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Monthly Newsletter of Vigyan Prasar

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VP News

S & T Popularisation in J & K

Vigyan Prasar organised a two-day VIPNET workshop at Khanabal, Anantnag in Jammu & Kashmir, in association with the District Students Welfare Society (SWS), an NGO active amongst students and teachers of that region. The workshop held on 24th & 25th of August 2002, received an overwhelming response from students and teachers alike. While initially it was expected that only 70 existing and prospective Vigyan Prasar NETwork (VIPNET) members would attend, due to the latent enthusiasm the workshop was attended by more than 115 participants.

Participants at the Workshop

The workshop held at Govt. Boys Higher Secondary School (GBHSS) at Khanabal, was conducted by Dr. T. V. Venkateswaran (SSO) and Shri Harvinder Singh Shergill (Fellow) from Vigyan Prasar. Ms. Habla Kausar (Headmistress of the local school) inaugurated the workshop by the traditional lighting of the Shamma (light), and urged the teachers and young students to take firm steps to save the nature and natural beauty of the Valley, and cautioned against unbridled exploitation of natural resources for immediate gains. The welcome address was by Shri Shabir Ahmed Shabir, Secretary, (SWS) and Shri Harvinder Singh Shergill explained the objective of VP and its programmes. In the technical sessions, Dr. T.V. Venkateswaran, elucidated how one could communicate basic scientific facts by way of demonstration and simple experiments that involve little or no cost. Prof. Rafiq Ali, college lecturer delivered a demonstration and talk on the subject of water pollution. Officials from the local Pollution Control Board also elucidated on the efforts taken by them to keep the environment green and clean, and called upon the students to join force with them in making Kashmir a green valley. Shri Sharir Ahmed Bhat, teacher Senior Secondary School, and Mr. Wakeel Ali, teacher also conducted technical sessions.

Energized by the enthusiastic response from the local teaching and academic community, the local host organisation, SWS, came up with a follow up action plan. The Society has decided to conduct science festivals in about 30 schools in that region and demonstrate the potential of activity based science education, even while forming many more VIPNET clubs in J&K.

Vigyan Prasar participated in the Delhi Book Fair (24 August to 01 September, 2002). Picture shows the Vigyan Prasar stall.

Inside

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

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Actions Not Words

In 1992, representatives of over 150 countries came together in Rio De Janeiro, Brazil, for what is popularly known as the Earth Summit, or the United Nations Conference on Environment and Development. They resolved to save all of the nature, from algae to elephant. They also agreed that the planet's delicate climate urgently needed protection before global warming rises to dangerous levels. At Rio evolved what is known as "Agenda 21". It is really a blueprint for change - legally binding conventions on biodiversity and climate change, a framework of principles on the conservation and use of forests, and a series of declarations. They constituted a commitment to taking the world away from the self-destructive path of "conventional" development, and established important linkages between environment and development. It was here that the concept of "sustainable development" was born which has since dictated the international agenda for development. Further, it facilitated cooperation between governments and non-government organizations on issues related to environment.

True, over the last decade since Rio, things have changed. But, much remains the same. The Rio Earth Summit had recommended that industrialized nations had to alter their consumption patterns and life-styles to reduce and eliminate the accumulation of gases in the atmosphere like carbon dioxide - also called the greenhouse gases - which raise the temperature of the atmosphere globally. It is heartening that several countries have already met the targets set for the reduction of greenhouse gases. However, the effectiveness of these steps gets reduced due to the refusal of a few developed countries whose contribution to global warming is far in excess of that of any country in the world! Indeed, carbon emissions by the United States are 16 per cent above 1990 levels making it a major polluter! Since 1990, 2.4 per cent of the world's forests have been destroyed, which works out to about 90,000 sq. km. every year. About40 per cent of world population now faces chronic shortage of fresh water for daily needs. Nearly two thirds of the farm lands of the world suffer from soil degradation. Hundreds of species of plants and animals have become extinct. Further, in last decade, 800 million more people were added to this planet, the global populations going up from 2.5 billion in 1950 to 6 billion in 2000!

It was in this backdrop that the recently concluded World Summit on Sustainable Development was held in Johannesburg, South Africa, and was attended by over 20,000 delegates that included some 100 heads of state, business leaders, representatives of some 700 companies, and representatives of a number of non-government organizations the world over. The objective was to take stock of the progress made since the Rio Summit, and discuss issues like bio-safety and the impact of genetically modified crops, control and regulation of hazardous wastes, crucial issues of livelihood and poverty and their links to the natural environment, along with translating environmental concerns into policies by the respective governments to ensure their implementation for sustainable development. However, the most daunting issues – species extinction, infectious diseases, trade subsidies, cleaner energy remained unresolved! No targets were set to resolve these issues! Indeed, activists left Johannesburg feeling betrayed by world leaders who, they said, offered "crumbs for the poor". "When the time came for targets, time tables, and money, they let the world down!". Environmentalists were equally unhappy - biodiversity and climate issues were nearly ignored.

Let us realize that the environment is people; the environment is individuals, and ultimately, the environment is us. It is not outside of us. It is a part of us, just as we are part of the environment. Is it fair to blame only the governments and the vested interests in maintaining the unsustainable development? We too have to share part of the blame. Our constitution makes it the fundamental duty of every citizen to protect the environment. We complain of wasteful consumption in developed countries, but fail to realize that we now have classes of people consuming much more than others. Austere living is a thing of the past. How tragic! It was in this country where Mahatma Gandhi lived and made a distinction between need and greed. He gave the mantra for sustainable development when he uttered "Earth has enough for everyman's need, but not for everyman's greed!" True, in practical terms, an individual may be able to do very little, but in moral terms a lot. Remember the Chipko movement initiated by Sunderlal Bahuguna and his followers to save the trees? Or the efforts of Anna Hazare and Rajendra Singh that greened the parched earth in Maharashtra and Rajasthan through watershed management programmes? When international celebrities espoused animal rights, animal products became unfashionable. Indeed "green consciousness" has to sprout from within, and spread from the individual, to the communities, to the national and international levels. When the individual voices get transformed into community voice, it cannot be ignored by any powers that be.

Indira Gandhi once said that poverty was the greatest polluter. What she meant was that we may do all that we can for the environment, but if the problem of poverty was not addressed, human misery may outweigh everything else. How do we tackle this issue? Programmes for empowerment of women and poverty alleviation need to be implemented with greatest vigour, according to R. Rajamani, former secretary, Ministry of Environment and Forests. This would enable them to improve their lives without destroying natural resources. Emphasis should be on development of cleaner technologies. Entrepreneurs and industrialists, on their own, need to adopt technologies which are least polluting. Why do we keep using the ubiquitous plastic bag despite being aware of its non-biodegradable properties? Or not use renewable energy sources? Is it asking too much? At Johannesburg, during the Earth Summit, Justin Frieden, an eleven year old Canadian boy said in no uncertain terms, "too many adults are too interested in money and wealth to take notice of serious problems that affect our future. Think about your children, your nieces, nephews and may be grandchildren. What kind of world do you want for them?" Sustainable development is for our children and grandchildren. We need actions not words.

❒ V. B. Kamble

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Marie Curie

The First Woman Nobel Laureate

Subodh Mahanti

In science we must be interested in things, not in persons

Marie Curie

The life of Marie Curie contains prodigies in such number that one would like to tell her story like a legend. She was a woman; she belonged to an oppressed nation; she was poor; she was beautiful. A powerful vocation summoned her from her motherland, Poland, to study in Paris, where she lived through years of poverty and solitude. There she met a man whose genius was akin to hers. She married him; their happiness was unique. By the most desperate and arid effort they discovered a magic element, radium. This discovery not only gave birth to a new science and a new philosophy: it provided mankind with the means of treating a dreadful disease.

Eve Curie in *Madame Curie by her Daughter*
(translated by Vincent Sheean)

Marie Curie was the first to use the term 'radioactivity'. Through her discovery of radium, Marie paved the way for nuclear physics and cancer therapy. She was the first woman in Europe to earn a doctorate degree (1902). She was the first woman to win a Nobel Prize. In 1903 the Nobel Prize for physics was jointly awarded to Marie, her husband Pierre Curie (1859-1906) and Henri Becquerel (1852-1902) for the discovery of radioactivity. She was the first woman to be appointed as lecturer and professor at the Sorbonne University in Paris (1906). She was the first person ever to receive two Nobel Prizes. In 1911 she was awarded the second Nobel Prize in chemistry for her discovery and isolation of pure radium and radium components. She was the first mother-Nobel Laureate of a daughter -Nobel Laureate.

Marie Curie

Marie Curie (her original name was Marya Sklodowska) was born on November 07, 1867 in Warsaw, the capital city of Poland. She was the fifth and the last child of her parents Bronislawa and Vladislav Sklodowski. At the time of her birth, Poland had not been an independent country. It had been divided up among Austria, Prussia and Russia. Warsaw was in the part of Poland that was under the control of Russia. Czar Alexander II, the then Ruler of Russia, hoped to stamp out Polish nationalism by keeping the people ignorant of their culture and language. It is said that when the Czar was assassinated by revolutionary students in 1881, Marie and her best friend Kazia celebrated by dancing around the desks in their classroom.

After the birth of Marie, her family's fortune deteriorated. Her birth led her mother to resign her position as a head of a school, where the family had resided until then. They moved to a boys' high school, where her father taught mathematics and physics. However, the Russian supervisor in charge of the school fired him for his pro-Polish sentiments. And subsequently he was forced into a series of progressively lower academic posts. Her mother after fighting for five years against tuberculosis died at the age of 42 in May 1878. At the time Marie Curie was 10 years old. In 1873 Sklodowski lost his job. He was replaced by a Russian teacher. At about the same time her father lost most of his savings through an unwise investment in a scheme promoted by a brother-in-law. Sklodowksi never forgave himself for losing the family savings in a bad investment. However, his children honoured him for nurturing them emotionally and intellectually. He read classics of literature to his children. He also exposed to the scientific apparatus he had once used teaching physics in school but now he had kept them in home as Russian authorities removed laboratory instruction from the Polish curriculum. Marie Curie wrote : "I easily learned mathematics and physics, as for as these sciences were taken in consideration in the school. I found in this ready help from my father, who loved science... unhappily, he had no laboratory and could not perform experiments.

Marie did very well in her school studies. She was awarded a Gold Medal at her high school graduation in 1883. However, her joy was overshadowed by the fact that she had to shake the hand of the grandmaster (of course a Russian) of education in Russian Poland. After finishing her school education she suffered from depression. Her father persuaded her to spend a year with her cousins in the country. This was the only year in which she lived a carefree life.

