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VP News

Tsunami and Ham Radio

When all the public telecommunication networks were extensively damaged in the tsunami struck Andaman & Nicobar Islands, ham radio became the only lifeline of communication from the tsunami affected areas to the mainland. Immediately after the tsunami struck on December 26, 2004, ham radio operators from different corners of the country rushed to the tsunami affected areas, specially the Andaman & Nicobar chain of Islands. These stations were activated from Port Blair, Car Nicobar, Little Andaman and Campbell Bay area. Several teams of ham radio volunteers from Gujarat, Andhra Pradesh and Karnataka operated from the A&N Islands. Fortunately a team of National Institute of Amateur Radio was on an expedition operating from Port Blair even before the Tsunami struck. Hams in the coastal areas of South India activated emergency stations from the relief camps. Also, several ham radio control rooms were operating from different parts of India. An emergency Ham Control station operated from Manthranalaya on behalf of the Government of Maharashtra.

It was on the morning of December 26, 2004, that Smt. Bharathi Prasad (VU4RBI) first reported through ham radio that the VU4 Dxpedition (distant expedition) team survived the tsunami. Immediately, she and her team *contd. on page....38*

Inside




Demonstration of Scientific Experiments Using a PC in Bhopal

Vigyan Prasar has initiated an effort in Bhopal to explore possibility of enhancing science popularization activities. To begin with, a series of Demonstrations were organized on Scientific Experiments using a PC. Shri V. K. Joshi and Shri Rintu Nath of Vigyan Prasar visited Bhopal between 1 - 3 December, 2004 and deliberated with officials of Navodaya Vidyalaya Samiti, Bhopal Region, and District Education Officer at Bhopal. Demonstrations were organized at three schools: HEMA Public School, BHEL ; Jawahar Navodaya Vidyalaya, Ratibad, and School of Excellence, Bhopal. During the demonstrations, it was shown and explained how students can undertake projects using computer to measure and control physical parameters like temperature, intensity of sound/ light, humidity, pH, voltage, current etc. Over 500 students and teachers from 20 schools attended these interactive demonstrations. *contd. on page....23*

Shri Rintu Nath (right), of VP, giving demonstration of scientific experiments using a PC at HEMA Public School, BHEL, Bhopal

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

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Editor : Dr. V.B. Kamble

Tsunami Lessons

Till a few days ago, the word 'tsunami' did not exist in our day-to-day vocabulary. Today it has become a household term synonymous with instant death and devastation by a violent sea. On the morning of Sunday the 26 December, 2004, when the world was still in a Christmas mood, a powerful earthquake with its epicenter under the Indian Ocean off the western coast of the Indonesian island of Sumatra shook the region. This was world's strongest earthquake in last 40 years that recorded 9 on the Richter scale. The quake set off shock waves through the ocean – the giant tsunamis - that lashed across the coast of 13 nations, and were felt more than 6500 kilometres away on the coast of East Africa. Sumatra suffered double shock – that of the quake and the earliest strike of the tsunami. There would have been 90 to 150 minutes in which warnings could have been sounded by radio, television or even by loudspeakers in the areas most affected – Thailand, Sri Lanka, the Andaman and Nicobar chain of islands, and the eastern coast of Indian mainland. Alas! There was no established mechanism to pass warnings to the countries around the ocean's shores. The death toll in the first 10 days was put at about 150,000 people, and continues to grow with each passing day, and ten times more rendered homeless. But, how are these tsunamis - the giant killer waves - produced?

The Earth's surface is made up of a series of large tectonic plates – or landmasses. The term 'tectonic' refers to the large scale processes that take place within the structure of the Earth's crust. These plates are made up of the crust and the upper part of a layer, called the mantle, underneath. The crust and upper mantle together constitute the lithosphere (from Greek *lithos* meaning stone) which is about 80 km deep formed by the giant plates that form a giant jigsaw puzzle around the globe. These plates are in constant motion travelling at a few centimetres per year. The edges of these plates, where they move against each other, are the sites of intense geologic activity, such as earthquakes and mountain formation. Surely, when the plates move, the ocean floors also move. The puzzle pieces, that is, the plates shift each year by a few centimetres as they slide on top of a somewhat fluid part of the mantle called the asthenosphere (from Greek *asthenes* meaning weak). The asthenosphere is ductile like putty and responds to the temperature of the Earth. It is the asthenosphere that carries the lithosphere, including the continents - and oceans - on its back.

Tsunami stands for a Japanese word that translates as *harbour wave*, which is triggered by a vertical disturbance in the ocean, say, an earthquake, a landslide or a volcanic eruption. The disaster on 26 December, 2004 was caused by a massive earthquake off the coast of Sumatra, where two plates of the Earth's crust – the Indian plate and the Burma plate - grind against each other. The Indian plate usually moves northeast about 6 centimetres every year – or about twice the growth of the finger-nails every year! Stress built up as the Indian plate pulled down on the Burma plate. Apparently, the two plates slid about 15 metres at once! It is estimated that about 1,200 kilometres of the Burma plate snapped and forced a massive displacement of water in the Indian Ocean. Sudden motion forced water up and down. This generated waves that spread in all directions, moving as fast as 800 km / hr. In the deep sea the waves may be imperceptible. On the surface, one may not even notice what is happening underneath. *These are tsunamis!* In deep water, tsunamis are very long, shallow waves. Hence they do not lose much energy and can travel vast distances until they are slowed down by resistance from the sea floor near shore, and gain height. Further, their retreat from the land can be quick – and as dangerous as its approach. Tsunamis often come in a series.

How is it that the tsunamis killed over 1.5 lakh of people across the two continents? Despite the great speed, tsunamis travel much slower than the seismic waves. Hence earthquake information is often available hours before the tsunamis are able to travel across the ocean. India has all the equipment to monitor earthquakes, but none to spot tsunamis - nor does any other country from Thailand to Somalia. Tsunamis have mainly occurred in the past in the Pacific Ocean, ringed as it is by volcanoes and earthquake zones. For the last 55 years, 26 countries around the Pacific have shared a tsunami warning centre. Those around the Indian Ocean have no such centre, the tsunami phenomenon being so rare in this region! However, in view of the high stakes involved, India is now in the process of setting up a tsunami warning centre.

But the sending out of a warning signal is not the life saving part. It is the education of the people and the response to such warnings that is crucial for saving lives. Even if we had a warning, it would have served little purpose in the absence of an established system to disseminate information to coastal communities. Organising awareness programmes / campaigns

Contd. on page.....25

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The World Year of Physics

❑ V.B. Kamble

The Year 2005 has been designated the "World Year of Physics" by United Nations coinciding with the centenary of the enunciation of the Theory of Relativity. Albert Einstein's seminal paper entitled "On the Electrodynamics of Moving Bodies" appeared in *Annalen der Physik* in 1905. It was a breakthrough in the history of physics centuries after Isaac Newton enunciated the laws of motion and the law of universal gravitation. Theory of Relativity – special and general – has stood the test of time for a century now, and remains one of the greatest creations of human mind that helps us understand nature in the proper perspective.

The year 2005 not only marks the centenary of the Theory of Relativity, it also marks the centenary of the Golden Decade 1895 – 1905 in which momentous discoveries in physics were made, say, for example; X-rays in 1895, Radioactivity and Zeeman Effect in 1896, the Electron in 1897, Quantum Theory in 1900 and explanation of Photoelectronic Effect and Relativity in 1905. This period also witnessed the first trans-Atlantic telegraphic radio transmission and the existence of ionosphere. Surely, Theory of Relativity is a feather in the cap of discoveries made in this decade. Individually, each discovery had enormous significance, while collectively; they heralded what we today call "Modern Physics".

The practitioners of classical physics of that period claimed that all the great discoveries had already been made and the physics would be reduced merely to measurements of greater and greater accuracy. Surely, a few discoveries did lie in the next decimal place as revealed by the discovery of argon during very accurate measurements of the constituents of air. The enormous advances around 1895 brought into question or directly contradicted theories that appeared to have been strongly supported by experimental evidence. For example, the experiments of Hertz demonstrated, beyond doubt, the fundamental nature of Maxwell's electromagnetic theory of light. Yet, by an irony of fate, these very experiments of Hertz brought to light the new phenomenon of the photoelectric effect, which played an important role in establishing the Quantum Theory.

There is no story more fascinating, enlightening, and inspiring than an account of the events and the people who made the fundamental discoveries possible during the decade 1895 – 1905. A peep in the lives of these makers of modern science, their approach and methods, dedication and sacrifice with an ardent desire to share their knowledge with others, provides an insight into the process and methodology of science. The discovery of Radioactivity by Becquerel is a beautiful example of the scientific method at work – that goes on to show that discovery is more of a process rather than an event.

