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VIGYAN PRASAR NEWS

Seminar on Information Technology in India in the next Millennium

Vigyan Prasar organised a seminar on "Information Technology in India in the next millennium" on 25 May 1999 at Technology Bhawan, Department of Science & Technology, New Delhi. The topics covered were Information Technology (IT) in Science Popularisation, Use of IT in the Society in the Next Millennium and Electronic Commerce. The distinguished speakers included Professor H.M. Gupta of IIT Delhi, Mr. Barun Deb, Vice President, India Online Pvt. Ltd., Mr. S. Sundara Vardan, Head–INDONET Strategic Business Unit, CMC Ltd., and Dr. Narender K. Sehgal, Director, Vigyan Prasar.

Prof. H.M. Gupta talked about the future of IT in India, government policy on Information Technology and the unlimited opportunities with the Indian IT industry. Currently there is spurt of interest in IT in education and research segment. Many institutions have been working on object technologies, imaging, super computers and multimedia. The successful prototypes built by IITs represent some original Indian efforts in focussed research tailored to Indian needs. They are doing pioneering work in databases notably data warehousing, networking and software engineering. Thanks to falling prices of hardware and software, open systems, availability of manpower and awareness created due to computer education a large number of end users have started building applications. There have been major applications in the core sector industry and these corporations viewed IT investment as a means to gain competitive advantage.

Speaking on "IT in Science Popularisation", Dr. Sehgal emphasised that Information Technology is crucial for the development of science and in particular science popularization. The media used for science popularisation are many. These include publications, newspapers, radio, television, dramatics, and folklore. IT has linked itself perfectly to science communication. He highlighted the various tools of IT, networking, communication that have advantages for the teaching community, the research community and of course for the other major requirement of edutainment. If the IT policy of the Government of India is followed information technology can be accessible to all. The opening up of e-commerce is another area which would be highly beneficial to all and would give Vigyan Prasar an opportunity to promote its products worldwide. Mr. S. Sundara Vardan talked about the use of Information Technology in Society in the next millennium, emphasizing the social dimensions, and human life cycle. He insisted upon making IT a HABIT – **H**umanity **A**ssisted **B**y **I**nformation **T**echnology.

Speakers of the Seminar: (from left) Mr. Barun Deb, Dr. Narender Sehgal, Mr. S. Sundara Vardan and Prof. H.M. Gupta

The e-commerce was well received by the audience where Mr. Barun Deb explained what e-commerce is and its components, the traditional verses of electronic business transactions, the basic requirements for electronic security which include confidentiality, integrity, authentication, authorization, assurance and privacy. He also talked about digital signature and cryptographic technique that provide a means for identifying senders, authenticating message contents, preventing denial of message ownership and protecting ownership. e-commerce is a system that includes: transactions that center on buying and selling goods and services to directly generate revenue, transactions that support revenue generation, viz. generating demand for those goods and services, customer services, facilitating communications between business partners, and so on.

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

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Editor: Dr. Narender K. Sehgal

PERSONAL CODE OF CONDUCT

Every individual is called upon to play several roles as he/she goes through life: as an individual in his/her place of work, as a member of a professional body/group/society/club/fraternity/association, as a member of a family, as a citizen of the country, of a State/UT, of a district, of a village/city, of a locality in the village/city, or/and of a neighbourhood in the locality.

Except for his/her role as an individual in his/her own right — and to an extent as part of a family — his/her conduct is subject to a lot of scrutiny by others. It is in this context that one talks about a code of conduct (and a code of ethics). Such a code is all about standards of public behaviour, dealings with others, about duties and responsibilities, about work ethics, about what is acceptable or unacceptable, and about a set of dos and don'ts, etc. All these elements in the code of conduct are dictated and shaped by the prevalent value system(s), social and societal expectations and of course by the ground realities!

Needless to say any "code" is as good as the extent of its compliance by those who are supposed to follow it! Looking around here, there and everywhere, it would almost be like unearthing the open secret that all `codes', and rules and regulations of all kinds in today's India are violated far more than followed — those following and complying with codes/rules etc being reduced to hopeless minorities, are often mocked and made to feel foolish by the overwhelming majority of violators and their cohorts and collaborators among people charged with overseeing and ensuring compliance.