While she was very good student in school in her early days but she did not show any startling characteristic to indicate that one day she would become the most famous woman scientist in the world. To quote her daughter Eve Curie, who wrote a marvelous biography of Marie : "I have attempted to show Marya Sklodovska, child and adolescent, in her studies and at play. She was healthy, honest, sensitive and gay. She had a loving heart. She was, as her teachers said, "remarkably gifted"; she was a brilliant student. But on the whole no startling characteristic distinguished her from the children who grew up with her : nothing had indicated her genius."

Marie had a brilliant aptitude for study and a great thirst for knowledge. However, as being a woman, as mentioned earlier, she had no hope for advanced study in Poland of those days. So she along with her sister Bronya started attending the Floating University. The name 'Floating University' derived

from the fact that it was an illegal night school and its classes met in changing locations. This was to evade the watchful eyes of the Russian authorities. The Floating University was founded by students who hoped that their grassroots educational movement would lead to eventual Polish liberation. To quote Marie Curie: "It was one of those groups of Polish youth who believed that the hope of their country lay in a great effort to develop the intellectual and moral strength of the nation…We agreed among ourselves to give evening courses, each one teaching what he knew best".

Pierre Curie

It was obvious that the education given by the Floating University could not be matched with the education provided by any major European university which admitted women. However, Marie became familiar with progressive thought and also with new developments in the sciences. Both Marie and her sister nurtured a hope of going to Paris and study at the Sorbonne University. However, their father was not in a position to send them to Paris for higher studies. Bronya was earning some money by giving private tuition. Marie also tried to earn some money by private tuition but without much success. Both the sisters realized that individually they would not able to earn enough money to enable them to go to Paris. So they decided that one of them will go first by pulling their resources together. But then they had to decide who would go first. Marie asked her sister to go first. Bronya replied :

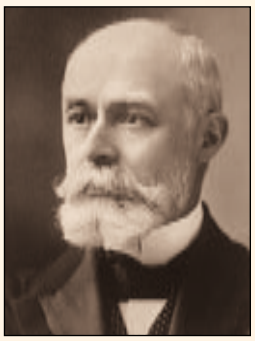
"Why should I be the first to go? Why not the other way round? You are so gifted – probably more gifted than I am. You would succeed very quickly. Why should I go?"

However, Marie had her own reason which seemed more practical. She argued :

"Oh, Bronya, don't be stupid! Because you are twenty and I am seventeen. Because you've been waiting for hundreds of years and I've got lots of time. That's what father thinks too, it is only natural that the elder should go first. When you have your practice you can bury me in gold – in fact, I count on it. We're doing something intelligent at last, something that will work…"

Marie Curie

To earn money Marie decided to work as governess. Her first stint as a governess was quite unpleasant. Describing her experience she wrote to her cousin Henrietta Michalovska : "Since we separated my existence has been that of a prisoner. As you know I found a place with the B——'s, a family of lawyers. I shouldn't like my worst enemy in such a hell ... It was one of those rich houses where they speak French when there is company - a chimney sweeper's kind of French - where they don't pay their bills for six months, and where they fling money out of the window even though they economise pettily on oil for the lamps. They have five servants. They pose as liberals and, in reality, they are sunk in the darkest stupidity. And last of all, although they speak in the most sugary tones, slander and scandal rage through their talk - slander which leaves not a rag on anybody... I learned to know the human race a little better by being there. ***I learned that the characters described in novels really do exist, and that one must not enter into contact with people who have been demoralised by wealth."*** (emphasis not in original).



Henri Becquerel

In 1886 she went to take up the job as a governess in a village which was 100 kilometers away from Warsaw. Her salary was 500 rubles a year. It seemed Marie liked the job here, as evident from her letter to Henrietta written on February 03, 1886 : "I have now been with M. and Mme Z . for one month : so I have had time to acclimatize myself in the new post. Up to now all have gone well. The Z.s are excellent people. I have made friends with their eldest daughter, Bronka, which contributes to the pleasantness of my life. As for my pupil, Andzia, who will soon be ten, she is an obedient child, but very disorderly and spoilt. Still, one cannot require perfection…."

She established friendly relation with the family to such an extent that they supported Marie when she decided to teach some of the peasant children to read and write in Polish. It may be noted that such an activity was then strictly prohibited in Poland. While working here she fell in love with the eldest son of the family, a mathematics student at the Warsaw University and they decided to marry. But her employers, the parents of the boy, absolutely refused to allow it. Though she felt humiliated at the turn of events she stayed in her post till her contract was over. This is because she knew her responsibility. She had to send money to her sister in Paris.

In mid-1889 Marie came back to Warsaw. She had got an appointment in the house of some rich industrialist. After finishing this assignment she started living with her father. She again joined the Floating University. During this time she had also an opportunity for entering a laboratory for the first time. It was in an institute called "The Museum of Industry and Agriculture" which was teaching science to young Poles. At the time it was directed by her cousin Joseph Boguski. The name of the institute was to mislead the Russian authorities. A museum would not arouse suspicion. Commenting her experience Marie wrote : "I had little time for work in this laboratory. I could generally get there only in the evening after dinner, or on Sunday, and I was left to myself. I tried to reproduce various experiments described in the treatise on physics or chemistry, and the results were sometimes unexpected. From

time to time a little unhoped for success would come to encourage me, and at other times, I sank into despair because of the accidents or failures due to my inexperience. But on the whole, even though I learned, to my cost, that progress in such matters is neither rapid nor easy, I developed my taste for experimental research during these first trials."

Finally the moment, for which she was waiting, arrived. In November 1891 she set off for Paris. She had just turned 24. She travelled in the cheapest class on the three day journey by rail. She enrolled at the Sarbonne University. She had to struggle hard in her studies. After finishing school she had been away from her studies for six years. She was mostly self taught and so there were inheritable gaps in her knowledge. Moreover, though she had good knowledge of French but it was not the same technical French spoken by her fellow students and professors at the Sorbonne University.

Gabriel Lippmann

At first she lived in the home of her sister, Bronya, who married another Polish patriot, Casimir Dluski, whom she had met in Medical School. The Dluskis' home, however, was an hour's journey by horse - drawn bus from the university. So Marie had to waste two hours a day of valuable working time. Moreover, the Dluski apartment was a meeting place for Poles, full of distraction from work. The young doctor was frequently called out to his patients in the middle of the night which meant disturbance of sleep for others. In the absence of visitors Casimir played the piano which was also a source of distraction for Marie from her studies. So within few months Marie moved to the Latin Quarter, the artists' and students' neighbourhood, close to the university. She had to struggle a lot. There was no comfort for her. To quote her daughter Eve curie :

"All the rooms Marie was to inhabit were alike in discomfort and cheapness of rent. The first was situated in a poorly furnished house where students, doctors and officers of the neighbourhood garrison lived. Later on the girl, in search of absolute calm, was to take an attic like a servant's room at the top of a middle-class house. For fifteen or twenty francs a month she found a tiny nook which was lit from a loop-hole giving directly on the slope of the roof. Through this skylight appeared a small square of the sky. There was no heat, no lighting, no water… No service, of course : even one hour of cleaning a day would have overweighed the expense side of the budget. Transportation costs were suppressed : Marie went to the Sorbonne on foot in all weathers. Coal was kept down to a minimum : one or two sacks of "lumps" for the winter, which the girl brought from the merchant on the corner and hoisted up the steep stairs herself to the sixth floor, bucketful by bucketful, stopping at each floor to breathe. Lights were at minimum : as soon as night fell, the student took refuge in that blessed asylum called the Library of Sainte-Genevieve, where the gas was lighted and it was warm. Seated at one of the big rectangular tables with her head in her hands, a poor Polish girl could work until they closed the doors at ten O' clock. From then on all that was needed was enough oil to keep the light going in her room until two in the morning. Then, with her eyes reddened by fatigue, Marie left her books and threw herself on the bed."

Marie was obsessed by her dreams. She was harassed by poverty. But she was proud of living alone and independently in a foreign country. She wanted to achieve something and she had so much confidence in herself that she knew that she would achieve the target one day. In a letter written during this period to her brother, Marie wrote:

Wilhelm Conrad Roentgen

"It is difficult for me to tell about my life in detail; it is so monotonous and, in fact, so uninteresting. Nevertheless I have no feeling of uniformity and I regret only one thing, which is that the days are so short and that they pass so quickly. One never notices what has been done; one can only see what remains to be done, and if one didn't like the work it would be discouraging.

I want you to pass your doctor's thesis ... it seems that life is not easy for any of us. But what of that? We must have perseverance and above all confidence in ourselves. We must believe that we are gifted for something, and that this thing, at whatever cost, must be attained. Perhaps everything will turn out very well, at the moment when we least expect it ..."

Ms. Meloney, Irene, Marie and Eve Curie in USA

Irrespective of tremendous hardships Marie not only completed in 1893 her Master's degree in physical science but stood first. For her spectacular success she was awarded an Alexandrovitch Scholarship, worth 600 rubles, when she came to Warsaw for the summer. The scholarship was meant for an outstanding Polish student wishing to work abroad. The scholarship enabled her to return Paris and take the Master's degree examination in mathematics in 1894 after one more year of study. This time she stood second. It may be noted that Marie after getting her first paid employment returned her scholarship money 600 rubles to the Alexandrovitch Foundation so that they could use it to give another young student the same opportunity she had enjoyed.

At Sorbonne Marie had the opportunity to hear some of the very well-known physicists and mathematicians like Marcel Brillouin, Paul Painleve, Gabriel Lippmann and Paul Appell.

Before completing her mathematics degree Marie was

commissioned by the Society for the Encouragement of National Industry to do a study, relating magnetic properties of different steels to their chemical composition. For this work she needed a laboratory where she could do the work. One of her acquaintances, a Polish physicist, M. Kovalski, Professor of Physics in the University of Fribourg, who was visiting Paris at that time suggested that Pierre Curie might be able to assist her. Pierre, who had done pioneering research on magnetism, was Laboratory Chief at the Municipal School of Industrial Physics and Chemistry in Paris. So Marie met Pierre, a meeting that would change not only their individual lives but also the course of science. With Pierre's assistance Marie could find rudimentary lab space at the Municipal School.

Friedrich Wilhelm Ostwald

When Marie met Pierre, he was 35 years, eight years older than Marie. Though Pierre was an established physicist, he was an outsider in the French scientific community. He was a dreamer, an idealist, whose sole aim in life was to devote his entire life in the pursuit of science. He was totally indifferent to recognition. The Municipal School of Industrial Physics, which he was heading, trained engineers. His research work concerned with crystals and the magnetic properties of bodies at different temperatures. With his brother he had discovered piezoelectricity, which means that difference in electrical potential is seen when mechanical stresses are applied on certain crystals, including quartz.