Mentioned above are only a few pages from the history of science and technology that has shaped our present day lives. This story is inspiring and enlightening, not only for scientists but also for the common man. Recognition did not come instantaneously to them. They had their own share of misfortune and failures. But a trait common to all of them was a positive approach and a scientific outlook in whatever they did.

Celebrating the Year of Physics is, therefore, celebrating 100 years of the golden decade, and offers a great opportunity to communicate the basic scientific aspects of these discoveries and how they have shaped our lives, promote the method of science, and spread a scientific outlook among the people. Numerous programmes, conferences, and festivals would be organized the world over to celebrate the "World Year of Physics". Vigyan Prasar (VP) has planned activities built around the work and lives of the makers of modern physics in collaboration with NCSTC and other agencies. Also planned is a variety of software – publications, films, radio and TV programmes, CD - ROMs, and slide shows; and resource material for training programmes of resource persons.

(Tsunami and Ham Radio) *contd. from page....40*

switched to emergency mode. One ham radio station was activated at the Deputy Commissioner's office (Port Blair) and another at Government Polytechnic College, which was manned by Shri Sarath Babu, VU3RSB. Shri Ram Mohan, VU2MYH established an emergency station at Car Nicobar. Ham radio operators from various parts of India joined hands in the emergency operation to handle third party welfare messages from and to the mainland.

The Vigyan Prasar/NCSTC amateur radio station VU2NCT in New Delhi was also immediately activated as an emergency communication station and operated as an emergency control station for fifteen days handling and relaying welfare and relief messages. Relief messages for several government organizations were also handled by VU2NCT club station. Most of the innumerable queries handled by VU2NCT with people enquiring about the whereabouts and well being of their relatives stranded or missing in the Andaman & Nicobar Islands, were replied to by networking with ham radio stations from the tsunami affected areas. Mr. Jose Jacob, VU2JOS reported from Hut Bay (Little Andaman) that electricity and telephone service were not restored even after 14 days of the disaster. No landlines were restored at Little Andaman. He could operate ham radio only with the help of generator sets and solar panel.

As usual, Hams once again rose to the occasion and proved the importance of Ham Radio in rescue and relief operations following a natural disaster. There are countless numbers of relatives across the country, who received phone calls with welfare messages, but they never knew that these messages reached them only as a result of the tireless efforts of ham radio operators. In one case, the news about survival of a Principal of a high school from Car Nicobar could reach his family in Gwalior after 12 days of the disaster! Incidentally this news was conveyed by Vigyan Prasar/NCSTC station bringing renewed joy to his family.

Werner Karl Heisenberg

Co-founder of Quantum Mechanics

❑ Subodh Mahanti
e-mail : mahantisubodh@yahoo.com

To be sure, rational thinking and careful measurement belong to the scientist's work, just as the hammer and chisel belong to the work of the sculptor. But in both cases they are merely the tools and not the content of the work.

Werner Heisenberg

Heisenberg had a special, intuitive way of getting to the essential point. This together with an incredible force of persistence and determination, made him the most prolific and successful physicist of the recent past.

Victor Weisskopf

"If Einstein had not discovered relativity theory, it would have been discovered sooner or later by someone else, perhaps by Poincare or Lorentz. If Hahn had not discovered uranium fission, perhaps Fermi or Joliot would have hit upon it in a few years later. I don't think we detract from the great achievement of the individual if we express these views. For that very reason, the individual who makes crucial discovery cannot be said to bear greater responsibility for its consequences than all other individuals who might have made it. The pioneer has simply been placed in the right spot by history, and has done no more than perform the task he has been set.

Werner Heisenberg on the morality of scientific research

Werner Heisenberg was one of the most creative physicists of the twentieth century. He played a pioneering role in the development of quantum mechanics. In 1932, he was awarded Nobel Prize in Physics for "the creation of quantum mechanics, the application of which has led, among other things, to the discovery of the allotropic forms of hydrogen." He discovered the Matrix Mechanics, one of the two standard formulations of quantum mechanics in 1925 at the age of 24. The other formulation called Wave Mechanics, was discovered by Erwin Schrodinger. Apparently the two formulations look very different from each other. However, Carl Eckart and Schrodinger demonstrated the equivalence between the two.

As Victor Weisskopf stated quantum mechanics marked "a turning point in man's understanding of nature comparable to Newton's discovery of the universal nature of gravity, Maxwell's electromagnetic theory of light, and Einstein's relativity theory."

Heisenberg is best known for his uncertainty principle. It posits limits to the accuracy of knowledge about atomic behaviour. Heisenberg also made important contributions to the theories of the hydrodynamics of turbulence, the atomic nucleus, ferromagnetism, cosmic rays, and elementary particles.

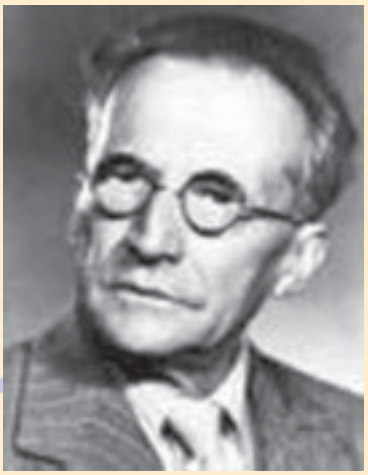
Werner Heisenberg

Above all he was a good human being. His son Jochen H. Heisenberg wrote: "He was a good father, a warm, caring and compassionate human being who taught us his love for the outdoors, for mountain climbing, music or the spiritual which he called the central order."

Heisenberg was born in Wurzburg on December 05, 1901. His father August Heisenberg rose from school teacher to a Professor of Greek Philology at the University of Munich. His mother Annie Hiesenberg (nee Wecklein) was the daughter of a headmaster in Maximillian Gymnasium at Munich. Heisenberg's initial schooling was in a primary school in Wurzburg before his father moved to Munich in 1910. At Munich, Heisenberg attended Elisabethenschule for a year before he joined the Maxmillian Gymnasium, where his maternal grandfather was the headmaster.

During the World War I, when studies at school were disrupted, Heisenberg undertook independent study. His records at school were excellent. His mathematical abilities were proverbial. It has been reported that when he was at school, Heisenberg tutored a family friend who was at university in calculus. In the Gymnasium, Heisenberg led a somewhat right wing youth movement called German Youth Movement, with anti-modernist romantic leanings.

Heisenberg's personality was influenced by his association with this movement. During this period Heisenberg also worked with a voluntary organisation, which sent its volunteers to help in the fields in spring and summer. In 1918 Heisenberg was sent to work in a diary farm in Upper Bavaria. This was the first occasion for Heisenberg when he was away from home. The work in the farm was quite laborious and what is more there was not even sufficient food. In his spare time Heisenberg played chess and he played it very well. He also studied mathematics. By this time he had become interested in number theory. He read Leopold Kronecker's work and he even tried to work out a proof of Pierre de Fermat's last theorem.



Erwin Schrodinger

The First World War ended in 1918 but by this time the political situation in Germany had become quite fluid. Different factions were fighting with each other to grab power. Heisenberg joined the military suppression of the Bavarian Soviet forces. Though it was a serious business but it seems young Heisenberg treated it like a game as he later said: "I was a boy of 17 and I considered it a kind of adventure. It was like playing cops and robbers."

Heisenberg joined the University of Munich in 1920 to study physics under Arnold Sommerfeld. At the beginning he did not make up his mind to plunge wholeheartedly in theoretical physics. He mostly attended mathematics classes to ensure that he could return to mathematics in case theoretical physics went badly. At the University his mathematical interest shifted from number theory to geometry. However, it did not take much time for him to be engrossed in theoretical physics and he started attending all the classes of Sommerfeld. He also took courses in theoretical physics, as they were compulsory. At the beginning he toyed with the idea of doing research in relativity. But Wolfgang Pauli, who was carrying out a major survey of the theory of relativity, advised him against it. Pauli told Heisenberg that there was much to be done in the field of atomic structure, as the existing theory had no experimental basis. Recalling his early years at the university, Heisenberg wrote: "My first two years at Munich University were spent in two quite different worlds: among my friends of the youth movement and in abstract realm of theoretical physics. Both worlds were so filled with intense activity that I was often in the state of great agitation, the more so as I found it rather difficult to shuttle between the two."

