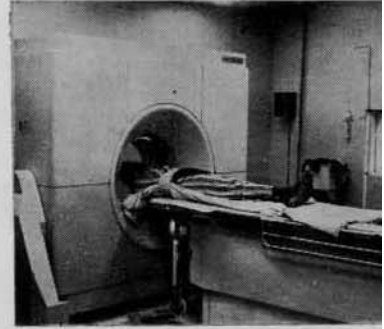
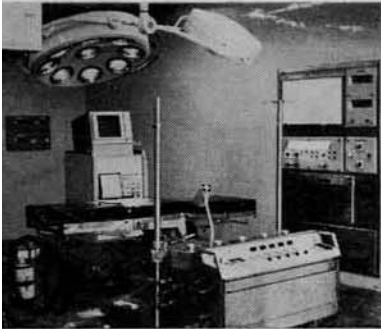




Annual Report 84/85



**SREE CHITRA TIRUNAL INSTITUTE FOR
MEDICAL SCIENCES AND TECHNOLOGY
TRIVANDRUM KERALA**



OVERVIEW

The report covers the activities of the 2007-2008 financial year and is divided into two main parts: the Overview and the Survey of major programmes. The Overview provides a high-level summary of the Department's activities and performance, while the Survey of major programmes provides a detailed analysis of the key areas of activity. The Survey of major programmes is divided into three main sections: Hospital Services, Biomedical Technology Wing, and Educational programmes. Each section provides a detailed overview of the activities and performance of the respective area, including a list of key achievements and challenges. The Departmental Reports, Scientific publications, Administrative Bodies, and List of Hospitals referring patients are also included in the report.

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OVERVIEW

1984–85 marked the final year of the Sixth Plan which witnessed major changes in the structure and functions of the Institute. The transformation from a scientific society into an Institute of National Importance, the expansion of the hospital to a modern, 200 bed centre for cardiac and neurologic diseases, transfer of indigenous technologies for commercial production and the introduction of postgraduate degree programmes were significant events which crowded the life of the Institute during the past quinquennium.

The opening of the Setu Parvati Bayi Surgical Centre and the virtual doubling of patient services during the year served to meet a growing public need very substantially. Given the present capacity of 200 beds and the mandate of the Institute to dovetail patient care with technologic development, the size of the hospital was likely to stabilise at the present level and permit further growth to occur in the quality of patient care during the next Plan period. A trend in this direction was already visible in the introduction of the computer and updating of equipment which sought to modernise the hospital services. The appearance of the Chitra blood bag in routine hospital application marked another important trend which emphasised the

integral role of the hospital in developing and adopting indigenous technology. The growth in patient services and the accent on the modernisation of hospital technology were responsible for the rising demand for training opportunities at the Institute at various levels.

While the hospital recorded significant expansion, the entire range of facilities for research and development at the Biomedical Technology Wing came into existence during the Sixth Plan period. The tonic effect which the new and impressive laboratories had over research programmes which had been operating quietly in the outhouses of an old Palace was dramatic and could be readily seen in the flowering of biomedical technologies in less than five years. Given the fact that complex devices such as vascular graft, disposable oxygenator, blood bag systems and prosthetic heart valve are developed and produced in no more than four or five advanced countries in the world, the record of the Institute in developing them from the stage of conceptualisation to the level of pilot scale production was creditable by any standard. In taking the initiative for transferring these devices for commercial production, the Institute could also claim to have made a modest contribution to the growth of a hospital based industry in the country. The technological programmes advanced side by side with basic research which continued to receive support and encouragement at the Institute.

The DM and M.Ch. courses which formed the core of the academic programme of the Institute were basically patterned on the curricula and training programmes of

other national Institutes, but bore a distinct technologic imprint since their inception. The Institute aimed at strengthening the scientific and technological orientation of all its training programmes to produce specialists who would feel at home in the medical endeavour of future years which would be dominated by biotechnology, electronics, computer, materials science, lasers, and other technologies. On the eve of the Seventh Plan, the Institute also began an exercise to identify new thrust areas for research and development keeping in view its past experience, national priorities in health and no less importantly, the current advances in science and technology.

