

from days of yore. He talked about the excellent work done on observational astronomy by the Kodaikanal observatory in the early days of astronomical research in India. He dwelt on the programmes of the Indian Institute of Astrophysics in optical astronomy, the TIFR in X-ray and radioastronomy and the Raman Research Institute in radioastronomy. The GMRT being built by the National Centre for Radioastrophysics at Poona is expected to yield exciting results about the origin of the universe. He also talked about the establishment of IUCAA and its role in promoting the study of astrophysics in universities.

Dr K. V. L. Sarma of the TIFR

introduced the audience to the ultimate constituents of matter, namely the leptons, quarks and gluons. He described the standard model and spoke about the discovery of the top quark announced recently. Experimental research on elementary particles involves very costly and huge accelerators and a very large team of scientists, engineers and technologists. Though our country cannot afford to build such machines, our scientists are actively participating in such research in CERN and at other big accelerator laboratories in USA.

Dr B. L. Saraf dealt with the pressing problem of the deteriorating condition of laboratory instruction in the educational curriculum of many universities. He said

that no attention is being paid to the improvement of experiments and there is no money to maintain equipment in good condition. He described some attempts being made to set up advanced experiments in nuclear physics at the MSc level in a few colleges in Madhya Pradesh under a Physics Education project sponsored by the UGC and managed by the IUC-DAEF.

The IUC-DAEF had also organized a display of charts, photographs, etc., highlighting its progress in the centres at Bombay, Indore and Calcutta.

R. Srinivasan, Inter-University Consortium for DAE Facilities, Indore

## Indian initiative in liquid crystal research\*

We are living in the age of information technology (IT), which is nothing but a combination of computers and communication. Now we are witnessing a further coming together of audio and video technologies also and this combination of evolving into what is called multimedia. A significant fact of the IT scene is the continuous evolution of new technologies and also their increasingly ubiquitous application. In fact one can say that there is no area of manufacturing or services where you cannot apply IT and get benefits.

Man has been called a tool-making animal. We can classify human beings as *Homo spiritualis*, *Homo sapiens*, *Homo ludens* and *Homo faber*, displaying respectively, the spiritual, the reasoning, the playful and the tool-making aspects of man. When man has to interact with a machine, especially in areas like IT, there is a need for information display by the machine, which is done using display devices. Today's function inaugurating the Centre for Liquid Crystal Research is an index of India's determination to be a part of the exciting new area of display devices.

There are six basic types of displays available in the international market.

These are: cathode ray tubes, liquid crystal displays, light-emitting diodes, plasma display panels, vacuum fluorescent displays and electrode emission displays. Some of these are specialized displays. Except for the conventional cathode ray tube (CRT), with which all of us are familiar, thanks to computers and television sets, all other displays are flat-panel displays. The world over, there has been a growing interest in the development of advanced flat-panel displays. Even for the CRT, there have been attempts to develop and manufacture flat CRTs.

A look at the different types of displays indicates the increasing presence of non-CRT devices, as is obvious from Table 1.

The global display market is expanding rapidly. The total global display market is expected to be 11.6 billion and this is likely to go up to 38 billion in the year 2000. LCD devices are likely to have higher volume of the market compared to CRT beyond 1996. In the global display market, the large Japanese companies are dominating in all segments of displays. Due to the special features of each display, each of them caters to a niche market apart from generalized applications.

Table 1. Percentage of revenues by display tubes for 1987-97

Year	Type of display					
	CRT (%)	LCD (%)	EL (%)	ACP (%)	DCP (%)	LED (%)
1987	79.9	8.5	0.5	1.7	3.5	5.9
1988	79.8	8.5	0.5	1.8	3.5	6.0
1989	79.4	8.6	0.6	1.8	3.6	6.0
1990	79.0	8.9	0.6	1.9	3.6	6.0
1991	78.4	9.4	0.7	1.9	3.6	6.0
1992	77.4	10.2	0.9	2.0	3.6	6.0
1993	76.1	11.3	1.0	2.0	3.6	6.0
1994	74.5	12.8	1.2	2.0	3.6	5.9
1995	72.2	14.8	1.5	2.0	3.6	5.9
1996	69.1	17.8	1.9	2.0	3.5	5.7
1997	65.1	21.7	2.5	1.9	3.4	5.4

CRT - Cathode ray tube; LCD - Liquid crystal display; EL - Electroluminescent; ACP - AC plasma; DCP - DC plasma; LED - Light emitting diode.