Marie, too was an idealist. And like Pierre she had also an urge to pursue science single-mindedly. Pierre and Marie immediately discovered an intellectual affinity, which was very soon transformed into deeper feelings. Initially Marie had no plans to settle in France. On being asked by Pierre whether she was going to remain in France permanently Marie replied : "Certainly not. This summer, if I succeed in my master's examination, I shall go back to Warsaw. I should like to come back here in the autumn, but I don't know whether I shall have the means to do so. Later on I shall be a teacher in Poland; I shall try to be useful. Poles have no right to abandon their country." After her success in her mathematics examination Marie returned to Warsaw for a vacation. She was not sure whether she would return to Paris or not.

Pierre wrote her frequently. He argued strongly that by leaving Paris for good she would be abandoning not just him, but a promising career in science. In one of his letters Pierre wrote : "We have promised each other haven't we ! to be at least great friends. If you will only not change your mind ! For there are no promises that are binding ; such things cannot be ordered at will.

It would be a fine thing, just the same, in which I hardly dare believe, to pass our lives near each other, hypnotised by our dreams : your patriotic dream, our humanitarian dream, and our scientific dream.

Of all those dreams the last is, I believe, the only legitimate one. I meant by that we are powerless to change the social order and, even if were not, we should not know what to do : in taking action, no matter in what direction, we should never be sure of not doing more harm than good, by retarding some inevitable evolution. From the scientific point of view, on the contrary, we may hope to do something; the ground is solider here, and any discovery that we may make, however small, will remain acquired knowledge."

Marie came back to Paris and in July 1895 she married Pierre. In 1896, Marie passed her teacher's diploma, coming first in her group. Their daughter, Irene, the future Nobel Laureate, was born in September 1897. Pierre persuaded the authorities for allowing Marie to work in the School's laboratory.

In 1897 Marie decided to take a physics doctorate. Her choice of a thesis topic was influenced by two recent discoveries by other scientists. In December 1895 Wilhelm Conrad Roentgen (1845-1923) had discovered a kind of ray that could travel through solid wood or flesh and yield photographs of living people's bones. Roentgen, who became the first Nobel Laureate in physics, dubbed these mysterious rays X-rays, with X standing for unknown.

Frederic Henri Moissan

In 1896 Antonine Henri Becquerel, showed that uranium compounds, even if they were kept in the dark, emitted rays that would fog a photographic plate. This was an accidental discovery. He was trying to find out whether the new radiation discovered by Roentgen could have a connection with fluorescence. The scientific community initially ignored Becquerel's intriguing finding. Marie decided to make a systematic investigation of the mysterious uranium rays for her doctorate degree. As the topic was quite new she did not have long bibliography of published papers to read. Thus she was able to begin experimental work on them immediately. She had an excellent aid at her disposal, an electrometer for the measurement of weak electrical current. This new kind of electrometer was invented by Pierre Curie and his brother Jacques. It was based on piezoelectric effect. This device was very useful as she decided to determine the intensity of the radiation of uranium compounds by measuring the conductivity of the air exposed to the action of the rays.

While working on this topic she discovered that thorium gives off the same rays as uranium. Thus she proved that uranium was not the only radioactive element. She also demonstrated that the strength of the radiation did not depend on the compound that was being studied. It depended only on the amount of uranium or thorium present in the sample. This was a very surprising result. Because as we know different compounds of the same element have very different chemical and physical properties. But in case radiation given off by uranium and thorium it mattered only how much uranium or thorium a compound contained. Based on her findings Marie concluded that the ability to radiate did not depend on the arrangement of the atoms in the molecules but it must be linked to the interior of the uranium itself and not to its interaction with something else. It had to be an atomic property. And from a conceptual point of view it is her most important contribution to the development of physics. That radioactivity was an atomic phenomenon was demonstrated by Rutherford and his pupils. After these discoveries Marie decided to study

the natural ores that contain thorium and uranium. She found that two uranium minerals, pitchblende and chalcocite, were more active than uranium itself and so she hypothesized that a new element that was considerably more active than uranium was present in small amounts in these ores.

Pierre, after being fascinated with new vistas that were opening up from Marie's research, gave up his own research into crystals and symmetry in nature and joined Marie in her project. They found that the fractions containing bismuth or barium showed strongest activity. By the end of June 1898 they found a substance which was 300 times more strongly active than uranium. In this research paper announcing their findings they wrote : "We thus believe that the substances that we have extracted from pitchblende contain a metal never known before, akin to bismuth in its analytic properties. If the existence of this new metal is confirmed, we suggest that it should be called polonium after the name of the country of origin of one of us." The term `radioactivity' was first used in this paper read on December 26, 1898. They announced the existence of an additional very active substance that behaved chemically almost like pure barium. They suggested the name `radium' for the new element.

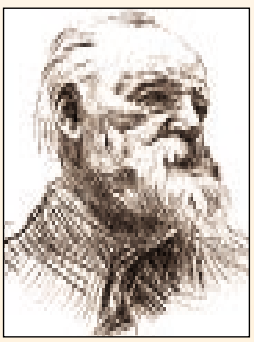
Svante Arrhenius

In their joint work Pierre observed the properties of the radiation while Marie, for her part, purified the radioactive elements. It turned out that in order to extract even tiny traces of radium one would require to process tonnes of the ore, pitchblende. Moreover Curies would require to buy this costly raw material. Pitchblende was expensive because uranium salts produced from it was used in industry to make glazes. But luckily for Curies the residue of the ore after the uranium had been extracted was almost worthless and could be bought cheaply. Being persuaded by Professor Edward Suess (1831-1914) and the Academy of Science of Vienna, the Austrian government which was the proprietor of the state factory, presented a ton of residue to the Curies. And what is more if they require more they could obtain it at the mine on the best terms. However, they had to pay for its transportation from Austria to Paris. They processed it in a dilapidated shed. While describing about the shed Eve Curie wrote : "The Faculty of Medicine had formerly used the place as a dissecting room, but for a long time now it had not even been considered fit for a mortuary. There was no floor and an uncertain layer of bitumen covered the earth. It was furnished with some worn kitchen tables, a blackboard which had landed there for no known reason, and an old cast iron stove with a rusty pipe.

The Curies' honeymoon trip was a tour of France on bicycles purchased with a wedding gift.

A workman would not willingly have worked in such a place : Marie and Pierre, nevertheless, resigned themselves to it. The shed had one advantage : it was so untempting, so miserable, that nobody thought of refusing them the use of it". Marie and Pierre were really grateful to the Director of the institute for allowing them to use it. Friedrich Wilhelm Ostwald (1853-1932), who traveled from Berlim to Paris to see how they worked, wrote : "At my earnest request, I was shown the laboratory where radium had been discovered shortly before. It was a cross between a stable and a potato cellar, and if I had not seen the work table and items of chemical apparatus, I would have thought that I was played a practical joke."

After struggling under the most adverse circumstances, Marie finally isolated almost pure radium chloride. She had just obtained one tenth of a gram. She took it to the French chemist Eugene Demarcay (1852-1904), who had first identified the new elements spectroscopically. He now had enough to determine its atomic weight, which he calculated as 225.93. Marie defended her doctoral thesis on June 15, 1903. Among the three members of the Examination committee were two future Nobel Laureates – Gabriel Lippmann (1845-1921) and Ferdinand Frederic Henri Moissan (1852-1907). The Committee was of the opinion that the findings represented the greatest scientific contribution ever made in a doctoral thesis. The same year Marie and Pierre were awarded half the Nobel Prize in physics "in recognition of the extraordinary services they have rendered by their joint researches on the radiation phenomena discovered by Professor Henri Becquerel." The other half went to Becquerel for his discovery of spontaneous radioactivity. The announcement of 1903 Nobel Prize for physics aroused tremendous curiosity of the press and the public. Earlier only the Prizes for Literature and the Peace used to be widely covered by the press. The Prize in science were not given publicity because they were considered all too esoteric to be able to interest the general public. After getting the Prize Marie wrote : "We have been given half of the Nobel Prize. I do not know exactly what that represents : I believe it is about seventy thousand francs for us, it is a huge sum. I don't know when we shall get the money, perhaps only when we go to Stockholm. We are obliged to lecture there during the six months following December 10th.



Victor Huge

We did not go the ceremonial meeting because it was so complicated to arrange. I did not feel strong enough to undertake such a long journey (forty-eight hours without stopping, and more if one stops along the way) in such an inclement season, in a cold country and without being able to stay there more than three or four days : We could not, without great difficulty, interrupt our courses for a long period.

We are inundated with letters and with visits from photographers and journalists. One would like to dig into the

ground somewhere to find a little peace. We have received a proposal from America to go there and give a series of lectures on our work. They ask us how much we want. Whatever the sums may, we intend to refuse."

In 1914 Marie helped found the Radium Institute. Throughout the first World War Marie devoted herself to the development of the use of X-ray radiography. She trained army's radiologist nurses at the Radium Institute, at what is now known as the Curie Institute. She equipped more than 20 vans that acted as mobile field hospitals and about 200 fixed installations with X-ray apparatus. She obtained funds from charitable institutions such as the Red Cross and adopted X-ray equipment to make portable radiology units. She persuaded rich women to donate cars to carry those instruments. Marie travelled with one of the cars herself operating the X-ray equipment at field hospitals to locate shell fragments in the bodies of wounded soldiers. Her elder daughter Irene helped her in her effort. Together they trained 150 other radiographers. The total number of men examined by these installation exceeded a million. After the end of the war, Marie undertook a campaign to raise funds for the Radium Institute. She was persuaded by Mrs. William Brown Meloney, an American journalist, to tour the United States for publicising the project in 1921. Meloney herself campaigned to raise funds from American women to purchase a gram of radium for Marie. The then United States' President Warren G. Harding presented her the radium thus purchased.

Irene Joliot Curie

On April 19, 1906 Pierre while hurrying to cross a road he was run over by a horse-drawn wagon with a load of military uniforms, weighing some six tons. He was killed instantly. The top of his skull was crushed by the left rear wheel of the vehicle.