SURVEY OF MAJOR PROGRAMMES :

i. HOSPITAL SERVICES

Medical Superintendent:

Dr. (Maj.) K. A. Hameed, MBBS

AAMO: Dr. D. Hariprasad, MBBS

**Setu Parvati Bayi
Surgical Centre**

The full commissioning of the Setu Parvati Bayi Surgical Centre was the most important event in the growth of hospital services during 1984-85. Its impact was immediately felt in every department of hospital services, academic programmes and research. Its addition raised the total bed strength of the hospital to 200 which is substantial by any standards for a speciality hospital devoted to Cardiology and Neurology. The rise in the volume of patient services which it produced in a few months during 1984-85 is shown in Figs. 1 to 4.

Apart from the growth of patient services, the availability of new outpatient areas in the Setu Parvati Bayi Surgical Centre made it possible to reorganise patient clinics and optimise their public utility. The new measures which were introduced with the co-operation of referring institutions for outdoor services included the acceptance of referrals solely from hospitals, gradual restructuring of outpatient follow up on the basis of special clinics and the regular letter contact with patients whose longterm follow up had been transferred back to the referring hospital. On a preliminary assessment, these measures seemed to be advantageous to patients who were not only spared unnecessary referrals and follow up visits to Trivandrum but who were also assured of adequate expert attention during their visit to the outpatient clinics of the Institute. The special clinics which were already functioning at this time were those for epilepsy, headache, pacemaker, paediatric cardiology, postoperative cardiac surgery and neurosurgery respectively.

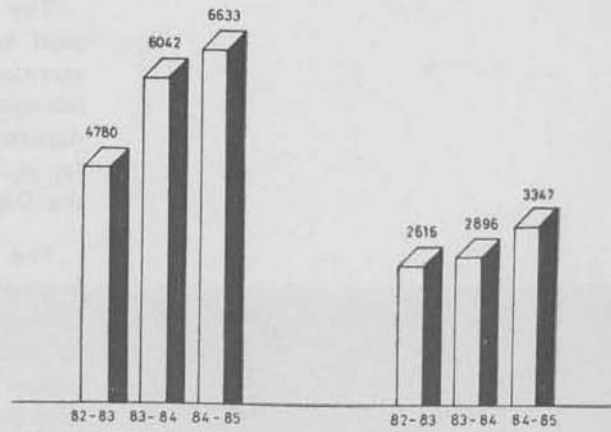


Fig. 1. Outpatient Registration

Fig. 2. Admissions

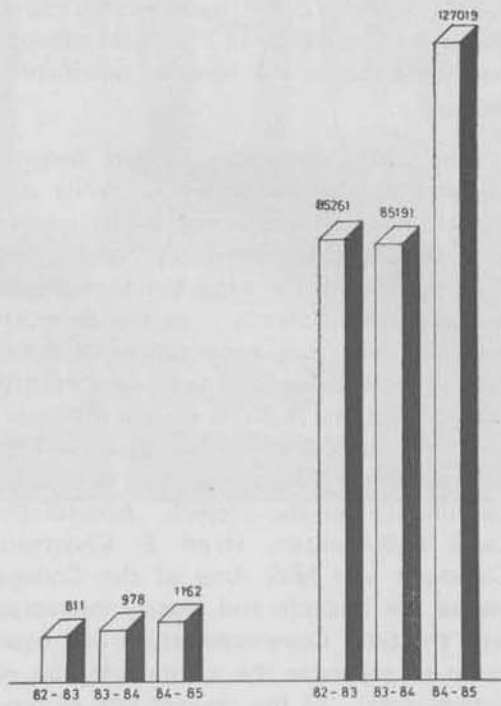


Fig. 3. Surgical Procedures

Fig. 4. Investigations

GROWTH IN PATIENT SERVICES

The areas vacated in the original hospital block by cardiac and neurological services were converted into additional laboratories for cardiology, an expanded department of neurology and a new unit for pulmonary oesophageal surgery under the Department of Cardiothoracic Surgery.