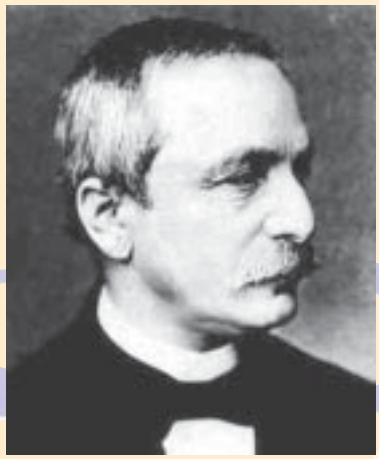
Victor Weisskopf

It is interesting to note that Heisenberg almost failed in the oral examination conducted by the famous physicist Wilhelm Wein, who was the examiner. Wein asked Heisenberg some questions related to experimental techniques and after getting no satisfactory replies he declared the candidate failed. However, after an animated dispute, Sommerfeld procured the lowest grade called 'rite' for passing the examination for his outstanding student. One of Wein's questions that Heisenberg failed to reply was concerned with the resolving power of optical instruments due to the finite wavelength of electromagnetic radiation. This question impressed on Heisenberg as fundamental. He continued to think about it and the result was his discovery of the Uncertainty Principle.

During 1922-23, when Sommerfeld was away in the United States, Heisenberg spent a session at the Gottingen University studying with Max Born, James Franck, and David Hilbert. He worked on atomic theory and he wrote a joint paper with Born on helium. He received his PhD in 1923. His doctoral dissertation was on turbulence in fluid streams. After obtaining his PhD, he first went on a trip to Finland and then returned to the Gottingen University to work with Max Born. He worked with Niels Bohr at the University of Copenhagen as Rockefeller Fellow during 1924-1925. It was at Copenhagen that Heisenberg first met Albert Einstein. In 1926 Heisenberg was appointed Lecturer in Theoretical Physics at the University of Copenhagen. In 1927 he was appointed Professor of Theoretical Physics at the University of Leipzig, a post he held till 1941. At the time of his appointment as Professor at the Leipzig University he was just 26 years old. He became the youngest full professor in the country. In 1929 he went on a lecture tour to the United States, Japan and India.

Heisenberg's Matrix Mechanics was developed by questioning the old planetary model of the atom, originally proposed by Bohr and subsequently modified by Sommerfeld. Bohr's concept was based on the classical motion of electrons in well-defined orbits around the nucleus and the quantum restrictions were imposed arbitrarily so that the consequences of the atomic model fit in with the existing experimental results. Borhr's model was a great success in explaining the existing knowledge and a direction for new research but it failed to reconcile the results of new research. Heisenberg found this model not only inadequate

but also without sufficient firm foundations. Heisenberg stated that at any given point the position of an electron in space cannot be assigned. Similarly its movement in an orbit cannot be followed. This means that it cannot be assumed with sufficient certainty that the planetary orbits of electrons postulated by Bohr really exist. The orbital picture visualised for this model could never be put to the test of experiment. Heisenberg argued that it was a mistake to think of the structure of the atom in visual term at all. What we really know of the atom is what we can really observe of it. Thus Heisenberg proposed to construct a theory for describing the structure of the atom in terms of quantities which can be actually observed such as frequencies and intensities of the light emitted or absorbed by atoms. Heisenberg argued that mechanical quantities, such as position, velocity etc., should be represented, not by ordinary numbers but by abstract mathematical structures called matrix. In 1925, while recupertating from an attack of hay fever at Hogland, an island in the North Sea, Heisenberg formulated his new theory in terms of matrix equation. Heisenberg, after completing his paper, sent it to Pauli. Heisenberg wrote: "…I dare to send you this brief preliminary manuscript of my work because I believe that it….contains actual physics…I must beg you to return it to me in 2-3 days, since I must either make its existence known in the next few days or burn it." Pauli, who was Heisenberg's friend and also a critic, wrote back: "It was the first light of the dawn in quantum theory." After showing it to Pauli, Heisenberg showed the paper to Born, who in turn sent it to the German journal *Zeitschrift fur Physik*, where it was published in its September issue. The paper, entitled "Quantum theoretical re-interpretation of kinematic and mechanical relations", completely reformulated the existing quantum theory. The details of the matrix-based quantum mechanics were worked out jointly by Heisenberg, Born and Pascual Jordan. Their joint paper, which later became known as `three-man paper', was also published in *Zeitscrift fur Physik*. Heisenberg's quantum mechanics made possible a systemisation of spectra of atoms. When Heisenberg applied his theory to molecules consisting of two atoms he found that the hydrogen molecule must exist in two different forms, which should appear in some given ratio to each other. This prediction was subsequently experimentally verified.



Leopold Kronecker

Pierre de Fermat

The mathematical devices called matrices had been known since the 1850s but Heisenberg was the first to apply them in physics. For a non-mathematician the concept of matrices is not easy to understand. Even Schrodinger, who formulated the wave mechanics, found it difficult to understand. Schrodinger wrote: "My theory was stimulated by de Broglie and brief but infinitely far-seeing remarks by Einstein. I am not aware of a generic connection with Heisenberg. I, of course, knew of his theory but was scared away, if not repulsed, by its transcendental algebraic methods which seemed very difficult to me." So it was not surprising that physicists preferred the more usual language of wave equations used in the equivalent system of Schrodinger

In 1927 Heisenberg discovered the Uncertainty Principle, another aspect of quantum mechanics. Heisenberg stated that it was impossible to determine exactly both the position and momentum of fundamental particles such as electron. The principle states "the more precisely the position is determined, the less precisely the momentum is known in this instant and vice versa." To demonstrate his observation Heisenberg used a thought experiment. He argued that if we attempt to locate the exact position of an electron we must use radiation of very short wavelength such as gamma rays. But while irradiating with gamma rays, the electron's momentum will be changed. But now if one uses a lower-energy wave, the momentum of electron will not be much disturbed but then as lower-energy implies larger wave-length such radiation will lack the precision to provide the exact location of the electron. The uncertainty principle removed absolute determinacy, or cause and effect, from physics for the first time and replaced with statistical probability. Einstein and some other scientists were deeply troubled by this development but later it was generally accepted.

Wilhelm Wein

After the Nazis came to power many scientists left Germany. Heisenberg remained in Germany throughout the Nazi era including the period of the Second World War. He

was not a Nazi himself. However, he thought that being a German it was his duty to remain in Germany to preserve traditional scientific values developed in Germany for the next generation.

Arnold Johannes Wilhelm Sommerfeld

In 1939 Enrico Fermi wanted to know what made Heisenberg stay in Germany. To this Heisenberg replied: "I don't think I have much choice in the matter. I firmly believe that one must be consistent. Every one of us is born into a certain environment very early in life, he will feel most at home and do his best work in that environment. Now history teaches us that sooner or later, every country is shaken by revolutions and wars; and whole populations obviously cannot migrate every time there is a threat of such upheavals. People must learn to prevent catastrophes, not to run away from them. Perhaps we ought even to insist that everyone brave what storms there are in his own country, because in that way we might encourage people to stop the rot before it can spread."

James Franck

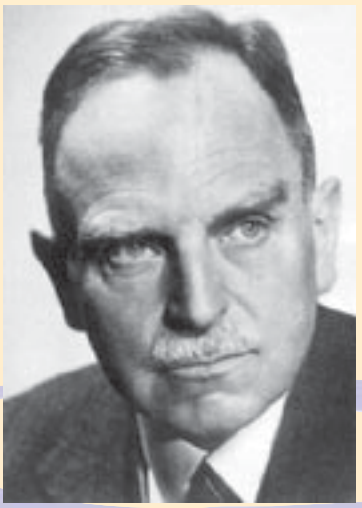
The Nazis did not relish Heisenberg's refusal to compromise his support for the physics of Einstein in any way. This was the time when the Nazis termed the works of scientists of Jewish origin as "Jewish science". So the relativity theory was termed as "Jewish physics." In fact the whole theoretical physics itself was viewed as Jewish. This was the reason that when he wanted to move to the University of Munich to succeed his teacher Sommerfeld, he was vehemently opposed by the press controlled by the Nazis. As a result the post finally went to the little-known W. Muller.

Soon after the outbreak of the Second World War on September 01, 1939, Heisenberg was asked to join Germany's nuclear fission research as a part of its war effort. Initially he headed a small reactor at Leipzig and at the same time he also visited Berlin to advise a larger group working there on the same project. In 1942 he was asked to take charge of the fission research conducted at Kaiser Wilhelm Institute for Physics at Berlin. On the development of a nuclear reactor he worked with Otto Hahn, one of the discoverers of the nuclear fission. His role in Germany's war effort during the Second World War has been widely debated. Today we know that Germany's project for preparing the Atom Bomb was a failure. When Heisenberg learned of the Hiroshima bomb on August 06, 1945, Heisenberg's first reaction was of disbelief. Heisenmberg believed that a bomb could not be made before the war. He once declared "I never thought we would make a bomb." Perhaps this was the reason that he did not feel the urgency to argue the case strongly enough before the German government. He never thought that the Allies would ever succeed.

