



Annual Report 1982-'83

**Sree Chitra Tirunal
Institute for Medical Sciences and Technology
Trivandrum, Kerala**



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OVERVIEW

The development of science and technology as an instrument of social and economic progress has been a major aim of successive Five-year plans. The positive role of science and technology in the development of medical science has found equal emphasis in the objectives and functions of the Sree Chitra Tirunal Institute for Medical Sciences and Technology. Its objectives of self-reliance in biomedical technology, demonstration of high standards of patient care and the organisation of integrated training programmes are clearly designed to fuel the growth of medical technology and investigative medicine. During the third year of its existence as an Institute of National Importance, Sree Chitra Tirunal Institute for Medical Sciences & Technology made recognisable progress in its march for the attainment of its objectives. Its hospital, technology and educational fronts functioned with mutual responsiveness and strengthened the integrated image of the Institute.

HOSPITAL SERVICES

Patient Services

The hospital services of the Institute continued to grow as shown in Fig. 1 during the year under review. The outpatient registration, inpatient admissions and special investigative procedures continued their sharp upward trend and substantially met the regional demand for specialised care in cardiology and neurology. Fig. 1 also illustrates the widening gap between rising outpatient registrations and the slower increase in surgical procedures which can match the need only with the expansion of physical facilities. While the volume of services grew and the total number of employees reached 490 with 48% component of scientists and technical personnel, qualitative changes also occurred to tone up the hospital programmes of the Institute.

Oxygen Concentrator

A significant example of improvement related to the uninterrupted supply of oxygen which is essential for the functioning of any hospital. Even though the Institute had standing arrangements with two reputed firms for the regular supply of bulk oxygen cylinders to feed its pipeline system, breakdown in supply and consequent dislocation of surgical procedures were not infrequent in common with the experience of other institutions in the country. The introduction of an oxygen concentrator for the hospital during 82-83 was an important event which ensured continuous supply of oxygen and minimised the dependence of the hospital on the erratic arrival of bulk oxygen cylinders. Introduced for the first time in India, the oxygen concentrator is based on the modern technology of molecular sieving which enables the trapping of unwanted molecules from a mixture by a zeolite resin. In the oxygen concentrator, the resin simply removes nitrogen from the atmospheric air and supplies 95% pure oxygen for the pipeline system of the hospital. The new technology for the supply of hospital oxygen had its impact on other institutions several of whom have made subsequent plans to instal oxygen concentrators.