After Pierre's death, Marie was appointed as a professor at the Sorbonne University. She was the first woman to be appointed at Sorbonne. Marie continued to produce several decigrams of radium chloride. And finally with Andre Debierne, she isolated radium in metallic form. In 1911 she was awarded the Nobel Prize in chemistry 'in recognition of her services to the advancement of chemistry by the discovery of the elements radium and polonium, by the isolation of radium and the study of the nature and compounds of this remarkable element'. The discovery and isolation of radium is regarded as the greatest event in chemistry since the discovery of oxygen. The fact that an element could be transmuted into another element, revolutionised chemistry and signified a new epoch. Some people have questioned the decision of the Nobel Committee awarding Marie a second Nobel Prize in chemistry. According to them, the second award was also given for the same discovery, for which Marie and her husband Pierre was awarded the Nobel Prize in Physics in 1903.

Her alleged love affair with Paul Langeven, her colleague at Sorbonne and her husband's collaborator scandalized France. It shook the University world in Paris and the French Government at the highest level. It made headlines on the first pages of newspapers. Her situation in Paris became impossible. She became a prisoner in her own house. Svante Arrhenius, a senior member of the Swedish Academy Sciences, wrote to Marie suggesting that she should not come to Stockholm to receive her second Nobel Prize. In fact Arrhenius pointed out that if the Swedish Academy knew the full details of the affair it would not have awarded her the Prize. However, Marie made it a point to attend the function. She insisted that her private life should not be linked to her scientific works. In her Nobel lecture delivered on December 11 in Stockholm, she declared that she also regarded this prize as a tribute to Pierre Curie. She said :

"Before approaching the subject of the lecture, I wish to recall that the discovery of radium and that of polonium were made by Pierre Curie in common with me. We also owe to Pierre Curie in the domain of radioactivity, some fundamental studies which he carried out either alone or in common with me or in collaboration with his pupils.

The chemical work which had as its aim the isolation of radium in the state of pure salt and its characterisation as a new element was carried out especially by me, but is intimately linked with the work in common. I therefore believe I shall interpret exactly the Academy's thought in admitting that the high distinction bestowed upon me is motivated by this work in common and this constitutes a homage to the memory of Pierre Curie"

On July 4, 1934 Marie died of leukemia. She was 67. The leukemia was caused by her long exposure to hard radiation.

In April 1995 Marie and Pierre Curie's remains were enshrined under the famous dome of the pantheon in Paris alongside the author Victor Hugo, the politican Jean Jaures and the Resistance fighter Jean Moulin. The Pantheon is the memorial to the nation's great men". Here some of the France's most distinguished personalities lay buried. Marie was the first woman to be honoured on her own merit.

It may be noted here though Marie and Pierre worked under the most adverse circumstances they refused to consider taking a patent as being incompatible with their view of the role of researchers. If they had taken a patent it would have facilitated their research and spared their health.

We would like to end this article by quoting what Curie had to say for making a better world : "You cannot hope to build a better world without improving the individuals. To that end, each of us must work for an own improvement and, at the same time, share a general responsibility for all humanity, our particular duty being to aid those to whom we think we can be most useful."

For Further Reading :

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The Hot Stuff

T.V. Venkateswaran*

Columbus was twice lucky - though he sailed into high seas in search of India, stumbled upon Americas, and instead of pepper that he hoped to amass in India, he chanced upon chilli quite a sufficient substitute for pepper. Just as he was deluded into holding Americas to be India and consequently named the natives as 'Red Indians', Columbus, mistook the small fiery pod used by the natives as seasoning to be another kind of pepper, and he called them 'Pimiento'- a Spanish word for black pepper, although pepper has no relation to the species of chilli - capsicum.

For most of us, potato, tomato, onion and chilli are the most common staple vegetables. Amongst these, chilli is rather essential for Indian cooking, with a very few exception, and a dash of chilli is a must for seasoning. In South East Asia, China and Thailand, hot, fiery red chilli is part of many a culinary, and for the Hunan and Szechwan Chinese soup - that would be too hot and fiery for many of us - chillis are a must. Yet, chilli and capsicum are not native of India or China, but are indigenous to Americas! The fiery, pungent red chilli has been popular for thousands of years (in America) among the Native Americans. That is in 5000 B.C., Indians in South America were already enjoying meals prepared with hot chillies.

Chilli Plant

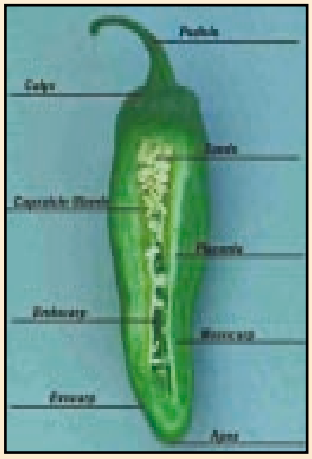
VARIETIES: *Hot Peppers* - C. frutescens abbreviatum (Short Pepper); C. frutescens conoides (Cone Pepper); C. frutescens fasciculatum (Red Cluster Pepper); C. frutescens longum (Long Pepper). The last named includes Chili, Cayenne and Long Yellow. Varieties of hot Pepper are: Hungarian Wax, Large Cherry, Long Red Cayenne, Maule's Red-Hot, Red Chili and Tabasco. All have red and orange-scarlet fruits when ripe.

Sweet or Bell Pepper - C. frutescens grossum and varieties Merrimack Wonder, Patrick Henry, Harris' Early Giant, Ruby King and Ozark Giant.

Chilli or Capsicum?

What is the difference between chilli and capsicum? Well, maybe there are apparent distinction in the shape - while chilli is like a pod, capsicum is bell shaped. However, in terms of botany, they both belong to same genus - Capsicum minimum, C. frutescens. Popularly it is also called as chili, chile, chilli, aji, paprika and capsicum interchangeably. They are also called as cayenne, red pepper, bird pepper, African pepper. Nonetheless, capsicum is not related to piper genus, which contains piper nigrum L., the source of black and white pepper.

The word capsicum comes from the Greek kapto, meaning "to bite" , obviously a reference to pungency or heat sensation that one feels on biting a chilli. However, the older name - Chiltepin - for this plant, arises from the Nahuatl dialect of the Aztec language. This was the name given to one of the earliest known varieties. The name is believed to be a combination of the words chile and tecpintl, that means 'Flea Chile', which is believed to allude to the sharp biting taste of the chile pepper.



Parts of Chilli

It was first domesticated in the American continent and we have historical evidences about its cultivation between 5200 and 3400 BC, thus placing it to be one of the oldest cultivated plant in Americas.

It is thought that chile peppers made their first appearance around 7000 BC in Americas, it came to light to the rest of the world only after 1500s. It is one of the most widely cultivated crops in the Indian subcontinent, South East Asia, North America, Latin America and Southern Africa.

Chilli and capsicum are the two groups. The sweet peppers or mild-flavoured varieties are usually called as capsicum in India, which are used for stuffing, salads and garnishing and the hot chilli in pod shape, are usually called as 'chilli' that is mainly used in sauces and flavouring.

Chilli (and capsicum) are tender annuals or perennials that have straight, woody stems. The genus Capsicum is a member of the Solanaceae (Nightshade) family, that includes tomato, potato, tobacco and petunias. This plant has single, star-shaped, white flowers in the axils of the leaves. The flowers are followed by juiceless berries or pods, which vary in shape and size. They are green at first and change to red, yellow or purple. They contain many flat, kidney-shaped, white seeds, which are very hot tasting. In fact most of the pungent inducing chemicals are present not in the skin or other parts but around the seeds. Capsaicin, is the molecule that causes the biting and pungent sensation and this molecule is abundantly found in the white "ribs" of the seeds in hot chillies.

How chilli burns

Why do we feel the pungent hot fiery sensation on tasting chilli? Capsaicin, is a molecule found in the white "ribs" – not in the seeds, but more in the placenta of the seeds - of hot peppers that is the root of our perception of heat from the peppers. It is assumed to be a defence mechanism in a variety of pepper plants. The capsaicin found in hot peppers work by binding to and stimulating capsaicin receptor proteins found in neuronal cells. The fibres of the neuronal cells then carry the stimulus from areas such as the tongue, to the roots of the spinal cord. Capsaicin also allows a deluge of calcium ions to enter the neuron. This is dangerous, because an extended exposure to calcium causes the fibres of the neuron to die. Capsaicin excites a

special type of neurons called nociceptors. These types of neurons transmit information regarding tissue damage to pain-processing centres in the spinal cord and brain. When these nociceptors come in contact with capsaicin, these neurons get excited. As these neuron types are particular for transmission of tissue damage, there is a perception of pain. Once the pain is perceived as a reaction and rectification, there is a local release of inflammatory mediators that attempt to resolve the damaged tissues.

If we bite a fiery hot chilli and sense pain, drinking milk would help and sooth out tongue. Casein, an enzyme found in milk products disrupts the bond between capsaicin and neurons.

Chilli's pungency is not considered technically as a distinct taste at all for they are not tasted by the taste buds, rather chilli induces a sense of pain. When we consume, the capsaicinoids in chilli bind to a receptor in the lining of the mouth. This is the same receptor that registers pain from heat, thus the effect is a burning feeling. This is a result of the flow of calcium ions from one cell to the next. The pungent molecule has an electron poor area, which is attracted to the electron rich area on the receptor protein. As this results in pain, it leads to the release of endorphins. Endorphins are a class of neurotransmitters produced by the body and used internally as a pain killer. Endorphins are similar in their action to opiates, as they attach to some of the same receptors in the brain. Thus they are a strong analgesic, and give a pervasive sense of happiness also the release of endorphins lowers the blood pressure, a major indicator in heart disease.

Different types of Chilli

This is why capsaicin is useful as pain a reliever. On application of capsaicin, the brain perceives tissue damage and a surge of reactions occur. Release of such mediator molecules soothes the sore muscle. Nonetheless, prolonged and sustained use of capsaicin will cause long-term loss of responsiveness because it kills off the nociceptor, or it destroys the peripheral terminals.

Capsaicin, on contact with the neurons, depletes 'substance P', which is involved in the transmission of pain from the skin to the spinal cord. By blocking substance P, capsaicin acts as a dramatic and long-lasting anesthetic bringing relief.

Though chillies are indigenous to Americas, rich varieties with different quality factors are now found in India than in any part of the world. The mildly pungent *munda* and medium

Chilli and hotness:

Chillis come with various shapes, sizes and also pungency. The Lavang Mirch of Maharashtra is a David in size but Goliath in its pungency. The variety called Gandhari Melagu in Kerala is also small in size but really hot. Recent studies indicate that the Naga Jolokia, (or the Tezpur variety) to be the hottest variety of chilli in the world.