Wolfgang Pauli

There have been lot of controversies about Heisenberg's role in the Second World War with respect to development of the atomic bomb. Heisenberg has been accused of misleading others in the aftermath of the Second World War by his claim of having purposely undermining the German Bomb effort. Heisenberg's wartime visit to Niels Bohr has been dramatised in Michael Fryan's play "Copenhagen". But then it has also been argued that there was no reason for Heisenberg to do it because he was fully aware that the bomb could not be made before the end of the World War. Heisenberg's son Jochen H. Heisenberg wrote: "Looking at the feasibility was essential for my father, because as he said if it was trivial building one then nobody could avoid doing so, however, if it was impossible, the point was moot. Of course there is a lot of grey area between those two extreme possibilities. My father at this time had made a serious effort to estimate the requirements for such a bomb project. While they had not solved all the problems, they knew enough to make a realistic assessment of such a task. In an interview with the `Spiegal Magazin' in 1967 he states that his estimates were that it would require a critical mass about the size of a pineapple. This would translate into development time frame of about three years under the best of circumstances; and those definitely did not exist in wartime Germany. This was exactly how he, Otto Hahn and other scientists presented the situation to the government. Albert Speer's memoirs confirm this. My father knew very well that this recommendation meant that these were the objective facts. He did not have to distort anything as the facts alone necessitated the conclusion."

A few days before the surrender of Germany, Heisenberg was captured by the Allied forces. He was kept with other leading German nuclear scientists such as Otto Hahn, Carl von Weizsacker, Max von Laue, Karl Wirtz and Walter Gerlach at Farm Hall, a country estate near Cambridge. The house in which the scientists were kept was bugged and their conversations were recorded for six months.



Otto Hahn

David Hilbert

Heisenberg played a very important role in reconstructing post Second World War German science. In 1946, after returning from England, Heisenberg became the Director of Kaiser-Wilhelm Institute, the name of which was later changed to Max-Plank Institute and it moved to Munich. In 1958 Heisenberg was appointed as Professor of Physics at the University of Munich. In 1953 he became the President of the Alexander von Humboldt Foundation. As a president Heisenberg did much to further the policy of the Foundation, which was to invite scientists from other countries to Germany and to help them work there.

Heisenberg was interested in the philosophy of physics. He believed that new insights into the problems of Part and Whole and One and Many would help discovery in microphysics.

Heisenberg loved music in addition to physics and saw a deep affinity between these two interests. He was an accomplished pianist. His son Jochen H. Heisenberg wrote: "Music was my father's equivalent to emotional passion. ....He played regularly for himself and with others, and music was a connector to the people who were not his scientific peers. As children we benefited from this common language our parents taught with such great care. If I know him so well now, it is partly because of the many hours of music we played together. It was through music that he shared the depth of his feelings about beauty and transcendence with us, although he did not go for the so-called romantic excess of emotion at all. A clean and classical exuberance was more his style, but above all else the slow movements were his true strength."

Among his writings were: *Philosophical Problems of Quantum Physics* (Ox Bow Press, 1979), *Physics and Philosophy—the Revolution in Modern Science* (Harper & Row, 1958) and *Physics and Beyond—Encounters and Conversations* (George Allen & Unwin 1971) and Encounters with Einstein and Other Essays on People, Places, and Particles (Princeton University Press, 1983). Commenting on Heisenberg's writings N. Mukunda wrote: "Heisenberg's writings on many profound subjects are so beautiful that they appear deceptively simple. One enjoys reading him many times over to truly appreciate his thinking." Two important books on Heisenberg's life and works are: *Uncertainty—The Life and Science of Werner Heisenberg* by David C. Cassidy (W. H. Freeman, 1992) and *Recollections of a Life with Werner Heisenberg* by his wife Elisabeth (Birkhauser, 1984).

Heisenberg died of cancer on February 01, 1976 at Munich.

Heisenberg not only set the limit to accuracy of experimental observation but perhaps also believed in the limit of man's capacity to understand nature. He said: "Almost every progress in science has been paid for by a sacrifice, for almost every new intellectual achievement previous positions and conceptions had to be given up. Thus, in a way, the increase of knowledge and insight diminishes continually the scientist's claim of `understanding' nature."

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Vaccination

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A healthy mind in a healthy body in a healthy environment is the ideal of medical science. In this content, freedom from diseases is more important than treating them. Several strategies exist for such preventive interventions:

- a balanced diet,
- appropriate physical exercise and practice of yoga,
- prevention of accidents and injuries, and
- providing healthy environments

Great benefits have accrued from prevention of infective diseases caused by microorganisms. Vaccination is one such means, and remains the most cost-effective measure to improve public health.

Since early times, man observed the 'benefits' accruing to survivors following an epidemic of a disease. These survivors faired better during subsequent epidemic of that disease. Smallpox was one such dreaded disease.

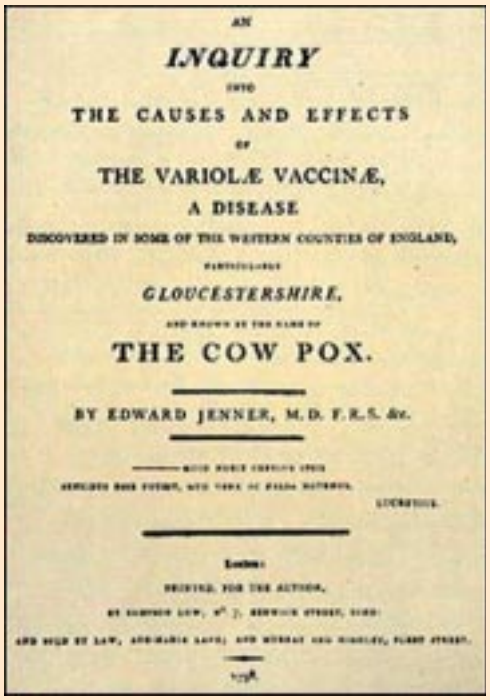
A Malaba woman invoking the Goddess of smallpox with fire on her head

In India of 10th century A.D., this was exploited to benefit the healthy persons by injecting into their skin the fluid from pustules or healing-scabs of smallpox lesions. These attempts at 'variolization' were the forerunners of modern vaccination. Europe sent Jesuit priests to India to learn practice of this technique.

But Europe had to bear the brunt of a terrible smallpox epidemic of 1721 A.D., before vaccination found its way into medical science. Edward Jenner is credited with the bold experiments using VACCINIA virus that lead to successful prevention from smallpox. This was in 1796 A.D.

Edward Jenner 'vaccinating' James Phipps

To honour work of this great physician, the term VACCINE was subsequently applied to all microorganism derived products capable of inducing protection against a disease. For all this good work, Jenner had to face a lot of resistance and many an enquiry.



AN

INQUIRY

INTO

THE CAUSES AND EFFECTS

OF

THE VARIOLÆ VACCINÆ,

A DISEASE

DISCOVERED IN SOME OF THE WESTERN COUNTIES OF ENGLAND,

GLOUCESTERSHIRE,

THE COW POX.

BY EDWARD JENNER, M.D. F.R.S. &c.

Enquiry is commissioned against a pioneering work

Success of Jenner and Pasteur paved the way for an era of vaccines against • Anthrax • Rabies • Cholera • Tuberculosis • Typhoid • Plague • Tetanus • Yellow fever • Influenza • Poliomyelitis • Measles • Pertussis • Mumps • Rubella • Japanese encephalitis • Meningococci • Pnumococci • Varicella (chickenpox) • Hepatitis B • Hepatitis A • Haemophilus influenzae

And the list is ever increasing. There are more than 50 licensed vaccines available in the market to combat bacterial or viral diseases. Parasitic diseases still loom large especially in the developing world. And effective vaccines are lacking. Some older and major killers like malaria and HIV still elude a successful vaccine. There is hope of developing vaccines against the deadly newer viral diseases like Ebola, SARS, and Bird-flu etc.

Louis Pasteur, the Jenner of France

Vaccines are universally effective amongst healthy population, though the extent and the degree of protection may vary. Booster does are essential for some. Also, several different vaccines can be combined into a single shot for convenience e.g. DPT, MMR.

Use of vaccine a given population is dictated by the

- Risk of exposure to disease,
- Prevalence of that disease, and
- Health status of that given population

In general, extremes of ages incur greater risk of contracting infections. Naturally, benefits of vaccination accrue most to these two categories of our population. During early years of childhood, vaccinations against tuberculosis, polio, DPT, MMR, Haemophilus influenzae, Hepatitis B and varicella (chickenpox) are routinely advocated (see Table). Amongst the elderly, vaccination against influenza virus, pneumococci, haemophilus influenzae and tetanus produce tangible benefits.

All adults benefit from vaccination against tetanus, Hepatitis B, varicella and other regional diseases. Interestingly, vaccination of expectant mother protects the newborn baby against tetanus neonatorum – a deadly disease that still kills 800,000 newborns in the developing world every year. Developing nations also need widespread coverage against other 'big-killers' like tuberculosis, polio, measles and rubella. With the threat of bio-terrorism looming large, preventive vaccination against 'agents of biological warfare' is in the frontiers of current research. Even a conventional war increases the demand for vaccines.