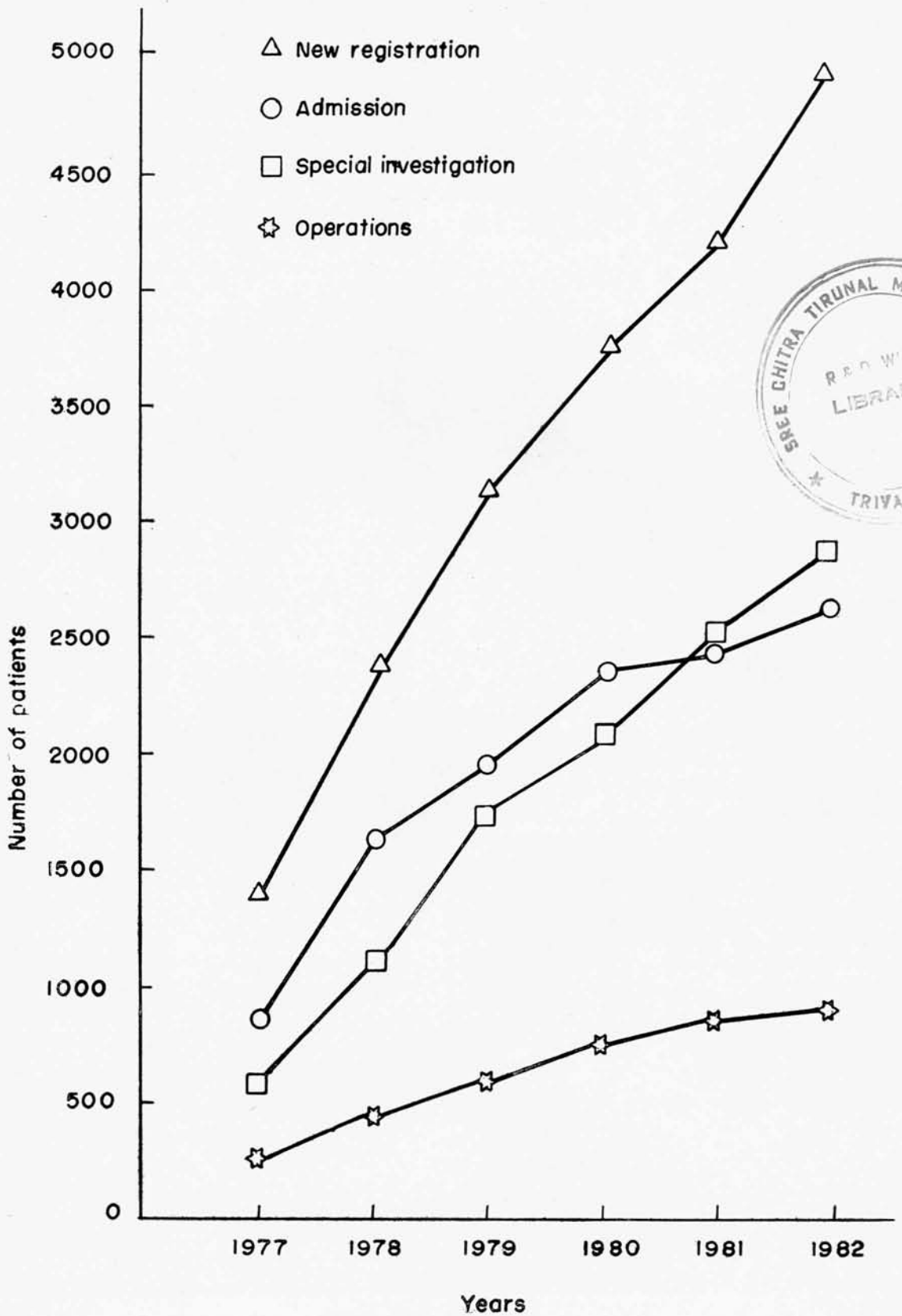


Fig. 1. Hospital Services over the years

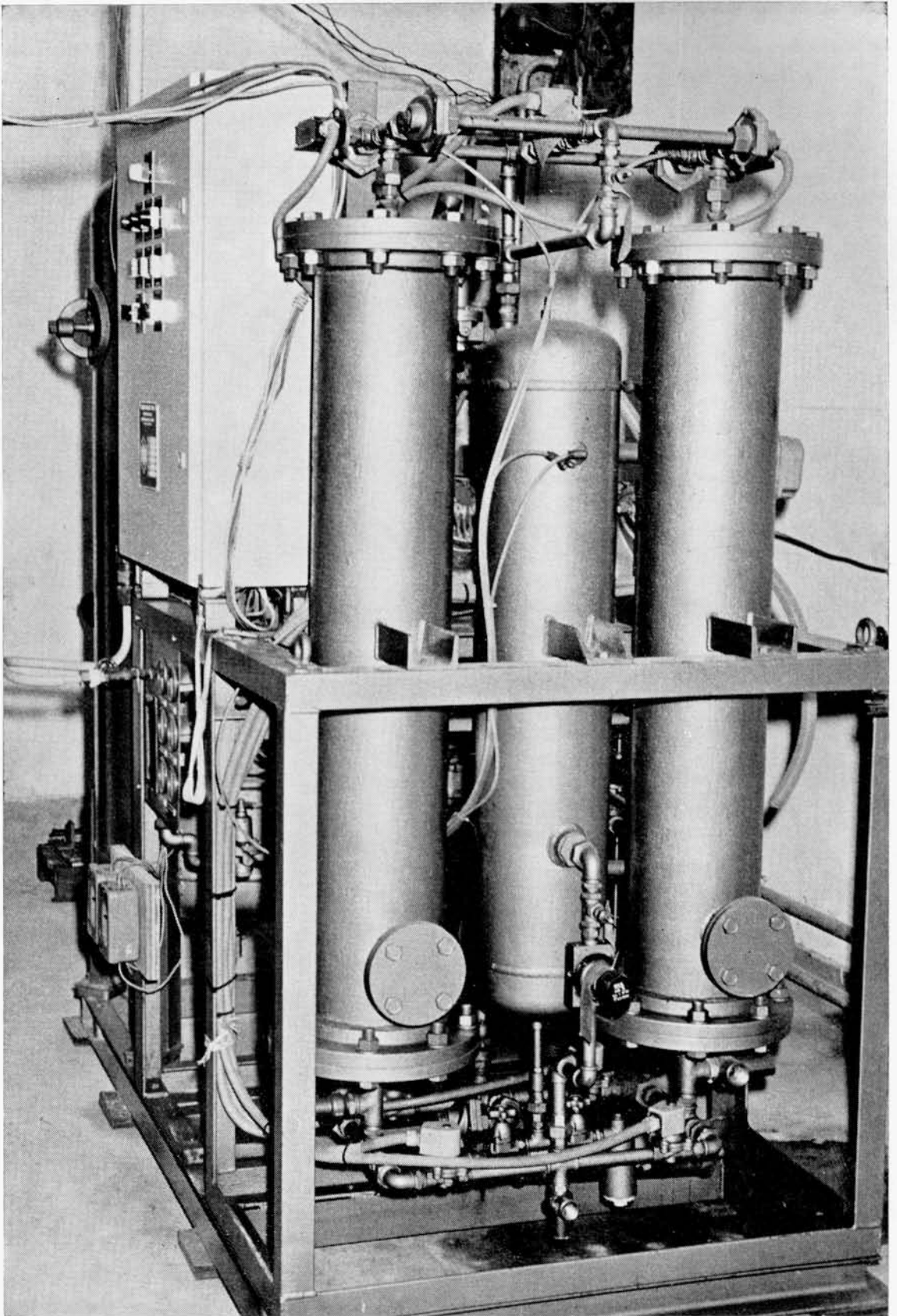


Fig. 2. Oxygen concentrator: The proverbial Indian swan imbibed milk and discarded water from a mixture. Devoid of swan like beauty, the oxygen concentrator is nevertheless more generous in retaining nitrogen and releasing oxygen from air for the benefit of patients.



Hospital Computer

The impending installation of an Indian computer system is another step in modernisation which will update the hospital procedures in relation to medical records, patient billings, accounts and inventory control. The special committee which studied the introduction of the computer system had examined, in particular, the development of software for medical records and emphasised its central role in clinical research. The system chosen PSI (OMNI) has multiuser, multi-tasking, multilingual capability. It is a terminal based system supplied with four intelligent terminals and provision to control upto 16 terminals besides capacity for virtually open ended expansion. In addition to routine batch processing of business applications, it comes equipped with software for word processing, database management, scientific and engineering calculations. An additional advantage is that, thanks to its PDP emulation, it would be possible to use all DEC software available worldwide without change on this system. The computer system is expected to become fully operational in September 1983.

Hospital Ethics Committee

The emergence of an Ethics Committee during 1982-83 was another important step in the evolution of the hospital as a major centre of biomedical research. Composed of medical and non-medical scientists from within and without the Institute, the Ethics Committee was set up by the Governing Body to screen and approve all requests for clinical trials of drugs, techniques and devices in accordance with the guidelines of the Indian Council of Medical Research. The first device to be cleared by the Ethics Committee for clinical trial was the Chitra disposable oxygenator which had been under development for almost four years at the Bio-medical Technology Wing of the Institute. The successful results of the clinical trials were presented at a national symposium as a prelude to the multi-centric trial of the Chitra disposable oxygenator in the country.

Setu Parvati Bayi Surgical Centre

The year saw the opening of administrative offices in the Setu Parvati Bayi Surgical Centre which was scheduled to admit patients in the latter half of 1983. Its major equipment for CT Scan, operating rooms and intensive care units were already on order and were expected to be installed before the end of 1983 when inpatient services would begin and substantially reduce the current pressure for hospital admissions.

Postgraduate hostel

The construction of a postgraduate hostel with 32 flats made satisfactory progress at the Kumarapuram housing colony. The flats were to be furnished and made available on schedule to the postgraduate doctors who had joined the degree and certificate courses at the Institute.

Patient Welfare Fund

The Royal Family of Travancore continued their generous support for the completion of the Setu Parvati Bayi Surgical Centre and other important activities of the Institute. A notable gift, in particular, was the donation of nearly two lakhs rupees for the Patient Welfare Fund which will greatly strengthen medico-social programmes for the very poor.



BIOMEDICAL TECHNOLOGY WING

Panoramic Batch Irradiator

A major new facility to be added during the year was the panoramic batch irradiator which underwent pre-commissioning trials including simulation trials under the supervision of BARC. The Co⁶⁰ radioactive source already made up and calibrated by BARC was expected to be installed and tested in May 1983 and the entire installation handed over to the Institute for regular use a month later.

Chitra disposable Oxygenator

The successful clinical trial of the Chitra disposable oxygenator underlined the essential soundness of the scientific programmes of the Biomedical Technology Wing which had laid equal emphasis on scientific research and need-based development of technology. A companion device of the oxygenator and an integral link in heart-lung bypass is a cardiotomy reservoir cum filter which was also developed by the Biomedical Technology Wing during the same period. Apart from providing reliable import substitutes which are on the threshold of productionisation, these devices served to build a valuable base of experience for developing a second generation of extracorporeal technology.

Chitra blood bag and Transfer of technology

A major problem faced by the hospital network in the country has been the constant shortage in blood supply which reaches crisis proportions from time to time. While the health authorities had identified several problems in organising a national blood transfusion service with regional centres, an important hurdle was always recognised to be the high cost of imported blood bags which are essential for the economic storage and component separation of blood. To meet this national need, the Biomedical Technology Wing undertook the development of a double blood bag nearly two years ago and brought the project to a successful conclusion during the current year. The Chitra double bag had at this stage not only met the standards prescribed in advanced countries for blood bags but had also shown excellent red cell and platelet

