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Monthly Newsletter of Vigyan Prasar

DREAM 2047

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VP News

HAM RADIO WORKSHOP ORGANISED BY VIGYAN PRASAR AT IIT, GUWAHATI

A ham radio workshop and demonstration programme was organised by Vigyan Prasar at the Indian Institute of Technology, Guwahati (IITG), from October 8 to 10, 1999. It was attended by 120 participants from different engineering colleges across the country. The distinguished guests present in the programme were Dr. Narender K. Sehgal (VU3NKS), Director, Vigyan Prasar, Sri J.M. Misra, Chief General Manager, Telecom (Assam Circle), Dr. D.N. Buragohain, Director, IITG, Dr. Anil Mahanta, Head of the Deptt., Electronics & Communication, IITG, and Dr. Anup Gogoi, Assoc. Prof., Electronics & Communication, IITG.

Sri Amalendu Piplai (VU2AP), a veteran ham from Calcutta, responded to a general radio call given from the homemade radio station of Sri Ranjit Chaliha (VU2RCH), who had represented the VU2NCT Club station of Vigyan Prasar. Sri Piplai (VU2AP) enlightened the participants with his on-the-air lecture on ham radio. Sri Sandeep Baruah (VU2MSY), Scientific Officer, Vigyan Prasar, also delivered a lecture apprising the participants about the different exciting aspects of ham radio. It was followed by a lecture on "Technology and Indians" delivered by Dr. Sehgal, Director, Vigyan Prasar. Sri P.M. Dastidar, Director, Assam Police Radio Organisation, in a lecture stressed the promotion of ham radio in the North Eastern part of India citing its importance in the event of frequent natural calamities taking place in this region. There was a keen interaction between the participants and the organisers in the interactive session where many queries related to ham radio were answered by Sri Debajit Sarma (VU2DBM). A practice session apprised the participants of the ham radio communication procedures along with an on-the-air demonstration of Morse Code communication given by Sri D.P. Dey (VU2DPD) from Calcutta. A laboratory session for transmitter design was also conducted at the basic electronics laboratory of IITG where study materials and booklets on ham radio published by Vigyan Prasar were distributed among the participants. This Vigyan Prasar venture was very satisfying in the sense that all the participants were greatly motivated towards this noble scientific pursuit.

Inside

A field day ham radio station was established by Vigyan Prasar at IIT, Guwahati. The home-made ham radio equipment were provided by Sri Ranjit Chaliha (VU2RCH), a self made expert in this field.

Participants at the ham radio workshop during the transmitter design session at the basic electronics laboratory of IITG.

Sandeep Baruah (VU2MSY) gave ham radio demonstration to the ham radio enthusiasts.

Hepatitis-B Vaccination

Vigyan Prasar organised a vaccination programme, from 01.11.99 to 03.11.99 at Technology Bhavan, for the second dose of Hepatitis-B vaccination for employees of Vigyan Prasar, Department of Science and Technology (DST) and Department of Scientific and Industrial Research (DSIR). First dose was vaccinated during 30.09.99 to 02.10.99. Third and last dose will be vaccinated after appropriate interval.

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

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Editor: Dr. Narender K. Sehgal

SCIENCE CHANNEL: WHY AND HOW?

Do we need a separate "Science Channel"? With the present-day ground realities, yes, we most certainly do! Having said that, we need to look at several issues and questions. For example: Who will foot the bill for such a channel? Both the running expenses, as well as the cost of software to be employed? Since there already are several channels in India showing foreign `science' programmes (Discovery, National Geographic, BBC etc), we would obviously not be thinking of deploying imported software on the proposed "Science Channel". Where would then the software come from? We would need to produce it afresh — most, if not all of it! What language or languages would we use for the programmes? Who would exercise editorial control, if at all, over view-points and opinions expressed over the channel? What kind of programmes would, or would not, qualify for inclusion on the channel? There are other countless questions.

First of all, a separate Indian TV Channel exclusively devoted to Science (& Technology) is long overdue. When there are already at least three TV channels in India devoted to "sports", at least three devoted to "News", and at least three channels which beam a large number of science-based foreign programmes, this, in my view, is justificaion enough for an Indian "Science Channel". Besides, the very inadequate coverage at present of science and technology in India on existing television channels (both Indian and foreign) ought to provide further justification if any were required!

As things stand, here and now, a "Science Channel" may not be a commercially viable proposition. (Else, there would have been a private channel already in operation!) But there are reasons to believe that a "Science Channel" could become financially viable in phases over a period of five years or so. The first target would be for the software to pay for itself — through sponsorships, sales to other channels worldwide, and utilisation of the content in several other saleable forms. The running costs would have to be recovered next, possibly through commercials advertisements and sales of slots for programmes which are in tune with the Science Channel's objectives/mandate.

The key element in the success, and financial viability of the "Science Channel" (as indeed would be the case for any channel) would be the software i.e. the programmes we show. Of course the size of the population which has ready access to these programmes, and the quality of reception are the other important factors in determining the viability of the channel.

All said and done, ultimately it is the content and quality of the channel software which would attract or put off viewers and spell success or failure of the channel. Thus resources, efforts and attention in adequate measure would have to be devoted to the planning, production and procurement of software for the "Science Channel". There would have to be something for everyone in a language and idiom they can feel comfortable with and comprehend.

The programmes shown should give the channel a unique Indian character and stamp. Indian stories, Indian perspectives on issues, and Indian points of view ought to come out clearly in the programmes telecast. Success stories of all kinds at all levels and from all over India ought to find their way into the programming. As far as possible, Indian examples ought to be used to illustrate or in support of points, points of view being presented – there are plenty of them around. The programming would have to create a niche for itself in India (and outside) with its quality, clear and crisp presentation, comprehensive sweep and coverage of anything and everything about science and technology in India in an authoritative manner – i.e. scientifically and technically correct, zero error and with high credibility – taking full responsibility for whatever is shown.

In order to accomplish the above, all existing media, humanware, hardware and software resources would need to be pooled to get synergies; all resource persons, subject experts and language converters would have to be networked; a parallel programme would have to be mounted for locating, training and developing all the humanware required for the big challenges; teams would have to be created and developed (through training, orientation and upgradation) to cover all our laboratories, educational and research institutions, industries and so on, in different parts of the country.

And then there is the challenge of languages. While we can make a beginning by producing good programmes in Hindi and English, it would be impossible to reach all our viewers in India with just Hindi & English. We would have to cover at least all the major regional languages with our programmes. This could be attempted first by linking with, or feeding, regional language channels with dubbed programmes. Eventually, Science Channel programmes would also have to be produced orginally in regional languages as well – the speed with which we move towards this would depend on the demand and viewership sizes we are able to generate in different language regions. There is no escape from this.