Prevalence of diseases may restrict use of specific vaccines to certain geographical regions, as in the case of Yellow Fever. Likewise, travellers may benefit from vaccines against Cholera, Typhoid, Hepatitis A, Meningitis, Plague, Rabies, and Chickenpox when traveling to affected areas.

Vaccines are often derived from live/ attenuated or dead microorganism, or its toxoid or other products that stimulate production of protective cells & proteins (antibodies) without

VACCINES IN CLINICAL PRACTICE – I

S. No.	Vaccine Name	Type of Vaccine	Mode of (and age at) administration	Remarks
During 1st year of life				
1.	B.C.G. (Bacillus Calmette-Guerin)	Live attenuated	Singe dose (injection) within 3months of birth	i) To protect from tuberculosis ii) Also beneficial in carcinoma of urinary bladder
2.	Polio myelitis (polio)	Live attenuated	Oral doses at 0,6,10,14 weeks and a booster at 16-24 month	National Pulse polio programme is on to eradicate polio
3.	DPT (Diphtheria, Pertussis, Tetanus)	Adsorbed/killed	Three doses (injections) at 6,10,14 weeks	A triple vaccine against common childhood infections
4.	Measles	Live attenuated	Single injection at 9 months – 1 year	Being replaced by MMR
5.	Hi b (Haemophilus, influenzae type b)	Killed/conjugated	Three doses (injection) at 6,10,14 weeks	Children under 13 months are at high risk of this infection
6.	Hep B (Hepatitis B)	Killed/adsorbed	Three/four doses (injection) at 0,6,10,14 weeks	An extra dose if mother is HBs Ag positive
7.	Meningococcal group C	Killed/conjugate	Three doses (injection) at 2,3,4 months	Vaccine against other groups A, W135 and Y is also available

causing a full disease. Poliomyelitis, typhoid, BCG, MMR, and varicella are some examples of live attenuated vaccines. Administration of a vaccine is expected to evoke a reaction, which is mostly beneficial to the body. Side effects do occur.

Side effects are usually mild and self-limiting; and may invoke local pain, body aches, sweating, or mild fever. Anaphylactic and other serious reactions are rare. Newer vaccines based on recombinant DNA technology give fewer reactions. Persons with serious egg-allergy or an immunodeficiency state pose special problems. Vaccines are always administered under supervision of authorized medical personnel.

Vaccination policy of a nation takes into account all the parameters relating to vaccine use. Availability of vaccines by itself does not translate into their optimal usage. Healthy individuals tend to overlook potential risk of disease, even when glaringly real. The role of IEC – information, education and communication – cannot be overemphasized. World Health Organization has played a key-role in promoting vaccination across the globe. The deadly smallpox, the forerunner of vaccination, stands eradicated for the last quarter century.

In 1974, WHO came up with EPI – Expanded Programme of Immunization – with the objective of providing protection through vaccination to all the 120 million children born every year. This covered six diseases initially – poliomyelitis, tetanus, diphtheria, pertussis, tuberculosis, and measles. Subsequently in 1991, WHO advocated inclusion of Hepatitis B vaccination (and also yellow fever wherever applicable) to all newborn children. In 1993, World Health Organization unified all vaccination & immunization programmes under one umbrella, the GPV – the Global Programme for Vaccine and Immunization. The support also comes from NGOs like Bill Gates and Melinda Foundations.

All these efforts have paid dividend by increasing the coverage of target population from 5% to over 80%. Falling incidence of diseases and improved health standards are visible. Smallpox stands eradicated and Polio is on way out. World Health Assembly in 1988 took upon itself the challenge to eradicate polio by the year 2000. We are now seeing the end of tunnel in this regard. Next in line is eradication of measles by 2020 AD.

Nevertheless, there is a long way to go. With better longevity of life, there is a need to universalize vaccination

VACCINES IN CLINICAL PRACTICE – II

S. No.	Vaccine Name	Type of Vaccine	Mode of administration and at what age	Remarks
During Childhood (beyond 1 year)				
1.	MMR (Mumps, Measles, Rubella)	Live	Single dose (injection) at 15 to 18 months. A booster may be given at 3 to 5 years	Do not combine with another live vaccine
2.	Hi B (Haemophilus influnzae)	Killed/conjugate	Three doses (injection) at 0,1,6 months and booster at 5 years	If not already vaccinated during 1st year (see table I above) not recommended beyond 2 yrs.
3.	DTaP/DT (Diphtheria, Tetanus)	Adsorbed/killed	Single injection at 5 years	Booster to DPT during 1st year of life (which if not administered that time may be given up till 5 years)
4.	Polio (Poliomyelitis)	Liver	Single oral dose at 16 to24 months	Booster to vaccination done during 1st year of life
5.	TT (Tetanus toxoid)	Killed	Booster injection at 10 yrs.	To be boosted once every 10 years
OPTIONAL VACCINES				
6.	Chickenpox (varicella, zoster)	Attenuated diploid cell	Single dose (injection)	Those at high risk of infection
7.	Hepatitis A	Virus, diploid cell	Single dose (injection)	Those at high risk of infection or contacts
8.	Typhoid, Vi	Attenuated, polysaccharide	Single injection at 2 years age or beyond	Those at risk (travel/contacts) Booster may be needed at 3 pears)
9.	Typhoid, oral	Live attenuated	Three doses at interval of 2 days	For those over 6 yrs.

programmes for the elderly. Recent invasion by 'new microbial diseases' is a matter of great concern – there have been almost two dozen of them during past three decades, the latest being SARS and Bird-flu endemic. We have to devise strategies that enable quick vaccine development against diseases from 'new errant micro-organisms'.

Another exciting research is on to produce plant-based vaccines. Attenuated viruses are injected into plants, which would result in their production of certain plant proteins. The later on oral consumption would stimulate antibody production. Such vaccines may turn out to be cheaper and maybe safer. One such trial of a plant-based anthrax vaccine is scheduled to commence by mid-2005 in USA.

WHO disseminates vaccination

Once vaccines tame the dragon of infectious diseases, need would arise for vaccines against non-communicable diseases like diabetes, heart disease, vascular diseases, and the dreaded cancers.

Vaccines are no substitute for a healthy life style that gives us a stronger body and a safer environment. The idealism should be 'Health without Vaccines.' Until then, the realism prevails – ...vaccination ...vaccination and ...vaccination to benefit yourself and your dear ones.

(Dr. Naresh Gupta, Professor and Head, Department of Medicine, LHMC & RML Hospitals, New Delhi)

VACCINES IN CLINICAL PRACTICE – III

S.No	Vaccine Name	Type of Vaccine	Mode of Administration	Remarks
C	**During adulthood**			
1.	Tetanus toxoid	See above, Table – II	Booster dose (injection) once every 10 years	A very useful effective vaccine
2.	Hepatitis A	See above, Table – II	Single dose (injection)	Those with exposure or at risk of infection
3.	Hepatitis B	See above, Table- I	Three doses injections at interval of 1 and 6 month from 1st dose. Booster at 5 years	Those with exposure or at risk of infection or spouse of positive case.
4.	Prreumococcal	Polysaccharide	Single dose (injection)	All adults above 65 yrs, and those with risk of recurrent/ chronic respirating infection or their systemic disease, those with compromised immunity or prior to splenectomy
5.	Influenza	Inactivated	Single dose (injection)	All adults above 65yrs or as under pneumococcal (vide supra)
6.	Meningococcal C	See above, Table- I	Single dose (injection)	Risk during an out break or travel to endemic areas, or immune deficiency state
7.	HiB (Hibttannophilus influenzae)	See above, Table-II	Single dose injection	Those at risk of invasive infection as in splenectomizm or on immuno suppossives
8.	Chicken pox (Variculla-Zoster)	See above, Table II	Single dose (injection)	All susceptible individuals or family contacts
9.	Rabies	Human diploid cell or chick or embryo cultivated	Five doses (injection) at interval of 3, 7, 14, and 28 days	Post exposure prophylaxis For those at regular risk, 3 doses are sufficient
10.	Yellow fever	Attenuated	Single dose (injection)	Only if one is visiting the endemic countries of Africa and South America.

Top Science Discoveries and Events - 2004

❑ Rintu Nath
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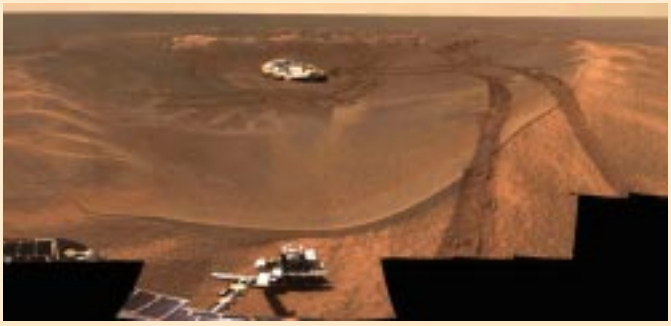
Mars Exploration Rovers

The discovery that Mars could have supported life billions of years ago is one of the most important events of year 2004. Two mobile robots named Spirit and Opportunity sent by NASA (National Aeronautics and Space Administration) could collect evidence that clearly shows that Mars was once wet enough to possibly harbour life.