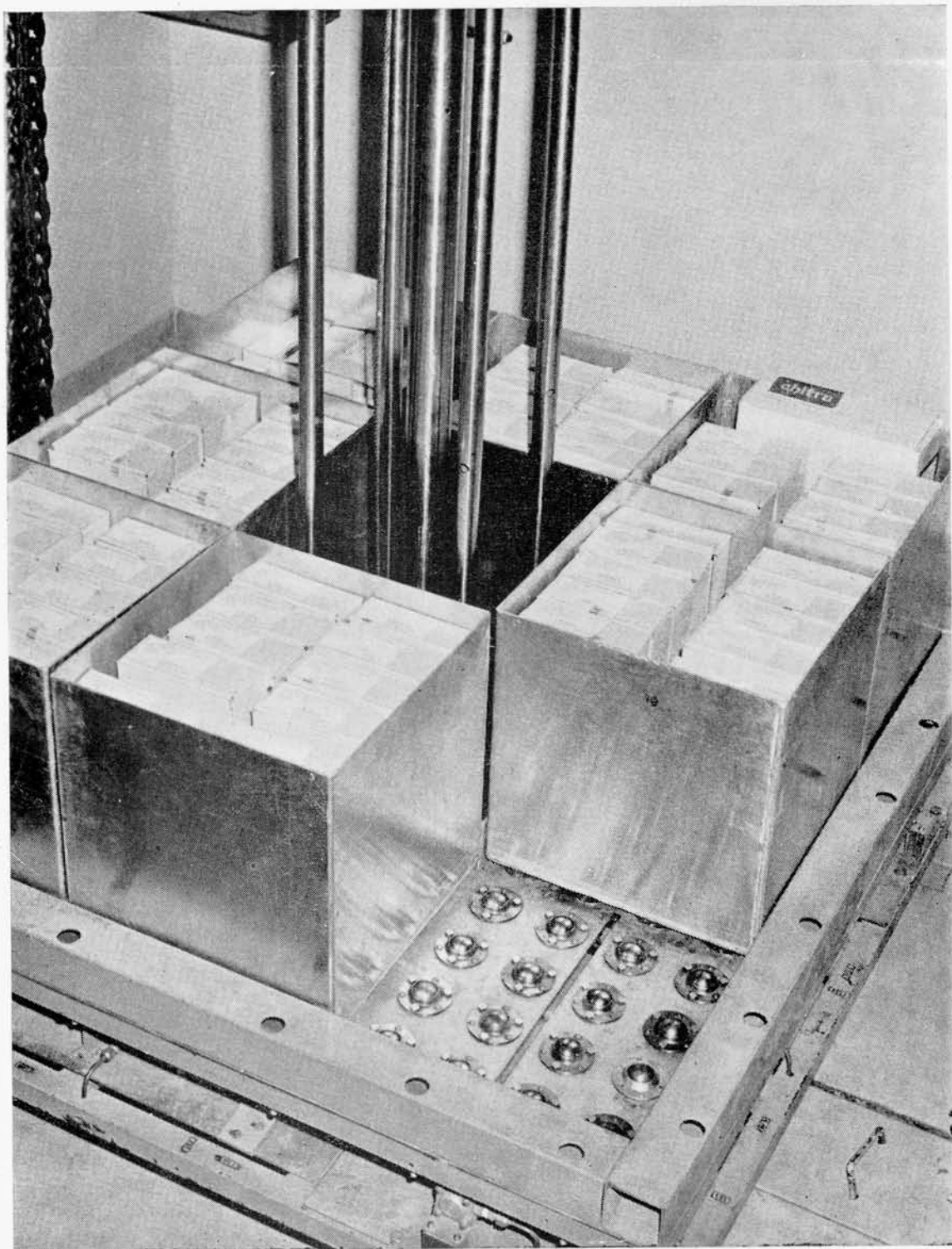


Fig. 3. Panbit: Capable of sterilising materials and devices by gamma irradiation, the Panoramic batch irradiator is also a useful tool for modifying polymers for specific applications.



survival in initial studies. The Chitra bag was expected to be considered shortly for multicentric trials by the Ethics Committee of the Institute.

As the transfer of technology from the laboratory to the factory has been generally problematical in India, considerable efforts were made during 82-83 to identify a manufacturer for the Chitra devices. The Governing Body had considered this question at an early stage and resolved that the process of transfer for production must safeguard the high quality of biomedical devices and ensure their availability for the Indian consumer at reasonable prices. A Technology Transfer Cell was subsequently set up under the charge of an engineer to coordinate technology transfer and patent applications which involved several agencies in the public and private sector. A symposium which was hosted by the Institute on Blood Compatible Materials and Devices served to heighten the interest of entrepreneurs in Chitra technology and made it probable that a satisfactory arrangement would be made with a reputed manufacturer for the commercial production of Chitra blood bags, disposable oxygenator and cardiotomy reservoir during the current year. An agreement of this kind would have major significance for the Institute which had on its developmental anvil other important devices including the tilting disc valvular prosthesis.

The spectrum of activities including the development of disposable oxygenators and blood bags formed the subject of a symposium which was organised by the Institute on 31st March and 1st April 83. Inaugurated by Dr. S. Sriramachari, Additional Director-General, Indian Council of Medical Research and attended by cardiac surgeons, anaesthetists and blood transfusion specialists from across the country, the symposium featured papers and discussions on every aspect of the ongoing programmes at the Biomedical Technology Wing and provided

an opportunity for the participants to gain first hand knowledge of the efforts for self-reliance in biomaterials technology (Appendix 1) Dr. Vincent Gott, Professor of Cardiac Surgery, Johns Hopkins Hospital, Baltimore and Dr. Yukihiro Nose, Chairman, Artificial Internal Organs Division, Cleveland Clinic, USA were two distinguished invitees who contributed significantly to the success of the symposium. The birth of the Indian Society for Artificial Internal Organs which was announced at the conclusion of the scientific sessions and its prospective affiliation to the International Association were an eloquent acknowledgement of the maturation of the efforts of the Institute in biomaterials science and technology.

EDUCATIONAL PROGRAMME



The response to the national notification for admission to DM, M.Ch. and Post-doctoral certificate course in Anaesthesia was nationwide and enthusiastic in 1982-83. Except for M.Ch. in neurosurgery, the applicants for admission to all postgraduate courses greatly outnumbered the seats available. The posting of post-graduates to the Biomedical Technology for specified periods made a beginning during 82-83 and underlined the role of both wings of the Institute in the training of young medical scientists.

The Institute organised a three day conference from 15th to 17th September 82 on 'The care of critically ill with special reference to cardiac and neurologic patients' which was attended by fifty five nursing delegates from several parts of Kerala. The course which was directed by Prof. Mohammed Ahad of the East Carolina University, USA stimulated considerable interest in introducing specialised educational programmes for nurses at the Institute. As the first step in creating a nucleus of nursing instructors, one graduate nurse was deputed to the Christian Medical College, Vellore for post-graduate training to M.Sc. In view of the large number of nurses at the Institute and the central role of good nursing in patient care, the Governing Body approved an additional scheme for supporting the postgraduate and postdiploma training of selected nurses at recognised institutions within the country.

The distinguished visitors to the Institute during 82-83 included a delegation of haematologists and blood transfusion experts headed by Academician Prof. O.K. Gavrilov of the Ministry of Health of the USSR, Moscow who were particularly interested in the development of the Chitra double bag. The Indo-USSR protocol on the development of blood transfusion technology which was signed in New Delhi at the conclusion of their visit to India included a clause for collaboration between Sree Chitra Tirunal Institute and the Institute of Central Haematology and Blood Transfusion and the Institute of Transplantation of Organs and Tissues, Moscow for mutual benefit.

REPORTS FROM DEPARTMENTS

HOSPITAL WING

Department of Anaesthesia

| | |
|--------------------------|--|
| Dr. K. Mohandas, M.D. | Associate Professor |
| Dr. V. Padmanabhan, M.D. | Associate Professor |
| Dr. R.C. Rathod, M.D. | Assistant Professor |
| Dr. Annapurna Rout, M.D. | Assistant Professor |
| Dr. H.D. Waiker, M.D. | Candidate for Post-doctoral Certificate course in anaesthesia |
| Dr. N.S. Kodandaram, M.D | -do- |

The Department continued to provide anaesthetic and ventilatory support for surgical patients and anaesthetic cover for investigative procedures. It was to the credit of the Department that this service record could be maintained in spite of its depletion of staff at senior and junior levels.

The first ever Post-doctoral certificate course in Anaesthesia which had been started during the previous year continued to attract post-graduates and became well-established during the year under review. Apart from the Departmental teaching activities consisting of seminars and journal club, the faculty members also contributed to the teaching programmes of DM and M.Ch. candidates on a regular basis.

The staff in Anaesthesiology participated in the clinical trial of the Chitra disposable oxygenator and cardiotomy reservoir cum-filter as members of an interdisciplinary team. The post-doctoral trainee received his share of experience in experimental procedures at the Biomedical Technology Wing where porcine trials of the Chitra tilting disc valve had begun.

Division of Biochemistry

Dr. K. Subramonia Iyer, Ph. D.

Associate Professor

Mrs. Santha A. George, M.Sc.

Lecturer

Aided by the new Clinicon corona autoanalyser and IL system 502 Na⁺/K⁺ analyser, the Division carried out nearly 28000 routine and sophisticated biochemical investigations requested by the clinical specialities. Dr. Iyer, Head of the division also attended a training programme on the advanced operational procedures for the auto-analyser at Stockholm, Sweden during August, 1982.

Studies on the serum proteins of patients with endomyocardial fibrosis were continued. Using the technique of two-dimensional electrophoresis, the occurrence of at least two abnormal globulin components of probable diagnostic importance could be demonstrated in the sera of these patients. These findings were presented at the International Congress on Tropical Cardiology held in Bombay in October, 1982. Further experiments to isolate and identify these abnormal globulins are in progress.

Division of Blood Transfusion

Dr. P.A. Jayaprakash, MBBS, DIBT

Blood Transfusion Officer

Dr. D. Hariprasad, MBBS

Junior Blood Transfusion Officer

During 1982–83, the Division added 1000 more volunteers to its voluntary-donor panel and increased its total blood collection by 10% over the previous year's level.

Among the specialised services, blood component separation became better established with the inevitable increase in demand from the Institute as well as neighbouring institutions. Secondly, the more sensitive third generation test (RPHA) was introduced for the detection of

Hepatitis B surface antigen in donors. Thirdly, the Division collaborated with the Department of Neurology in the treatment of immune mediated neurological diseases like acute polyneuritis and myasthenia gravis by providing facilities for therapeutic plasmapheresis.

The Division took an active part in the development of Chitra double bag for blood collection and component separation and was scheduled to undertake its clinical trial with the approval of the Ethics Committee.