There are two other aspects which, traditionally, have not been given much importance. But they will be crucial for the success of the "Science Channel". They have to do with "documentation" and "distributions & marketing". The former is essential for the latter. For each programme made for the "Science Channel", "documentation" would include a written script for the programme itself, a synopsis, an informative pamphlet, reference and background materials for details on the subject, credits, mechanical details on duration, format, language(s), related materials, CD with clips for the website; posters for publicity, still-scenes from the programme, materials for release to the press; lesson materials for use in a class-room etc; materials for publicity on radio, banner-ads on web-page(s) etc.

The abovementioned ducumentation would also be needed for marketing and distribution of programmes to other channels in India and elsewhere. For this, pricing information for clips, whole programme(s), for purposes of telecast (in different formats) and distribution through cassettes etc, would have to be prepared and included in a catalogue.

There would have to be a mechanism for responding expeditiously to all queries received concerning programmes, from viewers as well as prospective distributors, broadcasters etc.

If we want a "Science Channel" – and we do – we would have to pay attention to all the aspects mentioned here and perhaps more. In fact the "Science Channel" would be able to link together activities and programmes of a variety of organisations involved with science and technology and bring out synergies. Once the Channel is in place, there would be need to involve concerned voluntary and other organisations in undertaking follow- up activities to make use of information and contents of the programmes telecast, and also provide feedback for new programmes and/or programme lines. In this and other ways, viewers and user organisations like the science clubs, voluntary organisations involved in science communication, schools, colleges etc would be able to participate in and interact with the programming activities.

Readers' views are solicited.

❑ NKS

Editor-in-chief Narender K. Sehgal
The team Kinkini Dasgupta, Subodh Mahanti, Arup Kumar Misra, 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

WHEN EXACTLY DOES THE 21ST CENTURY BEGIN?

The moment which we had been eagerly waiting for is not far away. We are on the threshold of the 21st century. But the question is: when exactly will the present century end and the new one begin ?

The question would not have arisen if precedent had been respected. But our media, following their big brothers in America, are making a mess of the whole thing. The way things are going, in the media, it appears that the 20th century will not include the year after which it is named. The inclination is to see the end of the century or the millenniun coming at midnight on December 31, 1999.

But this view is incorrect. If the established precedent is to be followed, the 20th century should include the year 2000. The matter concerns the Gregorian calendar and the Christian Era, now in use almost all over the world. According to the accepted tradition of this calendar, the 20th century will end at midnight on December 31, 2000 and the 21st century or the 3rd millennium will begin on January 1, 2001.

The reason behind all this is the fact that the starting point of the so-called Christian Era is taken from January 1, 1 A.D. In the chronological order of the years the 'zero year' (0 A.D.) is wanting. The year immediately preceding A.D. 1 is B.C. 1. True, mathematically this is wrong. Therefore, in finding the interval in years between the B.C. and A.D. years it is necessary to lessen the number of the B.C. years by 1.

To illustrate this point, let us take an example : Aryabhata-I in his *Aryabhatiyam* states that in the Kali year 3600 (elapsed) he was twenty-three years of age. We know that this Kali Era, possibly created by our astronomers, started on February 18, 3102 B.C. Therefore, 3600 – (3102–1) = 3600 – 3101 = 499 A.D., the year when Aryabhata was 23. This gives us Aryabhata's year of birth, 476 A.D.

The creators of the Christian Era had no idea of the 'year 0'. The concept of and symbol for zero is India's contribution to world culture; it was introduced in Europe about 1000 A.D.

Thus, it is a well established fact that the Christian Era has no 'zero year' for its beginning; it starts from January 1, 1 A.D. Therefore —

1 Jan. 1 A.D. to 31 Dec. 10 A.D. — 1st decade,
1 Jan. 1 A.D. to 31 Dec. 100 A.D. — 1st century,
1 Jan. 101 A.D. to 31 Dec. 200 A.D. — 2nd century,
... ...
1 Jan. 1901 A.D. to 31 Dec. 2000 A.D. — 20th century,
1 Jan. 2001 A.D. to 31 Dec. 2100 A.D. — 21st century.

All this is in accordance with the Gregorian calendar. The century here is similar to the century in cricket. When a cricketer completes his 100 runs, he has scored his century. His second century begins with the run 101.

Yet, the confusion prevails. American papers such as *The Washington Post* and *The New York Times* are propagating the idea of the end of the century at the end of 1999.

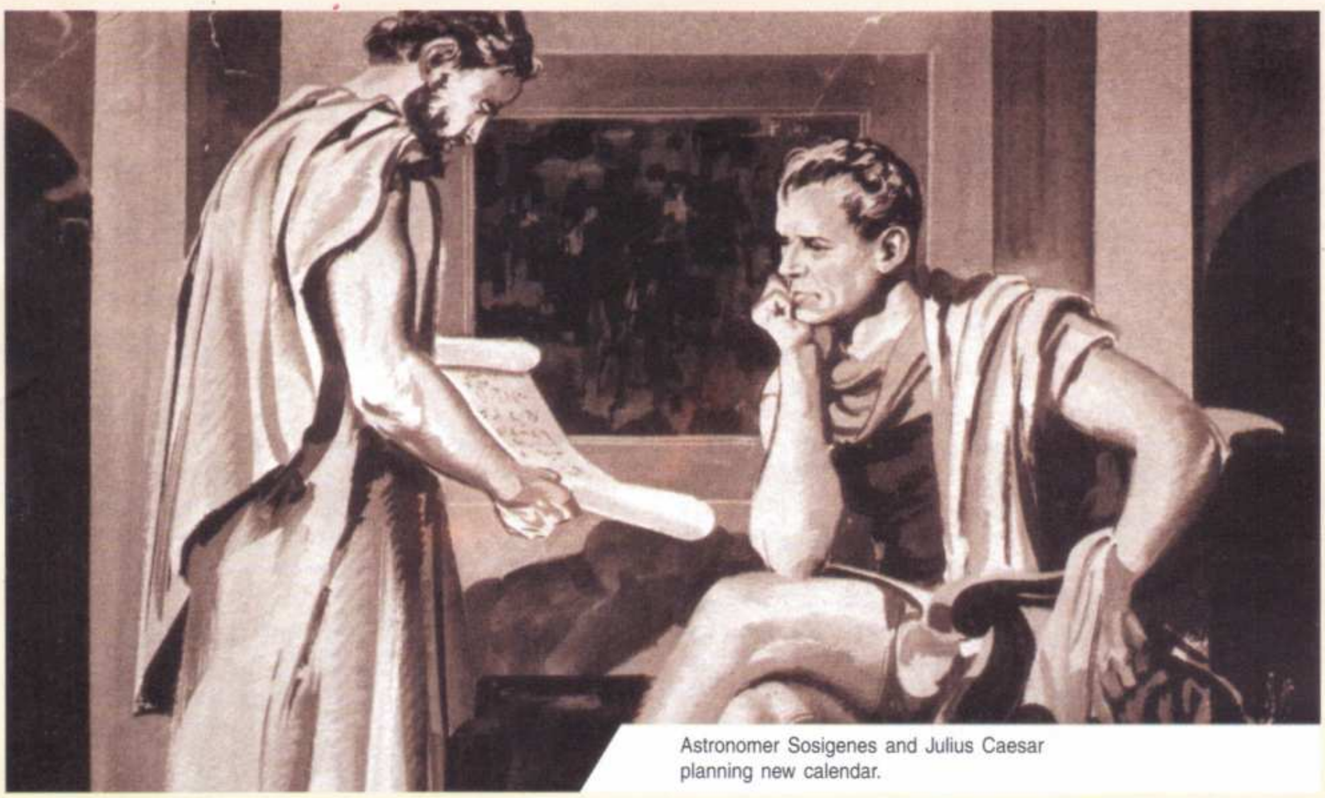
Many in our country are following them, unthinkingly. The Y2K problem has also contributed its substantial share to this misconception. We have been rather forced to believe that the 'Big Change' will occur at midnight on December 31, 1999. But this purely computer-related problem has nothing to do with the end of the century; it is related only with the change from number 'one' to 'two';. A little history of the Christian calendar will make the whole thing even clearer.