Both rovers were launched from Cape Canaveral Air Force Station on central Florida's Space Coast. Spirit ascended in daylight on June 10, 2003. Opportunity followed with a nighttime launch on July 7. After traveling nearly 487 million kilometers, Spirit landed on Mars on Jan. 3, 2004 and Opportunity on Jan. 24, 2004.



"Eagle Crater" and some of the surrounding plains in Mars. It was obtained by the Mars Exploration Rover Opportunity's panoramic camera. Image Credit: NASA/JPL/Cornell

Like a human field geologist, each Mars exploration rover has the capabilities to scout its surroundings for interesting rocks and soils, to move to those targets and to examine their composition and structure. Spirit and Opportunity have identical suites of five scientific instruments: a panoramic camera, a miniature thermal emission spectrometer, a Moessbauer spectrometer, an alpha particle X-ray spectrometer and a microscopic imager. The payload also includes magnetic targets to catch samples of Martian dust for examination.

Within two months of its landing in Mars, Opportunity found gray hematite, a mineral that usually forms in the presence of water. Preliminary interpretation points to a past environment that could have been hospitable to life and also could have preserved fossil evidence of it, though these rovers are not equipped to detect life or fossil.

Spirits first photo revealed a rock-strewn plain. A few shallow, dusty hollow lays, hills and crater rims. However, on March 31, 2004, after carrying out the inspection of a boulder for eight days, Spirit could send information that suggest that rock might have been affected by water at some point.

The rovers successfully completed their three-month primary missions in April, 2004 and still in perfect working condition. The unanticipated longevity is allowing both rovers to reach additional destinations and to keep making discoveries.

This image, taken by the panoramic camera on the Mars Exploration Rover Opportunity, shows a close up of the rock dubbed "El Capitan," located in the rock outcrop in "Eagle Crater" at Meridiani Planum. El Capitan was a significant find on Mars due to the multiple ways it provided clues to lead scientists to believe the entire outcrop in Eagle Crater was once covered in water. Image Credit: NASA/JPL/Cornell

Cassini – Huygens Mission

After seven years of jounney, Cassini spacecraft entered in the orbit near the Saturn on June 30, 2004 and started to explore the Saturnian system in detail.

The Cassini-Huygens mission to Saturn is the most ambitious effort in planetary space exploration ever mounted. It is a joint endeavour of ESA(European Space Agency), NASA(National Aeronautics and Space Administration) and the Italian space agency, Agenzia Spaziale Italiana (ASI).

Cassini-Huygens is designed to shed light on many of the unsolved mysteries arising from previous observations, such as: what is the source of heat inside Saturn that produces 87 percent more energy than the planet absorbs from sunlight? What is the origin of Saturn's rings? Where do the subtle colours in the rings come from? Are there

any more moons? Why has the moon Enceladus such an abnormally smooth surface? (Has recent melting erased craters?) What is the origin of the dark organic material covering one side of the moon Iapetus? Which chemical reactions are occurring in Titan's atmosphere? What is the source of methane, a compound associated to biological activity on Earth, which is so abundant in Titan's atmosphere? Are there any oceans on Titan? Do more complex organic compounds and 'pre-biotic' molecules exist on Titan?

On December 24, 2004 Cassini successfully deployed Huygens probe. On January 14, 2005, it will enter the murky atmosphere of Titan, Saturn's biggest moon, and descend via parachute onto its mysterious surface. The Huygens probe will send its measurements and images to Cassini, which will then beam them back to Earth. The Cassini orbiter will then orbit around Saturn for four years; it will send back valuable data to Earth that will help us understand the vast Saturnian region.

A Cassini image of Saturn taken a month before orbit insertion on June 30, 2004.

During its stay, Cassini will complete 75 orbits of the ringed planet, 44 close fly-bys of the mysterious moon Titan, and numerous fly-bys of Saturn's other icy moons.

A new human-like species

Another discovery during year 2004 suggests that human evolution is far more complex than it was envisaged. A species of tiny human has been discovered, which lived on the remote Indonesian island of Flores just 18,000 years ago. Researchers have so far unearthed remains from eight individuals who were just one metre tall, had a brain one-third the size of that of modern humans, and lived on an isolated island long after *Homo sapiens* had migrated through the South Pacific region.

The find has been classed as a new species - *Homo floresiensis*

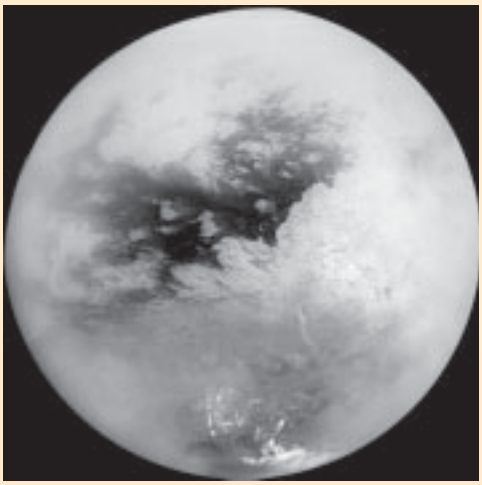
This new species, reported in *Nature*, was found by Australian and Indonesian scientists in a rock shelter called Liang Bua on the island of Flores. The team unearthed a near-complete skeleton, thought to be a female, including the skull, jaw and most teeth, along with bones and teeth from at least seven other individuals. In the same site they also found bones from Komodo dragons and an extinct pygmy elephant called Stegodon.

Stems cells extracted to be used for medical research

A team of South Korean researchers announced a major advance in human cloning, offering a powerful new tool in the war on disease.

The researchers placed genetic material from a Korean volunteer into a human egg cell and coaxed it to develop into a blastocyst, a cluster of about 100 cells that is substantially more advanced than any embryo previously known to have been created in a human cloning experiment.

In another experiment, the team also extracted embryonic stem cells, powerful cells with the ability to become any other kind of cell, from the cloned blastocyst. The researchers did not allow the blastocyst to develop further, and stressed that they would not attempt to use the technique to create a cloned baby.



Recently acquired image of Titan taken during Cassini's first very close flyby on Oct. 26, 2004, constitutes the most detailed full-disc view of the mysterious moon.

New discoveries about water

What happens when you dissolve a substance in water and then add more water? Conventional wisdom says that the dissolved molecules simply spread further and further apart as a solution is diluted. But a team in South Korea have found that some do the opposite: they clump together, first as clusters of molecules, then as bigger aggregates of those clusters. Far from drifting apart from their neighbours, they got closer together.

German chemist Kurt Geckeler and his colleague Shashadhar Samal stumbled on the effect while investigating fullerenes at their lab in the Kwangju Institute of Science and Technology in South Korea. They found that the football-shaped buckyball molecules kept forming untidy aggregates in solution, and Geckler asked Samal

to look for ways to control how these clumps formed. What he discovered was a phenomenon new to chemistry. "When he diluted the solution, the size of the fullerene particles increased," says Geckeler. "It was completely counterintuitive," he says.

Skeletal remains of *Homo floresiensis*

Study shows that dilution typically made the molecules cluster into aggregates five to 10 times as big as those in the original solutions. The growth was not linear, and it depended on the concentration of the original.

Geckeler and Samal are now anxious that other researchers follow up their work. "We want people to repeat it," says Geckeler. "If it's confirmed it will be groundbreaking".

Junk DNA is not "Junk" at all

Till recently, only the function of a few percent of the DNA was known, the rest has been believed to be useless garbage, commonly called "Junk DNA" by molecular biologists.

Increasing evidence is now indicating that this DNA is not "junk" at all. Especially, it has been found to have various regulatory roles. This means that this so-called "non-coding DNA" influences the behavior of the genes, the "coding DNA", in important ways.

However, the knowledge is still very incomplete about this DNA. And there is little knowledge about the relationship between non-coding DNA and the DNA of genes.

Without this knowledge it is completely *impossible to foresee and control* the effect of artificial insertion of foreign genes.

This is a very important reason why genetic engineering is unsuitable for commercial application. It is still at a stage of early experimentation with very incomplete understanding about its consequences.

New Condensates

In the year 2004, U.S. and Austrian scientists created a new form of condensate, an ultracold gas in which a group of atoms can act like a superatom. The discovery may shed light on how electrons act in complex materials.