Department of Cardiology

| | |
|-----------------------------------|----------------------------|
| Dr. K.G. Balakrishnan, MD, DM | Associate Professor |
| Dr. C.G. Venkitachalam, MD, DM | Assistant Professor |
| Dr. R. Subramoniam, M.D, DM | Assistant Professor |
| Dr. V. Ramakrishna Pillai, MD, DM | Assistant Professor |
| Dr. Thomas Titus, MD | Lecturer (on leave for DM) |
| Dr. K. Raman, MD, DM | Lecturer |
| Dr. P.S. Bhat, MD, DM | Lecturer |
| Dr. K. Suresh, MD | Candidate for DM |
| Dr. M.V. Joseph Joy, MD | -do- |
| Dr. R. Krishnan, MD | -do- |
| Dr. K. Venugopal, MD | -do- |
| Dr. S. Gobisankar, M.D | -do- |

While the total referrals to the Department showed a significant rise over the previous year, the proportion of patients with coronary artery disease was higher than before. In comparison with 100 patients with coronary artery disease who were registered during the previous year 143 were seen to have been referred during 1982-83. This was thought to be due to the

increasing awareness regarding coronary artery disease among the medical profession and members of the public rather than an increase in disease incidence. In accordance with this trend, stress ECG tests, coronary arteriograms and repeat angiograms following coronary bypass operations increased in number and added a new dimension to the practice of cardiology at the Institute.

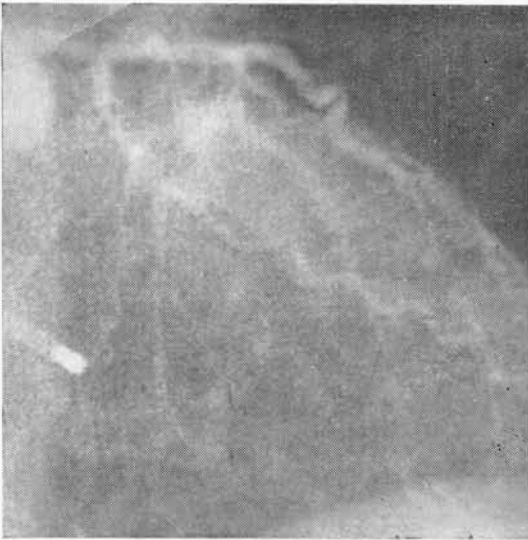


Fig. 4 & 5 The success of coronary artery bypass depends on the patency of the vein graft which bypasses the arterial obstruction. These selective angiograms show the diseased segment of an artery (one arrow) and the post operative patency of the vein graft (Two arrows)

The Department continued its active collaboration with other Departments in the investigation of endomyocardial fibrosis which looms large in the cardiac horizon of the region. These investigations received a new boost in the form of a research grant from the Lady Tata Memorial Trust, Bombay.

The DM programme made progress with the admission of the second batch of students. The first batch admitted during 81-82 took their Part I examination during the year under review.

Department of Cardiothoracic Surgery

| | |
|---|---------------------|
| Dr. M.S. Valiathan, Ch.M. (L' pool), FRCS (Edin), FRCS (Eng.) FRCS (C), FACC, FAMS, FASc. | Professor |
| Dr. M.P. Mohansingh, FRCS (Eng) FRCS (Edin) | Associate Professor |
| Dr. K.S. Neelakantan, MS, M.Ch. | Lecturer |
| Dr. R. Sankarkumar, MS (on deputation for M.Ch.) | Lecturer |
| Dr. A.K. Shrivastava, MS, M.Ch. MNAMS | Lecturer |
| Dr. K.G. Shyamkrishnan, MS, M.Ch. | Lecturer |
| Dr. K.V. Krishnan, MS (on leave for M.Ch.) | Lecturer |
| Mr. D. Ranjit, BE | Perfusionist |
| Dr. M. Unnikrishnan, MS | Candidate for M.Ch. |
| Dr. C.P. Shrivastava, MS | -do- |
| Dr. K.S.V.K. Subba Rao, MS | -do- |
| Dr. H.L. Subba Rao, MS | -do- |

The clinical services maintained the volume and profile of previous years but laid greater emphasis on the surgical treatment of coronary artery disease and endomyocardial fibrosis.

Given the limit imposed on surgical services by the existing physical facilities, it was not surprising that the waiting list of patients for open heart surgery grew at a disturbing rate and increased the pressure for the opening of the Setu Parvati Bayi Surgical Centre. The anticipated doubling of surgical services in the surgical Centre during 1983 was expected to help the waiting patients substantially.

The introduction of the Chitra oxygenator and cardiotomy reservoir cum filter in regular clinical practice was a major event for the Department which had played an important role in

their development. The Department continued its active participation in the development of a tilting disc valvular prosthesis and vascular graft which were currently undergoing trials in pigs.

The secondment of a post-graduate in cardiothoracic surgery to the Biomedical Technology wing made a beginning during 82–83 and held out promise for the nurture of a new generation of cardiothoracic surgeons with the composite culture of surgery and technology.

Three post-graduates were admitted to the M.Ch. course and the earlier batch took their Part I examination during 82–83.

Dr. A.K. Shrivastava obtained Membership of the National Academy of Medical Sciences.

Division of Microbiology

| | |
|----------------------------|----------------------|
| Dr. J. Shanmugham, Ph.D. | Associate Professor |
| Dr. Ashalatha Nair, M.D. | Lecturer |
| Mr. M. Ravindranath, B.Sc. | Scientific Assistant |
| Miss Molly Thomas, M.Sc. | Scientific Assistant |

In addition to providing diagnostic support to the clinical Departments, the Division of Microbiology initiated two research projects on the "Study of viral etiology of chronic pancreatitis" and "Experimental production of Pancarditis due to coxsackie B group viruses in mice" which were respectively financed by the Indian Council of Medical Research and Department of Science & Technology, Government of India. Two collaborative studies with the neighbouring Medical College Hospital and SAT Hospital for Women and Children on Rheumatic fever and viral encephalitis were completed. The Division took active steps to organise the First National workshop on "Serological Markers of Hepatitis

B virus" in October 83 in partnership with the National Institute of Virology, Pune, Christian Medical College, Vellore and Postgraduate Medical Institute, Madras.

Dr. John L Sever, Chief, Infectious Diseases Branch, National Institute of Neurological and communicative disorders and stroke, Bethesda, USA visited the Division during January 1983.

Department of Neurology

| | |
|---|----------------------------|
| Dr. Vimla Virmani, MD(Psy), FRCPE, FAMS | Visiting Professor |
| Dr. P.K. Mohan, MD, DM | Assistant Professor |
| Dr. John Tharakan, MD, DM | Lecturer |
| Dr. P.K. Saha, MD, DM | Lecturer |
| Dr. P.P. Ashok, MD | Lecturer (on leave for DM) |
| Dr. C. Sarada, MD | Candidate for DM |
| Dr. A. Anandkumar, MD | -do- |
| Dr. N.K. Ravi Subramanya, MD | -do- |
| Dr. K. Venkateswarlu, MD | -do- |

While the rise in clinical services claimed most of the time and attention of the Department, research efforts were also initiated in collaboration with other Divisions and Departments. Notable among the projects were the study of intracranial infections, plasma pheresis for immune mediated diseases and the neurological complications of cardiopulmonary bypass.

The first batch of DM students appeared for Part I examination and the second batch of two post-graduates was admitted during 82-83. The Department also provided facilities for project work in neurology for a post-graduate student of the Medical College, Trivandrum on 'Skeletal muscle changes in hypertrophic cardiomyopathy'.

Department of Neurosurgery

| | |
|----------------------------------|---------------------|
| Dr. Damodar Rout, MS, M.Ch. | Associate Professor |
| Dr. R.N. Bhattacharya, MS, M.Ch. | Assistant Professor |
| Dr. S.M. Pillai, MS, MNAMS | Lecturer |
| Dr. Ajay Sharma, MS, M.Ch. | Lecturer |

In common with other clinical Departments, the volume of clinical services in neurosurgery increased during 82–83 when the surgical repertoire of the Department also expanded thanks to the introduction of therapeutic embolisation for cerebral AV malformations. Significantly, the radioopaque silastic spheres for embolisation procedures were developed by the Biomedical Technology Wing of the Institute. Another procedure of interest was the successful use of prosthetic reconstruction for aqueduct stenosis. An experimental laboratory for microsurgery was established in the hospital wing for the further development of microneuro-surgery.