	Hotness in Scoville units		
Bell - Pimento - Sweet Banana - Cubanelle - Pimento - Romanian	0	up to	0
Cherry - Pepperoncini - NuMex R-Naky - Mexibell - Aji Flor	100	up to	500
Santa Fe Grande	500	up to	750
Anaheim - Sandia - NuMex Big Jim - NuMex 6-4	500	up to	2,500
Espanola - Poblano - Mulato - Ancho - Espanola Improved - Pasilla	1,000	up to	2,000
Cascabel - Chilaca - Hot Cherry	1,000	up to	3,000
Rocotillo	1,500	up to	2,500
TAM Jalapeno - Mirasol - Cayenne Large Thick - Guajillo - Cascabella - Hungarian Wax - Peter pepper - Turkish	2,500	up to	5,000
Wax - Puya - Aji Amarillo - Romesco	5,000	up to	10,000
Jalapeno - Serrano	5,000	up to	25,000
de Arbol - Catarina - Japones	15,000	up to	30,000
Aji - Cayenne Long Thin - Piquin - Prik Khee Nu - Dundicut - Tabasco - Andean Aji - Costeno	30,000	up to	50,000
Yatsafusa	50,000	up to	75,000
Chipotle - Santaka - Thai - Chiltepin - Aji Amarillo - Aji Limon - Aji Oro - Cusqueno - Datil	50,000	up to	100,000
Habanero - West Indian Hot	100,000	up to	200,000
Jamaican Hot	100,000	up to	325,000
Bird - Birdseye	150,000	up to	225,000
Scotch Bonnet	150,000	up to	350,000
Red Savina Habanero	300,000	up to	577,000
Pure Capsaicin	15,000,000	up to	16,000,000

pungent *sannam* are internationally recognized. And chillies from India are exported to many countries, including USA!. To cap it all, possibly the hottest variety of chilli is an Indian variety called as Tezpur variety. The Mexican variety of chilli called 'Red Savina' Habanero is tested as 300,000 Scoville units while the common varieties like Jalapeno and Peperonico are about 5000 Scoville units only. But Tezpur is tested to be 855000 Scoville units by the scientists of a DRDO laboratory in Gwalior.

Scoville scale or How to measure the 'hotness' of chilli.

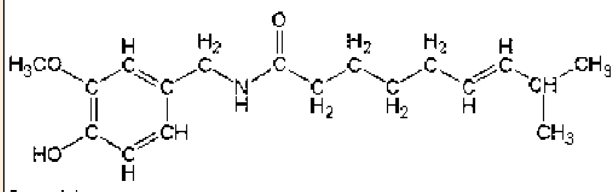
Wilbur Scoville, a chemist working with Park Davis Pharmaceuticals, developed a method to measure the heat level of a chilli in 1912. The test is named after him, Scoville Organoleptic Test, is an ingenious dilution-taste procedure. Pure ground chillies were blended with a sugar-water solution and a panel of testers then sipped the concoctions, in increasingly diluting the concentrations, until they reached the point at which the liquid no longer burned their mouth. A number was then assigned to each chilli based on how much it needed to be diluted before you could taste no heat. Nowadays the **High-Performance Liquid Chromatography** (HPLC) test is used. In this procedure, chilli pods are dried, ground and the chemicals responsible for the pungency are extracted. The extract is analyzed by the HPLC analysis, and the amounts of the various capsaicinoids present in the sample is determined. This provides the objective units for measuring the pungency of chillies.

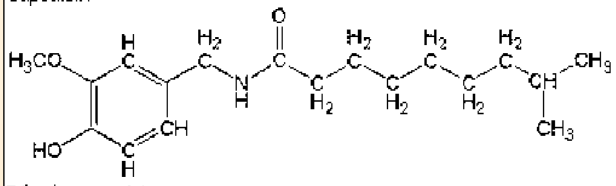
The pungency of chile peppers is measured in multiples of 100 units, from the bell pepper at zero Scoville units to the incendiary Habanero at 300,000 Scoville units! If you mix just one drop of pure capsaicin to 1,000,000 drops of water then it will be 1.5 Scoville units for the pure capsaicin rates over 15,000,000 Scoville units.

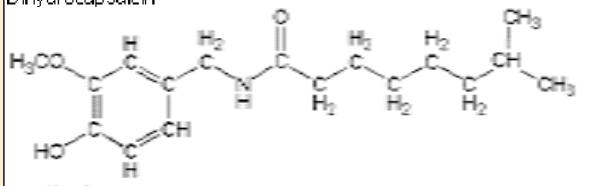
In fact there are closely related seven molecules that are called as capsaicinoids that are the source of the fiery sensation. But among them, capsaicin and dihydrocapsaicin found in the chilli contribute to more than 90% of the pungency in the chillies. Oleoresin Capsicum (OC) is an extract that is made from cayenne chilli (that is chillies other than capsicum) in powder form and it can be used for the production of riot control agents. OC powder is mixed with aerosol and used to control riot. The natural oleoresin capsicum extracted from chilli is less lethal than the synthetic counterparts such as ortho-chloro benzalmalononitrile and choloroacetophenone. The natural OC extracted from chilli also environmental friendly and much safer, hence, it is most sought after product for preparation of riot control agents. Next time you see a riot scene on your TV screen and watch police use riot control agents, think of chilli. For the most sought after riot control agent is derived from chillies!!.

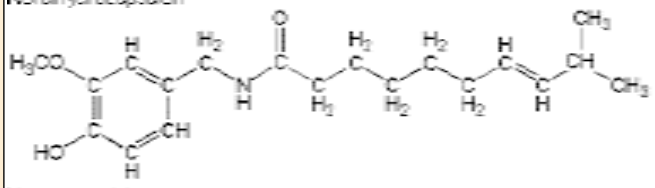
Chemistry of chilli

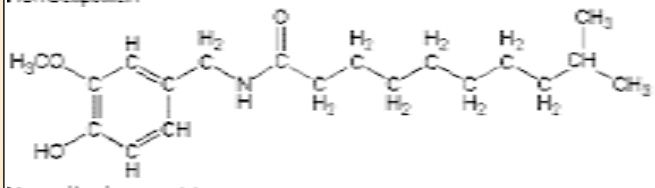
Capsaicinoids that can be extracted from chillis include N-Vanillyl-8-methyl-6-(E)-noneamide (known as Capsaicin), Nordihydrocapsaicin (or Dihydrocapsaicin), Homocapsaicin, and Homodihydrocapsaicin. Capsaicin and Dihydrocapsaicin together make up 80-90% of the Capsaicinoids found in chilli.


Capsaicin


Dihydrocapsaicin


Nordihydrocapsaicin


Homocapsaicin


Homodihydrocapsaicin

Medicinal uses

Capsicum, or hot red chilli peppers, have come into their own recently, both as a culinary spice and as a hot new medical remedy. Long used as a food spice and an aid to digestion, red chillies or cayenne peppers were once thought to aggravate stomach ulcers. This fear has been discounted by researchers, rather, it is widely held that capsicum could help prevent the formation of dangerous blood clots. Now new research is focusing on this spice's ability to act as an anti-inflammatory agent, and aid in controlling pain.

Researchers in Thailand first noticed that people who consume large amounts of red chilli peppers experienced a lower incidence of thrombo-embolism, or potentially dangerous blood clots. Scientists then looked at the medical records of countries where hot spicy foods were regularly consumed, and found that people who eat a diet high in red peppers experience a much lower incidence of blood clotting diseases. Scientists have now concluded that capsicum does indeed possess fibrinolytic activity, meaning that it is able to break down blood clots.

Capsicum or cayenne, derived from chilli, is highly nutritious, containing Vitamin C and B-complex vitamins as well as iron, calcium, and phosphorous. The red colour of many chilli peppers is due to their high Vitamin A content. Traditionally, chilli peppers have been used in condiments to promote digestion and are believed to cleanse the blood. Capsicum has also been used as a gargle to treat throat conditions.

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Recent Developments in Science & Technology

Cosmic smog ' Key to life in Milky Way'

Cosmic smog may have seeded life not only on our planet, but in countless other solar system throughout the galaxy.

This is the implication of a new study of meteorites, which reveals that important complex organic molecules survived the formation of our Solar System and were brought to earth on these rocks. It suggested ours and any other solar system would have been dusted with this mix of organic ingredients very early on giving life a head start could make it common elsewhere.

Max Bernstein of NASA's Ames Research Centre in Mofett California says "It makes us more sanguine about finding other habitable places".

The molecules, called polycyclic aromatic hydrocarbons are common in interstellar space, and many believe they were among the raw materials for life. But until now no one knew if the PAHs in meteorites are ones that survived the birth of our solar system or if they formed from scratch only later.

New Scientist, August 2002

Fish-Rich Diet May Reduce Levels of Fat Hormone

A diet rich in fish may lower levels of the fat-regulating harmone leptine, scientists say. Levels of leptin produced by fat cells in the body lead to obesity and cardiovascular disease. But till now, it was difficult to know exactly how the system works and what other factor influences the hormone levels are unknown. But a new finding published in journal Circulation suggests that diet plays a key role.

Scientists have known for some time that fish or fish oil seems to provide some protection against cardiovascular disease in humans. And earlier studies in rats indicated that unsaturated fatty acids in fish may affect leptin levels. Mikolaj Winnicki of the Mayo Clinic and his colleagues wanted to see if a fish-rich diet has a similar effect on the hormones in humans. To do this, team examined the body mass index, fat content, age, gender, diet and leptin level of about 600 individuals. Half of them lived on a lake and ate a lot of fish, the others were vegetarians. The scientists found that fish eater, however possessed significant lower level of hormones than vegetarians. Although women generally posses higher level of the hormones than men do. The investigator found that leptin levels of women who ate fish to be less than half that of both the female and male vegetarian.

Scientific American, August 2002

Scientists create smallest ever laser-like light beam

As computer technologies continue to shrink to nanoscale dimensions, scientists are finding it increasingly difficult to view and measure their tiny creations. Just billionths of a metre in length, modern machine components are actually becoming smaller than the wavelength of light used to view them. Researches have attempted to create laser-type light beam of extremely short wavelength for viewing these tiny objects, but the results have typically been weak and the apparatus too cumbersome for practical applications. Now according to new findings scientists have found a way to create this by using extreme ultra violet light using equipment .

In a traditional laser, mirrors at either end of a gas filled chamber reflect light back and forth, which forces the photons to synchronize and increase the light's intensity. have Randy Bartels of the University of Colorado and his colleagues shown a high-intensely visible light laser through an argon-gas-filled tube. After travelling through specially designed "structured wave guide" a stream of synchronized photons with an extreme ultraviolet wavelength of only tens of nano-metre emerged. Intense and powerful, the beam holds its focus far longer than that of typical laser and can detected much smaller object.

Potential applications for this new technology could be numerous. In particular, the small size of the apparatus makes it extremely practical, especially for the examining the behaviour of molecules and for helping engineers design and test the manufacturing system.