Originally, this Christian or Gregorian calendar had nothing to do with Christianity. Its origins are in the new Roman calendar adopted by Julius Caesar in 46 B.C., much before the birth of Christ. Earlier the Romans used a lunar calendar consisting of 12 months, totaling 355 days, and added an intercalary month of 22 or 23 days after every two years.Thus, their average year was of 366 days. The intercalary month was inserted after February 23. But this arrangement was irregular and confusing. The Roman rulers often lengthened or shortened the months for their political gains. The calendar was changed so many times and fallen so far behind, that it became impossible to use it for administration. Reform was necessary.

In 47 B.C. Caesar sojourned for some time in Egypt. He was by now not only Pontifex Maximus (chief of the pontifices), but also commander of the armies and ruler of the Roman empire. Being interested in astronomy, it was natural for Caesar to consider the necessity of a reformed calendar which would be the official calendar of the Roman empire.

Caesar secured the collaboration of the Egyptian astronomer Sosigenes of Alexandria. The two men decided to replace the old Roman calendar with an altered version of the solar calendar of the Egyptians. The Egyptians divided the year into twelve months of 30 days each and added a 'holiday season' of five days. Hence, their year measured (30 x 12) + 5 = 365 days, which was a little too short. They had also discovered that the true tropical year measures close to 365¼ days. In the 3rd century B.C. Ptolemy III, the ruler of Egypt, decided to add one day every fourth year, but this leap year amendment was not accepted by the priests. Ptolemy's idea of leap year was adopted by Julius Caesar in 46 B.C.

Caesar, in consultation with the astronomer Sosigenes, decided to abolish the 5 additional days placed



Astronomer Sosigenes and Julius Caesar planning new calendar.

at the end of the Egyptian year, and each year was assigned 365 days. But as the actual length of the year being approximately ¼ day longer than 365 days, Caesar decreed that every fourth year should be a leap year of 366 days.The extra day of the leap year was added to the shortest month, February. The year began on January 1, and it was divided into 12 months. In order to bring the months back to their correct seasons, in total 90 additional days were added to the year 46 B.C. Thus, the year 46 B.C. totaled 355 + 23 + 64 = 445 days in all and came to be called the *year of confusion (annus confusionis)*!

The new calendar, also called the Julian Calendar in honour of Julius Caesar, began on 1 January 45 B.C. Caesar wanted to start the new year on the 25th December, the winter solstice day. But that year the new moon, considered lucky by some, being due on January 1, Caesar had to accept the choice of his people.

The Julian calendar became the calendar of the Roman empire, but it was not until A.D. 325 when it was approved by the Nicene Council that it became the official calendar of the Christian countries. The seven-day week, of Jewish origin, was introduced in the Christian world by a decree of the Roman emperor Constantine in A.D. 321.

There is no mention of the week-days in the Vedic literature or in the *Mahabharata* or the *Ramayana*.The oldest inscription that mentions the week-day (*Suraguru Diwasa* – Thursday), along with the *tithi*, appears on a pillar erected in the reign of Budhagupta in A.D. 484 at Eran in Madhya Pradesh.

Though adopted by the Christians, the Julian calendar was yet to become a Christian calendar. The dates that I have used in B.C.(Before Christ) style, obviously, could not be there before Christianity. The A.D. (*Anno Domini*) dates were introduced in A.D. 525, and did not obtain currency until the tenth century. The B.C. dating was a much later innovation.

In dating a historical event it is important to determine the starting point of the era accepted in a given calendar. Most of the eras begin on dates associated with various events, real or legendary. Eras came to be used in India from the time of the Kushanas and the Shakas. Eras such as the Shaka, Malava and Gupta are related to historical events. But the Kali Era was created by extrapolation, most probably by our astronomers. The Christian Era, which has the Nativity for its starting point, is also an extrapolated one.

The Calendar with the Christian Era was devised in 525 A.D. by the abbot and scholar Dionysius Exiguus, who based his calculations on the 'facts' that :

(a) Christ was born on December 25, 1 A.D., in the reign of Herod, king of Judaea, in the year which was said to be a census year in the Roman empire.

(b) The Resurrection of Christ, when he was 30, occurred on Sunday the 25th of March, 31 A.D., at the full moon. This was the first Christian Easter.

Thus, proceeding from these data, Dionysius fixed the 25th of December, 1 A.D., as the day of Nativity and the 25th of March, 31 A.D., as day of Resurrection of Christ.

"Father Time", once the Roman god Saturn.

But now we know from authentic records that King Herod died four years before the Nativity and therefore could not have prosecuted Christ, and the census was carried out not in the year of Nativity but six years later.

However, with Nativity as the base date, the Dionysian chronology, with the consent of the Christian Church, began to be adopted in all Christian countries. The Christian base date was adopted in Rome in 532, in France in the 8th century and in Russia in 1699. Today this calendar with Nativity as base is recognised all over the world, and the mathematicians have had to do enormous calculations to convert the dates of major historical events to B.C. and A.D. dates. In our country this tedious task was carried out and the required conversion tables prepared by scholars such as S.K. Pillai (1911) and V.B. Ketkar (1923).

In the Julian calendar the year of 365.25 days was 0.0078 days (11 minutes 13.9 seconds) longer than the tropical year (365.2422 days). This added up to 1day in 128 years. In 1000 years the Julian calendar fell behind nearly 8 days. The departure of Easter day from its traditional position became so noticeable that in the Christian world it became the topic of much comment. A change was needed.

Finally, the improvement in the Julian calendar was introduced in 1582 A.D. under Pope Gregory XIII. Assisted by a council of scientists, Gregory stabilised the calendar to within 26 seconds of the tropical year; the error is only one day in 3280 years.