Physicist John E. Thomas and his colleagues at Duke University in Durham, N.C., were experimenting with lithium gas with intense lasers in a vacuum chamber at temperatures next to absolute zero. When the scientists turned off the lasers, peculiar things began to happen. At first, the microscopic puff of lithium billowed out of the spot where the lasers had held it. But then, instead of expanding evenly in all directions, as any normal gas would, the lithium cloud morphed into a pancake.

That was the first glimpse of a new state of matter—a kind of ultra frigid vapor—strongly interacting, degenerate Fermi gas. These aggregations of particles can behave, according to quantum mechanics, as if they're a single entity.

It is believed that such gas clouds might bear an uncanny resemblance to several other types of exotic matter, including even certain solids that have been extraordinarily difficult to study. Among these are materials known as high-temperature superconductors, which conduct electricity without resistance, and ultra dense stars made mostly of neutrons. Fermi gases could also impersonate the hottest matter that has ever existed, which is the quark-gluon plasma. For the most part, these substances have been extraordinarily difficult to explore. They're either inaccessible, as are neutron stars, or nearly impossible to make in the lab, as is the quark-gluon plasma. None of them readily submits to theoretical calculations and simulations. The new option of making Fermi gases in the lab may enable researchers to circumvent some of these obstacles and to experiment indirectly with these rare states.

A microscopic photo released by Seoul National University shows eight of the cloned embryos.

Death Chirp - Neutron star pair

Astronomers have discovered two neutron stars that are orbiting each other once every 2.4 hours and spiraling inward toward an eventual collision. The finding suggests that such intense events are far more common than was thought.

The neutron-star pair was detected with the CSIRO Parkes radio telescope in Australia. One of the objects, named PSR J0737-3039, pulsates due to its own rapid rate of spin about its axis. Despite their 2.4-hour orbit, the two objects are about twice as far apart as Earth and the moon.

The newfound duo will hit in 85 million years. But there was an interesting twist in the observations. The pair just detected is relatively nearby — less than 2,000 light-years away — yet has very faint radio emissions compared with others. That suggests that probably of lot more such pairs

are more than previously assumed. Many undiscovered mergers are in the making!

Based on assumptions about other pairs that must be out there, astronomers had calculated that neutron-star mergers might take place once every decade or two within 60 million light-years of Earth, a span that includes our galaxy and a few neighbors. It is also the distance to which ground-based gravitational wave observatories expect to be able to detect the events. With the new data, theorists think the events might take place once every year or two. "If gravitational waves can be expected more frequently than previously thought, that is exciting news indeed," said E.P.J. Van den Heuvel of University of Amsterdam. Van den Heuvel cautions, however, that error margins for the estimates are sizeable since so few binary neutron star systems are known.

Gravitational waves are said to be similar to light waves which are emitted after the merger of two neutron stars. Both propagate through space at different frequencies, radiating outward like ripples on a pond. But gravitational radiation is much weaker than electromagnetic radiations.

Transit of Venus

People all over the world watched Venus pass in front of the Sun on June 08, 2004. Indeed this was a much-awaited event that had not occurred for last 122 years -

Venus Transit - Black Drop Effect as seen by Vigyan Prasar

since December 06, 1882 to be precise. The entire transit was visible from Europe, the Middle East, and most of Africa and Asia.

Contd. from page.....39 (Tsunami Lessons)

giving scientific information would go a long way in minimizing loss of life and property. Prior mock-drills are equally important and are regularly practised in Japan – the most tsunami-prone country. Further, we need core groups that are familiar with physical and emotional needs of the victims – educational, medical, housing, relief operations and rehabilitation, working in collaboration with the village panchayats. Equally important is the development of an official interactive website giving important and latest information about the disaster and responding to the queries of the people. Ham radio activity has proved its utility time and again – even during the present disaster - by establishing an emergency communication network soon after the natural calamities, and therefore needs to be promoted. Vigyan Prasar, incidentally, has been promoting the activity in different parts of the country. Ham radio station of NCSTC/Vigyan Prasar actively participated in setting up emergency communication network with ham stations established in the affected areas, especially the Andaman and Nicobar islands.

The tsunami disaster reminds us of the disasters like the Latur and Gujarat earthquakes; and the super-cyclone in Orissa in the last decade – and our unpreparedness every time the disaster struck. Still, sky scrapers continue to rise in the reclaimed lands of Mumbai and Kolkata. Delhi is no exception. How much prepared are we to face up to a Gujarat-type earthquake should it ever take place in Mumbai or Delhi?

May be we shall never be able to fully and correctly predict a tsunami and its impact, or an earthquake. But, we cannot afford to be complacent, and must remain prepared to face any eventuality with minimum response time. These are the Tsunami Lessons.

❒ V. B. Kamble

Corrigendum

In the last para of the article 'Relation between solar day and sidereal year of Mercury' by Sri. Utpal Mukhopadhyay, published in November 2004. There were number of typographical errors. We regrets for the same. We are thankful to Prof. K. D. Abhyankar (Retired Prof from Osmania University, Hydrabad) and Dr. B.S. Shylaja (Jawaharlal Nehru Planetarium, Bangalore) for pointing out these errors. We are reproducing here the correct version of the last para of said article. (Please refer the article and figure published in November 2004 before reading below mentioned para).

Suppose on a particular day, midday occurs at A and midnight at B on the diameter AB of Mercury. One earth-day later the center of Mercury shifts from M_1 to M_2 due to its orbital motion through Ð M_2SM_1. If Mercury were not rotating around its axis the diameter AB would be in the position A_1B_1 which is parallel to AB. But due to axial rotation it will be positioned at A_3B_3 by rotation through Ð $A_1M_2A_3$. And at this time there will be midday at A_2 and midnight at B_2 where A_2B_2 is the diameter passing through SM_2. So for the observer at A, the sun would have moved from the zenith through Ð $A_2M_2A_3$. If D is the length of Solar day of Mercury Ð $A_2M_2A_3 = 360^0/ D$.

Similarly, if V and y are the length of sidereal day and sidereal year respectively,

we have Ð $A_1M_2A_3 = 360^0/ V$ and Ð $M_2SM_1 = 360^0/ y$.

However,

Ð M_2SM_1 = Ð $A_1M_2A_2$ (as A_1B_1 is parallel to AB)

Now,

Ð $A_2M_2A_3$ = Ð $A_1M_2A_3$ - Ð $A_1M_2A_2$

\ $360^0/ D = 360^0/ V - 360^0/ y$

OR

$1/D = 1/V - 1/y$

\ $1/D = 1/58.6 - 1/87.9$

➔ D = 175.8 Earth days.

Therefore the length of the solar day of Mercury is 175.8 earth days that is equal to twice the sidereal year of Mercury.

Editor

Bad Breath

20 Tips for a Clean Up Job

❑ Dr. Yatish Agarwal
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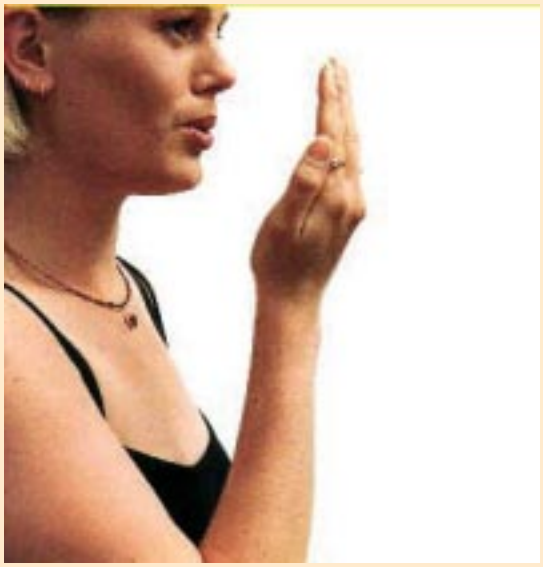
Except for manufacturers and ad companies who thrive on "selling" clean up toothpastes and mouthwashes, nobody quite relishes a bad breath. Still, you must never despise your self, a friend or a colleague for an occasional default. Indeed, to suffer from an occasional bad breath, especially in the morning, is as natural as breathing itself! The worry begins if the breath is too offensive or chronically foul. That could cast a devil of a shadow on your social life. Plus it can sign trouble.



A number of conditions can taint the breath. The most obvious are pungent foods, poor oral hygiene, and smoking—all conditions that are amenable to treatment and can be attended to without delay. Yet, there are times, when bad breath is a sign of more serious bodily ailment. Inflamed sinuses, respiratory infections, lung disease, digestive disorders, and kidney failure all can cause bad breath. Some medicines also may lead to halitosis. Unless you bell the cat, there can be no real remedy.