In collaboration with the Department of Anaesthesia, a clinical study was carried out on the role of lignocaine in reducing intracranial hypertension with encouraging results. Funded by the Indian Medical Research Society, Bombay, two research projects were also initiated on the radiological exploration of craniovertebral anomalies in the region and the role of hyaluronidase in experimental cryptococcal infections of the central nervous system with the collaboration of the Divisions of Radiology and Pathology.

Dr. S.M. Pillai obtained Membership of the National Academy of Medical Sciences.

Division of Neurochemistry

| | |
|----------------------------|----------------------|
| Dr. Debkumar Basu, Ph.D. | Professor |
| Dr. P.S. Appukuttan, Ph.D. | Lecturer |
| Mrs. K.I. Annamma, B.Sc. | Scientific Assistant |
| Mr. Suresh Kumar G., M.Sc. | Candidate for Ph.D. |
| Mr. Farhat Azimkhan, M.Sc. | -do- |
| Miss Sarasija P.N., M.Sc. | -do- |

The work on the utilisation of hospital wastes continued and B galactosidase was purified to homogeneity by the Sepharose-mercurial affinity chromatography. As a step in developing ELISA test for myocardial creatine kinase (MB) whose sub unit B is identical to the brain creatine kinase, a simple affinity chromatography procedure was developed using Blue-Sepharose column and elution with ATP. Development of antibodies to brain creatine kinase was also simultaneously undertaken.

The sugar binding parameters of the lectin from jack fruit seed were further studied with special emphasis on their response to physico-chemical variables such as change of temperature, pH and KCNS. Equilibrium dialysis studies with P-nitrophenyl- α -D-galactose revealed two binding sites for α -D-galactose moiety per tetramer protein molecule. This observation was confirmed by fluorescent quenching studies with 4-methyl umbelliferyl α -D-galactose.

Division of Pathology

| | |
|----------------------------|----------------------|
| Dr. V.V. Radhakrishnan, MD | Associate Professor |
| Dr. C.C. Kartha, MD | Assistant Professor |
| Dr. Pushpa Mahadevan MD | Lecturer |
| Mrs. Annamma Mathai, M.Sc. | Scientific Assistant |

The laboratories of the Division provided round the clock service to patients as in previous years in clinical pathology, histopathology, frozen section studies and immunologic investigations. New studies were also initiated on the histochemistry of skeletal muscle and single nerve preparations. These techniques are currently being standardised to diagnose clinical cases of peripheral neuropathies and muscular disorders.

The ongoing project on the experimental induction of cryptococcal infection in albino rats and the role of hyaluronidase as an adjuvant in therapy received financial support from the Indian Medical Research Society of Bombay. Immunohistological studies on endomyocardial fibrosis were also carried out systematically to identify specific immune complex depositions in the endocardium and myocardium.

Department of Radiology

| | |
|----------------------------|---------------------|
| Dr. K. Sasidharan, MD | Associate Professor |
| Dr. V.R.K. Rao, MD | Associate Professor |
| Dr. Ravimandalam, MD | Assistant Professor |
| Dr. Bhat Venkataraman, MD | Lecturer |
| Dr. R. Venkatarama Rao, MD | Lecturer |

The trend and volume of diagnostic studies in cardiology and neurology showed no significant change except quantitative increase over

the previous years. The Department played a major role in finalising the specifications of a whole body CT Scanner and choosing the Hitachi model for the Setu Parvati Bayi Surgical Centre where a separate X-ray diagnostic facility was also established for the outpatients.

The research projects of the Department related to the clinico-radiological evaluation of cranio vertebral anomalies and endomyocardial fibrosis.

BIOMEDICAL TECHNOLOGY WING

Head Mr. A.V. Ramani, B.Sc. (Chem. Tech.)

Department of Biomaterials Science

Laboratory for technical evaluation of biomaterials:

| | |
|---------------------------|---------------------|
| Dr. V.V. Bhujle, Ph.D. | Scientist in-charge |
| Mrs. Prabha D Nair, M.Sc. | Scientific Officer |
| Mr. K. Srinivasan, M.Sc. | Scientific Officer |

The laboratory screened and characterised many polymeric materials for use by other Divisions and projects as part of its general service activity. Whenever possible, the facilities were extended to other academic institutions including the Regional Research Laboratory, Kerala University, and Rubber Research Institute.

The laboratory developed a new technique using liquid chromatography to evaluate the leaching of plasticisers into blood stored in PVC bags. Work on estimations of oligamers present as contaminants in processed polymers was also initiated.

(ii) Laboratory for Thrombosis Research

| | |
|-----------------------------------|----------------------|
| Dr. M. Jamaluddin, Ph.D. | Scientist in charge |
| Mrs. Lissy Kalyanakrishnan, M.Sc. | Scientific Assistant |

The Laboratory continued its studies on the aggregation of blood platelets and its regulating molecular mechanisms. Platelets were purified using a modified sepharose -2B gel filtration technique. Adopting standardised spectrophotometric methods, the group discovered a kinetic cooperativity in the initial stages of aggregation of platelets in response to ADP.

The Laboratory purified a haemoprotein from calf platelets having a mol. wt. of 40,000

daltons and a Soret band at 405 nm. This haemoprotein was found to bind arachidonic acid with an accompanying shift in Soret band to 412 nm. It also bound hydrogen peroxide, the simplest analogue of prostaglandin endoperoxides. Further work on this important observation is in progress.

Department of Biomedical Engineering

(i) Division of Artificial Internal Organs:

Mr. G.S. Bhuvaneshwar, B.Tech., MS

Biomedical Engineer

Mr. A.V. Raviprakash, B. Tech.

Scientific Officer

In collaboration with the South India Textile Research Association, Coimbatore this Division developed a vascular graft (10 mm diameter), which showed excellent results upto six months of implantation in pigs. Experimental observation for longer periods is currently in progress.

The major integral strut cardiac valvular prosthesis was successfully developed by this Division with the support of the Division of Engineering services. This model underwent accelerated wear testing upto 350 million cycles and satisfied the international draft standards for valve durability. In its search for a hard wearing tilting disc, the Division came up with a totally new material, synthetic corundum (artificial sapphire or ruby) as a candidate. Discs made of single crystal sapphire and ruby are under evaluation.

Mr. G.S. Bhuvaneshwar was deputed to visit the Biomedical Engineering unit of the University of Liverpool under Prof. David Annis and other Bioengineering Centres in UK on an INSA/Royal Society Fellowship.

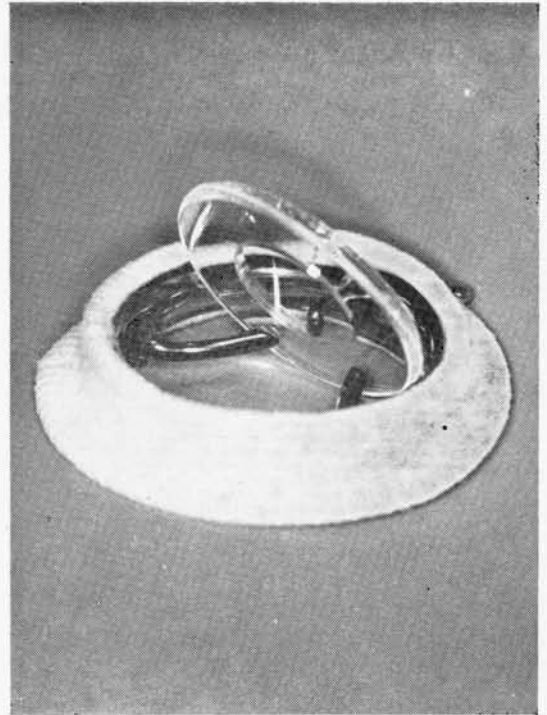
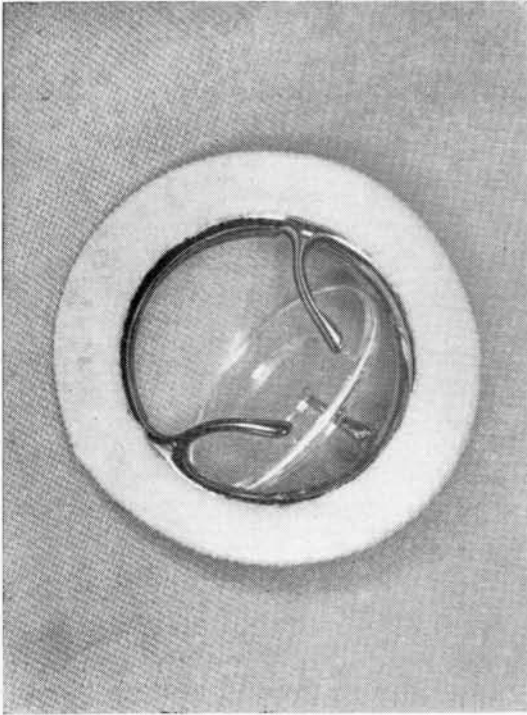


Fig. 6 & 7 Chitra Valve: An all integral cage of Titanium and disc of Sapphire are unique features of the preclinical model of Chitra Valvular prosthesis.

