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Monthly Newsletter of Vigyan Prasar

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VP News

AMATEUR RADIO (HAM RADIO) PROMOTIONAL ACTIVITIES

Vigyan Prasar has been continuing with its effort to popularize the hobby of ham radio amongst school children. On April 24, 2002, a lecture-cum-demonstration programme on ham radio was organized by Vigyan Prasar for the students of Springdale School, Dhaulakuan, New Delhi. It was an exciting experience for the young students to listen to and at the same time talk to an unknown person located hundreds of kilometers away through short wave radio. Shri Dattatry Deogaonkar, VU2DSI, a ham radio operator located in Ahmednagar, Maharashtra responded to the call given from VU2NCT club station of Vigyan Prasar and interacted with the children. Students from sixteen different schools in and around Delhi got an opportunity to attend another such programme organized on May 3, 2002, on the occasion of a science fair 'Indradhanush-2002'. The science fair was organized by SEARCH (Society for Science & Environment, Awareness, Research, Communication & Heritage). The students interacted with Shri Dattatry for almost an hour exchanging varieties of information through the amateur radio club station VU2NCT/MUE. The demonstration programme was assisted by Shri Sushil Dhingra, VU2LFA (New Delhi) by way of on-the-air contact with VU2NCT/MUE. Students from Mount St. Mary's School, Delhi Cantt. attended another awareness programme organized by Vigyan Prasar on May 8, 2002. Shri Muktesh Chander, VU2HJZ, an IPS official with the Delhi Police, also participated in the programme. The utility of amateur radio from the disaster mitigation point of view was explained by him to the students. Mrs. Bharthi Prasad, VU2RBI (New Delhi) and Shri Sushil Dhingra, VU2LFA (New Delhi) assisted the programme by establishing radio contact with the demonstration station VU2NCT/MUE.

Inside

Ham Radio demonstration to Mount St. Mary's School, Delhi Cantt

Ham Radio demonstration at "Indradhanush-2002".

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

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Not the end of the road

Central Board for Secondary Education results for class XII were declared on May 25, 2002. Within a week of declaration of results, six teenagers committed suicide in Delhi. One observes this pattern almost every year after the declaration of CBSE results. Why does it repeat so regularly? What prompts these promising youngsters to take this extreme step? Surely, there cannot be one single reason, but a combination of reasons. Children, and parents, perceive the Board examination as the examination of their life. They, however, fail to realize that it is only one of the many examinations that would eventually shape their lives – it's not the end of the road. Then, what is it that drives them to the point of no return? Is it the lethal combination of parental pressure and ambition? Is it growing competition? Or, is it the uncertainty about the future?

It is ingrained in the minds of children from the very beginning that only doctors, engineers, or professionals like MBAs count. A majority of children – and parents - do not even know that there are several other avenues and opportunities. May be this is one reason we have lakhs of children taking entrance tests for admission to medical and engineering courses every year with exponentially increasing numbers. Indeed, Arts and Science courses are looked upon as uncertain alternatives. This is why the idea of a career in these fields is rarely entertained by majority of the people. Unfortunately, it is ignorance among the parents and the society regarding opportunities in other fields that gives rise to this unfortunate scenario.

Surely, a majority of children fall within the middle part of the spectrum – termed 'average' as regards their academic achievement. It is likely that many of them may have a natural flair for fine arts, performing arts, science or literature. Every individual has a definite slot in the society where he / she snugly fits in. However, rarely they are allowed to pursue their own interests. Their interests, desires and liking are systematically suppressed. An effort is made to fix a square peg in a round hole. Unrealistic expectations from parents, schools and society put a tremendous pressure on them. Only if they are allowed to set realistic goals and blossom in a natural way, stress and tension could be considerably alleviated. Alongwith realistic goals, they need to be taught the need and value for hard work as well. This would help fight stress and depression effectively.

According to a psychiatrist, examinations or results could just be a trigger to a long term problem. The pressure of scoring high marks, parental ambition, and guilt of failing to do well convinces the youth that the only way out is suicide. Let us not thrust our ambitions on our children, and let us not make them feel guilty if they do not score well in the examinations. To begin with, it is imperative that we try to ascertain the child's natural interests and then help him / her identify a suitable career. This should help a child overcome inflexible and narrow vision of success. After all, a successful career implies that an individual puts in his / her best efforts in the chosen field, enjoys doing what he / she does, and excels in it. We also need to develop a support system with elders and friends. They should play a positive role in brushing aside a sense of despondency that is found among the suicide-prone. This would help them prepare in the event of a bad result. Further, it is desirable that the child's teacher in the school is able to communicate with him / her and help find out hidden worries and doubts. Regular counselling in a school also would play a positive role in curbing any violent tendencies.

At any point of time, one finds that more opportunities exist in one particular field than the rest. Remember the days, in early seventies, when admission to science courses used to be so tough? This was when career with the Atomic Energy programme of the country was considered highly prestigious. Also, mid-seventies, when there was a stampede for commerce courses following expansion of banks especially in the rural areas? Later on, it was non-conventional energy sources, environment, and telecommunication. In the nineties, it was information technology, and of late, it has been biotechnology. However, it is important to remember that jobs in any particular field are limited, even if that happens to be the field of one's choice. Surely, Government, or for that matter, private establishments cannot promise or provide jobs for all.

Where are the avenues and opportunities, then? Let us help our children find an appropriate slot for themselves, and refrain from imposing our ambitions on them. Let us help them grow in an environment where they can make their own choices, and pursue their own interests. They are sure to find sufficient avenues and opportunities to choose a career most suited to them. Our children then will not reach a point of no return.

❒ V.B. Kamble

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Charles Robert Darwin

The Father of Modern Biology

❒ Subodh Mahanti

What are we? Where do we come from? Where will we go?.

Every human being is confronted with these age-old questions without any satisfactory answers.

Nothing in biology makes sense except in the light of evolution.

Theodosius Dobzhansky

…My success as a man of science, whatever this may have amounted to, has been determined…by complex and diversified qualities… the love of science—unbounded patience in long reflecting over any subject—industry in observing and collecting facts — and a fair share of invention as well as of common sense. With such moderate abilities as I possess it is truly surprising that I should have influenced to a considerable extent the belief of scientific men on some important points.

Charles Robert Darwin in his Autobiography

Charles Robert Darwin's scientific achievement can be equalled by very few — either for breadth or depth. Biology came of age as a science when Darwin published *"On the Origin of Species"*. Darwin's writing is remarkably clear and persuasive. His style of writing has a charm seldom encountered in scientific works. As Nicolaus Copernicus showed that the Earth has no privileged position in the universe, Darwin convincingly proved that human's ancestry is no different from the other animals. Darwin was ridiculed for his theory. Even Darwin himself towards the later part of his life was not very convinced of his theory. But today his theory is regarded as the cornerstone of modern biology. And as Julian Huxley said that Darwin's idea "is the most powerful and most comprehensive idea that has ever arisen on earth. It helps us understand our origins…We are part of a total process, made of the same matter and operating by the same energy as the rest of the cosmos, maintaining and reproducing by the same type of mechanism as the rest of life".

Charles Robert Darwin

Charles Darwin was born on February 12, 1809 at Shrewsbury, Shropshire, England. He was the fifth child of Dr. Robert Waring Darwin, (the son of physician scientist Erasmus Darwin) and his wife Susannah, the daughter of the pottery magnate Josiah Wedgwood. Darwin's mother died in July 1817 when he was eight years of age and he was brought up by his sister, Caroline.

Darwin was enrolled in Dr. Butler's Shrewsbury School in 1818 at the age of nine. Darwin did not enjoy learning at school. For him, studies at his Shrewsbury School were a complete bore. Commenting on his school education Darwin wrote : "The school as a means of education to me was simply a blank. I learned absolutely nothing except by amusing myself reading and experimenting with chemistry". However, he had an intense curiosity about natural world. Since his childhood he developed a thirst for discovery and adventure. He liked to collect unusual objects both living and non-living. Luckily for Darwin his home was surrounded by woods and wildlife. The River Severn flowed right by *The Mount*, his family home. There were always things to discover, places to explore. He took interest in the birds, fish and frogs found in the surrounding areas. He had a great fascination for collecting beetles, the rarer the species the better. At the age of 13, he had even described, in a scientific journal, a new species he had captured in the neighborhood. In his autobiography he describes a particular beetle hunt in detail : "I will give a proof of my zeal : one day on tearing off some old bark, I saw two rare beetles and seized one in each hand ; then I saw a third and new kind, which I could not bear to lose, so that I popped the one which I held in my right hand into my mouth. Alas it ejected some intensely acrid fluid, which burnt my tongue so that I was forced to spit the beetle out, which was lost, as well as the third one."