This accuracy was achieved by changing the rules for determining the leap year.

In the Julian calendar every year that could be divided by 4 without a remainder was made a leap year. The new calendar introduced by Gregory followed this rule except that the centennial years (1800, 1900, 2000, etc.) were only leap years if divisible by 400. The year 1900, for example, was not a leap year, but the year 2000, the closing year of the 20th century, is a leap year.

For bringing the Julian calendar back in line with the tropical year, it was necessary to delete 10 days (accumulated since 325 A.D.) from the year 1582. Pope Gregory decreed that October 4, 1582, should be called October 14, instead of October 5.

SUMMARY OF IMPORTANT ERAS

No.	Era and kind of year	Began in Calendar		Year begins with	Where or by whom is used
		B.C.			
1.	Julian Era, Cur. Trop.	–4713 Jan.	Solar	January 1	Astronomers
2.	Kaliyuga Exp. Sid.	–3102 Feb.	L.S.	Chaitra Shukla	Indians
3.	Buddhist Nirvana	–544		Vaishakha Shukla	Shrilanka, Siam, Myanmar
4.	Vikram (I) Ex. Sid.	–58 Nov.	L.S.	Kartika Shukla	Gujarat
5.	Vikram (II) Ex. Sid.	–58 Apr.	L.S.	Chaitra Krishna	North India
		A.D.			
6.	Christian Cur. Trop.	+ 1	Solar	January 1	All over the world
7.	Shaka, Exp. Sid.	+78 Apr.	L.S.	Chaitra Shukla	Astromomers' Era
8.	Gupta Era, Cur. Sid.	+319 Apr.	L.S.	Chaitra Krishna	—
9.	Bengali San, Cur. Sid.	+593 Apr.	Solar	Vaishakha 1	Bengal
10.	Hijri San, Cur. Lunar	+622 July	Lunar	Muharram 1	Muslim
11.	Kollam (1) Cur.Sid.(2)	+825 Sep.	Solar	Kanyadi Sinhadi	N. Malabar S. Malabar
12.	Raja Shaka Cur. Sid.	+1673 June	L.S.	Jyeshtha Shukla 13	From Shivaji's coronation

Abbreviations: Cur. = Current; Sid. = Sidereal; Trop. = Tropical; Exp. = Expired.

The Catholic countries were the first to adopt this new Gregorian calendar, as it is now called. It was recognized by the Protestant countries in the 18th century. It was officially introduced in Great Britain in 1752. Then only its use spread in India.

Ring Sun-Dial
18th Century

Signal Canon
Sun-Dial
16th Century

Now the Gregorian calendar has become almost a universal secular calendar. There should not be partisan efforts to change its established rules. Changing the year of Nativity from 1 A.D. to 0 A.D. or arbitrarily ending the 20th century with the year 1999 will not make the Gregorian calendar more scientific or the contents of the Scriptures more authentic.

❑ Gunakar Muley

THE EVOLUTION OF LAMPS

In the beginning, the primitive man used to wander about hunting and when no animal was available, he ate fruits to satisfy his hunger. He seldom used to go in search of food after sunset, because he considered the darkness as a demon and the Sun as the giver of light. With the passage of time he discovered FIRE. Fire too was light giving and heat giving. Man, therefore saw fire as a deity.

The flaming sacrificial altar in the Ashramas of the Rishis was the focus of faith during Vedic times. The cultural tradition of ancient India has thus its genesis in the spark of the yajna-vedi. This spark later assumed the form of a "Deepa" — a lamp. With the 'Deepa'– the lamp — begins a new chapter in civilization, that which may be called the "Deep-yuga".

Western theory also considers the origin of lamp during the stone-age, as early as 70,000 B.C. Originally it consisted of a hollowed-out rock filled with moss or some other absorbent material that was soaked with animal fat and ignited. This type of lamp is still used by the Eskimos of Alaska.

In the Mediterranian area and the East, the earliest lamp had a shell shape. Originally actual shells were used, with sections cut out to provide space for the lighting area; later these were replaced by pottery or metal lamps. Shell shape pottery lamps are found in many different areas of the world. Another basic type of primitive lamp has been found in Egypt and China also. Made of clay or bronze, it was sometimes provided with a spike in the centre of the declivity, to support the wick.

The very word 'lamp' is derived from the Greek 'lampas', meaning a torch. The most common model was originally adapted from Egyptian sources, but as its domestic use became more widespread, it gradually took on more complex forms. The pottery lamps were shaped like a shallow cup, with one or more spouts or nozzles in which the wick burned. It had a circular hole in the top for filling and a carrying handle. A more expensive type was produced in bronze.

The Romans introduced a new system of manufacturing terra-cotta lamps, using two molds and then joining the parts together, a process that stimulated the use of surface ornament and design. In metal, shapes became more complex, sometimes assuming animal or vegetable forms. The large versions of the lamps, for use in circuses and other public places appeared during the 1st century, AD.

Not much information is available about medieval lamps, but it would appear that those that existed were of the open, saucer type and considerably inferior in scientific terms to the closed lamps of the Romans. Generally, medieval lamps seem to have had wicks that floated on buoys of cork or wood. The glass sanctuary lamps, supported in ornamental brass holders, are still seen hanging in some churches.

The oldest design of lamps in India, is the 'Deep' found in Mohenjo-Daro. These were of round or oval shape and on one side a spout was made for putting the wick. The excavations at Mohenjo-Daro have also shown the prevalence of street lights more than five thousand years ago. There used to be a deep-stambh along each main street of a town and small lights over the main gates of the houses. With the development of the civilisation the terracotta lamps were given beautiful designs. Alongwith this, metal lamps had also started appearing. The ancient shapes of metal lamps can also be seen in the lamps of Adivasis. The folk art and culture have their own effect on them. In the lamps made by Gonds and Bhils of Bastar etc., animals like bull, lion, elephant, horse and birds like peacock were also given shape of a lamp.

With the development of the civilization other materials were also used alongwith fat for lighting the lamp and ultimately Ghee and edible oils were used prominently. For lighting torches and lamp-posts only oil was used. There were variety of oils such as castor oil, linseed oil, til oil, mustard oil etc., but for lighting only, edible oil appeared to be costly and hence cheaper oils like castor oil, linseed oil and til oil were used.

The lamp for worship of the deity is called "Aarti". The wick soaked in ghee is burnt in it and with the hand, it is moved round from right to left before the idol of the deity and prayer is sung. The importance of Aarti inspired the metalists to give it attractive and artistic shapes. In these "Aartis", one to seven places were made for putting the wick. The handles of the "Aartis" were given the shapes of a snake or some other animal or bird. In some, figures of Hanuman or Ganesh were also made and also that of the lion, peacock, cobra, lotus etc.