Scientific American, August 2002

Compiled by: Kapil Tripathi

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Some like it hot !

People of Andhra are known for their liking for hot tasting food full of chillies. But it appears that birds also like fiery chillies. Chilli seeds are dispersed by birds and it is amazing why this fiery chilli fruit is a desired food for the birds. Its fruit is bright red-orange, so it's attractive to birds. But when the bird eats the fiery hot chilli, will it not experience the pain and avoid them in future? If birds are essential for the seed dispersal, why, then, do chillies burn? If you want a bird to eat the fruit and carry the seeds, on its digestive tract, to a new site, then why fill the fruit with fiery capsaicin?

Well, indeed because birds have a poor sense of smell and taste, the fiery fruit does not discourage them. However, mammals, small and large, tend to avoid eating chillies because of the burn, saving the fruits for the birds.

For dispersing the seed the birds are also suitably rewarded. Chillies contain beta-carotene, vitamin C, and fats, so it is possible that the burn might actually be a nutritious meal to the birds. The fats are especially important because they provide a source of concentrated energy, something most fruits don't do.

Unlike mammals, in birds food through the digestive tract moves quickly; the seeds of a fruit may be "in transit" for as little as 20 minutes. Consequently, seeds are not damaged and will germinate after the bird has dropped them. In this mutual cooperation, the chilli plant succeeds in dispersing its seeds and the birds get essential nutrients, a definite evolutionary symbiosis between the bird and plant !!

Capsicum

Taken internally to aid digestion, red chilli should be consumed slowly to avoid distress. Capsicum is called the purest and most certain stimulant known. By getting things moving in the body capsicum aids the circulatory and digestive systems, relieves pain and aids in the healing of colds.

This small and spicy fruit helps many ailments, but most significantly, capsicum is known to be unequalled in promoting outstanding blood circulation. It revitalizes cells, arteries, veins and the heart. Here are some other illnesses capsicum has been historically known to help. High blood pressure, nose bleeds, vericose veins, sinus, too much mucus, insect bites, heart failure, asthma, arthritus, energy, digestion.

**Dr. T.V. Venkateswaran has recently joined Vigyan Prasar as Senior Scientific Officer*

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Planetarium and Science Education

N. Rathnasree*

The Jawaharlal Nehru Memorial Fund was established in 1964 to further the ideals that were held dear by Pandit Jawaharlal Nehru, the first Prime Minister of India. He considered children as the most precious resource of the country and wished that every opportunity be provided to them to become responsible citizens. He saw that understanding the spirit and method of science would form a crucial part of this process. Therefore the Jawaharlal Nehru Memorial Fund undertook to build two planetaria, a small one in Anand Bhavan, Nehru's ancestral home in Allahabad, and the second, larger one at Teen Murti Bhavan, New Delhi, his official residence as Prime Minister for 17 years. The planetarium at Teen Murti Bhavan was inaugurated on February 6, 1984 by Shrimati Indira Gandhi, the third Prime Minister of India to serve as an active, vibrant memorial to him.

Teen Murti Bhavan was built in 1928 as the residence of the commander-in-chief of British India. It is a magnificent example of colonial architecture. The mansion itself is located on extensive grounds, most tastefully laid out with a variety of trees, shrubs and flowering plants. Today it houses a museum, preserving the spartan living and working quarters of Jawharlal Nehru when it was his official residence. A photographic story of the independence movement is on display in the other wings of this huge mansion. An auditorium and a world class library of modern history were added after his passing away. The planetarium was designed to be in tune with its locale. Architecturally it blends with the nearby monument, the Kushak Mahal. This is a 13th century hunting lodge built by the Lodhis. Where the planetarium stands today was the location of tennis courts framed by bougainvillae slopes and a canopy of shady neem trees. Care was taken during the construction of the planetarium to preserve all the original trees and recreate the mound. Today a new generation of bougainvillae in full bloom frames the stone clad Planetarium dome, making it quite unique architecturally and a harmonious member of the beautiful Teen Murti Complex.

Many innovations in Planetarium construction were introduced for the first time in India while building this planetarium. The airconditioned Sky Theatre has a dome shaped screen made of fibre glass. This big screen consisting of 26 curved segments has one million hand drilled holes for good acoustics and is one of its kind. The Carl Zeiss Spaceflight Master projector is placed on a hydraulic lift, which brings the projector up from a well at each show. This is another first for this planetarium. So is the gallery all around the sky theatre, which helps in locating the slide and special effects projectors. The aircooled display area with cofferred ceiling adds to the beauty of the exhibition area. It houses many interactive working models and photographs. The planetarium is proud to have on display the historic space module Souyz T-10 in which India's first and only cosmonaut Rakesh Sharma came back to earth, his space suit and his mission journal.

The planetarium has an air conditioned room where temporary event based photo exhibitions are mounted. Photo and Sound Studios are two other air conditioned units. Other units are, Offices, Library, Electronic and Mechanical workshop, and Service rooms. The Book and Souvenir shop and a Canteen on the terrace overlooking Teen Murti Bhavan, complete the physical facilities.

The Nehru Planetarium was the first one in India to explicitly declare that its primary goal was astronomy education. How does the Planetarium meet this goal? All the in-house facilities help in achieving this objective. Taped public shows are important in this respect as indeed they are in all public planetaria. Where the difference starts is the curriculum based live shows that have been especially devised for school students and on demand for university students. Story based children shows is another innovative format used in communication. Activity sheets have been designed by the Planetarium for many live shows for schools, another first in keeping with trends worldwide in using the planetarium for effective learning. An interactive exhibition area complements the shows and is an integral part of the planetarium visit. Activities with school and college students are another continuous feature of the Planetarium educational outreach programs.

Curriculum based live shows to students are made available to schools regularly. These are continuously updated and new programmes are added periodically to the list given below, of currently available live shows to the schools. About 270 students at a time can attend these live lectures. These are highly interactive lectures with hands on activities where many simple concepts of Astronomy are tackled in a lecture that uses all the Planetarium display facilities, interactive models and live question answer sessions. In the last two years a total of 375 special school shows were held at the planetarium. The topics covered in these shows have been the following -

For classes IX-XII : 1. Mars in focus - history of mars exploration and our current understanding of mars science. 2. Sun, our day time star - a physical understanding of the sun, its interior and energy generation processes. 3. Our universe - an understanding of the universe from its building blocks-the quarks, to its beginnings-the big bang. 4. Light - an understanding of light, its generation, propagation and properties. Electromagnetic radiation from celestial bodies telescopes and other instruments in detecting radiation from different wavelength regions. 5. The earth system - the nature of the dynamic interior of the earth, its interaction with its surroundings and the sun-earth connection. 6.pulsars - an overview of these exotic objects in the sky, their observations and current understanding. 7. Seti - current status of the ongoing search for extra-terrestrial intelligence. 8. Life stroy of a star - current understanding of origin, evolution and death of stars.

For classes VI-VIII : 1. Watching the night sky - some interesting constellations, binocular nebulae and galaxies in the sky theatre along with a beginning to understanding of co-ordinates in the sky. 2.solar system - an update on our current understanding of the solar system objects. 3. Moon, our neighbour in space - a history of moon exploration, to our current day understanding, and future prospects. 4. Eclipses - a

complete eclipse primer - solar to lunar eclipses in the solar system and from partial to total and annular eclipses. 5. Comets, meteors and meteor showers - an understanding of debris of different kinds in the solar system and their interesting manifestations observed from earth.

For classes I-V : 1. Watching the night sky. 2. Pole star and the direction north 3. Shapes of the moon 4. Night, day and the seasons

Specialized workshops are conducted at the Planetarium periodically for Senior School and College students. These are somewhat technical workshops involving theoretical lectures usually followed by observations. The most recent two such workshops conducted from the Planetarium have been 1. Sunspot Observation Workshop that was organized for senior school and college students during December 2001 and 2. A Summer workshop in Astronomy was conducted in May 2002 and the following topics were covered : Celestial Sphere - Changes in the Sky and Co-ordinates; Beginning skywatching - A sky theatre session; Computers in Astronomy - Basic Planetarium software; Computers in Astronomy - Advanced software; Night Sky watching; Understanding the Sun; Sunspots - Theory and Observations; Solar System; Stars and their Evolution; Optical Aids in Astronomy; Careers and projects in Astronomy.

Every year a number of school and college students work at the Planetarium towards completing a long-term project in any Astronomy related topic as part of their curriculum requirement. In the last two years about 22 students - Class XII, BSc and MSc have worked at the Planetarium on various projects and have submitted these for their course requirements. Students from JD Tytler School, Holy Child Auxillium School, Sardar Patel Vidyalaya, St. Stephen's College, Miranda House, Khalsa College, SD college and Delhi University MSc (Physics) have done various projects in this time. The topics have ranged from Studies of Keplerian Orbits for Jovian Satellites, Meteor Showers, Studies of individual Planets, etc. for senior schools students. Sun, Sunspots, and Pulsars as topics for BSc and MSc Students.

During vacations special activities involving some fun and learning about the celestial objects are undertaken at the Planetarium, usually in collaboration with the Amateur Astronomers Association. These have included a Solar System Walk - with rough simple scaled objects to represent the Planets and a scaled walk in the vicinity of the Planetarium to explain relative sizes and orbits of the Planets, Moon Carnival, Jupiter Carnival etc. to explain some concepts about these celestial objects with a lot of fun filled activities interspersed with these.

International student competitions like Astronomy Olympiad or the Intel Science Talent Fair are events where students find the Planetarium as one useful resource centre. In the last three years there has been an active participation from the Planetarium towards the International Astronomy Olympiad. Preliminary workshops are usually organized even before the prescreening of students for the Olympiad - these are made available to all interested students from the NCR region to give them an exposure to the kind of background that may be required to participate in these Olympiads.

Some students have also been working on their projects for the Intel Science Fair at the Planetarium and an increased participation is expected in the coming year as the Planetarium has been approached by the Intel Science Fair Authorities to give its resources to students participating in these fairs.

About 600 students registered with the Nehru Planetarium as participants in the Planetary Society and NASA organized worldwide contest for students, titled 'Red Rover Goes to Mars'. Students taking part in this contest had to write an essay on the best science to do on Mars by certain instruments on board the proposed Mars Surveyor 2003. This activity was a little away from usual contests for school children, and, particularly, this required them to have an appreciation of frontline research on Mars.

To prepare the students to take part in this contest a series of workshops were held over a two months period wherein an appreciation of Mars science and exposure to results from previous ventures like the Viking Landers and Pathfinder was given to the students. The follow up project under this venture titled Student navigator contest, involving students working with models of Mars exploring equipment and the submission of journals of their ensuing work has also been successfully completed.