Darwin's father once said to him "you care for nothing but shooting dogs, and rat-catching, and you will be a disgrace to yourself and all of your family". But Darwin commented, "…my father, who was the kindest man I ever knew and whose memory I love with all my heart, must have been angry and somewhat unjust when he used such words".

Darwin was influenced by his grandfather Erasmus Darwin (1731-1802), who was professionally a physician but he also established himself as a philosopher, naturalist and poet. Erasmus' books *Zoonomia* : or *the Laws of Organic Life* and *The Botanic Garden* or *Lovers of the Plants* were famous. Erasmus had even offered a theory of evolution. He helped found the Lunar Society. Its members called "Lunatics", met only during full moons, so that they find their way home in their horse-drawn carriages by bright moonlight. Among its members were inventor James Watt (1736-1819), the industrialist Matthew Boulton (1728-1809), the chemist Joseph Priestly (1733-1804) and potter Josiah Wedgwood (1730-95). Among Darwin's other heroes were Georges Cuvier (1769-1832), the great zoologist, Karl von Linne or Carolus Linnaeus (1707-78), who classified thousands of plants and animals and Alexander von Humboldt (1769-1859), the explorer who traveled over much of the world, making discoveries.

In his early years Darwin developed interest in geology, zoology, botany and to a lesser extent in astronomy. Darwin's interest in natural science did not mean much to his father because there were hardly any jobs in natural science. After seeing that his son was not doing good at school, Dr. Robert Darwin sent Charles to the University of Edinburgh to be trained as a physician. While studying medicine Darwin continued to pursue his old hobbies – beetle collection, bird watching and so on. He made friends with a few other scholars older than himself but having interest in natural history. Robert Edmond Grant (1793-1874), a Professor of Zoology, took him on field trips. John Edmonston, a talented taxidermist, taught him how to mount birds and mammals specimen for collection.

Dr. Robert Waring Darwin

Darwin could not complete his studies in medicine, and it had to be abruptly terminated. As Darwin did not have the courage to face his father he took refuge with his maternal uncle Joshia Wedgwood II at the Wedgwood home called *Maer Hall*, at Staffordshire about 30 km from Shrewsbury. His maternal uncle who was very fond of him took him on tours of Scotland, Ireland, London and Paris much to the dislike of Darwin's father.

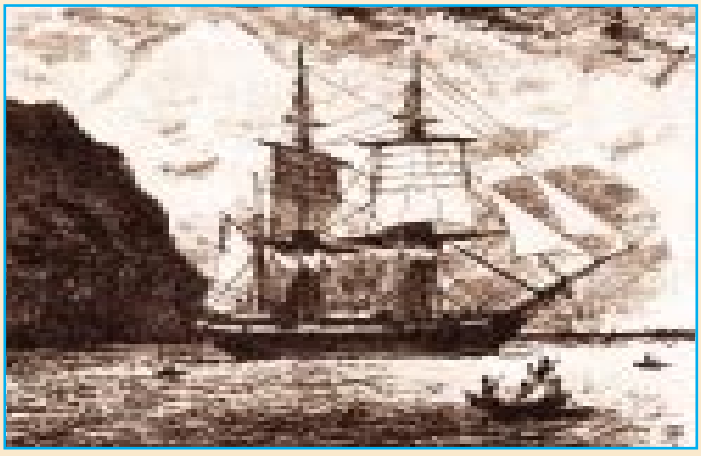
Erasmus Darwin

After seeing Darwin's failure at becoming a physician, his father sent him to the Christ's College, Cambridge in 1827 to study theology with a view to be ordained as a clergyman. But here again Darwin could not concentrate in his studies. Here he became attached with two scholars — the Reverend Adam Sedgwick, a geology professor and the Reverend John Henslow, a botanist. The latter played a major role in shaping Darwin's career. Of his Cambridge years, Darwin says, "…my time was wasted, as far as the academic studies were concerned as completely as at Edinburg and at school." According to Darwin the only things he enjoyed in his studies at Cambridge were geometry, and the works of William Paley (1743-1805), a distinguished eighteenth century theologian. Darwin admired his beautiful logic and clear expression.

Darwin returned home from Cambridge in 1831 without having completed his studies. With Professor Henslow's encouragement Darwin had turned to be a promising naturalist and he had developed a specific interest in learning geology but he had no formal educational degree. At this stage something unexpected and dramatic appeared that was to change Darwin's life and also the course of scientific discovery forever. It was a letter from Darwin's favourite professor Henslow. Henslow was requested to help Robert FitzRoy, the captain of *HMS Beagle* to find a naturalist. Henslow himself wanted to join the expedition but after realizing the fact that he could not be away from his home, he offered the job to his brother-in-law, the Reverend Leonard Jenyns, a qualified naturalist. However, he also could not accept it as he was tied down Church responsibilities. After this Henslow wrote to Darwin urging him to take up the assignment. In a letter dated 24 August 1831 Henslow while explaining that the captain was seeking a young man to serve as ship's naturalist not a 'mere collector' but also to be intelligent companion for the captain. He further wrote : "I consider you to be the best qualified person I know of who is likely to undertake such a situation… I state this not in the supposition of your being a finished naturalist, but as amply qualified for collection, observing and noting anything worthy to be noted in Natural History. Don't put on any modest doubts or fears about your qualifications, for I assure you I think you are the very man they are in search of."

Georges Cuvier

It may be noted here that though FitzRoy is mostly remembered as "Darwin's Captain', he made his mark as seaman, explorer, surveyor, mapmaker and meteorologist. He also became governor of New Zealand. His family name is from the French *fils roy* meaning "son of the king". Robert FitzRoy graduated from the Royal Naval College at Portsmouth. He served on several vessels. In 1828, he was given the command *HMS Beagle* which had been sent to map the southern coasts of South America, including Patagonia and Tierra del Fuego. During his first command of *Beagle* (1828-1830) FitzRoy became interested in the Indian tribes of Tierra del Fuego and he brought four young members of the tribe including a nine-year old girl to England. His idea was to teach them English, and the plainer truths of Christianity, reading, gardening and "the use of common tools" and subsequently return them to their homeland. FitzRoy named the girl Fuegia Basket and the other three boys were called : York Minster, Boat Memory and Jemmy Button. One of the tribal youths, called Boat Memory died soon after reaching England. Among the other three Jemmy Button and Fuegia Basket made good progress in their learning and attracted the attention of the Press. After a few months of their stay in England FitzRoy wanted to take back these tribal youths to their homeland. The British Admiralty, however, did not show any interest in financing the project. But FitzRoy was determined to keep his word. Accordingly he took a year's leave and arranged the money for hiring a ship. At this juncture one of his uncles came in his rescue by persuading the



HMS Beagle is hailed by Fuegian tribesmen near the southern tip of South America

Admiralty to sponsor another surveying voyage for the *Beagle*. The British Admiralty commissioned *Beagle* for a five-year voyage with the purpose of mapping the coasts of Patagonia, Tierra del Fuego, Chile and Peru and then continue on around the globe to survey longitudes. Besides other normal crew FitzRoy wanted a naturalist preferably a young one to accompany him. It was a common practice to take a naturalist on a voyage of this kind. The main purpose of engaging a naturalist was to provide intelligent and gentlemanly company for the ship's captain as British captains were expected to remain aloof from their hired crews. The post of naturalist was an upaid one.

Down House - the Home of Darwins at Downne

Darwin was very much interested in taking up the job but his father was not in its favour. He said that no man of common sense would approve such a foolish idea. His father thought that his son was trying to escape the responsibility of preparing a sensible career. He advised his son to forget about it and return to Cambridge to complete his studies to be qualified as clergyman. So young Darwin had no option other than to inform Henslow his inability to accept the offer. However, Darwin did not give up the hope of convincing his father. His only hope was that his father had said, "If you can find any man of common sense who advise you to go, I will give my consent". Dawin went to his maternal uncle Josiah Wedgwood II (or uncle Josh as Darwin called him) to persuade him to convince Darwin's father. Josiah Wedgwood II after listening Darwin carefully explained the risks involved in such a journey. And after seeing that Darwin was not only aware of the risks but he was perfectly willing to accept them, Josiah Wedgwood II decided to take up the matter with Darwin's father. Darwin provided him a list of objections raised by his father. Josiah Wedgwood II wrote a letter answering every objection. In answer to the very first objection that the voyage would be "disreputable to (Darwin's) character as a clergyman" Wedgwood II replied, "The pursuit of Natural History, though certainly not professional, is very suitable to a clergyman". Answering Dr. Robert Darwin's objection that "it would be a useless undertaking" Wedgwood II replied, "Looking upon Charles as a man of enlarged curiosity it (the voyage) affords him such an opportunity of seeing men and things as happens to few". Darwin attached a separate note stating that he would accept his father's decision on the subject as final and "he would never mention the subject again". Instead of waiting for a reply Darwin and Wedgwood II went to Shrewsbury to meet Dr. Robert Darwin. Finally Dr. Robert Darwin consented and agreed to pay all Darwin's expenses.