There have been changes in the designs of pedestals for lamps from time to time. In the beginning these were round or rectangular. These were made of stone or wood. After sometime these pedestals were raised in height. These "deep stambhas" were used for more light. In courtyards of the forts and temples, these were made of stones, with a provision of putting many lamps. Metalists also experimented in designing the lamp stands. Some made tree like pedestals alongwith lamps. The main types of trees were emulated : one with outspreading branches like the 'Aswatth..' i.e. Peepal, and the other conical like the Pine. These kinds of lamp-stands can be seen in the temples of India. Some more experiments were made by putting the lamp on the head of a peacock and adding a handle in the form of a snake. In south India, big lamp-stands of brass are also made. These are used for lighting before the start of cultural functions. On top of these lamps prototype of the birds like peacock, Garuda, and Swan are made.

1

2

3

4

1. A wooden stand supporting a small lamp
2. A globular hanging lamp
3. A votive lamp with a row of musicians shown as supporting the oil-wells.
4. A Kakada Arati.

Lighting the lamps is not only a symbol of light, but also of wealth. That is why the 'Deepavali' festival is celebrated by lighting of lamps and worship of the Goddess of wealth Laxmi. Considering the lamp as the symbol of Goddess Laxmi, artists made statues of women with lamps in hand. These were called 'Deep Laxmi' and placed at the main gate of forts and temples as decorative pieces. These Deeplaxmi's were shown in different poses such as sitting on elephant, dancing, etc. In one of the old Deeplaxmi's found in Rajasthan, she has a shell in one hand filled with oil and a lamp on the other.

Hanging lamps made of metal has also been popular. Those designed as birds were most popular. In Moghul period hanging lamps of metal and glass were made as decorations. These were given different shapes. The wick was kept in the centre of these lamps for better lighting.

Thus, in India, with the development of civilization, culture and art, lamps were made in different shapes and designs. After the availability of kerosene oil, kerosene-lamps came in to popular use. In Europe, kerosene lamps were introduced in 1860 when kerosene became plentiful. Compared with other oil lamps these were safe, efficient and simple to operate. The kerosene fed the wick by capillary action alone. An adjustment knob, the only mechanism needed, controlled the lamp's brightness by raising or lowering the wick to vary the size of the flame. A glass chimney, which was used more widely and effectively on kerosene lamps than on any other lamps, enhanced the steadiness, brightness and cleanliness of the flame. No inventor of Kerosene lamp can be named but hundreds of persons filed patent applications. In 1865, the duplex burner with two flat wicks, set near each other to augment the heat and brilliance of their flames, was introduced. Later, kerosene lamps were introduced in India also and with the availability of kerosene oil, their use increased even in the remote areas. On the basis of kerosene lamps, lanterns were made. Thus lamps became easier to carry with the help of a round handle fitted on them. In lantern, provisions were made for getting the oxygen and throwing out carbon dioxide. In the centre, glass-chimney was fitted. A handle was also placed on it. Lanterns are still popular in the areas where electricity has not reached.

Use of candle has also been popular use alongwith that of the lamps and lanterns. It is presumed that candles were invented as early as 3000 BC. In the 19th century a French Chemist Michel - Eugene Chevreul, separated the fatty acid from the glycerine of fat to produce stearic acid, from which superior candles could be made. In addition to stearic acid, two other important sources were found - spermaceti, from the head cavity of the sperm whale, and paraffin wax, from petroleum. A composite of paraffin wax and stearic acid became the basic candle stock. In use, heat from the flame liquefies the wax near the base of the wick. The liquid flows upward by capillary action and gets vaporized by the heat. In the 19th century, candle moulding machinery was also developed. It consisted of 10 rows of moulds in a metal tank, which is alternately heated and cooled. After the moulds are cooled, the candles are ejected by pistons. Spools of the wicking from the bottom of the machine are threaded through the pistons to pass through the candle mould. As the cooled candles are ejected, the wicks are cut. Now-a-days candles are available in different shapes and colours. Decorative candle-stands are also made.

Use of lamps and candles became outdated with the availability of electricity. When electricity became the main source for lighting, attempts were made to invent electric lamps. At last, Thomas A Edison successfully produced a lamp in 1879 containing a carbonized thread for the filament. The lamp burned for two days. Later carbonised bamboo was used as the filament material which could give light for several hours. Since then the electric lamp has been improved and diversified a great deal. Tungsten filament replaced the carbon filament. The vacuum technique was perfected which extended the life of the filament. Then came mercury and fluorescent lamps. Thus, electric lamps are the most common source for lighting now-a-days. Still, the "deepak" is in use in various forms as it is a symbol of eternal-light.

Hari Krishna Devsare

LITTLE-KNOWN POLYMATH AND EDUCATIONIST

The introduction of modern science in our country a century ago triggered a number of cognitive encounters which were often viewed as mere conflicts between different knowledge systems, in particular eastern and western. One of the forms which these encounters shaped, was the revitalisation of traditional knowledge systems by the 'avant-garde' of the Indian intelligentsia. Here we deal with one such cognitive encounter : the efforts of the little-known polymath and Urdu translator Master Ramachandra, who saw in Algebra the greatness of Hindu intervention. He developed a new method of solving all problems of maxima and minima by algebra and sought to introduce the Indian people to the latest developments in calculus in their native idiom.

The achievements of western civilization filled Ramachandra with wonder and awe. He held the scientific temper of Europe to be the paragon of social harmony despite a sense of inadequacy and exploitation. He tried to overcome this inadequacy by adopting as his creed, the teaching of science in the vernacular. He felt convinced that the medium of instruction in schools and colleges could only be the mother tongue, as this is the channel by which Indians can make their own contributions in science. So he set out in search of alternative pedagogic devices for teaching mathematics (to bring out the best in his students), which attempt was as significant as his efforts for the popularisation of science in the vernacular.


Master Ramachandra (1821-1880)

MAN OF LETTERS AND EDUCATIONIST

There are two conspicuous sides to Ramachandra's personality. In his capacity as an Urdu Litterateur, he had been well-known to scholars of Urdu literature. His writing covered a wide spectrum – politics and government, geography and history, geology and the natural sciences, theological topics and a series of biographical sketches of famous men such as Bhaskara, Lagrange, Laplace, Leibnitz, Galileo, Newton, Pythogoras, Archimedes, Bacon, Cicero and Darwin (published in his book *Taxkirat-i-kamileen,* Delhi 1849).

The second is the role he played as a teacher and educationist. He worked as a missionary in his commitment to science education in the vernacular. So Ramachandra translated a number of classics on science from English into Urdu. Likewise in Bengal, Raja Rammohan Roy catalysed the process by translating works on science from English into Bengali.

Ramchandra wrote two books : 'A treatise on the problems of Maxima and Minima' (referred to as 'The Treatise') first published in Delhi in 1850 and then in London in 1859; the second book 'A specimen of a New Method of the Differential Calculus', published in Calcutta in 1863.

Sir Syed Ahmed (founder of Aligarh Muslim University), who was his contemporary, gave unqualified support to Ramachandra for translation of a number of important English books on science into Urdu.