The overall effect of the expansion of inpatient services on hospital administration was significant in so far as it called for redeployment of personnel and several logistic changes in relation to the laundry, kitchen, maintenance and general administrative services. That such a pervasive change across the entire spectrum of patient services could be smoothly introduced was indicative of the basic strength and resilience of the hospital administration.

Computer

The OMNI computer system became operational after initial trials. While pay roll and financial accounting were successfully computerised, inventory control and patient billing were expected to undergo computerisation shortly. As the development of patient data base called for innovation and considerable experience in software design, the Institute sought the assistance of the Administrative Staff College of India, Hyderabad who agreed to provide consultancy for the project. Accordingly Dr. A. V. Srinivasan, Head & Chairman, Computer and MIS Area of the College visited the Institute and closely interacted with the Staff Committee which had been setup to supervise the computerisation of patient data. At the present rate of progress, development of patient data base and its regular operation for research could be expected to go on stream towards the end of 1985.



Fig. 5. New Neurology Wing

Medical Records

The Medical Records Section met the demands of additional patient load and successfully carried out its expanded role in income assessment, registration of new patients and organisation of follow up clinics, reimbursement arrangements for patients, preparation of statistical bulletins and management of medical records. The Medical Records Officer took full part in the ongoing effort to computerise medical records and served on the Staff Computer Committee.

Nursing

As the total number of nurses reached 209 with the commissioning of the Setu Parvati Bayi Surgical Centre, additional accommodation became necessary over and above the 100 rooms which had been available earlier. Accordingly construction of the new block of nurses was speeded up to make additional accommodation available for allotment later this year.

Clinical Engineering

The responsibilities of this Division grew considerably during the year with the addition of a wide range of monitoring instruments, ventilators, operating theatre systems, computer, CT Scan and hospital installations such as the new airconditioning plant. Apart from monitoring service contract operations by other agencies on major equipment systems, the engineers and technical staff in the Division carried out preventive maintenance of other equipment and break down maintenance whenever necessary. The Division also contributed to hospital services by designing and fabricating instruments for a token system for patients in the outpatient clinics.

ii. BIOMEDICAL TECHNOLOGY WING

Head: Shri A. V. Ramani
BSc., (Chem. Tech.)

Aid to Hospital Services

The contribution of the Biomedical Technology Wing to the overall performance of the Institute grew over the previous years and embraced day to day services of the hospital, research and development in biomedical technology and the training of young medical scientists.

The impact on hospital services could be readily seen in the regular use of the Panbit facility for the sterilisation of a wide variety of disposables and the oilfired incinerator for the disposal of hospital wastes. To these services, newer items were continually added such as the supply of non-injectable crystalloids and siliconised chest tubes. While the claim of these activities on the time and energy of scientists and engineers was small, their role in improving the quality of patient care was large, leaving aside the commercial potential of hospital disposables. The Biomedical Technology Wing accordingly made plans to develop and supply for the hospital one or two disposables a year which could be transferred in due course to the small scale sector for commercial production.

Research & Development

In research and development which constituted its central activity, the Biomedical Technology Wing made progress in basic as well as applied investigations. The best examples of basic research were those relating to the kinetics of platelet aggregation and the characterisation of polymers under diverse experimental conditions which could conceivably influence the development of blood compatible surfaces and biomaterials. In the applied category could be classed the development of albuminated surfaces for a small diameter vascular grafts, blood bag systems,

rigid shell oxygenator, large diameter polyester graft and a tilting disc cardiac valve which represented virtually all the sequential stages in the development and transfer of biomedical technology. In going beyond research and laboratory scale development and accepting the equally large responsibility for transferring technologies for commercial production, the Institute obtained wide and varied experience which covered patents, financing of pilot scale production, negotiation with industries in the private and public sector, consultancy support for new biomedical industries and other related areas of technology transfer.