Robert FitzRoy

Georges Lonis Lecrec, Comte de Buffen

The *Beagle* set sail on December 27, 1831. Darwin was only twenty two years old. There was no proper accommodation for Darwin. He had to share a cabin with the captain and there was virtually no room for keeping his instrument. Darwin wrote in his *Journal*: "The absolute want of room is an evil that nothing can surmount". Darwin was plagued with sickness throughout the voyage.

Darwin took four books with him for the journey – the Bible, a copy of Milton's work, Alexander von Humboldt's account of his exploration of Venezuela and the Orinoco basin and Volume One of Lyell's *Principles of Geology*. The other two volumes of Lyell's book were sent to him during the journey by Henslow. Darwin sent frequent reports on his observations to Henslow. Many of these reports were read by Henslow at meetings of the Philosophical Society of Cambridge.

The *Beagle* visited many lands in the southern Pacific seas before returning to England in October 1836 via the Southern Cape of Africa in an effective circumnavigation of the globe. The ship visited amongst other places the Cape Varde Islands, Brazil, Argentina and Chile.

After coming back from the voyage, Darwin started working on his "Journal of Researches", a work based upon the journal which he had kept during the voyage of the *Beagle*. This was published in 1839 and became an immediate' success. The success of his first "literary child" always pleased Darwin more than that of any of his other books.

Carolus Linnaeus or Karl Von Linne

Following the continued deterioration of his health, Darwin moved to a country residence at Downe, Kent. The home of the Darwins, Down House still stands in the village of Downne, about 23 km South of London. Darwin lived a life of a country gentleman of independent means among his gardens, conservatories, pigeons and fowls. However, he conducted extensive experiments especially in variation and interbreeding. It was at Downe that most

of his life's work was done. Because of his continual health problem Darwin's activities were mainly confined to writing books. The books written by Darwin are given at the end of the article. The first of his major geological works., *The Structure and Distribution of Coral Reefs*", was published in 1842. In this book, Darwin presented a theory of the structure and mode of formation of coral reefs. Darwin's theory was very different from the one existed then. However, his keen observation and accurate thinking made his theory acceptable to most of the geologists. In fact his theory is even now generally accepted among geologists.

Thomas Robert Malthus

Darwin, based on his observation of various facts of paleontology and biogeography, saw the possibility that species might not be immutable. But then he had no theory to work upon. However, he decided to apply the method adopted by Lyell in solving geological problems. Lyell had attacked geological problems by accumulating all applicable data in the absence of a working theory, in the hope that the sheer weight of facts might throw some light upon these problems. Darwin decided to adopt the same method to the species problem. Accordingly he started in July 1837 his work on variation in plants and animals, both under domestication and in nature. Darwin did not want to overlook any possible source of information. Thus he looked into personal observations and experiments, published papers of other biologists, conversations with breeders and gardeners, correspondence with biologists at home and abroad and so on. Based on the analysis of accumulated facts from various sources Darwin realized that man's success in producing useful varieties of plants and animals depended upon selections of desired variation for breeding stock. However, Darwin had no clue on how selection could be applicable to nature.

Caricature of Darwin and his earthworms that appeared in Punch magazine in 1881, the year before his death

But then he stumbled upon a theory to work upon. In October 1838, Darwin happened to read for sheer amusement "Malthus on Population". The book written by Thomas Robert Malthus (1766-1834) was first published anonymously in 1789. It was titled *An Essay on the Principle of Population*. The book was not about biology. In his book Malthus proposed that human population increases geometrically (e.g., 2,4,8,16…), while means to support them increases only arithmetically (e.g.1,2,3,4,5…). Accordingly natural selective forces such as overcrowding, disease, war, poverty and vice take over to remove those who are not fit and thus only the fittest survive. Darwin extended Malthus's ideas and developed the idea of natural selection in species, a concept that is often referred to as "survival of the fittest". The phrase "survival of the fittest" is often used synonymously with natural selection. The phrase is both incomplete and misleading. The word survival is only one component of selection and perhaps one of the less important ones in many populations. Also, the word `fit' is often confused with physically fit. Fitness, in an evolutionary sense, is the average reproductive output of a class of genetic variation in a gene pool. `Fit' does not necessarily mean biggest, fastest or strongest.

The theory of natural selection answers the question of who made the selection of what is to be evolved. The species that do survive in the competition for existence will go on to produce the next generation. The environment, an organism lives in, helps to determine which organisms survive and produce young, and which do not.

Alfred Russel Wallace

Commenting on Malthus's work, Darwin wrote : "In October 1838, that is fifteen months after I had began my systematic enquiry, I happened to read for amusement Malthus on Population, and being well prepared to appreciate the struggle for existence which goes on from long-continued observation of the habits of animals and plants, it at once struck me that under these circumstances favourable variations would tend to be preserved, and unfavourable ones to be destroyed. The result of this would be the formation of new species. Here, then, I had at last got a theory by which to work…"

However, Darwin took four years to write the first outline of his theory. This is because he had to collect a great deal of more data. In 1842, Darwin produced a pencil draft of thirty-five pages. By 1844 Darwin enlarged this draft to 230 pages. Early in 1856, following the advice given by Lyell, Darwin began his work on a much larger scale with a view to prepare a full account of his ideas on the origin of species. But while Darwin was half on its way in completing his work a certain development took place which forced Darwin for early publication of his work. Alfred Russell Wallace (1823-1913) sent Darwin a short essay on the "Tendency of Varieties to Depart Indefinitely from the Original Type" with a request that if Darwin think it worthy he should forward it to Lyell for his comments. Darwin liked it very much because he recognized his own theory in it. Darwin sent Wallace's paper to Lyell along with a covering letter. Darwin wrote: "Your words have come true with a vengeance – that I should be forestalled; if Wallace had my MS sketch written out in 1842, he could not have made a better short abstract". At one point Darwin decided to withhold his own publication in favour of Wallace. However, Lyell and Joseph Dalton Hooker (1817-1911) had for years been familier with Darwin's work on the transmutation of species. Lyell had read Darwin's outline of 1842. Lyell and Hooker therefore suggested that Darwin write a short abstract of his theory and that it be published jointly with Wallace's paper in the *Journal of the Linnean Society*. These papers appeared in that Journal in 1859 together with portion of a letter which Darwin had written to Asa Gray (1810-

88), the great American botanist, in September 1857, in which Darwin set forth his views on natural selection and the origin of species.

In his autobiography, Darwin wrote : "Early in 1856 Lyell advised me to write out my views pretty fully, and I began at once to do so on a scale three or four times as extensive as that which afterwards followed by my *Origin of Species* : yet it was only an abstract of the materials which I had collected, and I had got through about half the work on this scale. But my plans were overthrown far early in the summer of 1858. Mr. Wallace, who was in the Malaya Archipelago, sent me an essay "On the tendency of varieties to depart indefinitely from the original type" and this essay (arrived June 18th) contained exactly the same theory as mine. Mr. Wallace expressed the wish that if I thought well of this essay, I should send it to Lyell for perusal. The circumstances under which I consented at the request of Lyell and Hooker to allow an extract from my own M.S., together with a letter to Asa Gray, dated September 5, 1857 to be published at the same time with Wallace's essay, are given in the *Journal of the Linnean Society* 1858 p. 45. I was at first very unwilling to consent, as I thought that Mr. Wallace might consider my doing so unjustifiable, for I did not then know how generous and noble was his disposition."

Charles Lyell

Joseph Dalton Hooker

Following this, Lyell and Hooker persuaded Darwin to prepare for early publication of a book on transmutation of species. Accordingly, he condensed the manuscript he had begun in 1856 to about one-third or even one-fourth its original size. The *"Origin of Species"* thus produced, was finally published in November 1859.

The original title of the manuscript was "An Abstract of an Essay on the Origin of Species and Varieties through Natural Selection". However, his publisher, John Murrey, persuaded Darwin to reduce this to *On the Origin of Species*, but Darwin insisted on keeping the words *by means of Natural Selection* as a kind of subtitle. Darwin also included on the title page the words *"Or the Preservation of Favoured Races in the Struggle for Life"*. Every copy of the original 1, 250-copies printed was sold on the very first day. Commenting on the success of *Origin* Darwin wrote: "The success of the *`Origin'* may, I think, be attributed in large part to my having long before written two condensed sketches, and to my having finally abstracted a much larger manuscript, which was itself an abstract. By this means I was enabled to select the more striking facts and conclusions. I had, also, during many years followed a golden rule, namely that whenever a published fact, a new observation or thought came across me, which was opposed to my general results, to make a memorandum of it without fail at once; for I had found by experience that such facts and thoughts were far more apt to escape from the memory than favorable ones, owig to this habit, very few objections were raised against my views which I had not at least noticed and attempted to answer."

