of an invention.

Revocation : The validity of a patent granted by a Patent office after examining it within the framework of the Patents Act can be challenged. There are prescribed grounds for challenging a patent. When a challenge is upheld by the High Court, the patent becomes "invalid" and is "revoked". The entire process of challenging a patent which leads to making the patent invalid is known as revocation.

Register of Patents : A register maintained by the Patent Head Office. In contains all the information related to the propriety/validity of the patent. Besides it contains name and addresses of the inventor, patent number, date of sealing, all details of assignment, transmission, amendments, revocation and licenses.

Royalty : Payment of the license to the licenser as quid pro quo (one thing in return for another) for the concession of a licenses.

Search : It means making a survey for identifying the state of the art for a patent application.

Sealing of Patents : A patent is considered sealed when its details are entered in the Register of Patents maintained by the Patent Head Office.

Selection Invention : A selection invention is an invention, the subject of which is contained in the prior art by a more general teaching, for example, a generic term but which has not been specifically described. For example methyl is contained generically by alkyl.

Sui Generis : Literally it means of his or her or its own kind without a counterpart or equal. It has been used as an option given in TRIPs to the member countries of WTO to evolve their own system for protection within the GATT framework.

Supplementary Protection Certificate : It proceeds limited possibility for the extension of the duration of patent protection for a pharmaceutical in the European Union and some other European countries.

Territoriality Principle : Patent protection is always only available for the territory of that state or those states for which the patent has been granted.

Unobviousness : An invention has unobviousness or inventive step if the modification or improvement or state of the art provided is not obvious for the average person having skill in the art, but it appears to be unexpected and surprising.

Working of a patent : When a patent is put to use for commercial purpose.

"Wrongful Obtaining" : A term used when the invention is obtained (fully or partially) buy someone by wrong or unfair means from the inventors/assignees.

Trademark : Trademarks are visible signs which serve to identify the goods and services of an enterprise and to distinguish them from those of another. The term

"visible sign" is very broad in scope and includes any of the following or combination thereof : arbitrary or fanciful designation, names, slogans, devices, numbers, letters, pictures or symbols, labels, combinations or arrangements of colours and shapes of containers of the goods themselves.

Trademark Piracy : It means the registration or use of generally well-known trademark that is not registered in the country or is invalid as a result of non-use.

Traditional Knowledge : The term traditional knowledge included innovations and the volume of knowledge continually developed, acquired, used, practised, transmitted and sustained by communities through generations supported by their ecology, environment, life styles, attitudes, societies and culture. Categories of traditional knowledge include: agricultural knowledge, scientific knowledge, technical knowledge, ecological knowledge, medicinal knowledge including related medicines and remedies, bio-diversity related knowledge, expression of folk in the form of music, dance, song, handicraft designs, stories, artworks; elements of languages such as names, geographical indications and symbols and movable cultural properties.

Trade Secrets and Undisclosed Information : A provision for providing protection to individuals/ institutions on information, which is lawfully under their control from being disclosed to, acquired by or used by others without their consent or in a manner contrary to commercial practices so long as the information is secret and has commercial value because it is secret and that the individual/institution has taken reasonable steps to keep the information secret.

Unfair Competition : Acts of unfair competition are those which are contrary to honest practices, whether or not specifically prohibited by law for example statement or allegations which, in the course of trade are liable to mislead the public as to the nature characteristics, suitability for their purposes etc., of the goods or services in question or false allegations which in the course of trade, or liable to discredit the goods or services of a competitor. Protection against unfair competition has been recognised as forming part of industrial property protection for little over a century. It was in 1900, at the Brussels Diplomatic Conference for the Revision of the Paris Convention for the Protection of Industrial Property, that this clause was added.

Unity of Invention : An invention may well be defined by different claim categories. However, no distinct inventions may be collected in one and the same patent application, that is, the inventions would show unity. In the absence of unity the distinct subject matter must be made part of divisional application.

Utility Model System : It offers 'protection' of innovation which are new and useful but fail to qualify for grant of a patent as per the patent laws. The purpose of the system is to foster "small innovation" of demonstrable practicability. It is operative only in few countries like France, Italy, Spain, Germany, Poland, Portugal, Philippines, Korea Taiwan, Japan, Mexico, Uruguay and Brazil. The system does not exist in India.

Withdrawal: Protective rights can be actively withdrawn. Withdrawal is distinctly different from the case of being allowed to become abandoned by not fulfilling a necessary duty say, payment of a fee.

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IPR related information on the internet

1. http://www.wto.org : This is the official site of the World Trade Organisation (WTO)
2. http://ipdl.wipo.int : It provides access to various intellectual property data collections currently hosted by the International Bureau of WIPO. It also provide a selection of other sites providing access to intellectual property information.
3. http://pctgazette.wipo.int (PCT database) : It contains the first page data of published PCT applications.
4. http://www.cas.org/ONLINE/CATALOG/inpadoc.html: The International Patent Documentation file contains data for patent documents and utility models of 56 patent-issuing organisations, including the European Patent Office and the WIPO.
5. http://dopales.wipo.int : The Dopales Patent Database contains the first page data of patent documents of 19 Latin American Countries.
6. http://indpat.wipo.int: It contains the first page data of Indian patents.
7. http://chinpat.wipo.int : It provides access to Chinese patent.
8. http://patents1.ic.gc.ca : It provides access to over 75 years of data on Canadian patents.
9. http://www.ipdl.jpo-miti.go.jp/homepg-e.ipdl : It is searcheable database of patent and trademark information held by the Japanese Patent office.
10. http://www.uspto.gov/patft/index.html: It provides comprehensive, searcheable access to United States Patent bibliographic data and abstracts.
11. http://www.cordis.in/ipr-helpdeskenh_001_en_htm :The multilingnae IPR-Helpdesk established by the European Commission provides a wealth of information for visitors from diverse backgrounds and with varied interests.
12. http://www.patents.ibm.com : It provide free access to over four million patents granted by various patent offices.

(Concluded)

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Letters to the Editor

Please accept my compliments on account of your article "All Motion is Relative" which appeared in Dream 2047 issue. I found it quite informative. You have made the subject interesting upto the last printed work.

Dr. V.M. Vaidya
Hon. Secretary
Marathi Vigyan Parishad,
Vigyan Bhwan, V.N Purav Marg,
Sheev Chuna Bhatti, Mumbai - 400 022

I read the article , "X-rays, the Unknown Glimmer" in March 2001 issue of the monthly newsletter of Vigyan Prasar, Dream - 2047. The article is interesting and informative.

The article, "Development of Cometary thought" part-1by Subodh Mahanti is also one of his customary careful and skillfully collected presentations. But I do not see mention of any Indian thought in the chronological order. Brihat Samhita of Varaha and another Sanskrit work `Adbhuta Sagara' contain elaborate descriptions on various types of ketus, of which `dhumaketu' (Comet) is only one type.

Dr. Prahallad Chandra Naik
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I have been receiving Dream for while and I find it of high quality value. It's a very useful information material for graduates.

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