The situation is getting out of hand and appears to have become so bad that no one seems to know how or where to begin correcting it! What makes it much worse is the almost total loss of face and credibility of leaders, leadership and institutions in virtually all fields of human endeavour. So, the obvious dilemma facing us is: people without credibility looking into and trying to find ways of improving credibility of others.

To cut the long discourse short, we are left with only one credible choice: i.e. of mounting efforts so that each individual concerns her/himself with, and concentrates on self-correction and self-improvement! That brings us to the personal code of conduct for everyone. What does that mean?

If you are an adult, only you are responsible for your actions and deeds, as also for your behaviour and dealings with others. But no matter who you are and what you do, you are first and foremost accountable to yourself; everyone else comes only later!

Generally, most people go through life trying to follow an unwritten code of conduct (and ethics) of their own. Such a code is comprised of a set of dos and don'ts, a set of rules, basic principles or/and guidelines. The rigour with which people follow their own code of conduct varies widely and is interminably linked with the value-system prevalent in society. The very wide gap, as at present, between what people profess while speaking and what they actually do while in action, lies at the heart of many of the ills and problems plaguing India.

What we are suggesting here is the determined and persistent launch of a campaign focussed on convincing more and more individuals to consciously prepare a written code of conduct for themselves and rigorously follow it and monitor their own compliance periodically. Only if more and more individuals could strictly and rigorously adhere to their own codes of conduct, in their day to day life, narrowing the gap between their words and deeds — and do wherever and whatever they do in a manner that would make them feel proud of their actions — shall we be on the right track. There are countless individuals who would be willing to join. Only if they could be identified and networked, we would gradually be able to build a viable nucleus of the required critical size to generate a self-sustaining process of correction of our entire system. This has to be sustained and persisted with for results.

Readers' views are solicited.

NKS

A VISIONARY OF INDIAN SPACE PROGRAMME

"There is no leader and there are no led. A leader, if one chooses to identify one, has to be a cultivator rather than a manufacturer. He has to provide the soil and the overall climate and the environment in which the seed can grow. One wants permissive individuals who do not have a compelling need to reassure themselves that they are leaders."

– Vikram Sarabhai

Sarabhai's name will remain inseparable from India's space programme. It was Sarabhai who put India on the international map in the field of space research. But then he made equally pioneering contributions in other fields. He worked in the fields of textiles, pharmaceuticals, nuclear power, electronics and many others incessantly till the last day of his life.

The most striking aspect of Sarabhai's personality was the range and breadth of his interests and the way in which he transformed his ideas into institutions. Sarabhai was a creative scientist, a successful and forward looking industrialist, an innovator of the highest order, a great institution builder, an educationist with a difference, a connoisseur of arts, an entrepreneur of social change, a pioneering management educator and more.

Vikram Sarabhai (1919-1971)

However, the most important thing is that besides being all that he was a very warm human being with tremendous compassion for others. He was a man who could charm and win the hearts of all those who came in contact with him. He could instantly establish a personal rapport with those with whom he interacted. This was possible because he could convey a sense of respect and trustfulness to them and also a sense of his own trustworthiness.

He was a dreamer with a seemingly unmatched capacity for hard work. He was a visionary, who could not only see opportunities but created some where none existed. To him the object of life, as Pierre Curie (1859-1906), the French Physicist who was co-discoverer with his wife Marie Curie (1867-1934) of polonium and radium, had observed, was "to make life a dream and to turn the dream into a reality". What is more, Sarabhai taught many others how to dream and to work towards realising the dream. The success of India's space programme is a testimony to this. Sarabhai was a "rare combination of an innovative scientist, forward looking industrial organiser and imaginative builder of institutions for the economic, educational and social upliftment of the country." He had an excellent sense of economics and managerial skill. No problem was too minor to him. A large part of his time was taken up by his research activities and he continued to supervise research till his untimely death. Nineteen people did their PhD work under his supervision. Sarabhai independently and in association with his colleagues published eighty-six research papers in national and international journals.