(ii) Division of extracorporeal devices

Mr. V.S. Venkatesan, BE

Biomedical Engineer

The first biomedical device to be put into clinical use, the bubble oxygenator, was developed by this Division and the initial reports on its clinical performance were highly encouraging. A unique soft shell cardiomy reservoir with a built-in-filter and safety bypass developed by this Division was also approved for clinical trials during 1982-83. Both the bubble oxygenator and the cardiomy reservoir are being made by the Division in production batches for multi-centric trials in India prior to technology transfer.

Sri. V.S. Venkatesan was deputed to the Department of Artificial Internal Organs, Cleveland Clinic, USA as an International Scholar for a period of six months.

(iii) Division of Polymer Technology

Mr. S.N. Pal, M. Tech.

Chemical Engineer

Mr. Kalyanakrishnan, M.Sc.

Scientific Officer

The division produced dry blend compounds of special non-toxic PVC formulations in 200 Kg batches. These formulations were made with specific properties such as low temperature flexibility and high strength for use as sheetings and tubings for the manufacture of blood storage systems.

The major activity of the group during the year was the development of a disposable PVC blood storage system in collaboration with several other Divisions of the Institute. These bags passed the battery of biochemical, haematological, and cell survival studies as recommended by British standards. The technology for bulk manufacture of blood bags was also developed to facilitate their commercial production.

The Division continued to produce injection moulded components for other projects of the Institute.

(iv) Laboratory for Biosurface Technology

Dr. Chandra P. Sharma, M.Tech, M.S.,
Sc. D., MEBE.

Scientist-in-charge

Mr. Thomas Chandy, M.Sc.

Scientific Assistant

As part of the ongoing studies on artificial surfaces, the interaction of five complement proteins namely C_1 , C_{1q} , C_2 , C_3 and C_4 was studied at the blood polymer interface. The preliminary results suggested that C_1 and C_{1q} were capable of platelet inhibition but not C_2 , C_3 and C_4 . Possible interactions among complement protein, polymer surface and platelets were elaborated during the course of the study.

As long term deposition of lipids is known to weaken implants, the interfacial phenomena of three lipids namely cholesterol, cephalin and sphingosine and their interaction with protein were studied. The results suggested that lipids can interact with protein and platelets at the interface.

Using ellipsometric measurements, it was demonstrated that the deposition of proteins on a polymer surface is enhanced (50 A°) in the presence of Vitamin C at 1.5 mgm% concentration in blood. Polymcrylamide gel electrophoresis and attenuated total reflection spectroscopy technique confirmed the observation.

In a DST funded project on 'Development and evaluation of biocompatibility of polyurethanes', attempts were made to graft hydroxyethyl methacrylate to a polyurethane surface as a tool for adjusting its hydrophobicity to hydrophelicity. These studies are making further progress.

In a BRNS funded project on 'The development of a new antithrombogenic polymer surface and its interaction studies with blood protein at interface', albumin was sought to be bonded permanently to polymer surfaces by various techniques including glutaraldehyde cross linking, irradiation and glow discharge. Small diameter polyurethane grafts (5 mm) which were irradiation bonded to albumin were found to have good in vitro blood compatibility and were used for replacing canine iliac artery in preliminary experiments.

(v) Division of Tool Room

Mr. O.S. Neelakantan Nair, B.Sc. (Eng.)

Tool Room Engineer.

This unit continued to provide vital infrastructural support to all divisions with maintenance of equipment, water and power supply in

addition to developmental work. The latter included the development of dies, moulds and fixtures for plastic moulding and metal working. A notable accomplishment of the Division was the making of an all-integral valvular prosthesis in collaboration with the Artificial Internal Organs Division. The support to sister groups took diverse forms as the design of special cages for rabbits and guinea-pigs for extramural fabrication and the making of fixtures for mechanical testing of blood bags.

(vi) Division of Patho-physiology

| | |
|--------------------------|--------------------|
| Dr. Mira Mohanty, M.D. | Scientist |
| Dr. N. Jayakumari, Ph.D. | Scientific Officer |

This new Division performed the complete range of biochemical and haematological tests for evaluating the flexible PVC blood bags developed by the Polymer Technology Division. Its laboratory also provided support for all experimental work which involved the study of tissue changes in relation to materials.

(vii) Technology Transfer Cell

| | |
|------------------------------|---------------------|
| Mr. H. Vijayakumar, B. Tech. | Biomedical Engineer |
|------------------------------|---------------------|

This cell was opened in January 1983 for looking after patenting of devices and transfer of technologies developed at the Institute. It was set up to function as an interface in the transfer of multidisciplinary technologies under development to various agencies in the public and private sectors. The cell has currently taken up the evaluation of the market potential for blood bags. Project profiles for use by entrepreneurs are also being prepared.

(viii) Materials Toxicology Division

| | |
|-------------------------------------|-------------------------------|
| Dr. P.V. Vedanarayanan, BVSc, Ph.D. | Senior Materials Toxicologist |
| Dr. A.C. Fernandez, Ph.D. | Scientist |
| Mr. K. Rathinam, M.Sc. | Scientist |

Detailed toxicological screening of approximately 40 materials were conducted during 82–83. Working in close collaboration with user groups, the Toxicology division was instrumental in the choice of safe plastic formulations and cleaning procedures for important devices such as disposable oxygenator and blood bag.

The Division also carried out pyrogenicity tests on completed devices wherever necessary.

(ix) Division of Vivarium

| | |
|-------------------------------|----------------------|
| Dr. Arthur Vijayan Lal, BVSc. | Veterinary Scientist |
|-------------------------------|----------------------|

The animal care and maintenance wing of the Division was responsible for the care of sheep, dogs, and pigs many of which were experimental animals with implanted devices for long term evaluation.

The volume and complexity of surgical procedures grew significantly during the year and included implantation of Chitra vascular graft in the thoracic aortic position of pigs, replacement of canine iliac artery by small diameter polyurethane graft and cerebral embolisation using radioopaque silicone beads in dogs.

An important contribution to the prosthetic valve programme was the development of a porcine model for its in vivo trials in the mitral position. The operative procedure and protocol for pre and post-operative management were standardised in a series of eight procedures which are crucial to the pre-clinical evaluation of the valvular prosthesis.

The Division attracted educational visits by the students of the Veterinary College, Hissar.