Some of the titles are : Plane Trigonometry (1859), An Elementary Treatise on the Theory of Eqnation (1861), The Elements of Euclid (1862), Algebra for Beginners (1863), Galbraith and Haughton's Scientific Manuals, 4 Vols (1859-65).

BIOGRAPHICAL SKETCH

Ramachandra was born in 1821 in a middle-class family at Panipat, the historically renowned town near Delhi. His father Sunder Lal Mathur, an official in the East India Company died in 1831, when the boy had just completed nine years. His mother educated him at home, braving innumerable economic hardships. He joined in 1833 an English School which, ironically, did not have then any provision for teaching mathematics. He had to teach himself the subject and this process brought him closer to the indigenous perception of mathematics. The scholarship he earned in the school brought him some relief economically.

Ramachandra was married at the age of 11, to a girl (named Sita!) whom he later found to be deaf and dumb. Despite the difficulty of caring for an invalid wife, he showed great composure and pursued his academic activities with devotion.

Ramachandra started his career as a science teacher at the Delhi College (now known as the Zakir Hussain College). Mr. Bourtos, the then principal, had already started translating European scientific works into Urdu. In 1843, the Vernacular Translation Society was set up. Under the aegis of the society, Ramachandra's journal "Fawaid-ul-Nazm" was published. In 1846, on the initiative of the next principal, Dr. Sprenger, another weekly "Qiran-us-Sadain" was started by Ramachandra. He ran a regular science column dealing with new inventions and discoveries in modern science.

Ramachandra embraced Christianity at St. James Church, Delhi, in May 1852. As a result, his life was endangered during the 1857 mutiny. He then joined the British army in June 1857 as a translator of news. A little later, in the same year, he shifted to Roorkee where he was appointed Head Master at the famous Thompson College of Civil Engineering, the first of its kind, founded by the British in our country. He returned to Delhi in September 1858, as Headmaster of the Delhi District School. He retired in 1866 on grounds of ill health.

Soon afterwards, he was appointed tutor to Maharaja Mohindra Singh of Patiala. He excelled in this position and was appointed director of education in 1870. He was honoured with a jagir for his contribution to the development of education in the state. Ramchandra's health deteriorated with age and he died on August 11, 1880, at the age of 59.

(Continued on Page 12)

INDIAN S&T FOR SOCIAL TRANSFORMATION

"The primary aim of research must not just be more facts and more facts, but more facts of strategic value."

Paul Weiss

Today's world is largely shaped by developments that have taken place in the field of science and technology (S&T). And more than the present the future of humankind belongs to S&T. That science would continue to occupy the central position in all human activities was apparent from the time of Industrial Revolution. In fact science in a generic sense has been the main tool available to humans right from the beginning of civilisation. Of course, in recent years, the negative impacts of S&T driven development on the earth's natural resources and environmental conditions of living beings accompanied by extinction of many species of plants and animals are becoming more pronounced. It has become obvious that there is a limit to material transformation of nature *vis-a-vis* survival of the human species and other living organisms. And so the development better be sustainable. What is important to note is that the sustainable development would require more widespread use of S&T than ever before though the approaches may have to be different. All-round development cannot be achieved simply by producing more and more material goods. It would require education, S&T, organisations and discipline–and all are interrelated.

India has the necessary infrastructure–manpower, money and institutions. It has been demonstrated that given a clear goal Indian scientists can deliver the desired results. In spite of all this everything is not well with Indian science. A certain feeling of discomfort with the state of affairs in science in India is growing. Here we attempt to put forth a brief review of ground realities, concerns and suggestions with regard to S&T *vis-a-vis* well-being of our people expressed in different fora by scientists, planners, political leaders and so on. To allow viable alternatives to emerge, the scope of discussion should be as wide as possible.

Like any other country India also recognises the importance of science. In post-independence India there has been breathtaking expansion and proliferation, both horizontal and vertical, of scientific and technical institutions in the government (both central and state), academic and industrial sectors. A large number of national laboratories has been setup under various agencies/departments covering all possible disciplines of science and technology.

India spent Rs. 8340.17 crores in 1996-97 on research and development (R&D) compared to Rs. 23 crores in 1958-59. In recent years the expenditure on R&D as percentage of Gross National Product (GNP) has declined — in 1996-97 it was 0.66% compared to 0.85% in 1991. Table -1 shows national expenditures on R&D in relation to GNP since 1958-1959. Out of the total R&D expenditure during 1996-97, 72.0% was incurred by the institutional sector in both Central and State Governments and the rest 28.0% was incurred by the industrial sectors. The central Government including the public sector accounted for 69.8% of the national R&D expenditure. Defence, space, agriculture, forestry, fisheries and development of industrial infrastructure accounted for more than 50% of total R&D expenditure. In fact the five major scientific agencies namely Defense Research and Development Organisation (DRDO), Department of Space (DOS), Department of Atomic Energy (DAE), Indian Council of Agricultural of Research (ICAR), and Council of Scientific and Industrial Research (CSIR), accounted for 83.0% of the total R&D expenditure with DRDO alone accounting for 30.7%. Table 2 shows the percentage share of total R&D expenditure of Central Government for some of the objectives for the year 1996-97.

About 3.35 lakh personnel were employed in R&D establishments including in-house R&D units of public and private sector industries—30.0% performing R&D activities, 32.5% performing auxiliary activities and the rest 29.5% were providing administrative and non-technical support. Out of the 1,27,226 personnel primarily engaged in R&D activities, 91,311 (72%) were employed in the institutional sector and the rest 35,915 (28%) were employed in the industrial sector. There were 36,181 women personnel employed that is 10.8% of the total personnel employed in R&D establishment. Out of the total women personnel 8.7% was primarily engaged in R&D activities, 8.4% in auxiliary activities and 16.1% in administrative activities.

The expenditure on education increased from Rs. 114.4 crores in 1950-51 to Rs.6577.6 crores in 1983-84 and further to Rs. 43722.7 crores in 1996-97. The State Governments were accounting for 85.5% of the expenditure during 1996-97. Table 3 shows the growth of universities/colleges and enrolment.

The main idea behind expansion of S&T infrastructure was to harness S&T in a meaningful way towards overall development of the people and the country. This was articulated by Pandit Jawaharlal Nehru, the first Prime Minister of India, who was largely responsible for creating a sound infrastructure in the form of scientific and technical institutions and trained personnel for effective pursuance of science in post-independence India. In 1947 at the Indian Science Congress Nehru said: "Surely science is not merely individual's search for truth ... For a hungry man and hungry woman, truth has little meaning. He wants food. And India is a hungry, starving country, and to talk Truth and God and even many of the fine things of life to the millions who are starving is a mockery. We have to find food for them, clothing, housing, education, health and so on – all the absolute necessities of life that every man should possess. So, science must think in terms of 400 million people in India". With Nehru's initiative the Government of India adopted the Scientific Policy Resolution on 4 March 1958, which reiterated India's obligation `to participate fully in the march of science, which is probably mankind's greatest enterprise today'.