We are told that anybody, irrespective of his position in the organisation, could meet Sarabhai without any fear or feeling of inferiority and Sarabhai would always offer him/her a seat and make him/her relax and talk on equal terms. He believed in an individual's dignity and tried hard to preserve it. He was always in search of a better and efficient way of doing things. Whatever he did, he did it creatively. He displayed extreme care and concern for the younger people. He had immense faith in their potentialities. He was always ready to provide opportunities and freedom to them.

Vikram Ambalal Sarabhai was born on August 12, 1919 to a wealthy family at Ahmedabad. During his childhood his ancestral home, The Retreat at Ahmedabad, used to be visited by important people from all walks of life. This played an important role in the growth of Sarabhai's personality. His parents were Ambalal Sarabhai and Saraladevi Sarabhai. Sarabhai had his early education in the family school started by his mother Saraladevi on the line propounded by Mme. Maria Montessori. After completing his Intermediate Science examination from Gujarat College, Ahmedabad, he joined St. John's College, Cambridge (UK) in 1937 where he obtained his Tripos in Natural Sciences in 1940. At the outbreak of the Second World War he returned to India and joined the Indian Institute of Science at Bangalore where he took up research in cosmic rays under the supervision of C.V. Raman. He published his first research paper entitled "Time Distribution of Cosmic Rays" in the Proceedings of Indian Academy of Sciences. Sarabhai's work on cosmic rays during the period 1940-45 included the study of the time variations of cosmic rays with Geiger-Muller counters at Bangalore and at the high level station in the Kashmir Himalayas. After the war he returned to Cambridge to work for his PhD in cosmic ray physics. In 1947, he was awarded PhD by the Cambridge University for his thesis `Cosmic Ray investigation in Tropical Latitudes". He also carried out an accurate measurement of the cross-section for the photofission of U-238 by 6.2 MeV γ-rays which formed a part of his PhD thesis. After getting his PhD he returned to India and continued his research in cosmic ray physics. In India he studied interplanetary space, solar-terrestrial relationships and geomagnetism.

Sarabhai was a great institution builder. He established or helped to establish a large number of institutions in diverse fields. Ahmedabad Textile Industry's Research Association (ATIRA) was the first institution that Sarabhai helped to build. This assignment he undertook just after returning from Cambridge after obtaining a PhD in Cosmic ray physics. He had no formal training in textile technology. Formation of ATIRA was an important step towards modernising textile industry in India. At the time of establishing ATIRA there were no quality control techniques in majority of the textile mills. At ATIRA, Sarabhai created conditions for the interaction of different groups and different disciplines which cross fertilise each other. While hiring personnel at ATIRA Sarabhai ignored the requirement of experience. The various institutions established and looked after by Sarabhai benefitted from each other's experience and techniques to their mutual advantage. Some of the most well-known institutions established by Sarabhai are :-

1. Physical Research Laboratory (PRL), Ahmedabad
2. Indian Institute of Management (IIM), Ahmedabad
3. Community Science Centre, Ahmedabad
4. Darpan Academy for Performing Arts, Ahmedabad (alongwith his wife)
5. Vikram Sarabhai Space Centre, Thiruvananthapuramm
6. Space Applications Centre, Ahmedabad [This institution came into existence after merging six institutions/centres established by Sarabhai]
7. Fast Breeder Test Reactor (FBTR), Kalpakkam
8. Variable Energy Cyclotron Project, Calcutta
9. Electronics Corporation of India Limited (ECIL), Hyderabad
10. Uranium Corporation of India Limited (UCIL), Jaduguda, Bihar

After the death of Homi J Bhabha in January 1966, Sarabhai was asked to assume the responsibilities of the office of the Chairman, Atomic Energy Commission. At that time he was deeply involved in three major areas. In his own words (what he wrote to the then Prime Minister accepting the offer):

"Currently I have substantive responsibilities in three areas. Firstly, at the Physical Research Laboratory as Director and Professor of Cosmic Ray Physics, where I continue my research and the supervision of doctoral candidates. Second, as Chairman of the Indian National Committee for Space Research Programme as well as the project for the development of rockets and space technology. Thirdly, I have been concerned with policy making, operations, research planning and evaluation of a significant segment of the family business interests, particularly centered around chemicals and pharmaceuticals." He had also regular association with the Laboratory of Nuclear Science of the Massachussetts Institute of Technology, USA. But all these did not deter Sarabhai form assuming the new responsibility in the interest of the country. He had to dissociate himself from the family business. He was at the helm of both atomic energy and space research programmes in India from May 1966 till his death.