Darwin as a public figure caricature from the periodical *Vanity Fair* (September 30, 1871)

Darwin always referred to his *Origin of Species* as abstract. He wrote in its introduction: "This Abstract, which I now publish, most necessarily be imperfect. I cannot have given reference and authorities for my several statements, and I must trust to the reader reposing some confidence in my accuracy. No doubt errors will have crept in though I hope I have always been cautious in trusting to good authorities alone. I can have given only the general conclusions at which I have arrived, with a few facts in illustration, but which, I hope in most cases will suffice. No one can feel more sensible than I do of the necessity of hereafter publishing in detail all the facts, with references, on which my conclusions have been grounded ; and I hope in a future work to do this. For I am well aware that scarcely a single point is discussed in this volume on which facts cannot be adduced, after apparently leading to conclusions directly opposite to those at which I have arrived. A fair result can be obtained only by fully stating and balancing the facts and arguments on both sides of each question; and this cannot possibly be here done."

Darwin is mostly known for his hypothesizing the pattern of common descent and proposing a mechanism for evolution — natural selection. Darwin's theory of evolution is no longer just a theory — an overwhelming amount of evidence has accumulated since Darwin. Thus it may be said that Darwin discovered a law as Copernicus, Galileo and Newton discovered laws — natural laws. According to Darwin's law, life has come into being and exists and is depended on the process of natural selection. In Darwin's theory of natural selection, new variants arrives continually with in population. Some of the variations may be neutral, but others help or hinder the organism in its struggle for survival. What Darwin did not know was the mode of inheritance.

Today we know that the true mode of inheritance was discovered by Gregor Mendel through his experiments on hybrid peas. In fact Mendel mailed his paper to Darwin, but Darwin never opened it.

The idea of evolution was not new to Darwin. Francis Bacon (1561-1626) in his book *Novum organum* (1620) noted the way in which species vary naturally from one generation to the next. Bacon observed that such natural variation could be used by the breeders of plants and animals to produce "many rare and unusual results:" Gottfried Wilhelm Leibniz (1646-1716), the German mathematician, speculated that species had changed because of difference in environmental conditions. Leibniz's observation was based on his studies of fossils and the possible relationship between the extinct ammonites and living species such as the nautilus. The term evolution was first used in its modern biological context in 1826 by Robert Jameson. In the eighteenth century Georges Louis Lecrec, Comte de Buffon (1707-88) suggested that the North American bison might be descended from an

ancestral variety of ox that had migrated there. Darwin's grandfather Erasmus Darwin was convinced about the importance of evolution. However, Erasmus mistakenly thought, that individual members of a species developed different characteristics during their lifetime. And once acquired these advanced characteristics are passed on to their offsprings.

Jean-Baptiste Lamarck (1744-1829) proposed a theory of evolution in 1809. He believed that species arose continually from nonliving sources. These species were initially very primitive, but increased in complexity over time due to some inherent tendency. Such type of evolution is called orthogenesis. Further Lamarck proposed that an organism's acclimation to environment could be passed on to its offspring. For example, Lamarck thought proto-giraffes stretched their necks to reach higher twigs and which caused their offspring to be born with longer necks. This is known as the inheritance of acquired characteristics. Lamarck also believed that species never went extinct, although they may change into newer forms. Lamarck's ideas have been proved to be wrong. The observations made by a number of scientists implicitly included the concept of evolution and also the notion that species have evolved to fit their environments — adaptation. Darwin offered an explanation of how evolution works – that is natural selection.

Jean-Baptiste Lamarck

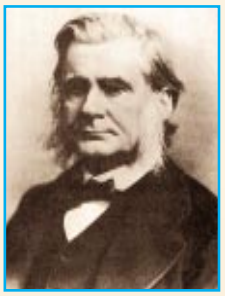
Darwin's theory of evolution made him many enemies among orthodox scientists and churchmen since beliefs in the Creation and divine guidance were threatened by Darwin's revelations. Apelike cartoons of Darwin appeared in newspapers. Essays and sermons proliferated everywhere. Among the scientific opponents were Richard Owens, a renowned geologist at Oxford, Louis Agassiz at Harvard University in the USA and Adam Sedgwick, an old-school geologist from Cambridge. Darwin was not in a position to combat the furore, raised against his theory because of his continued illness. Moreover, he never recovered from the untimely death of his daughter Annie.

The task of defending his theory was left to Thomas Henry Huxley (1825-95), a brilliant zoologist who became famous as "Darwin's bulldog". Huxley did his job quite well notably at the famous Oxford debate on June 30, 1860, where Huxley confronted Samuel Wilberforce, the powerful Bishop of Oxford. Besides Huxley and Wilberforce those present on the platform included : Darwin's old teacher and anti evolutionist John Henslow, J.S. Huxley's friends Joseph Hooker and John Lubbock, John Draper of New York University and Sir Benjamine Brodie, the Queen's physician and President of the Royal Society. Seven hundred people were crowded into the University Museum where the debate was organized. In this debate Huxley instead of being ridiculed had won a wider interest and fair hearing for the new theories.

Darwin and his wife Emma (left)

Besides Huxley, Darwin's prominent supporters were Charles Lyell and James Hooker. Lyell though convinced that Darwin was correct but he refused to come out squarely in favour of evolution in his public statements and writings before 1868 when he embraced the theory at the age of 71.

Though the debate following the publication of the *Origin of Species* led to wide acceptance of Darwin's theory among the scientists but it was far from being established during Darwin's lifetime. The main reason for this was that Darwin could not explain how characteristics passed on from one generation to another and why there are variations from one individual to another. Variation is found among individuals who share the same parents. It is important to note that in the successive revisions to the *Origin of Species* Darwin himself backed away from natural selection. In the first edition of his *Descent of Man* Darwin wrote : "In the earlier editions of my *"Origin of Species"* I probably attributed too much to the action of natural selection or the survival of the fittest". The first reason for Darwin's retreat was the failure to explain the cause of variation, a key component in Darwin's theory of natural selection. The second important reason was the enormous timescale required for evolution. In the second half of the nineteenth century the scientists believed that the Sun could not have been hot for more than a few millions years as there was no process known to scientists which could supply energy to keep the Sun shining for hundreds of millions of years required for the variety of forms of life on Earth to have evolved through small steps. Scientists of the twentieth century have established that the long time-scale required for evolution by natural selection is not a problem as the Sun has essentially remained unchanged for about 4.5 billion years, a more than sufficient time for evolution to happen. Today we know that the energy is supplied by nuclear processes. In the twentieth century biologists developed an understanding of genetics and how characteristics are inherited by offspring from their parents. As mentioned earlier it was Mendel who had first initiated work in this direction.



Thomas Henry Huxley

By the 1940s Darwin's theory of natural selection as spelt out in the first edition of the *Origin of Species* had become firmly established. So today, Darwin's theory of evolution and common descent are considered facts by the scientific community. Though debates continue on how various aspects of evolution work. For example, all the details of pattern of relationship are not fully worked out.

Evolution is regarded as the cornerstone of biology. While it is possible to do research in biology with little or no knowledge of evolution but then without evolution biology becomes a disperate sets of fields. Evolutionary explanations

pervade all fields of biology and brings them together under one theoretical umbrella.

The process of evolution can be summerised in three sentences: **Genes (hereditary units) mutate. Individuals are**

Darwin in the field on the Galapagus Islands, Measuring the speed of an Elephant tortoise

selected. Population evolve. Evolution requires genetic variation. In order to continue evolution there must be mechanism to increase or create genetic variation and mechanism to decrease it . Mutation is a change in a gene. These changes are the source of new genetic variation. Natural selection operates on this variation. Natural selection

Cartoons like this one appeared in countless periodicals in Darwin's time. Here, the gorilla, pointing to the bearded Darwin, exclaims : "That man wants to claim my pedigree. He says he is one of my descendants." To which Mr. Bergb (center), founder of the society for the Prevention of Cruelty to Animals, rejoins, "Now, Mr. Darwin, how could you insult him?"

favours traits or behaviours that increase a genotype's inclusive fitness. The opportunity or natural selection to operate does not induce genetic variation to appear. Selection only distinguishes between existing variants. Selection merely favours beneficial genetic changes when they occur by chance — it does not contribute to their appearance. The potential for selection to act may long precede the appearance of selectable genetic variations. Natural selection does not have any foresight. It only allows organisms to adapt to their current environment. Structures or behaviours do not evolve for future utility. An organism adapts to its environment at each stage of its evolution. As the environment changes, new traits may be selected for.

Darwin died on April 19, 1882 after prolong illness. Following a suggestion from of a group of members of British Parliament, he was accorded the honour of being buried in Westminster Abbey. (A burial place for English monarchs, outstanding statesmen etc).