Since the time of Nehru, science has not been unduly

Table -1 : National expenditure on R&D in relation to GNP

Year	GNP at Current prices (Rs. crores)	Expenditure on R&d at current prices (Rs. crores)	Expenditure on R&D as percentage of GNP
1958-59	13231	22.93	0.17
1965-66	23899	68.39	0.29
1970-71	39424	139.69	0.35
1975-76	70946	356.71	0.50
1980-81	122772	760.52	0.62
1985-86	232370	2068.78	0.89
1986-87	258225	2435.40	0.94
1987-88	292232	2853.07	0.98
1988-89	348210	3347.26	0.96
1989-90	402913	3725.74	0.92
1990-91	470269	3974.17	0.85
1992-93	618969	5004.60	0.81
1994-95	930325	6622.44	0.71
1995-96	1089754	7483.88	0.69
1996-97	1272177+	8340.17	0.66

+ Provisional

Source: Research and Development Statistics 1996-97, DST, Govt of India, 1999.

Table -2: Percentage share of central sector R&D expenditure by objective, 1996-97

Objective	Percentage
Defence	26.8
Space	18.8
Promotion of Industrial Development	10.0
Development of Agriculture, Forestry and Fishing	9.7
Production Conservation and Distribution of Energy	9.4
General Advancement of Knowledge	6.6
Protection of Environment	5.7
Development of Health Services	4.2
Development of Transport & Communication	3.3
Exploration & Assessment of Earth, Seas, Atmosphere etc.	3.1
Other aims	2.4
Total	**100.0**

Source: Research and Development Statistics 1996-97, DST, Govt of India, 1999.

affected by party politics. Again and again the Government of India (whichever political party or combination of political parties may be in power) has reiterated its firm commitment towards promoting S&T in the interest of the society.

Recently the Prime Minister Atal Behari Vajpayee added *Jai Vigyan* to the existing slogan *Jai Jawan Jai Kisan* coined by the late Prime Minister Lal Bahadur Shastri. Shri Vajpayee by adding two words wanted to emphasise the role of science in transforming India into a secure, self-reliant and prosperous nation. To back the motto of *Jai Vigyan* with action Shri Vajpayee suggested a number of action possibilities (See *Current Science,* 1998, **75,** 93-94) :

- Science and scientific temper should be made an integral part of our national life and culture. There is a need to universalise the scientific spirit in the form of an 'innovation movement' as the innovation is the essence of science.
- Science and practitioners of science should be made central to all our planning and operations. Administrators and government officials should be facilitators and not masters of scientists. We need to create conditions that encourage young scientists to do research and not push paper. Mindset of science educators has to be radically changed.
- Our engineers to be accorded their due status in the S&T system so that important areas like manufacturing, original design and development of technology and solving problems at the shop-floor do not suffer.
- No longer India can afford to neglect R&D in industries. Investments in R&D by our industry, especially private industry are miniscule compared to international standards.
- We need to accord greater recognition to highly talented scientists not only within the scientific community, but also in the larger national community.
- There is a need to make scientific research in our country more and more application-based.
- We need to make the use of Information Technology a National campaign.
- Indian science must face globalization with courage and confidence and make it work to our national advantage.
- In order to lift the prestige of Indian science, both nationally and internationally, Shri Vajpayee urged the scientific community to focus on some select areas of research including basic research, where it can show global excellence.
- There is an urgent need to overhaul our system of science education in the country to base it on knowledge and creativity, and not on memorizing and examinations.

Some of the questions on Indian S&T that are frequently being raised are:

- ☆ While S&T has expanded but is it good enough?
- ☆ Is its quality or its contribution towards social upliftment commensurate with its cost?
- ☆ Why before independence when there was hardly any government support for research India produced some extraordinary scientists but after independence when government's support increased tremendously there seems to be dearth of really outstanding scientists?
- ☆ Why we have not succeeded yet in spreading scientific temper among all segments of the society?

Despite massive input of public funds into scientific research, a large majority of our people remain largely untouched by the products of our modern science — they are still on a never-ending treadmill of poverty and deprivation.

C. Subramaniam, the elderly statesman, while calling for a Science Summit on behalf of Bharatiya Vidya Bhavan wrote: " We have certainly made great strides in development in many areas. Nevertheless we realise much to our dismay, that notwithstanding the gains we have made over half century, we remain the poorest the most illiterate country in the Asian region barring our adjacent neighbours, but we rank high in corruption among the countries of the world. Massive problems of environmental degradation, gender discrimination, joblessness and population which continues to grow at a fast rate, stare at us rather menacingly".

It has been stated by Ashok Khosla (See Current Science, 1999 **76** pp. 1080-86) that about 10 million Indians can claim to be part of the global elite in terms of material possessions, energy consumption, physical comfort, mobility and wealth. Some 100 million Indians live in relative comfort comparable to those in lower economy countries. And perhaps another 200 hundred millions manage to make two ends meet and have access to television, telephone and modern transport– if not privately atleast through public facilities. But the remaining 600 million Indians live in conditions that vary from the sub-human to the abysmal. Many among the last category of Indians do not have proper homes, drinking water within reasonable distance of their dwelling, toilets and what to talk of finer things of life.

There has been intensive application of S&T in many areas namely agriculture, health, space, atomic energy, industry, communication etc. Green revolution , which has made India self reliant on foodgrains has been possible because of the developments in a number of S&T fields like irrigation, production of new varieties of seeds and storage and processing and packaging techniques. S&T has played a key role in ushering the white revolution in India. This has been possible because of the improvement of inferior cattle through cross-breeding, animal health facilities and development of quality fodder and appropriate technology for preservation and transportation of milk etc. India is among the few select nations, which has mastered the technology for the design and construction of satellites and launch vehicles. India's successful space programme has revolutionized many key areas like telecommunication, TV broad casting technology and surveying and management of natural resources.

In the last 50 years India's literacy has gone up from 17% to 55%; steel production from 1.5 million tonnes to 25 million tonnes ; electricity generation from 3.5 million kW to 19 million kW; milk production from 17 million tonnes more than 70 million tonnes, food grain production from 50 millions tons to nearly 200 million tonnes and life expectancy has increased from 31 years to 62 years.

The extent to which indigenous research has contributed to these achievements may be debatable and in any case it needs more careful examination.

Why has Indian science not made the desired impact on the lives of majority of our people? Reasons for this may be many and some of them may have to do with the way scientific research is being carried out but some certainly lie outside the purview of S&T itself. The most commonly cited ones are:

1. Inadequate funds for R&D.
2. Wrong priorities.
3. Attitudes and commitment of the scientific community.
4. Dearth of talented individuals because of lack of interest among our young people in basic sciences, decline of standards in educational institutions and migration of the promising ones to the developed countries for better opportunities.
5. Non-involvement of scientists and technologists in policy formulation, decision making, preparation of developmental plans and implementation.