Sarabhai had realised the enormous potentialities inherent in space science and technology for a wide range of social and economic development activities–communication, meteorology/weather forecasting, and exploration for natural resources, to name only a few. The Physical Research Laboratory, Ahmedabad, established by Sarabhai pioneered research in space sciences and subsequently in space technology. Sarabhai also spearheaded the country's rocket technology. He played a pioneering role in the development of satellite TV broadcasting in India.

Sarabhai was also a pioneer of the pharmaceutical industry in India. He was among the very few in the pharmaceutical industry who recognised that the highest standards of quality should be established and maintained at any cost. It was Sarabhai who first implemented Electronic Data Processing and Operations Research Techniques in the pharmaceutical industry. He played an important role in making India's pharmaceutical industry self-reliant and self-sufficient by taking a lead in establishing basic manufacture of many drugs and equipment in the country.

> Sarabhai was a "rare combination of an innovative scientist, forward looking industrial organiser and imaginative builder of institutions for the economic and social upliftment of the country."

Sarabhai was a man of deep cultural interests. He was interested in music, photography, archaeology, fine arts and so on. With his wife Mrinalini, he established Darpana, an institution devoted to the performing arts.

He believed that a scientist should never shut himself up in an ivory tower or overlook the problems faced by the society in mere academic pursuit of pure science. Sarabhai was deeply concerned with the state of science education in the country. To improve the same he had established the Community Science Centre.

He had an uncanny ability to gauge the capability of a person just by talking to him for a few minutes. In fact he used to frequently say that he could judge a person from the sparkle in his/her eyes. He believed in systematically developing people. At times he will go out of the way to give a person full opportunity of developing himself/herself. He had a pleasant personality. It is said that by his mere smile he was able to transmit a great deal of inspiration to all those who worked with him.

Sarabhai died on 30 December 1971 at Kovalam, Thiruvananthapuram, Kerala. In 1974, the International Astronomical Union at Sydney decided that a Moon Crater BESSEL in the Sea of Serenity will be known as the Sarabhai Crater.

Subodh Mahanti

INDIA'S GREATEST CONTRIBUTION TO WORLD SCIENCE

It is India that gave us the ingenious method of expressing all numbers by means of ten symbols, each symbol receiving a value of position as well as an absolute value, a profound and important idea which appears so simple to us now that we ignore its true merit.... We shall appreciate the grandeur of this achievement when we remember that it escaped the genius of Archimedes and Apollonius, two of the greatest men of antiquity.

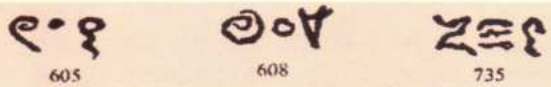
– French Mathematician-Astronomer Pierre Simon de Laplace (1749-1827)

Today we can write numbers, from the smallest to biggest, with the aid of ten symbols, including zero. The uniqueness of this system, used all over the civilised world, lies in the fact that each symbol, from one to nine, has a fixed value and also an infinite number of positional values. The zero, that material 'nothing', has the magic power to raise any number ten-fold when placed at the end of it.

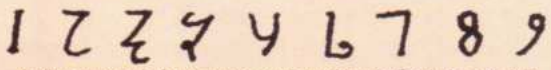
In this method of numeration, called the *decimal place-value system*, the tens, hundreds and thousands are not represented by different signs but by the same digit signs placed in different positions. Only then does position become significant. It alone shows which are tens, which are hundreds and which are thousands. Such a system needs only ten signs, the digits from 1 to 9 and a zero, or atleast a blank space.

This unique system of numeration originated in ancient India. The concept of and the symbol for the zero is one of the grandest creations of Indian genius. As the noted historian of mathematics Prof. G.B. Halsted said, "The importance of the creation of the zero mark can never be exaggerated. This giving to airy nothing not merely a local habitation and a name, a picture, a symbol, but helpful power, is the characteristic of the Hindu race whence it sprang. It is like coining the *Nirvana* (dissolution) into dynamos. No single mathematical creation has been more potent for the general go-on of intelligence and power."