Blood bag systems

Peninsula Polymers Pvt. Ltd. who had acquired the technology for the Chitra blood bag decided to relocate their factory in Trivandrum and obtained financial participation for the joint sector enterprise from the National Research Development Corporation and Kerala State Industrial Development Corporation. The Institute was represented on the Board of Directors of the Company which had Prof. S. Ramaseshan as its Chairman. As the construction of the factory and the purchase and installation of machinery made progress, the engineers and technicians of the Company received job training in the Biomedical Technology wing. The Company was also expected to produce and supply 2000 bags from the Institute's facilities on a monthly basis prior to the commissioning of the factory. Concurrently the new batch of Chitra blood bags which incorporated the suggestions emerging from multicentric trials found regular use in the blood transfusion service of the Institute.

Variflo Oxygenator

This device represented second generation technology as it had a builtin heat exchanger and two unique features of an integral cardiotomy reservoir and a simple mechanism for choosing adult or paediatric mode. The new oxygenator was under consideration of the Ethics Committee which was shortly expected to consider its clinical trial involving 100 clinical perfusions at the Institute and elsewhere in India. While arrangements were made to get these units fabricated by private industry and subsequently assembled in the Biomedical Technology Wing, discussions were also initiated with NRDC and other agencies for the commercial production of the Chitra variflo oxygenator.

Tilting disc heart valve

As the development of this implantable device fulfilled the criteria suggested by International Standards Organisation, approval for clinical trial was sought from the Ethics Committee which was to consider the application towards the end of 1985. As the clinical trial would require adequate supply of valves in different diameters, the Institute contracted to have 1000 valves produced during a two year period by the Toolcraft Industries, Bangalore on terms approved by the National Research & Development Corporation who provided the capital for the pilot activity. Commercial production of the device was expected to begin at the end of the two year period.

Educational

The candidates for postgraduate degree training spent varying periods in the laboratories to learn the methodology of research and to take part in ongoing projects. The involvement of M.Ch. trainees in

The year 1980 was a very busy one for the Institute. The work of the Biomedical Technology Wing was particularly intensive and involved performance of major procedures such as valve replacement on cardiopulmonary bypass.

cardiovascular and thoracic surgery was particularly intensive and involved performance of major procedures such as valve replacement on cardiopulmonary bypass.

During the year, the Biomedical Technology Wing introduced a hands-on basic course on the physical and engineering principles in medicine for the new batch of postgraduate students. The academic staff took enthusiastic part in the new teaching programme which covered SI units, Basic electricity & electronics, Electrical measurements, Instrumentation, Fluid flow, Imaging and other similar scientific areas of importance to the practice of modern medicine. This new experiment forged another link between the two wings of the Institute.

The year 1980 was a very busy one for the Institute. The work of the Biomedical Technology Wing was particularly intensive and involved performance of major procedures such as valve replacement on cardiopulmonary bypass.

The year 1980 was a very busy one for the Institute. The work of the Biomedical Technology Wing was particularly intensive and involved performance of major procedures such as valve replacement on cardiopulmonary bypass.

iii. EDUCATIONAL PROGRAMMES :

Registrar: Shri V. Narasimhan, MSc.

Postgraduate admissions

The growing response to the training programmes of the Institute over the years is given in Fig.6. Of a total of 182 applicants seeking admission to various postgraduate courses in 1985, the Statewise breakup of candidates is shown in Table 1.