The Amateur Astronomers Association, Delhi and the Planetarium have been having a very fruitful symbiotic relationship for many years. Many enthusiastic members of the Association have been helping the Planetarium with its various educational activities and public interactions. The Planetarium in turn makes various facilities available to the Amateurs for their activities. The Amateurs meet in the Planetarium Skytheatre every Sunday and use the dome for familiarizing new members with the skies, have discussions and lectures on topics of mutual interest. They have also developed considerable skill amongst themselves towards instrumentation for telescope making, manufacturing tracking drives for the telescopes as well as developing some skill towards doing serious contributory observations.

There are times when the heavens call and the Planetarium has to respond. Of these the most exciting times are when a Total Solar Eclipse beckons one imperiously - all too rare a phenomenon to be observed from one given site. Other events like active meteor showers, Lunar Eclipses, Planetary conjunctions, Lunar Occultations of Planets or bright stars - all these events have the Planetarium buzzing with activity in an effort to explain the underlying excitement of these phenomenons to those unfamiliar with sky phenomenon and try to show these events to the public using the equipment available at the Planetarium. Most recently some excitement was generated by repeated Lunar Occultations of Saturn that were happening this last year due to Saturn's path in the sky falling close to the Moon's in its 33 years cycle. The current Planetary groupings visible in the evening skies have also been generating a lot of interest amongst the people of the Capital and the Planetarium has been straining of its resources to satisfy the growing hunger to view these grouping through telescopes.

Planetarium is acting as a moderator for a yahoogroups site http://groups.yahoo.com/group/nehruplanetarium. This is a participatory group for discussions in Astronomy - anyone may post with any astronomy related question and it is answered by any one of the members of the group, and the Planetarium monitors and moderates the activity.

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Interview with Dr. S.Z. Qasim

Renowned oceanographer **Dr. Syed Zahoor Qasim** was the chief architect and leader of the first Indian expedition to the icy Antarctic continent, which has been a source of interest for scientists for a long time. Twenty years after the first Indian team landed in this remote and extreme continent Dr Qasim recounts his experiences in Antarctica and describes how the Antarctic programme has opened a new chapter in the annals of Indian scientific research in an interview to **Dream 2047**. Excerpts:

Dearm 2047: *Dr. Qasim, you led the first Indian expedition to Antarctica way back in 1981. What is, in your opinion, the significance of the Antarctic programme for a country like India?*

Dr. Qasim: When the first expedition to Antarctica was finalised, the scenario in the world about Antarctica was very different from what it is today. Antarctica was a monopoly of the rich and the developed countries at that time. And the only developing countries which had their presence in Antarctica were Argentina and Chile, because of their proximity to the icy continent. India's entry into Antarctica broke this monopoly. India was the first Asian country and one of the foremost developing countries to have its entry into Antarctica. Soon after India's entry many developing countries like Brazil, China and South Korea made efforts to land in Antarctica and build stations there. The main rationale behind our Antarctic programme was geopolitical and the other one was to open a new science for India, namely, the polar science which was non-existent before the first expedition landed in Antarctica.

Dream 2047: *How does it help us understand our glaciers up in the Himalayas better?*

Dr. Qasim: There is a major difference in the glaciers of Himalayas and those of Antarctica. In Antarctica, the glaciers provide the history of what has happened in the earth during the past thousands of years, because the core samples from a depth of 100 metres or more from the surface can yield many things of the past. A comparison between the Himalayan glaciers which are young mountains and that in Antarctica will provide geological history of the Himalayan glaciers and the differences will tell us about the antiquity. In this way a comparison can reveal many aspects of geological history of the Himalayas and whatever has been preserved in the ice of both the regions.

Dream 2047: *The Antarctic programmes, which have now become a regular feature, are multi-disciplinary in approach. Can you please tell us what are the major features of these expeditions in terms of Research and Development?*

Dr. Qasim: Actually the Antarctic programmes have provided many vital information to us. Our permanent station where our team stays throughout the year even in winter is giving us clues regarding the weather patterns in Antarctica. The second important feature of the Antarctic programme is that the acclimatisation of our defence personnel going to Antarctica who are facing the cold weather along the China and Pak borders and the development of several important features such as container accommodation, living in cold conditions, dress outfits, food and other usable features. The Antarctic programme has been important for scientists in the fields of physics, chemistry, geology, biology, navigation, instrumentation, etc. Whatever scientific research has been done in these fields in Antarctica is entirely original and hence important for India.

Dakshin Gangotri was the first permanent station which lasted for seven years and during this period, it was buried under ice. Subsequently, it functioned as a summer base. Our country has built an all-weather station *Maitri* which is in an ice-free hilly area. It functions throughout the year. It was completed in 1988 before I handed over the charge and it has been functioning for the last 14 years every efficiently. It is 100% Indian design and was entirely built with Indian technology and manpower.

Dr. S.Z. Qasim

Dr. Syed Zahoor Qasim has been a member (Science & Technology) of the Planning Commission from 1991-1996.

He acquired his Ph.D and DSc degrees in Marine Science from the University of Wales, United Kingdom. As an oceanographer, he has contributed in many areas and institutions and held positions as Director in several institutions including the National Institute of Oceanography, Goa. He was the first Secretary, Department of Environment and the First Secretary, Department of Ocean Development of the Government of India from 1981 to 1988. He started the Indian Antarctic Programme and was the leader of the First Antarctic Expedition in 1981-1982.

Besides being the author/editor of 8 books and more than 250 scientific papers, published in international and national journals, he is an Elected Fellow of all the National Academics of India and Honorary Professor in six Indian Universities including the IIT, Madras. He was the Vice-Chancellor of Central University, Jamia Millia. He has received Honorary Degree of DSc from four universities including the Banaras Hindu University. Besides being the former Chairman of the Research Council of the National Institute of Oceanography, Goa and President/Chairman of several scientific bodies. He was elected the General President of the Indian Science Congress for the year 1992-923. His illustrious contributions and outstanding services were well recognized and besides many national and international distinctions and awards to his credit, he was awarded Padma Shri in 1974 and Padma Bhushan in 1982. These are the two very distinguished awards conferred by the President of India for outstanding achievements. He was honoured with the prestigious Lifetime Achievement Award by the Oceanography International of the United Kingdom in April 1999 in Singapore.

He is presently the Vice-Chairman, Society for Indian Ocean Studies, Secular House, 1, Aruna Asaf Ali Road, New Delhi-110 067.

Dream 2047: *How do Antarctica and Arctic affect the global climatic regime and are we conducting any study to ascertain it?*

Dr. Qasim: I must clarify that the ice found in the Arctic is quite different from that in Antarctica. In the Arctic, there is no land underneath the ice and it is floating permanently. Submarines can cross the ice from underneath. In Antarctica, on the contrary, about 2% of the land is ice-free. Which means when you dig there is earth underneath the ice.

Coming to the global climate, if there were not so much ice in the Arctic and Antarctic Oceans, the climate of the world would have been very different from what it is today. Considerable apprehensions have been expressed about increasing global temperature caused by the high level emission of greenhouse gases which may lead to the melting of ice in the polar regions and to sea level rise. The global warming is feared to have a devastating impact on the earth climate and on its geomorphology.

Dream 2047: *Are there any economic benefits from the Antarctica expedition/research?*

Dr Qasim: The chief beneficiaries of our Antarctic programme, as I said earlier, are our defence forces. The next aspect is the introduction of a new science — the polar science – in our country. When we entered Antarctica in 1982, there was hardly any institution in the country carrying out research in the field of polar science. Today more than 30 institutions are working on the samples and data collected from Antarctica. The most important element of the Antarctic programme was that it displayed the strength of the country in being able to reach the difficult continent, build a permanent station and conduct research there – a capability of India appreciated all over the world. Going to Antarctica has really enhanced our image and prestige in the international circle.

Dream 2047: *Can you describe some of your personal experiences from Antarctica expeditions you led?*

Dr. Qasim: The most exciting thing for me was that I was selected as the leader of the first-ever expedition by the then Prime Minister, Smt Indira Gandhi. This was perhaps because of my considerable experience in oceanographic research and knowledge of the Indian Ocean. Before finalising the expedition she asked me just one question: "Can India reach Antarctica"? I answered in the affirmative: "It is possible Madam, provided that we have the right kind of vessel — an icebreaker – and some essential equipment". This was preparatory to the first expedition and I was determined to reach Antarctica because of my commitment to the Prime Minister no matter what happens. Since the destination was not known, we had to wander quite a bit in the pack ice and frozen sea to gain entry into Antarctica. Our three attempts to gain entry failed and it was in the fourth attempt, with a helicopter showing us the route from above, we could finally begin to see the Antarctic coast. Finally, we landed there. The first thought that came to the mind of the entire team was a sense of triumph and success which every one felt on landing. The experience was quite unique. Quickly we established a communication link between India and Antarctica and I had the greatest pleasure of my life talking to the Prime Minister who congratulated us and was extremely delighted about our success.

Dream 2047: *Oceanography has been an area of active research for the Government of India for quite sometime. What are major thrust areas of oceanographic research in India.*

Dr. Qasim: Oceanography is a relatively young science for India. It is a multidisciplinary in nature and embraces all sciences such as physics, chemistry, geology, biology, instrumentation engineering, computerisation of data, etc. If you take a view at the history of oceanography in India it began in 1960 when we started the first international programme called the International Indian Ocean Expedition (IIOE). In this programme more than 20 countries participated and many ships from different countries undertook the study of this ocean. India played host to many ships and was an active participant in the programme. The IIOE programme ended in 1965. Subsequently a new institution for oceanographic studies, namely the National Institute of Oceanography (NIO), was born in January 1966. The framework of this institution was outlined by the late Prime Minister Pandit Jawaharlal Nehru in 1963-64. In fact, it was he who suggested that our country must have an institution devoted to oceanographic research in its totality throughout the year. During the last four decades country has done exceedingly well in oceanographic science and NIO is rated as one of the seven best oceanographic institutions in the world. It conducts researches on almost all disciplines of oceanography. In 1993-94, another institution, the National Institute of Ocean Technology (NIOT), which deals with applied research in oceanography, was set up in Chennai.