Not only this decimal place-value system but also the symbols (1, 2, 3, 4, 5, 6, 7, 8, 9 and 0) are of Indian origin. These numerals, used with English and other foreign languages, are often called 'Arabic numerals' because the Europeans took them from the Arabs. In fact, their roots are in India; they have evolved directly from our old Brahmi numerals.



Numbers in the new system from south-east Asia.



Indian numerals from a manuscript written in Spain in 976 A.D.

All scholars admit that the decimal place-value system originated in India. But we do not know the name of its inventor, nor do we know if he was a follower of Brahmanism or Buddhism or Jainism (Jain contribution to mathematics is quite substantial). This system however is not the creation of a Vedic seer or Upanishadic preacher. The decimal place-value principle was invented in the early centuries of the Christian era and, even in India, it came to be fully accepted after 1000 A.D. By then it had reached the countries of south-east Asia, and in the west the Spanish Moors were propagating it among the Christian scholars of Europe. Not only the principle but with it also the numerals of Indian origin, 1 to 9 and zero, ultimately came to be accepted all over the world.

Early man, like the child of today, began to count his material possessions with the help of his fingers. This is the origin of our counting system based on ten - the decimal system. Sometimes, along with the fingers of the hands those of the feet were also used, giving rise to a counting system of some of our illiterate village folk. The ancient Mayans of Central America had developed a vigesimal system of calculation and the use of a distinct symbol for zero, but on the whole the system was cumbersome.

The Babylonians used both the decimal and sexagesimal systems. In the Seleucid period, we find them using the zero symbol but never at the end of a number, and even inside a number its meaning remained uncertain. It would therefore be wrong to consider the Babylonian (and also the Mayan) zero as having been functionally identical with ours. The Egyptian systen contained special signs for all powers of 10 up to one million, but lacked a zero. The Greek mathematicians used the letters of their alphabet for numeral symbols in the same way as the Jewish scholars did.

The Indus script still remains undeciphered, but the groups of vertical strokes inscribed on the seals probably represent numerals. In the Vedic period the basis of numeration was ten and the highest denomination found in the *Rigveda* is *ayuta* (10,000) and the largest number *shashtim sahasra navatim nava* (60,099). The word *shoonya* (zero) does not occur in the *Rigveda*.

The early Vedic Aryans might not have used any script, but there is literary evidence to show that they did use some sort of symbols for numeration. However, nothing is known about the form of number-symbols that were in use before the time of Ashoka (3rd century B.C.). For the first time numerals, both Brahmi and Kharoshthi, were found in the Ashokan inscriptions. But the system is of the old type, i.e. devoid of place-value and the zero. For example, in the Ashokan Brahmi inscriptions the number 256 is written as 200.50.6, as there were independent symbols for 200 and 50. In the Kharoshthi inscriptions, written from right to left,

the mumber 274 is expressed with the help of seven symbols as 2.100.20.20.20.10.4. Clearly this is not the decimal place-value principle.

For the first time, the new principle appears in a deed of gift, engraved on copper plates, from the Gurjara king Dadda II, where the *Chedi* year 346 (594 A.D.) is clearly expressed in the decimal place-value notation. In this three digit number the sign for three hundred is 3 and then the sign for forty is 4. The zero appears in a document from the year 681 A.D. where the number 20 is written with the figure 2 and a zero in the form of a small circle.

When the new system came into being, no new symbols were coined; for the numbers 1 to 9 the same old Brahmi numerals remained in use, and for the zero a dot or a small circle was used. This is why we can trace the continuous evolution of our present numerals from the Ashokan period.

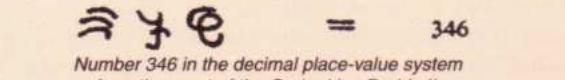
Soon, most probably through trade connections, the knowledge of positional notation reached south-east Asia and also western Asia. Thus, we find in the Sanskrit inscriptions from south-east Asia the *shaka* years 605, 608 and 735 expressed in the decimal place-value system and in numerals taken from India.