KEEP OFF THE PUNGENT FOODS : The garlic family is much the biggest culprit. Highly spiced foods laced with garlic, ginger and onions linger on your breath till long after the party is over. The effect can last 24 hours and more. The problem arises due to some odoriferous compounds in these foods. They enter the bloodstream when digested, and cause bad odour when exiting through the skin and lungs. Avoid them at all such times when you want your breath to smell good.

SAY 'NO' TO SMOKED MEAT AND CHEESE : Spicy smoked meat, though a palate-tickler, leaves a lasting effect long after you have swallowed it. You breathe, it breathes too. So, if an occasion calls for a sweet-smelling breath, it is best to avoid smoked meat for at least 24 hours before the appointment.

AVOID FISH : Not just the uncooked fish, the ready-to-serve-and-relish fish is also a stinker. Check that out!

CHEESE AND DAIRY PRODUCTS CAN PLAY SPOIL SPORT : Yes, difficult though it may be to believe this, it is a fact that dairy products also can corrupt the breath. For this reason, you could consider striking them off the list during active hours. However, yoghurt is free of this restriction.

TOBACCO IS A TROUBLEMAKER : In 1640, King James I of England and Scotland banned the use of tobacco, because it 'wilfully corrupted' man's breath by its stinking smoke. The restriction applies even today!

DO NOT SKIP MEALS : Skipping meals can also foul up your breath, because it reduces the production of saliva which keeps the teeth, tongue and gums clean. You can tide over this by taking snacks between meals. Fresh fruits and salads are excellent in this regard and keep the saliva flowing.

USE A TOOTHBRUSH : Almost ninety-five per cent people suffer from bad breath, at some point of time in their lives, as a result of inflamed gums. If the gums are inflamed, the best way to restore them to health is to clean them thoroughly with a brush at least twice a day. If this does not work, see a dentist.

MAINTAIN GOOD ORAL HYGIENE : Among the elderly, ill-fitting dentures or their improper use is a common cause of bad odour. In the young, poor oral hygiene and poor dental care are the biggest factors. To keep oral bacteria

to a minimum, frequent brushing (with or without toothpaste) helps.

RINSE YOUR MOUTH : In case you find it inconvenient to brush after every meal, just rinse your mouth with water. Rinsing makes a big difference. It saves the teeth from springing cavities, which in turn become a haven for germs causing bad breath.

KEEP YOUR TONGUE CLEAN : If you clean your tongue, it helps. Use a tongue cleaner, or just use your toothbrush. It may be three times as effective as dental brushing, when it comes to having good, clean breath. The reason is clear: Under the tiny hair-like projections on the tongue there are thousands of unfriendly bacteria ganging up. Unless you clear them, they are there to stay!

CLEAN UP YOUR BREATHING APPARATUS : The breath-tainters are many. If you know them, it is easier to think of a solution. A stuffed nose, chronic sinusitis, post-nasal drip, tonsillitis, bronchitis and a lung abscess can taint the breath with a distinctly unpleasant odour. You need to consult a physician to overcome these conditions.

KEEP YOUR STOMACH IN ORDER : Plain indigestion or an ulcer can also cause bad breath. At such times, the primary conditions demand immediate treatment.

SOME MEDICINES ACT AS SABOTEURS : Certain medicines can foul up your breath. Anti ulcer medicines top the list, but the others include the often-used antihistamines, decongestants and diuretics.

MANY TIMES IT'S PHYSIOLOGICAL : In women, some normal physiological processes such as menstruation, egg release and pregnancy can affect the breath adversely. This happens because of the hormonal changes that accompany these events. You just got to accept it and take measures to use a *mukhshodhak*.

SPICE IS NICE : Certain herbs and spices used in the kitchen or as mukhshodhaks after a meal make excellent breath enhancers. Try cloves (*laung*), anise seeds (*saunf*), or cardamom (*elaichi*) to give good semblance to your breath.

CHEW A MINT : Peppermints, chewing gum and lozenges are just as good for a cover up operation. Try them, if you have a date.

USE A MOUTHWASH : When you need a quick short break from bad breath, use a mouthwash to gargle. It is quite effective. Today, mouth washes and mouth rinses are available in all kinds of flavours. Try them out!

TAKE THE BREATH TEST : Finding out if you have bad breath is not easy, unless you know how, or are lucky enough to have a very special friend to alert you of it. Just in case you wish to check, here are two simple ways:

THE LICK TEST : If you do not find this offensive, sit in private and lick the back of your hand. Wait a minute or two. And then smell the results your self.

CUP YOUR HANDS : Breathe into them with a great, deep, haaaaaaa, and then sniff. If it smells awful to you, it needs no pundit to tell how those who come in contact with you must feel.

SEE THE DOCTOR : If your halitosis is particularly strong and won't go away no matter what self-care remedies you try, it's important to see your doctor to determine whether some underlying medical condition is to blame.

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(VP News)

Demonstration of Scientific..... Contd. from page 40

A series of meeting were also organized between various-stake holders and VP officials for possible collaboration on Science and Technology Communication. Discussions were held with officials of AIR and Doordarshan for identifying themes and resource persons for making radio/ TV Programmes. In another meeting with the Executive Director, State Council for S&T, Bhopal, discussions were held for exploring possible activities that can be taken up in the State of Madhya Pradesh.

Recent Devlopments in Science & Technology

Electronic tool 'could diagnose multiple diseases

Scientists in South Korea have published promising initial results from their research in biotechnology letters, on an electronic tool for rapid diagnosis of hepatitis C. The tool — a so-called 'protein chip' — could eventually lead to a multi-purpose diagnosis kit, used for detecting several diseases in a single test.

A protein chip is a small electrical device embedded with molecules designed to stick to and quantify specific proteins. A chip, for instance, can be created to detect certain molecules that are released into the blood stream when a person is infected with hepatitis C. According to Chul-Soo Yuk of the Korea University at Seoul and colleagues chip is as precise as the current, commercially available test. Hepatitis C is caused by a virus and spread primarily by direct contact with infected blood and blood products. In many developing countries, these are still being used medically without being screened for the virus.

The World Health Organization estimates that about 170 million people, three per cent of the world's population, are infected with hepatitis C and are at risk of developing liver disease, including liver cancer. There is no vaccine available against the virus.

Source scidev.net

Study shows effective malaria drug combinations

Researchers have identified two combinations of drugs to treat malaria in Africa that could replace the widely used combination of chloroquine and sulfadoxine-pyrimethamine (SP), which has been rendered ineffective as the malaria parasite has grown resistant to it. The researchers, led by Philip J Rosenthal at the University of California at San Francisco, published their findings in issue of The Lancet.

They gave 1,017 Ugandan children with malaria one of three drug combinations, then monitored them for 28 days to see whether the initial infection recurred or if the children got a new infection This treatment has proved to be so effective, and is in such high demand, that the World Health Organisation recently declared that there could be a shortage of it until next year.

A drug that works brilliantly but is expensive and in short supply is no good to the thousands of children currently dying of malaria.

Source scidev.net

Ultrasound May Explain Solar Weather Mystery

Astronomers have identified ultrasound like waves in our sun's atmosphere that could explain some strange aspects of solar weather. An analysis of data from NASA's TRACE spacecraft published in Astrophysical Journal Letters suggests that the waves could be responsible for the star's unexplained extra heat.

The surface of the sun reaches a blistering 6,000 degrees Celsius. The chromosphere, or middle solar atmosphere, is even more scorching at 100,000 degrees Celsius, whereas the solar corona is the hottest part of all, with temperatures nearing a million degrees Celsius. Just what causes these wide discrepancies in temperature has intrigued researchers for decades. Craig DeForest of the Southwest Research Institute and his colleagues analyzed data from the TRACE ultraviolet telescope and found evidence of waves with a frequency of 100 millihertz, which corresponds to a sound 300 times deeper than the lowest noise audible to the human ear. "These ripples seem to be carrying about one kilowatt of power per square meter on the surface of the sun," says DeForest. "That is similar to the sonic energy you might find coming out of the speakers at a rock concert. "

Source :Scientific American.com

Electrical Signals Key to Culturing Heart Tissue

Heart attacks strike many people in world annually. Because heart tissue cannot regenerate after an injury, the damage inflicted on the cardiac muscle worsens over time. Scientists report this in Proceedings of the National Academy of Sciences that they have successfully cultured working heart cells from rats. The feat should aid efforts to engineer patches for broken hearts.

Conventional culture methods don't work for heart cells—they tend to lose their shape and stop functioning properly. In the new work, the researchers placed cardiac cells from a rat onto a polymer scaffold and immersed the setup in a nutrient bath. The team then applied electrical signals, which were designed to mimic a beating heart, to the growing cells. After eight days, single cells were transformed into functional heart tissue with structure similar to that of mature cardiac tissue samples. In addition, the cells expressed cardiac proteins and showed a seven-fold increase in the amount they could contract compared with cells cultured without electrical stimulation.

Source : Scientific American.com

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