We would like to end this article by quoting Julian Huxley on Darwin. "Darwin's work…put the world of life into the domain of natural law. It was no longer necessary or possible to imagine that every kind of animal or plant had been specially created, not that the beautiful and ingenious devices by which they get their food or escapes their enemies have been thought out by some supernatural power, or that there is any conscious purpose behind the evolutionary process. If the idea of natural selection holds good, then animals and plants and man himself have become what they are by natural causes, as blind and automatic as those which go to mould the shape of a mountain, or make the earth and the other planets more in ellipses round the sun. The blind struggle for existence, the blind process of heredity, automatically result in the selection of the best adopted types, and a steady evolution of the stock in the direction of progress…

Darwin's work has enabled us to see the position of man and of our present civilization in a truer light. Man is not a finished product incapable of further progress. He has a long history behind him, and it is a history not of a fall, but of an ascent. And he has the possibility of further progressive evolution before him. Further, in the light of evolution we learn to be patient. The few thousand years of recorded history are nothing compared to the million years during which man have been on earth, and the thousand million years of life's progress. And we can afford to be patient when the astronomers assure us of at least another thousand million years ahead of us in which to carry evolution to new heights".

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3. *Geological observations on Volcanic Island*. London. 1844
4. *Geological observation on South America*. London. 1846
5. *On the Origin of Species by Means of Natural Selection*. London. 1859
6. *The Various Contrivances by which orchids are Fertilised by Insects and on the Good Effects of Intercrossing*. London. 1862.
7. *The Variations of Plants and Animals under Domestication*. London. 1868.
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9. *The Expression of the Emotion in Men and Animals*. London. 1872
10. *Insectivorous Plants*. London. 1875
11. *Climbing Plants*. London. 1875
12. *The Effects of Cross- and Self-Fertilisation in Vegetable Kingdom*. London. 1876
13. *Different Forms of Flowers on Plants of the Same Species*. London. 1877
14. *The Power of Movements in Plants*. London. 1880
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Contd. on page. 19

The Universal Physical Constants and the Cluster Hypothesis

❒ P.K. Mukherjee*

There are certain constants in physics that are regarded as universal constants. Each of these constants indicates the involvement of a particular branch of physics. For instance, the gravitational constant G appears in mechanics, in calculations involving gravity. The Avogadro constant N_A and the Boltzmann constant k appear in thermal and molecular physics. The speed of light (in vaccum) c is always associated with relativity and the propagation of light. Planck's constant h (the ratio between energy and frequency of radiation) is the cornerstone of quantum mechanics and is associated with the wavelike nature of particles and the corpuscular properties of radiation. Associated with the modern and elementary particle physics dealing with the subatomic particles, are the mass m_n of the nucleon (proton and neutron), the mass m_e of the electron and the charge e on the electron.

Arnold Sommerfeld

The constants of physics can be arranged to form natural (or dimensionless) numbers that are independent of our units of measurement. For instance, the ratio of the nucleon and electron masses (m_n/m_e) is a dimensionless number:

$$m_n/m_e=1836$$

Another example is furnished by the constant α:

$$\alpha = ke^2/\hbar c \ (k=1/4\pi\varepsilon_o, \hbar=h/2\pi)$$
$$= e^2/2\varepsilon_o hc = 1/137$$

First described by Arnold Sommerfeld as the fine structure constant, the constant α was the earlier known as the coupling constant. It appears whenever radiation interacts with particles and the combination of c, $\hbar$ (= h/2π) and e indicates a wavelike ($\hbar$) interaction between particles (e) and light (c).

The constant α was given the name fine structure constant by Sommerfeld as its size played a role in determining the separation of the fine, bunched-together lines in the hydrogen spectrum. The Balmer Lines of the hydrogen spectrum, on which Neils Bohr constructed his model of the atom, had subsequently turned out to be composed of many different lines of slightly different wavelength - a fine structure.

The constant α incidentally put together many of the mysteries of the 20th century physics. It was thought to be a consequence of deep and hidden connections among e, $\hbar$ and c.

Remarked Markus Fierz, Pauli's assistant and co-worker in the late 1930s, about the constant α : "People were fascinated by that number. Now e is electrodynamics, $\hbar$ is the quantum theory and c is relativity. So in this one constant all the fundamental theories are related. The hope was that if one could figure out why this number had its particular value-1/137-the whole thing would be solved. It was a magic number!"

Hiesenberg and Pauli spent years trying to understand why the fine structure constant was 1/137 and not, say, 1/136? They were not alone. The celebrated British astronomer and physicist Arthur S. Eddington viewed α as the key to the way nature 'hangs together'. That was perhaps the reason why he was so much fascinated by the number 137; he had the habit of hanging his hat on a peg of that number in the cloakroom!

Arthur S. Eddington

A third dimensionless number

Thus far we constructed two dimensionless numbers, that is, 1836 and 1/137 involving relativity, quantum mechanics, and the properties of subatomic particles. We now construct a third number that involves the gravitational constant G. The electrical and gravitational forces between a proton and an electron are both attractive, being proportional to the inverse square of the separating distance r. The electrical force between a proton and an electron is ke^2/r^2 ($k=1/4\pi\varepsilon_o$), while the gravitational force is Gm_nm_e/r^2. The ratio of these two forces gives a dimensionless number which is very large indeed:

$$ke^2/Gm_nm_e=0.2\times10^{40}$$

Astronomers say that when a star having an initial mass greater than three solar masses starts contracting, the gravitational field at its surface gets progressively stronger. This makes it more difficult for the light to escape from the star. The light, therefore, appears dimmer and redder to an observer at a distance. Eventually, when the star has shrunk to a certain critical radius, called the Schwarzschild radius, it collapses into a black hole from where nothing, not even light, can escape. The boundary of the black hole is called event horizon. If M be the initial mass of the collapsing star then the Schwarzschild radius is given by

$$R_S=2GM/c^2$$

It is theoretically possible for any object of mass m to collapse into a black hole by squeezing it to the critical Schwarzschild radius. If a nucleon of mass m_n were shrunk into a black hole it would have a Schwarzschild radius of $2Gm_n/c^2$. The coefficient 2 may be safely ignored and we may say that $a_g=Gm_n/c^2$. is the gravitational length of a nucleon. This means that if the nucleon had the radius a_g then gravity would have dominant influence in determining its size. However, as we know, gravity is not important in determining the structure of subatomic particles.

An electron travelling close to the speed of light has a characteristic wavelike size that is determined by the electron Compton length given by

$$\lambda_e=\hbar/m_ec$$

We may, in the same manner, define the nucleon Compton length $\lambda_n=\hbar/m_nc$ as a measure of the size of a nucleon. We

find that

$$\lambda_e/a_g = \hbar c/Gm_n m_e = (1/\alpha)\ (ke^2/Gm_n m_e)$$
$$= 137\times 0.2\times 10^{40}$$

and

$$\lambda_n/a_g = \hbar c/Gm_n^2 = (1\alpha)\ (m_e/m_n)(ke^2/Gm_n m_e)$$
$$= (137/1836)\times 0.2\times 10^{40}$$

Cluster Hypothesis

In the foregoing, we obtained two groups of dimensionless numbers from the universal constants of physics. The first consists of relatively small numbers clustered around unity:

$$m_e/m_n\ ,\ ke^2/\hbar c\ ,\ \hbar c/ke^2\ ,\ m_n/m_e$$

These numbers are 1/1836, 1/137, 137 and 1836 respectively. The second group consisting of relatively large numbers clustered around 10^{40} are:

$$ke^2/Gm_n^2\ ,\ \hbar c/Gm_n^2\ ,\ ke^2/Gm_n m_e\ ,\ \hbar c/Gm_n m_e\ ,\ ke^2/Gm_e^2$$

These numbers are 1/1836, 137/1836, 1, 137 and 1836 multiplied by 0.2 x 10^{40}, respectively. Each group consists of numbers covering a range that is quite small in comparison with the wide separation of the two groups. We may refer to the first set of numbers as the *unity group* and the second set of numbers are the *N_1 group.*

Wenner Karl Heisenberg

The clustering of dimensionless numbers into two groups of relatively narrow spread is sufficiently remarkable for us to postulate what is called a *cluster hypothesis*. According to this hypothesis, all dimensionless numbers compounded from the universal constants of physics are members of either the unity or the N_1 group. Other numbers, such as $N_1^{1/2}$ and N_1^2, may be obtained from N_1 and cannot be regarded as basic in the same sense as N_1. However, for the present, there is no theory to support the cluster hypothesis. But, presumably, the explanation may have something to do with the basic design of the universe.

Can the universal constants vary?

On various occasions, the scientists have considered the possibility that the universal constants of physics, either singly or in combination, change with time as the universe evolves. Let us see whether this idea contradicts the cluster hypothesis.