Table 3: Growth of universities/deemed universities/colleges and enrollment

Year	Universities	Deemed Universities	Colleges	Total Enrolment
1980-91	116	12	4722	27,52,437
1981-82	120	12	4880	29,52,066
1982-83	125	14	5039	31,33,093
1983-84	126	14	5246	33,07,649
1984-85	132	16	5590	34,04,096
1985-86	136	17	5816	36,05,029
1986-87	143	21	6040	37,57,158
1987-88	144	22	6685	40,20,159
1988-89	145	27	6773	42,85,489
1989-90	149	28	6942	46,02,680
1990-91	150	29	7346	49,24,868
1991-92	155	31	7761	52,65,886
1992-93	159	31	7996	55,34,966
1993-94	163	34	8317	58,17,249
1994-95	168	36	8613	61,13,929
1995-96	171	37	9252	64,25,624
1996-97*	172	38	9703	67,55,455
1997-98*	182	39	10555	70,78,214

* Estimates

Source: Research and Development Statistics 1996-97, DST, Govt of India, 1999.

6. Indifference of the bureaucracy to science and the oppressive atmosphere in which scientific research in being carried out.
7. Research being carried out by our scientists is mostly immitative of their western counterparts.
8. The private sector is not making adequate investments in R&D. The establishment of in-house R&D units in private industrial sectors has in most cases been triggered by tax or other concessions offered by the Government and not guided by an intrinsic need of R&D for innovation.

What are the strategies to be adopted for transforming the society by the application of S&T ? There has always been a plethora of suggestions. What is important here that there should be consensus among scientists, policy-makers and political leaders. It would also require the involvement of people at all levels. Science is not a magic wand that will solve all problems overnight–and many of our problems do not require intensive use of S&T. What is required is a scientific attitude. So the most important aspect is to inculcate scientific temper in society.

Recently a Science Summit was organised by the Bhartiya Vidya Bhawan at the Indian Institute of Science, Bangalore, under the Chairmanship of C.Subramaniam where many distinguished scientists, science policy makers and heads of science departments/ agencies were present. Some of the action possibilities suggested by the Summit in the form of a declaration are briefly indicated here. (For details see Current Science 1999, **77**.pp.851-53)

- A strategy for sustainable development will have to be worked out by having an integrated approach to planning, financing and management. Out of this should emerge programmes which provide not only the basic needs such as food, safe drinking water, shelter and so on, but also employment or livelihood opportunities particularly in the rural sector.

- In the area of infrastructure development attention has to be paid to important aspects such as reliability, professional management of infrastructure areas, promotion of environmentally sound practices, re-training of workers and managers and so on.
- It is necessary to work out completely new strategies for infrastructure in areas such as transportation.
- Education must be treated as an important infrastructural element. While listing some important aspects of the education sector that need immediate attention the Summit has recommended the setting up of a National Board of Higher Education for co-ordinating the programmes and plans of the various national academic authorities such as the University Grants Commission (UGC), The All India Council of Technical Education (AICTE), The National Council of Teacher Education (NCTE) and the Indian Medical Council (IMC), etc.,
- Critical technologies that will give the country a niche and competitive edge need to be identified and fully supported. The areas of information technology and biotechnology are vital.
- Innovation and creation of wealth through innovation have to get greater recognition as important tools of development.
- Networking of knowledge and infrastructure facilities to promote a synergistic and co-operative effort between industry, educational institutions and research laboratories should assume a priority ?
- Every effort should be made to increase the funding for science to about 2% of GNP in the next 4-5 years.
- Investment in basic science needs to be stepped up urgently. In order to make sure that research funding is administered properly by paying attention to priority areas and also provide the necessary support to the scientific community by adopting innovative policies and programme, a National Science and Engineering Research Board (NSERB) should be established along the lines of the National Foundation of USA/China.
- An attractive career development programme for scientists and engineers needs to be designed and implemented.
- Management and administrative practices employed today in our institutions are not conducive to promoting science.
- A Science Advisory Committee to the Cabinet (SACC) should be established by every government in power, together with a cabinet committee on S&T.

In the past efforts were rarely made to drive science by technological compulsions. The scientific community continued to argue that science is sustained more by the quest for knowledge and less by pursuit of profit. The component of knowledge generation must not be allowed to be eclipsed by the capacity for profit generation. The situation has changed.

There is increasing demand on the scientific community to deliver meaningfully for the betterment of the people. R&D institutions have been advised to earn 30-50% or more of their R&D expenditure by way of technology transfer in rendering consultancy services to industries. But how S&T will deliver from the present scenario of poverty, ignorance and chaos is to be widely debated keeping in view the ground realities. Then only it would be possible to evolve concrete policy measures. We have seen in the past that minor policy changes have not yielded any meaningful results. Changes will be possible only with the involvement of people at all levels. We should keep in mind that without structural transformation any amount of S&T will not be able to bring about rapid economic growth.

❑ **Subodh Mahanti**

(Continued from Page 8)

LITTLE-KNOWN POLYMATH AND ...

DE MORGAN'S EFFORTS TO POPULARISE "THE TREATISE"

Ramachandra dedicated the "Treatise" to reviving the Indian spirit of algebra, so as to resusicate the native disposition of the people which had been eroded over the centuries. Even though Ramachandra commenced from Bhaskaracharya's "Bija-Ganita" – a twelfth century text – the attempt to bridge the two familiar traditions was not revivalist, for he evolved a familiar tradition from which pedagogy could be developed. This book spread his fame as a mathematician which travelled as far as England and Europe. It was published again in 1859 from London, at the initiative of the English mathematician Augustas De Morgan who campaigned for its circulation abroad.

Ramchandra's ambition was to solve all problems of maxima and minima by Algebra to rejuvenate the algebraic heritage of the Indians. This was testified by De Morgan in his introduction to "The Treatise." "Ramachandra's problem — I think it ought to go by that name, for I cannot find it was ever current as an exercise of ingenuity in Europe — is to find the maximum or minimum without introducing the concept of differentiation.

"The first copy was presented to Lord Lyndhurst by the Secretary of State for India. De Morgan wrote a scholarly introduction to the book, where he recounted on what then was obtaining in our country:

"There still exists a body of literature and science which might well be the nucleus of a new civilisation, though every trace of Christian and Mohamedan civilizations was blotted out of existence. There exists in India, a philosophical language, Sanskrit, which is one of the wonders of the world, and is a near collateral of the Greek, if not its parent form. **From those who wrote in this language we derive our system of arithmetic, and the algebra** which is the most powerful instrument of modern analysis: as astronomy worthy of comparison with that of Greece in its best days; above comparison, if some books of Ptolemy's Syntaxis be removed."

❑ **R Parthasarathi**

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