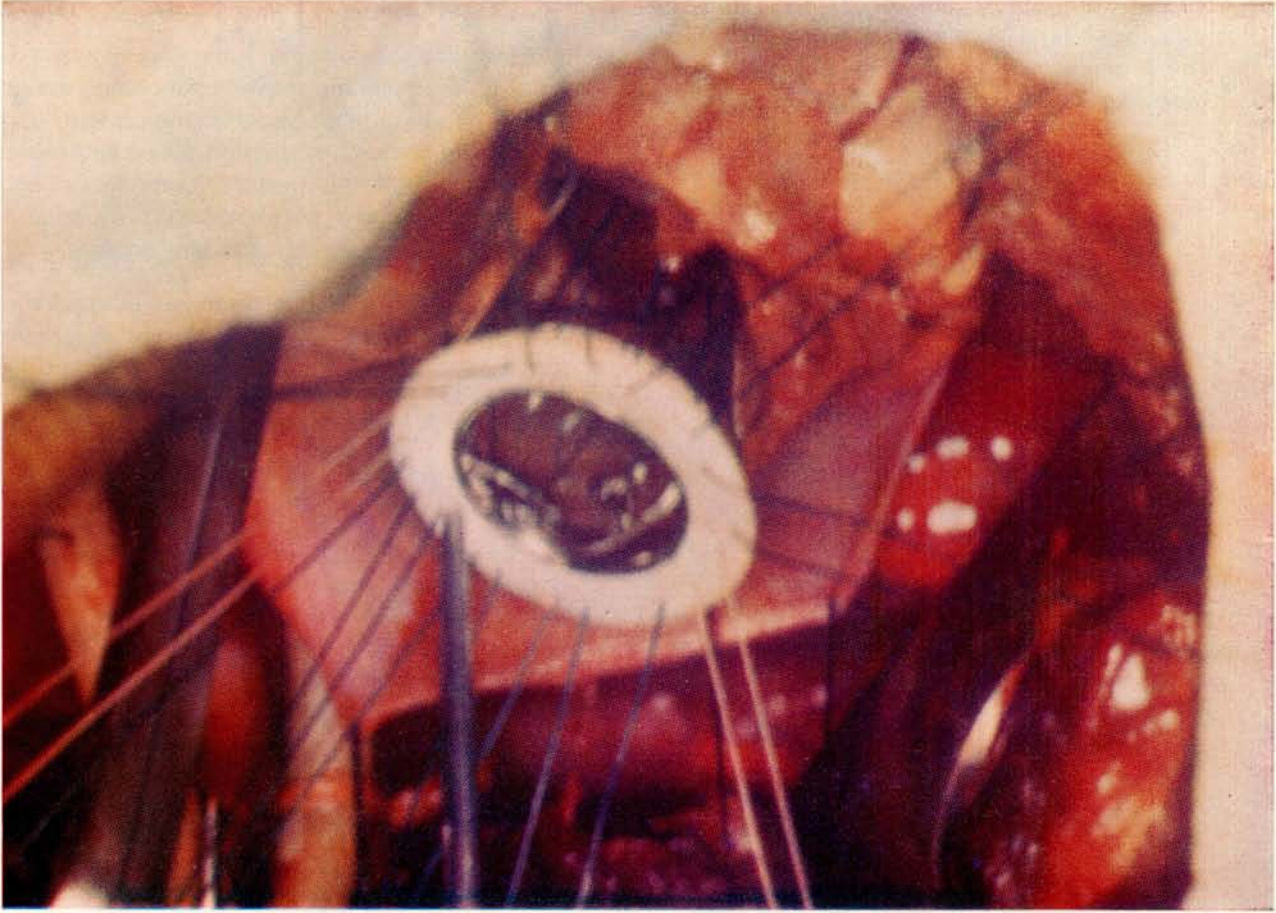


Fig. 8 Valve being placed in porcine heart: The trial of the Chitra valve in the porcine heart is an essential step in proving its reliability

SYMPOSIUM ON BLOOD COMPATIBLE MATERIALS AND DEVICES

The Symposium on blood compatible materials and devices was hosted by the Institute on 31st March and 1st April '83 to highlight the current status of research and development at its Biomedical Technology Wing. It attracted cardiac surgeons, anaesthesiologists and blood transfusion specialists from many parts of the country and provided an excellent opportunity for in-depth discussions which cut across disciplines. The participation of Dr. Vincent Gott of the Johns Hopkins Hospital and Dr. Yukihiko Nose of Cleveland Clinic was particularly appropriate as they had made major contributions to biomaterials science.

In his inaugural remarks, Prof. Sriramachari emphasised the scientific challenge of blood compatibility and referred to the growing demand for blood compatible devices in India. While individual initiative was the life breath of science, he pointed out that major advances in the technology of biomaterials and artificial internal organs could emerge only from organisations with expertise in multiple specialities.

Dr. C.P. Sharma and Mr. T. Chandy described their method for improving the blood compatibility of cardiovascular implants by protein bonding which was effected through irradiation, adsorption or chemical fixing. Their standard methods for the study of surfaces included ellipsometry, IR-ATR, goniometry etc. which were correlated with the clotting behaviour of the respective surfaces. They reported the successful development of a 5 mm vascular graft by depositing polyurethane from solution on a mandrel. The blood compatibility of the graft had been enhanced by albumination of its inner surface which had shown encouraging results

in preliminary implantation studies. Dr. Jama-luddin and Mrs. Lizzy Kalyanakrishnan presented their data on a new haemoprotein which had been identified in the course of a search for a protein receptor for the platelet activating prostaglandin. The protein which had been isolated and characterised appeared to have significance in the regulation of platelet behaviour. Smt. Prabha Nair and Dr. Bhujle outlined the analytic procedures currently used in their laboratory for the identification of candidate materials, assurance of batch constancy of composition and safety in use. Dr. Vedanarayanan reviewed the standard protocols for evaluation of materials toxicity according to BP and USP and the modifications which had been made for testing systemic toxicity, local irritation and haemolytic potential of candidate materials. It was pointed out that inputs from toxicologic studies had been instrumental in the improvement of component materials for the disposable oxygenator and blood bag. In his presentation, Mr. S.N. Pal covered the development of a flexible, disposable blood fractionation and storage system from a non-toxic PVC compound which had been formulated inhouse. The device had successfully passed the series of biochemical, haematological, safety and engineering tests and was expected to be put up to the Ethics Committee for approval of multicentric trials.

Dr. GAV Lal and Mr. GS Bhuvaneshwar discussed the current status of a 10 mm polyester graft which had been developed jointly by the South India Textile Research Association and the Institute. Porcine implantation studies had shown excellent results at three months and observation for longer periods was in progress.

Mr. V.S. Venkatesan chronicled the development of the Chitra disposable oxygenator which had successfully met the structural and functional criteria prescribed by professional bodies such as AAMI and ASAIO. It had also outperformed comparable imports. He also reported the

development of a soft shell cardiomy reservoir with an integral blood filter as a spin off of the oxygenator technology. It was disclosed that the Chitra cardiomy reservoir cum filter had already entered regular clinical use in the hospital. Mr. Ranjit and colleagues presented the results of the preliminary trial of the Chitra disposable oxygenator in 23 patients. The limited trial had been undertaken with the approval of the Ethics Committee and had shown excellent results in terms of gas transfer, blood trauma, air embolism and other indices of oxygenator function. Extended clinical trial were therefore thought to be fully justified and necessary.

In their paper on the Chitra tilting disc valve, Mr. Ramani and Bhuvaneshwar noted that the all integral monolithic titanium cage model had superseded the two previous models which had been based on electron beam welding of struts and integral major strut respectively. The latest model also differed from earlier designs in having a unique occluder of sapphire/ruby and showed promising results in accelerated wear tester. Its regular trial in pigs was reported to be imminent. Dr. Vincent Gott spoke on the current status of heparinised shunts which had been based on his original discovery of GBH. Heparinised shunts, it was reported, had become quite popular for operations on the descending thoracic aorta and also for less conventional indications. In his second lecture, he presented his experience at the Johns Hopkins Hospital with the use of St. Jude's valvular prosthesis which had butterfly type leaflets of pyrolytic carbon. The design features, component materials and early clinical results had encouraged his group to continue with the use of St. Judes valvular prosthesis in preference to other prosthetic valves.

Dr. Yukihiro Nose's contribution to the symposium related to the biolisation of surfaces for enhancing blood compatibility which was crucial in the design of a total mechanical heart.

In discussing the state of the art on mechanical heart at the Cleveland Clinic, he felt that a clinical model with an implantable compressor might become available in the nineties. An intracorporeal energy source, it was mentioned, would be farther away.

The symposium brought into sharp focus the fundamental and applied aspects of blood compatibility which holds equal fascination for the scientist and engineer. An unexpected outcome of the symposium was the formation of the Indian Society for Artificial Internal Organs which will be instrumental in promoting research on blood compatible materials and devices in India.

PARTICIPANTS IN THE SYMPOSIUM

Guest Speakers :

Prof. Sriramachari, Additional Director-General Indian Council of Medical Research, New Delhi.

Dr. Vincent L Gott, Professor of Cardiac Surgery, Johns Hopkins Hospital, Baltimore, U S A.

Dr. Yukihiro Nose, Chairman, Division of Artificial Internal Organs, Cleveland Clinic, Cleveland, USA.

External delegates :

Dr. A.P. Chaukar, Professor & Head of the Department of Cardiovascular & Thoracic Surgery, Lokmanya Tilak Municipal Medical College and Lokmanya Tilak Municipal General Hospital, Bombay.

Dr. M.R. Girinath, Additional Chief Medical Officer, Department of Thoracic and Cardiovascular Surgery, Southern Railway Headquarters Hospital, Madras.

Prof. J.S. Gujral, Professor & Head, Division of Cardiovascular & Thoracic Surgery, Postgraduate Institute of Medical Education & Research, Chandigarh.