A frequent suggestion is that the gravitational constant G decreases in value as the universe expands. The unity group does not contain G, and so it remains unaffected by the G-variation. As can be seen, all the members of the N_1 group are inversely proportional to G. Therefore, the G-variation merely moves the N_1 group without altering its tight clustering. So, the G-variation does not contradict the cluster hypothesis and all the dimensionless numbers retain their membership in two widely separated groups. However, variation in the values of either of the constants e, c, or $\hbar$ would certainly lead to the contradiction of the cluster hypothesis.

Recently, a group of scientists from the United States, Australia and Britain led by John Webb of the University of New South Wales in Sydney found evidence that over the 12-15 billion years history of the universe, the fine structure constant α might have changed by one part in 100,000. Using the world's most powerful Keek Telescope atop Hawail's Mona Kea, the scientists gathered measurements of light frequencies for seventeen distant quasars. As is now well known, quasars are extremely bright objects presumably associated with black holes.

At the time of the dawn of the universe, the light produced by the quasars, which are about 12 billion light-years away, is only now reaching the Earth. The light during its long journey has passed through the clouds of intergalactic gas; and in the process some of the light has been absorbed by these gaseous clouds. From the study of the absorption patterns the scientists are able to gather information about the gas, the speed of light and, of course, the fine structure constant. To arrive at their finding regarding change in the fine structure constant, the team scientists too had to rely on these absorption patterns.

However, more observations need to be performed before most physicists would be able to accept the change in the constant, opine the team scientists. They are, therefore, planning to confirm their results using a Very Large Telescope at the European Southern Observatory in Chile.

Wolfgang Pauli

The physicists are of the view that the finding regarding the change in the fine structure, if proved, would certainly lend credence to an unproven theory of physics, called string theory, that presumes either a 10- or 26-dimensional universe, rather than a four-dimensional one containing the three spatial dimensions and the single time dimension. The extra dimensions would be curled up or folded. So, it would be impossible to detect them in everyday life or even through any physics experiment.

But, even if the finding that the value of the fine structure constant α might have changed over time holds up, it will however be tricky to find out which component of α has changed. "We can't say if it's the speed of light or the charge of the electron or all of them", say Chris Churchill of Pennsylvania State University.

The change in α, if proved, would also mean the contradiction of the cluster hypothesis; for the unity and the N_1 groups will then not be able to preserve their tight clustering. The fate of the cluster hypothesis, which is yet tentative, would therefore depend on the final confirmation of the finding by the international team of scientists.

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Agharkar Research Institute, Pune

Meeting the Industrial and Agricultural Needs

❒ Dilip M. Salwi*

M.L. Sirkar, M.N.Saha, H.J.Bhabha, S.S.Bhatnagar, etc., are the names that immediately come to mind when one thinks of scientific institution-builders in India. But rarely does one come across the name of S.P.Agharkar, a renowned botanist, who set up the Maharashtra Association for the Cultivation of Science (MACS) in Pune as far ago as in 1946. In 1992, the Association was renamed as 'Agharkar Research Institute' in his honour. Today, it stands in a secluded and green hilly region of Pune cut off from the hubbub of the city renowned for its intellectually and culturally-rich atmosphere. "Presently, our thrust areas of research are, "bio-treatment of wastes, insect bio-control, medico-botany, plant biodiversity, human nutrition and growth" says its director Dr. V.S. Rao. Besides filing patents and publishing research papers in first-rate journals, the institute has been undertaking contract research, consultancy and transfer of technology for integrated process development to meet the demands of the industrial belts and agro-industries in the neighbourhood of Pune. The institute has already produced some marketable products. It supplies breeder seeds of wheat and soybean, nursery materials, medico-botanical resources and even microbial cultures. Recently, a plant growth promoting foliar spray called 'Biofert' developed at the institute has been manufactured by an industry and released into the market.

A view of main Building of Agharkar Research Institute

After his basic education in Maharashtra, the Germany-trained Shankar Purushottam Agharkar (1884-1960) went to Kolkata for research and teaching before India gained Independence. Here he was a Ghosh Professor of Botany at Calcutta University and was active not only as a botanist but also a science organiser. Two flowering plants and one centipede are his discoveries and have today been named after him. He actively participated in various activities of Indian Science Congress and Indian National Science Academy. A true patriot, he stopped the transfer of rare species of plants from Calcutta Herbarium to England. On retirement he shifted to Pune, where his dream of setting up a research institute in the footsteps of Mahendralal Sirkar's Indian Association for the Cultivation of Science, Kolkata, was realised. Initially, the laboratories and offices of MACS were set up in the buildings of other academic institutions. Finally, in 1966, the Ministry of Education and Culture granted five acre land to the MACS, where it stands today housed in European style building of grey stones with a garden in front and facilities and nurseries behind.

The institute has grown over the years since its inception. Several new buildings, departments, special research facilities and hostels have been added from time to time on the initiative of its past Directors and researchers. For instance, the eminent nutrition expert Dr P.V.Sukhatme added the Department of Biometry and Nutrition; Dr G.B.Deodikar started the Department of Genetics and Plant Breeding; and so on. Today, under the prevailing milieu of revenue-generation and industry- and society-oriented research, Dr Rao is laying special emphasis on the biological treatment of industrial waste waters and solid wastes and the manufacture of biochemicals/ agrochemicals. With its four crore annual budget, the institute earns three-fourth of its revenue through various research activities and even sale of its products. The research and development activities of the institute are mainly divided into three divisions, namely, Microbial sciences, Plant sciences and Animal sciences. In microbial sciences, the institute has developed several microbial processes for the treatment of various industrial wastes, dyes, toxic metals, etc., and also technologies for the enrichment of metal ores. " Our team has produced several microbial activity-based processes which have been adopted by various industries, " said proudly Dr.(Ms) P.P.Kanekar, Head, Microbial Sciences, recounting the achievements in her own laboratory " For instance, our microbial process for the removal of the corrosive hydrogen sulphide from biogas and of the toxic metal chromium from industrial waste have been utilised by various industries". Earlier, a fermentation process for the isolation and purification of Vitamin B 12 was also transferred to a Mumbai-based pharmaceutical company. " Our team has also isolated certain microbes from hotsprings in western Maharashtra, Lonar lake, etc.," continued she," which produce enzymes that can dissolve clots in blood. These have been found safer than other enzymes presently available in the market. We're now waiting for its technology transfer to industry". Besides, the institute has a United Nations Environment Programme's recognised data bank of specialised microbes used in metal recovery or removal, industrial waste water treatment, biogas production and fermentation of biochemicals. The data bank is called 'Pune MIRCEN (Microbial Resources Centre)'. In case of Plant sciences, the institute has been a leading centre for improvement of crops, such as, soybean, wheat and grapes, for the last more than 30 years. Six varieties of soybean, five varieties of wheat and five varieties of grape produced at the institute are very popular among farmers. In fact, it is one of the few centres in the country where researches on the disease resistance in grapes are in progress. Besides, it has a unique collection of more than 80 wild relatives of grapes from the Western Ghats, North-east India and Andaman Islands. The Institute researchers have also studied the much under-utilised minor fruit called 'Karvanda' and also neem tree.

One of the indigenous instances of researches in the field of biodiversity conducted by the institute researchers is the study of the 'Devrai'- the forests preserved with religious sanctity, sometimes present in inaccessible regions and mountains, untouched by human hand for several centuries, found in the neighbourhood of hermitages in Maharashtra. "In these sacred forests," said Dr M.S. Kumbhojkar, who has surveyed and studied these *Devrais, 'we've* identified several plants of medicinal value, especially in Ayurveda, and their

active principles. In fact, these are nurseries of wild plants not commonly found, which are now important from conservation point of view. We're collecting their germplasm as well as their ethnobotanical data".

"We've isolated the chemical `Queen substance'," said Dr D.G. Naik, Scientist Incharge, Chemistry Division, " which can help save a colony of honeybees from disintegrating due to the untimely death of the Queen". A patent has also been filed on this 'Queen substance' as well as on an anti-juvenile hormone which acts as a repellent to Red cotton bug. In fact, the institute has over the years developed several such non-toxic insect controlling agents. The institute researchers have also conducted several studies concerning food and nutrition in the neighbouring areas." According to our three year study on rural girls," said Dr (Ms) Shobha Rao, Head, Biometry and Nutrition Division, "more than 18 per cent suffer complications and high risks during pregnancy due to malnutrition". Talking about the present day high incidence of heart diseases, diabetes and obesity among children, she said that their study shows that it is due to fat-rich foods and inactivity. Obviously, TV-watching is the main culprit.