\*Inaugural address delivered in the Centre for Liquid Crystal Research, Bangalore, on 3 March 1995.

The many products where we can use LCD devices are petrol pumps, multimeters, medical instruments, thermometers, electronic balances, process instruments, etc. They can also be used in typewriters, pay phone communication equipment, cellular phones, paging, hand-held programming terminals etc.

India cannot afford to lag behind in this quest for higher technology. It will be noticed that high-tech products are helpful in bringing the benefit to a large country like India, where many live below the poverty line. For example, the extension of the TV network and the emergence of satellite communication has brought the benefit of entertainment and information to people in the remote parts of this country, which would not have been possible by traditional technology. India is a major developing country and, thanks to the technological expertise India is capable of, we should not lose or lag behind in high-tech areas. In this context the Department of Electronics (DOE), therefore, had defined its role clearly as the following:

- (a) To bring the benefit of electronics to every walk of life in India, and
- (b) To make the Indian electronics industry into a global player.

Today's function with the launching of the Centre for Liquid Crystal Research,

which is going to be an autonomous society under the DOE is one more example of the initiatives being taken by the DOE to build on the technical competence we have in this country. Ultimately, we need leaders among our scientists to build organizations. In Dr Chandrasekhar we have a leader who is an eminent expert and internationally reputed scientist on liquid crystals, fellow of the Royal Society and recipient of the Royal Society medal. In advancing areas of science, one strategy we must follow is to build organizations around the leadership and technical expertise of people like Dr Chandrasekhar. 'Yada yada aacharati sreshtah tat tat deve etharajanah sayatpramanam kurute loko tat anuvartate' says the Gita. It is the leaders who set role model for others to follow.

The intellectual engine behind the Centre for Liquid Crystal Research is of course Dr. Chandrasekhar. But as Kennedy said: 'Success has many fathers, failure is an orphan'. This Centre would not have been possible but for the cooperation among the Planning Commission, Bharat Electronics, the Department of Electronics, Department of Science and Technology, the State Government of Karnataka. The Government of Karnataka has always taken a positive and active interest in the development of Electronics

and Bangalore has emerged as the silicon plateau of India. In the setting up of the Centre for Liquid Crystal Research, today, we are witnessing one more addition to the string of excellent institutions in this city.

I particularly thank the Hon'ble Vice President of India, who in spite of his busy schedule, has spared his valuable time to come and be with us and inaugurate this Centre. We are also grateful to the presence of His Excellency the Governor and the Hon'ble Chief Minister of Karnataka.

While the Centre for Liquid Crystal Research will focus on research, emphasis will be laid also on coming up with products that can be marketed. This will mean that a close association with the industry is necessary. I would therefore welcome initiatives from the industry to be closely linked with this institution, both in implementation of the projects and also, if possible, in funding. It is ultimately with the combined support and active interests of all concerned that we can make progress.

I wish the Centre for Liquid Crystal Research all success.

N. Vittal, Department of Electronics, New Delhi.

## Dedication of the Jawaharlal Nehru Centre for Advanced Scientific Research\*

As the Jawaharlal Nehru Centre for Advanced Scientific Research is among the visible monuments erected to commemorate the 100th birth anniversary of Pandit Nehru, let me recall a passage from one of the most profound documents, viz. the *Scientific Policy Resolution (SPR)*, which Mr Nehru as the Prime Minister of India piloted through the Parliament in 1958. Several passages of SPR are quoted quite frequently, but I shall read one that appeals to me the most.

'It is an inherent obligation of a great

country like India, with its traditions of scholarship and original thinking, and its great cultural heritage, to participate fully in the march of science which is probably mankind's greatest enterprise today.'

With a visionary policy of this nature, Indian science took rapid strides during the years since independence. In the present-day scenario, globalization and international competitiveness are the keywords. Let me take this opportunity to remind ourselves that if there is one field in which international quality and competitiveness are a natural part of our strength, it is the field of basic sciences. Even today, if a young person decides

to embark upon a research career in science and enters the portals of a leading institution, one aspiration that he entertains is to come up with a publication that can appear in a peer-reviewed, internationally reputed journal. This is ingrained in the culture of the scientific milieu and the bright, young researcher knows to choose a frame of reference, the best in his field, against which he has to perform to make a mark.

It has been one of India's good fortunes that there have always been a few research leaders in our country who have assiduously built such strong scientific traditions and motivated all those who came into their fold to produce competitive

\*Speech delivered by P. Rama Rao at the INCASR, Bangalore on 4 March 1995