Dream 2047: *You, as the Director of the National Institute of Oceanography, have played a key role in India initiating the polymetallic nodules exploration project. Unfortunately, nothing concrete has emerged from the programme as yet. Why?*

Dr Qasim: It is not correct to say that nothing concrete has emerged from the polymetallic nodule programme because we have made considerable progress in locating the mining area in the central Indian Ocean. A site has been allotted to India in the central Indian Ocean and India has been the first country to get the recognition of the allotment of a site by the UN International Seabed Authority. The delay in implementing the exploitation of the nodules is largely due to economic reasons. African and Latin American countries, with huge mineral resources of the strategic minerals present in the polymetallic nodules and whose economies are dependent upon their export, have released considerable quantities of these minerals in the world market. It was, however, expected earlier that by 2005, there will be a shortage of these strategic minerals (copper,

nickel and cobalt) and we may have to depend on polymetallic nodules of the sea. This really has not happened. That is why even several advanced countries including the U.S., France, Japan, Germany and the U.K. have not yet commenced the production from the nodules, although the technology for polymetallic nodule exploitation and extraction of metals from them is already established. India too is in a similar situation. As soon as the scarcity begins to show up, the nodule programme will make a big news worldwide.

Dream 2047: *Of late, there has been some interest in methane hydrates, a source of hydrogen energy, trapped in the deep sea. Is India too interested in exploration and exploitation of undersea methane hydrates?*

Dr. Qasim: You are right in saying that there is commercial interest throughout the world on gas hydrates, particularly, methane hydrates, which will be an important source of future energy. There is no country in the world, which has started exploiting hydrate reserves commercially, although many have quite an active programme going on. India too is in a similar situation. NIO scientists have discovered some potential reserves of methane hydrate within the Exclusive Economic Zone (EEZ) of India.

Dream 2047: *Similarly, pharmaceutical firms and medical researchers have initiated major programmes to uncover and develop active chemical compounds from marine sources. Please tell us more about the potential of oceans to be a source for future drugs and medicines?*

Dr. Qasim: There are several institutions in India carrying out researches on "drugs from the sea". To name a few, NIO, Central Drug Research Institute (CDRI), Lucknow, Indian Institute of Chemical Biology (IICB), Kolkatta and others are working in this field. There are expectations that some new drugs will come out from marine sources. Only a few drugs of marine origin are presently in the market in the U.S.. The sea certainly forms a major source for future drug industry.

Dream 2047: *As a Planning Commission Member for Science and Technology, you were closely associated with formulating and fine-tuning S&T policies for India. What are your views on scientific and technological research in the country today?*

Dr. Qasim: I am quite optimistic about the future of science and technology in India. In fact I have always believed in it, even before I became a Planning Commission Member. The only point worth noting is that although the country has made tremendous progress in all fields of science and technology and some of our scientists and engineers are the finest in the world, it is unfortunate that we have not used science and technology as an instrument for socio-economic development and for bringing about a social change in the country. It is only now that we are vigorously thinking in terms of eradicating poverty by ushering in a new era using science and technology as a base in the country. It is through the use of S&T that we can improve the quality of life of our people (health, longevity, environment, etc)

Dream 2047: *Many lament the quality of science education in the country today. Your comments please?*

Dr. Qasim: I believe that the only way one can improve the base of science and technology is by introducing high quality in science education — in schools, colleges and universities. Unfortunately, the financial outlay available for education is very limited. A lot of effort is required to improve the quality of science education at various levels.

Dream 2047: *You are also interested in S&T popularisation. How do you think we could disseminate scientific information and inculcate scientific temper among our people?*

Dr. Qasim: Popularisation of science and technology is the most crucial element in inculcating scientific temper in the entire country. Today, in urban areas scientific awareness has come, although not fully, but in the rural areas we have to do a lot more work towards popularisation of science. Improvement of human health and environment is largely based on the awareness of the basic elements of science and technology. It is slowly penetrating in rural areas; thanks to the commendable work done by the Department of Science and Technology, Ministry of Human Resource Development, Council of Scientific and Industrial Research and others, including the electronic media, particularly AIR and Doordarshan. But a lot more is required to inculcate scientific temper.

Dream 2047: *What is your message for younger generation?*

Dr. Qasim: The younger generation is definitely better equipped mentally, emotionally as well as educationally than their older counterparts. The new syllabi which are being introduced have a lot of important elements in science, technology and environment. My message to younger generation would be to think about how knowledge gained in the field of science and technology would help in improving the quality of life of our people. It is our younger generation who will help shaping the future of our country in all fields of human endeavour and I wish them all success.

T.V. Jayan

Letters to the Editor

It is highly laudable that Vigyan Prasar takes the pledge to fully dedicate itself to turn President Dr. Kalam's dream of transforming our country into a developed nation. I would like to congratulate Dr. Subodh Mahanti also for his nice write-up on life and thoughts of Dr. Kalam quoting profusely from the book 'Wings of Fire'. However, I would have appreciated one more quotation - the last two sentences of the autobiography - "God's providence is your inheritance. The bloodline of my great-grandfather Avul, my grandfather Pakir, and my father Jainulabdeen may end with Abdul Kalam, but His grace will never end, for it is Eternal"

Dr. G. Goswami, Ratnapur, P.O.-Nagaon, Assam-782-001

I admire the bilingual presentation of DREAM-2047 which will help in propagating the contents through masses who otherwise remain unconnected to the world of science on account of language (English) problem. I once again congratulate you all at VIGYAN PRASAR for this unique effort of popularising & propagating science. I am also reading the publication and find it informative with a lot of supporting data colourfully & beautifully presented with a lot of pictures.

Anil N. Deshapande, Mumbai-53

Gopal Chandra Bhattacharya

One Who Observed Insects

Amit Chakraborty*

In the world of ants and bees, the queen's position is unique. She produces workers and soldiers. In the absence of queens, bee larvae fed on Royal Jelly, a special kind of food, are expected to grow as queens. Otherwise, they would turn into workers. The same phenomenon was first observed in ants by an unknown Indian entomologist, Gopal Chandra Bhattacharya, way back in early 1940's. The keen observer was watching an Indian variety of ants known as Occophylia. He persuaded the ants to make nests of transparent cellophane so that he could silently watch their activities and noticed that only a special food, the newly spouted leaves and buds, induces the formation of queens. This remarkable finding was published in the Transactions of the Bose Institute of Kolkata. Unfortunately, because of World War II, the journal was not well circulated abroad the Gopal Chandra's work remained unknown to the West.

Gopal Chandra Bhattacharya

Gopal Chandra Bhattacharya was born in Lonsing, a remote village in Faridpur district (now in Bangladesh) on August 1, 1985. His father was a village-priest whose untimely death compelled the five-year-old boy to take up his father's profession for maintaining the family. He continued his school education and passed the Matriculation examination with a first division. However, his financial poor compelled position him to forgo the academic career and take up the job of a schoolteacher to maintain his family.

Gopal Chandra was an observer of nature right from his childhood. He wrote an article on 'bio-luminescence', which was published in *Parbashi,* the then famous Bengali periodical and drew attention of Sir J. C. Bose. He offered him a job in his *Bose Institute.* This event that marked a turning point in Gopal Chandra's career. He joined the institute as an assistant and had to do odd jobs like instrument repair, drawing etc. However, within a short time he was allowed to start his own research. Sir J. C. Bose himself directed him to work in the field of entomology.

Gopal Chandra started observing the behaviour of various insects, e.g., ants, spiders and tadpoles. He was an expert photographer. He could pohotograph spiders, hunting fishes or even small bats. Based on his observation he used to write popular articles in Bengali, which were published, among others, in the popular science magazine *Gyan-O-Bigyan,* founded by Prof. S. N. Bose.

For a long time it was believed that man was the only tool-using and the tool-making animal. In the nineteenth century it was discovered that chimpanzees in Tanzania use tools and weapons. In their search for food, they drum with sticks on hollow tree-trunks, poke straws or twigs into termite holes, and then eat the insects that have seized hold of them. They sometimes prepare the twigs for this purpose, virtually making tools. The chimpanzees of certain populations attack and batter enemies with branches up to 2 metre long. Swiss zoologists have recently discovered that these anthropoid apes crack nuts with hard objects. This behaviour was found in certain variety of birds. When an Egyptian vulture discovers an unguarded ostrich egg, it picks up a stone and bangs it against the egg until the hard shell cracks. We learn from Gopal Chandra Bhattacharya that even the lowly insect is a tool user. He observed hunting wasps grasping small stone chips and using the same to close a nest hole. He also discovered an interesting feature of earwigs well known for protecting their eggs. During the breeding period, he observed, the earwing carries a muddy layer on his hind legs. The dried up mud forms a 'heavy boot' used for protecting its eggs from predators. If the mud is washed away, the insect promptly places its hind legs into the mud until a new 'boot' is formed. Once the hatching is complete this behaviour pattern also vanishes. This rare finding was again published a in popular Bengali language magazine and thus never reached the international scientific community.

After the demise of Sir J. C. Bose, D. M. Bose, the physicist director of Bose Institute, opened a new line of research for Gopal Chandra Bhattacharya. He started working with ants and tadpoles and observed the effect of antibiotics on them. It is known that tadpoles become frogs after a specific period, which is usually a few days, by a process known as *metamorphosis.* Gopal Chandra discovered that administration of penicillin prevents metamorphosis. He showed that penicillin destroys or inhibits certain bacteria present in tadpoles and they do not develop into frogs. The common idea that bacteria are always pathogenic i.e., disease producing, was proved to be wrong. Gopal Chandra established the existence of salogenic i.e., health giving bacteria. This pioneering study was later published by his associates in *Science and Culture,* a Kolkata based journal, which again had almost no international circulation.

Gopal Chandra was a field researcher for more than five decades. Despite his 22 original papers published in English, two of which were published in US based *Scientific Monthly and Natural History Magazine* he remained unknown even to Indian scientists primarily because he concentrated on writing in popular language. He wrote more than 800 popular science articles many of which were based on his observation. In 1975 he received the Rabindra Award, highest of its kind for Bengali writing, for his book on insects of Bengal.

Gopal Chandra did not have formal academic education and that is why he was not accepted as a scientist by many of his colleagues. In 1977, this author was producing a series of radio-features based on interviews with senior scientists of Bengal. Dr. J. N. Mukherjee, a well-known scientist of the yeasteryears, refused to given an interview when he came to know that Gopal Chandra Bhattacharya was included in the panel of scientists. He flatly remarked that Gopal Chandra could at best be considered as a popular science writer but never a as scientist because he never entered a college for studying science. Gopal Chandra knew about this attitude of contemporary scientists and he felt sad. The University of Calcutta however, conferred Honourary D.Sc. on him on January 21, 1981, less than three months before he died.

*Dr. Amit Chakraborty was with All India Radio and Doordarshan. He is a recipient of NCSTC National Award for S & T popularisation. Currently he is a Fellow at Vigyan Prasar.