Measurement of newborns in progress

A rich library and publication activity apart, the institute has also an experimental farm near Pune, worksheds and a hotlab for handling radio chemicals. In fact, about half an acre land is devoted to nursery activities. Experimental facilities, such as polyhouse, glass house and green house are available here. Two herbariums named after Dr Agharkar, which originated due to his interests, are housed in the institute. They contain the largest resource for taxonomical studies on plants in western India and an internationally recognised collection of 28,000 specimens of lichens and fungi. The institute also houses a palaeontological collection of over 5,000 specimens of trace fossils, bivalves, gas-tropods, ammonoids, echinoids, brachiopods, algae, pollen, spores, etc. Paleoenvironmental studies are also in progress here. Besides, the institute has excellent facilities for evaluation of toxicity in pesticides, pharmaceuticals and food additives. The institute is today a recognised post-graduate research centre affiliated to the University of Poona, Pune, and Mahatma Phule Agricultural University, Rahuri. With about 40 scientists and as many technicians, and with several research projects, both Government and private, always in progress, it has also a capable and qualified faculty to guide Ph.D. students in subjects such as botany, biometry and nutrition, biotechnology, plant breeding, environmental science, geology, microbiology and zoology. To date, about 200 students have done Ph.D. using the guidance and facilities available in the institute. "In the time to come," said

Dr. Rao emphatically, giving the future plans of the institute,'we intend to go for molecular biology and biodiversity assessment using modern techniques".

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Contd. from page 24

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Letters to the Editor

Please refer to the article 'Bosons – the Birds that Flock and sing Together' published in the January, 2002 issue of 'Dream 2047'. In that article the author has mentioned that (Box in page 33) in 1975, Prof. S.N. Bose said : "I had no idea that……." But Prof. Bose passed away in the year 1974 (4 February). Then how it is possible that he made the above remark in 1975?

Utpal Mukhopadhyaya
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The sentence should read, "years later, this is what he said" and NOT years later, in 1975, this is what he said". The error is regretted.

Editor

Dream 2047 is very informative. However, in the write-up on Raman Research Institute, Dream 2047, Feb. 2002, while mention has been made of Dr. Pancharatnam, there is no mention about his brother Dr. S. Chandrashekhar, FRS, particularly as the write-up indicates institutes work on Liquid Crystals which was started by Dr. Chandarshekhar.

K.N. Johry
Director, Centre for Science & Technology of the Non-Aligned and other Developing Countries, New Delhi

We regret the oversight. In one of our future issue of Dream 2047, we will try to highlight the contributions of Dr. S. Chandrasekhar

Editor

RICHARD SONNENFELDT

Who designed the first colour TV

Richard Sonnenfeldt was born on July 3, 1923 in the then East Germany. Because of anti-semitism, his early years were turbulent: school drop-out at 14; student in German Quaker School (1938-40) at Canterbury, England; deported to Australia in May 1940 as an enemy alien.

Richard Sonnenfeldt

On board the ship, he employed his resourcefulness by figuring out where they were going : he made observations out a porthole and put to practical use the spherical trignometry he had learned in the school in England.

On his arrival in Australia, he wrote a letter to Winston Churchill, offering his services for defeating Naziies. This won him the release, but on his way back to England, he got stranded at Bombay. He took up work in a radio factory.

In April 1941, Sonnenfeldt rejoined his parents at Baltimore; both were doctors, but did not have license to work in the US. He joined in 1943 the US Army as an electrician and supported his parents with his earnings.

Alongside, he studied at Johns Hopkins University and obtained in 1949 the B. S. Degree with distinction. He then joined the Radio Corporation of America (RCA). He was a central player in the company's television project at Camden. His work resulted in the development of several fundamental patents, 35 in five years, all in colour television. He considered the manager Max Sinnelt, to whom he owed this great opportunity, as an "apostle of engineering creativity".

From the world of radio and television signal processing, he sensed an opportunity for RCA, the then world's leading electronics company, in applying computers to industrial process control. He persuaded RCA to collaborate with Foxboro Co, an established manufacturer in process control. This was so successful that Foxboro overtook the well-known giants in the field like General Electric, IBM and Honywell.

From 1974 to 1979, Sonnenfeldt led the company's video disk project. Ultimately the project was a commercial debacle, swept into the dustbin of history by the video-cassette recorder (VCR). VCRs could record as well as play unlike the video disks. This resulted in a billion-dollar loss to RCA, though millions of disks were sold. He took cheerfully these amazing twists and turns of his career.

"Sonnenfeldt regards this dubious phase of his career as one of the most rewarding.....there was the opportunity to work with top-level research people and top-level management at the same time. It was a dream came true".

Sonnenfeldt was elected Fellow of the IEEE in 1962 for his contributions to colour television and digital techniques.

ELEVATION FROM OBSCURITY

Above all the achievements in his engineering career, Sonnenfeldt values his experience at the Nuremberg during the trials of Nazi war criminals the most rewarding of his life. How a 23 year old infantry soldier was recommended (July 1946) for being decorated for his services as Chief Interpreter at the Nuremberg trials, is a fascinating story.

In May 1945, Sonnenfeldt was inducted as the Chief Interpreter at the Nuremberg trials. While he displayed empathy, he gained the confidence of the American prosecutors. He would even suggest lines of questioning, which led to casual conversation with prisoners.

For example, Hitler's Army Chief of Staff, Franz Halder, mentioned that he had once heared Goering boast in Hitler's presence that "he had set the Reichstag fire" – the April 1933 event that Hitler seized upon to consolidate his power.

Goering's reaction, when he was confronted with the statement, was to pass it off as a joke. Sonnenfeldt put the question "Tell me, Field Marshal Goering, can you give us another example of a joke you told Hitler?" He did not fail to note that Goering was the only war criminal with some accomplishments.

Despite such experiences, Sonnenfeldt says his heart still burns when he hears Americans claim what things they would have done, 'showing no appreciation for what it is to live in a totalitarian society in which dissent is a capital offence'.

"Sonnenfeldt recommended policies and procedures concerning the treatment of prisoners during interrogations and the procedures were found so sound and practical that they were approved and have been used by the Interrogations to date. He handled them (military personnel of grades and ranks higher than his and civilians of many different nationalities) with such amazing diplomacy and tact that he managed to enlist their whole-hearted co-operation". This tribute by General Gill of the U.S. Army is the first of the many honors Sonnenfeldt received.

by R. Parthasarathy
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Acknowledgement: Based on the profile contributed by William Sweet in the July 2000 issue of IEEE SPECTRUM.

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Errata

In the article "Nuclear Science and Its Usage" written by Dr. Amit Roy in the May 2002 issue of **Dream 2047**, there were a couple of mistakes. In the penultimate paragraph on the page 33, a few figures were inadvertently mentioned as 5X106 MW, 1X106 MW and 2X106 MW. Please read them as $5X10^6$ MW, $1X10^6$ MW and $2X10^6$ MW respectively. The error is regretted.

— Editor

AIDS Is More Than a Medical Problem

*Dr. (Mrs) Suneela Garg, Professor of Community Medicine at the Maulana Azad Medical College, New Delhi, has been actively involved in designing and implementing AIDS control programmes at the state and national level for about a decade. She is on several committees of the State AIDS Control Organisation which works in collaboration with National AIDS Control Organisation (NACO). Dr Garg spoke to **Dream 2047** at length about the AIDS/HIV situation in the country. Excerpts from an interview with Dr. Garg:*

Dream 2047: Throughout the history of the mankind, man has been fighting against one infectious disease or the other. And the latest is AIDS – caused by the Human Immunodeficiency (HIV) virus. What sets it apart from other dreaded infectious diseases? Why is it considered deadlier than most others?

Dr. Suneela Garg: Acquired Immune Deficiency Syndrome, popularly known as AIDS, is a difficult infectious disease to tackle as it is closely linked with human behaviour. AIDS, or for that matter, HIV infection is not just a medical problem, but a social issue too. And it affects anyone and everyone without any discrimination of caste, creed and religion. Besides the social stigma attached to it, it costs huge sums of money in terms of controlling opportunistic infections such as TB, pneumonia, cryptococcal meningitis and it also affects the individual in their prime productive years. This complicates the management of the disease further. Unlike other sexually transmitted diseases (STD), there is no cure or vaccine currently available against AIDS. The mortality due to AIDS is also going up alarmingly. In 2001 alone about 3 million deaths were reportedly due to AIDS globally. HIV, the retrovirus which causes the disease, is highly mutant. Two types of HIV – HIV-1 and HIV-2 – have already been detected in the Indian context. These two types have a number of sub-types. For instance, the predominant number of HIV positive cases reported in India is caused by HIV-1C, a sub-type found in India. What is more, the treatment is very expensive and is not supported by the Government on account of indefinite period of treatment. The anti-retroviral drugs available for the treatment are not only prohibitively expensive, but also have adverse side-effects.