The new system must have reached Alexandria and from there the west Asian countries quite early. In 662 A.D. Severus Sebokht, a Syrian Christian scholar living on the banks of the Euphrates, wishing to show that the Greeks had no monopoly on science, praised the Indian numerals in these words : "I will omit all discussion of the science of the Hindus, a people not the same as the Syrians; their subtle discoveries in this science of astronomy, discoveries that are more ingenious than those of the Greeks and the Babylonians; their valuable method of calculation; and their computing that surpasses description. I wish only to say that the computation is done by means of nine signs." (Early Arabic and Latin scholars always refer to the nine signs because generally the zero was not regarded as a numeral).

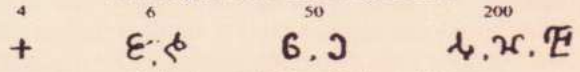
Most probably the early Islamic Arabs took the Indian numerals, developed from the old Brahmi signs, from Alexandria or Syrian scholars. When Baghdad became the intellectual centre of the Islamic world in Al-Mansur's reign (754-75 A.D.), a work called *Sindhind* is said to have been brought to his court by an Indian scholar named Kanka. This Sanskrit work, which may have been the *Surya Siddhanta* or Brahmagupta's *Brahma-sphhuta-Siddhanta* (628 A.D.), was translated into Arabic in 772/773 A.D. Thus Arabic scholars adopted not only the place-value principle but also the Indian numerals.

In Arabic these numerals are mentioned as *Gubar* (dust) numerals. This is because in ancient India calculations were often done on dust spread on a wooden board, and therefore arithmetic was known as *Dhooli-karma*. The *Gubar* numerals and the new decimal place-value system were adopted throughout the Arabic world mostly by mathematicians and astronomers. The central Asian mathematician Al-Khowarismi (825 A.D.) used these Indian numerals in his works, which were later translated into Latin.

Later the Arabs adopted the alphabetic *abjad* notation, but by this time the *Gubar* numerals were already transmitted to Spain. There, from the 10th century A.D., European scholars began to translate Arabic works, based on Sanskrit and Greek sources, into Latin. They adopted not only the decimal place-value principle but also the Gubar numerals,



Number 346 in the decimal place-value system from the grant of the Gurjar king Dadda II.



Brahmi numerals from Ashokan edicts.

which were of Indian origin. Thus the oldest manuscript which gives the *Gubar* numerals is from Spain and is dated 976 A.D. The Italian mathematician Leonardo 'Fibonacci' played a great role in propagating the Indian numerals in Europe. The first chapter of his monumental work *Liber Abaci* (1202 A.D.) deals with the reading and writing of numbers in the 'Indorum' (Indian) system.

But the Indian numerals and the new principle were not easily accepted all over Europe. They had to face stiff oposition from the Roman numerals (I, V, X, L, C, D, M), patronised by the church. In the beginning it was often argued that the zero (0) could easily be forged into 6 or 9. However scientists and merchants found this new principle very convenient and by about 1600 A.D., it came to be accepted all over Europe. The numerals 1, 2, 3, ... 9, whose origin can easily be traced back to our old Brahmi symbols, became almost fixed when they were set into types.

A large number of mathematicians have praised the Indian system of calculation in the most eloquent words. Paying tribute to the Indian contribution, the well-known historian of mathematics F. Cajori wrote : "The grandest achievement of the Hindoos and the one which, of all mathematical investigations, has contributed most to the general progress of intelligence, is the invention of the principle of position in writing numbers."

If anything of Indian origin has become truly international, it is our method of expressing all numbers with ten symbols. This may rightly be regarded as India's greatest gift to world culture.

Gunakar Muley

Editor-in-chief : Narender K Sehgal
The team : Kinkini Dasgupta, Subodh Mahanti, Arup Kumar Misra, Sushant Panigrahi, Sumita Sen, S.K. Singh, Kapil Tripathi

Address for correspondence:
Vigyan Prasar
C-24, Qutab Institutional Area, New Delhi - 110 016
Tel: 6967532; Fax: 6965986; e-mail: vigyan@hub.nic.in
website: http://www.vigyanprasar.com