Dr. J.G. Jolly, Director Blood Transfusion Department, Postgraduate Institute of Medical Education & Research, Chandigarh.

Prof. P.S. Narayanan, Professor & Head of the Department of Cardiothoracic Surgery, G.B. Pant Hospital, New Delhi.

Col. S.D. Palnitkar, Senior Adviser in Anaesthesia, Military Hospital, Pune.

Col. R.K. Rakshit, Commanding Officer, Military Hospital, Pune.

Dr. H.S. Rao, Managing Director, National Research Development Corporation of India, New Delhi.

Dr. Saibal Gupta, 58/1, Ballygunge, Circular Road, Calcutta.

Prof. S.M. Sen Gupta, Head of the Department of Thoracic and Cardiovascular Surgery, Institute of Post-graduate Medical Education and Research, Calcutta.

Prof. Sharad Panday, Hon. Cardiovascular Surgeon, Nanavati Hospital, Bombay.

Dr. K.R. Shetty, Hon. Cardiovascular & Thoracic Surgeon, Jaslok Hospital and J J Hospital, Hon. Prof. of Cardiovascular and thoracic surgery, Grant Medical College, Bombay.

Prof. Solomon Victor, Professor of Cardiothoracic Surgery, Government General Hospital, Madras Medical College, Madras.

Maj. Gen. Thirumalai, Dean of Medical Faculty & Director, Professor & Chairman, Department of Anaesthesiology, Sher-I-Kashmir Institute of Medical Sciences, Srinagar.

Col. R.N. Thareja, Professor & Head of the Department of Cardiothoracic Surgery, Armed Forces Medical College, Pune.

ADMINISTRATIVE BODIES

| | |
|-----------|-----------------------|
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| Directo | Dr. M.S. Valiathan |

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1. Dr. B.K. Bachhawat,
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2. Director General of Health Services
Nirman Bhavan,
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Lucknow.
4. Dr. V.R. Gowarikar,
Director,
Vikram Sarabhai Space Centre,
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Vallakadavu,
Trivandrum.
6. Prof. P.J. Kurien,
Member of Lok Sabha,
P.O. Vellikulam,
Alleppey.

7. Dr. (Mrs.) Leila Ramakumar,
302, Sector 35A, Chandigarh.
8. Shri C.V.S. Mani,
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(Ministry of Health & Family Welfare)
Nirman Bhavan, New Delhi
9. Prof. Y. Nayudamma,
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11. Dr. (Miss) K.M. Pavri,
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12. Shri A.A. Rahim,
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13. Mr. A.V. Ramani,
Head, Biomedical Technology Wing,
Sree Chitra Tirunal Institute for
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14. Financial Adviser,
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15. Dr. S. Ramaseshan,
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16. Shri S. Sadasivam,
Deputy Educational Adviser (T),
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Numgambakkam, Madras.

-
17. The Secretary,
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New Delhi.
 18. The Secretary to Government of Kerala,
Health Department,
Trivandrum.
 19. Dr. M.S. Valiathan,
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Sree Chitra Tirunal Institute for Medical
Sciences & Technology,
Trivandrum.
 20. Vice Chancellor,
Kerala University,
Trivandrum.
 21. Dr. S. Vasudev,
Chairman,
State Committee on Science &
Technology,
Government of Kerala, Trivandrum.
 22. Dr. N.H. Wadia,
Director of Neurology,
Jaslok Hospital and Research Centre, and
Consultant Neurologist,
J J Group Hospitals, and Grant Medical
College, Bombay.

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New Mehrauli Road, New Delhi.
2. Director General of Health Services,
Government of India,
Nirman Bhavan, New Delhi.
3. Chairman, State Committee on Science &
Technology, Government of Kerala.
4. Prof. S. Ramaseshan,
Director,
Indian Institute of Science
Bangalore
5. Dr. N.H. Wadia,
Director of Neurology, Jaslok Hospital
and Research Centre, and Consultant
Neurologist, J J Group Hospitals and
Grant Medical College, Bombay.
6. Dr. M.S. Valiathan,
Director, Sree Chitra Tirunal Institute for
Medical Sciences & Technology,
Trivandrum.
7. Mr. A.V. Ramani,
Head, Biomedical Technology Wing,
Sree Chitra Tirunal Institute for
Medical Sciences & Technology,
Trivandrum.
8. Prof. D.K. Basu,
Professor of Neurochemistry,
Sree Chitra Tirunal Institute for
Medical Sciences & Technology,
Trivandrum.

STANDING COMMITTEES

Finance Committee

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Dr. V.R. Gowariker,
Director, VSSC, Trivandrum.

Financial Adviser to the Department
of Science & Technology,
Government of India.

Member of the Institute representing
Department of Science & Technology.

Financial Adviser & Chief Accounts
Officer of the Institute (Convenor)

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Director, Institute of Chemical Biology,
Calcutta.

Prof. G.B. Parulkar,
Director Professor of Surgery,
KEM Hospital, Bombay.

Prof. R.M. Varma,
Professor Emeritus,
NIMHANS, Bangalore.

Prof. P.S. Bidwai,
Professor of Cardiology,
PGI, Chandigarh.

Prof. D.K. Basu,
Professor,
Sree Chitra Tirunal Institute for
Medical Sciences & Technology, Trivandrum.

Dr. M.P. Mohansingh,
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Dr. Damodar Rout,
Associate Professor,
Sree Chitra Tirunal Institute, Trivandrum.

Prof. (Mrs) Vimla Virmani,
Visiting Professor of Neurology,
15 Golf Links, New Delhi.

Sri. A.V. Ramani, Head BMT Wing,
Sree Chitra Tirunal Institute, Trivandrum.

Technology Development Committee

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Director, Indian Institute of Science,
Bangalore.

Prof. C.N.R. Rao,
Chairman, Solid & Structural Chemistry Unit,
Indian Institute of Science, Bangalore.

Dr. C. Ambasankaran,
Director, BARC (Electronics Dvn.)
Bombay.

Dr. V.R. Gowariker,
Director, VSSC, Trivandrum.

Dr. S. Sriramachari,
Addl. Director General,
ICMR, New Delhi.

Mr. A.V. Ramani,
Head, BMT Wing,
Sree Chitra Tirunal Institute, Trivandrum.

Sri. G.S. Bhuvaneshwar,
Biomedical Engineer,
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Sree Chitra Tirunal Institute, Trivandrum.

Dr. P.V. Vedanarayanan,
Senior Materials Toxicologist,
BMT Wing,
Sree Chitra Tirunal Institute, Trivandrum.

Building Committee

Director (Chairman)

Health Secretary,
Government of Kerala.

Construction Engineer,
VSSC, Trivandrum.

Head, BMT Wing,
Sree Chitra Tirunal Institute, Trivandrum.

Financial Adviser & Chief Accounts Officer,
Sree Chitra Tirunal Institute, Trivandrum.

A member to be coopted by the Director as and
when necessary.

Senior Staff Selection Committee

Director (Chairman)

Dr. N.H. Wadia,
Director of Neurology,
Jaslok Hospital and Research Centre and
Consultant Neurologist
J J Group Hospitals and Grant Medical College,
Bombay.

Head,
Biomedical Technology Wing,
Sree Chitra Tirunal Institute, Trivandrum.

A nominee of the Secretary,
Department of Science & Technology
of the Central Government.

An expert from outside the Institute nominated by the President.

A senior Professor of the Institute.

Junior Staff Selection Committee

Medical Superintendent of the Institute.

Head, Biomedical Technology Wing of the Institute.

Administrative Medical Officer of the Institute.

Financial Adviser & Chief Accounts Officer of the Institute.

Dr. C.G. Venkitachalam, Asst. Professor,
Sree Chitra Tirunal Institute, Trivandrum.

A representative of the academic wing of the Institute nominated by the Director.

Ethics Committee

Director (Chairman)

Dr. (Mrs.) Leila Ramakumar,
302, Sector 35A, Chandigarh.

Dr. N. Balakrishnan Nair,
Jawaharlal Nehru Fellow,
Head of the Dept. of Acquatic Biology,
University of Kerala.

Dr. M. Jamaluddin, Scientist, BMT Wing,
Sree Chitra Tirunal Institute, Trivandrum.

Dr. C.G. Venkitachalam,
Asst. Professor of the Institute.
Sree Chitra Tirunal Institute, Trivandrum.

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ANNEXURE II

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