Dream 2047: Medical scientists world over have been working on a number of candidate AIDS vaccines for quite some time. What is the status of the AIDS vaccine research? How soon can one expect an effective AIDS vaccine in the market?

Dr. Garg: As I told you earlier, HIV is a highly-mutant virus. Its ability to mutate into various sub-types at regular intervals has been one of the major deterrents in the development of an effective AIDS vaccine. Nevertheless, the efforts are going on in different parts of the world. For instance, India has been collaborating in the field trials of a vaccine against HIV-1C sub-type, being conducted in Thailand. This vaccine is already into Phase-III clinical trials. Other major factors to be considered in the vaccine development are safety, efficacy and cost. Besides, being absolutely safe, it has to have an efficacy rate of 70 per cent or above. And the price of the vaccine should be reasonably low so that people can afford it. Considering all these factors, a vaccine against AIDS will not be available for use not before five to six years.

Dream 2047: How serious is the threat of AIDS in India?

Dr. Garg: At the end of 2001, there are about 40 million estimated HIV/AIDS cases all over the world. Out of this, roughly 10% are in India. Currently, there are estimated 3.97 million HIV/AIDS cases in India. Over the years, the ongoing AIDS and HIV surveillance in the country has revealed a very disturbing and rising trend. Seropositivity which was just 2.5 per 1,000 in 1986, the year in which the first AIDS case reported in India, grew to 11.2 per 1,000 in 1992, to 16.3 per 1,000 in 1996, and to 24.22 per 1,000 in 1999. The latest AIDS surveillance programme conducted in October 2001 has found that 29007 Indians are suffering from AIDS, out which 22023 (about 76 per cent) are males and the rest females. The maximum number of AIDS cases is reported from Maharashtra and Tamil Nadu, with Maharashtra alone accounting for almost half the total number.

Dr. (Mrs) Suneela Garg

Dream 2047: Please tell us about some of the AIDS control initiatives being taken up in India.

Dr. Garg: The first AIDS case in India was reported in 1986. The official response initially was to treat it as a problem of vigilance by the law and order agencies. A high-powered committee was constituted in 1986 and National AIDS Control Programme (NACP) was set up a year later. By the early 1990s, the Government came forward to look at it as an important problem. The first major organised intervention in AIDS control happened in 1992 when the Government received a loan of $84 million from the World Bank as part of the first phase AIDS control programme in the country. Subsequently, 55 sentinel surveillance sites were set up in 26 states. In 1996, the Supreme Court banned professional blood donors. Blood transfusion has been identified as a major transmission route of HIV, after unprotected sex with multiple partners. Today there are about 320 sentinel surveillance sites to monitor trends in specific "high risk groups" such as those visit STD clinics and intra-venous drug users and in "low risk groups" such as the women attending antenatal clinics.

There have been large-scale programmes to create awareness about the potential threat of HIV/AIDS among the Indian population. Particularly during phase-II of NACO programme, commenced in 1999, widespread campaigns had been undertaken throughout the country. Many ministries and industrial sectors have been participating in such programmes. The social marketing of condoms found to be effective with the volume of condoms thus distributed going up by about three times to 465 million in 2000-01 from 163 million in 1995-96. The thrust has of late been given to blood safety. Another intervention was successful campaign for introduction of transfusion medicine, which deals with transfusion of blood and blood products, as a compulsory subject for medical students all over the country.

Dream 2047: What are the major features of the recently-announced National AIDS Policy?

Dr. Garg: The recently-unveiled National AIDS Policy's major aim is to level off the disease by 2007. Which means that the AIDS/HIV situation in the country will be contained without any additional increase in the disease burden. Among other things, it intends to create awareness regarding the implications of the disease and provide them with necessary tools to protect themselves. It seeks to reinforce traditional moral values among youth and other impressionable groups and also to create an environment that enables all sections of population protect themselves from the infection and families and communities provide support to those

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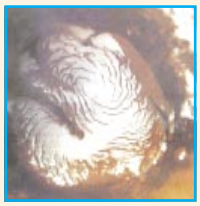
Recent Developments in Science and Technology

NASA finds Mars sea of Ice



A huge sea of ice lies just under the surface of Mars which can be a source of fuel and drinking water. Scientists studying Mars found that layer of ice just a little beneath the surface. Scientists studying Mars have been looking for water for a number of reasons. For one, life, as we know it, requires water, and any one who wants to spend any time on the planet would need water to drink and to use as a source of water.

Source: Science, May 2002

Protein to help treat Diabetes

A protein that affects the body's ability to handle fat and sugar might offer a way to treat obesity and diabetes, if a way can be found to block it, scientists have reported. Mice genetically engineered to lack the protein can eat high fat diet and stay lean. If a way can be found to block this protein in humans it may be a way to treat or prevent diabetes and obesity. The protein called PTP1B, for protein tyrosine phosphatase1B, joins a list of protein and enzymes that in mice and associated with obesity. Many different small biotech firms and large pharmaceutical companies are pursuing them as potential diet pills.

Source: New Scientist, May 2002

Organic Farms More Fertile

Organic farms are more efficient than their conventional cousins and leave soils far healthier. In a long-term study comparing productivity, environmental health, biodiversity and energy consumption of organic cultivation to conventional methods, Paul Mäder of the Research Institute of Organic Agriculture in Switzerland and his colleagues found that the organic approach used significantly less energy to produce the same quantity of crop. Though organic farms typically produce lower overall yields than common plots do, their ecological benefits are greater—a larger number of pest-eating creatures and other advantageous organisms live in soil farmed organically and decomposition occurs more efficiently on these lands, releasing much needed nutrients into the soil.

The researchers began studying four plots of land planted with winter wheat, potatoes, beets, grass clover and barley. Farmers cultivated two of these fields conventionally. For the remainder, they utilized organic methods, substituting compost and manure for synthetic fertilizers and using mechanical weeding and plant extracts instead of chemical pesticides. The scientists found that organic soils harboured about 50 per cent fewer nutrients (because plants received no artificial fertilizer), but yielded on average only 20 per cent less crop. Thus, plants farmed organically used available nutrients more efficiently. It happened because biodiversity on organic land is far higher than in traditionally cultivated soils. Moreover, root-colonizing fungi that help plants absorb nutrients, as well as pest-eating spiders and nutrient-cycling soil microbes, exist in significantly greater numbers on organically tilled plots.

Source: Scientific American, May 2002

Tea May Reduce Heart Disease

The beverage of choice in many cultures, tea has long been touted as having various healing properties. Now new research suggests that in the case of heart disease, that may well be true. According to study results published on *Journal of the American Heart Association,* heart attack patients who drank tea regularly had significantly elevated survival rates as compared with those who didn't.

Surveying 1,900 heart attack survivors, Kenneth Mukamal of Harvard Medical School and his colleagues found that those who reported drinking the most tea were the least likely to die during follow-up. More than half of the patients had not consumed any tea in the year leading up to their heart attack; 615 were moderate drinkers (fewer than 14 cups a week); and 266 were heavy users, imbibing on average 19 cups a week. By the end of the study period—roughly three and a half years later—313 individuals had died. All told, moderate drinkers exhibited a 28 per cent lower death rate than nondrinkers, whereas heavy drinkers had a 44 per cent lower death rate—regardless of differences in age, gender, and clinical and lifestyle factors.

The team suspects that antioxidants known as flavonoids, which are abundant in green and black teas, may explain the link between tea consumption and survival. Previous research has shown that flavonoids can prevent the oxidation of low-density lipoprotein, and that they can enhance the blood vessels' ability to relax in patients with cardiac disease. Furthermore, test-tube studies indicate that flavonoids may have an anticlotting effect.

Source: Scientific American, May 2002

Compiled by Kapil Tripathi

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living with HIV. Another major objective of the policy is to improve services for the care of those affected in times of sickness both in hospital and at home through community health care. Also on agenda is the strengthening of target intervention among "high-risk groups" such as truck drivers and commercial sex workers and intra-venous drug users. This would be done through integrated peer counselling. Considering the close linkage between sexually-transmitted diseases and AIDS/HIV infection, the policy delineates measures to closely monitor and contain STD cases. For this, the existing STD clinics in the country will be further strengthened and focussed awareness and counselling programmes will be organised for those attending such clinics. The efforts will also be taken to reduce the incidence of the mother to child transmission from HIV-infected mothers. NACO is already making drugs available free of cost to pregnant HIV positive women as an attempt to avoid the transmission of the disease to newborn babies. Improving the availability of low cost drugs for the AIDS/HIV infection, wider public awareness campaign and strengthening school AIDS awareness programme are some of the other features of the new AIDS policy.

The National AIDS Policy also intends to strengthen the State AIDS Control bodies by giving them enough financial powers to take up new and ongoing AIDS control programmes much more effectively.

❒ T.V. Jayan

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