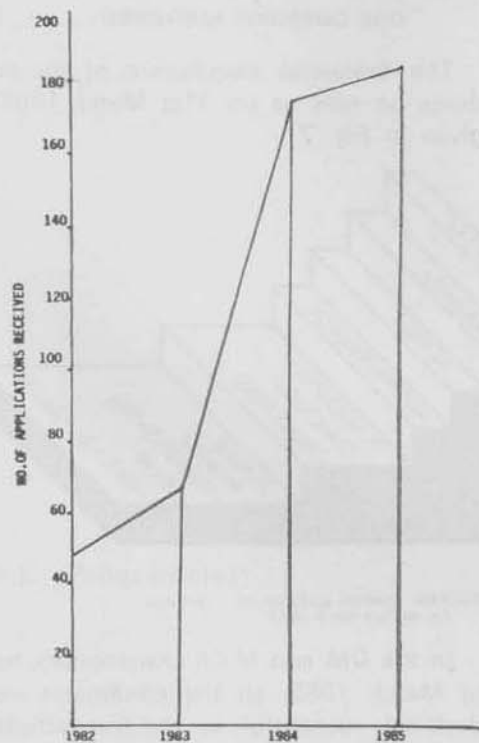


Fig. 6. Applicant Response to Postgraduate Courses

Table-1

<i>State</i>	<i>Number applied</i>
Andhra Pradesh	: 37
Assam	: 1
Bihar	: 8
Delhi	: 4
Gujarat	: 13
Haryana	: 2
Jammu & Kashmir	: 3
Karnataka	: 11
Kerala	: 21
Madhya Pradesh	: 22
Maharashtra	: 5
Orissa	: 6
Punjab	: 2
Rajasthan	: 13
Tamil Nadu	: 8
Uttar Pradesh	: 17
West Bengal	: 9

The number of applicants for various courses and the number selected for each course is given in Table-2.

Table-2

<i>Course</i>	<i>Applicants</i>	<i>Selected</i>
DM Cardiology	53	3*
DM Neurology	19	2
M.Ch. Cardiovascular Thoracic Surgery	38	3*
M.Ch. Neurosurgery		
3 year course	9	1
5 year course	50	1
Post-doctoral Certificate in Anaesthesiology	8	2
Post-doctoral Certificate in Radiology	5	1

* one candidate sponsored

The Statewise distribution of the students on rolls as on 31st March 1985 is given in Fig. 7

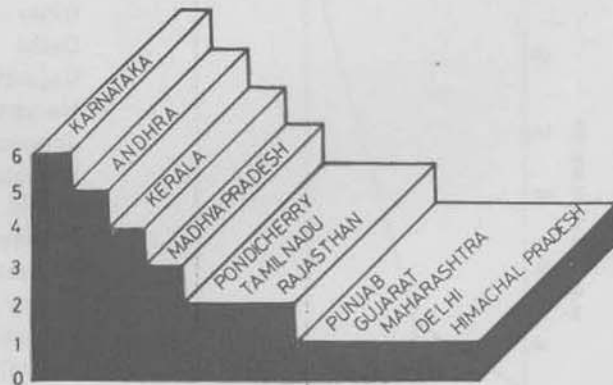


Fig. 7 POSTDOCTORAL STUDENTS DISTRIBUTION - STATEWISE (as on 31st March 1985)

Postgraduate Examinations

In the DM and M.Ch examinations held in March 1985, all the candidates were declared successful in the first attempt. Their names are shown below:

<i>Name of Candidate</i>	<i>Degree</i>	<i>Speciality</i>
M.V. Joseph Joy K. Suresh	DM	Cardiology
M. Unnikrishnan (Tata Scholarship holder)	M.Ch.	Cardiovascular & Thoracic Surgery
C. Sarada Anand Kumar	DM	Neurology
S.M. Upadhye V.K. Tambe	Postdoctoral Certificate	Anaesthesia*

*Completed one year successful training in December 1984.

Based on the experience gained during the three years, a revision was made in the curriculum. As a first step in giving technological dimension to the training programme a 15 day course was offered at the Biomedical Technology Wing laying stress on physical principles in medicine.

In compliance with the regulations of DM and M.Ch programmes, post-graduate students were posted for 2-3 months in other teaching institutions such as GB Pant hospital, New Delhi, NIMHANS, Bangalore and Madurai Medical college, Madurai. The extramural training proved very useful to the candidates.

Ph.D. Programmes:

The Institute gave approval to a scheme for the members of the staff to register for Ph.D.

The scheme proved popular and following staff members registered for Ph.D. programmes:

<i>Name of Staff Member</i>	<i>Thesis area</i>	<i>Guide</i>
Sri S.N. Pal	Studies on Polymer blends for medical applications	Dr. N. Subramanian, IIT, Madras (External Teacher Scheme)
Sri G.S. Bhuvaneshwar	In vitro fluid dynamics of prosthetic heart valves	Dr. T.S. Prahlad, VSSC, Trivandrum (External Teacher Scheme)
Sri Thomas Chandu	Fibrinogen-polymer interaction: influence of plasma components	Dr. C.P. Sharma, Scientist in-charge, Biosurface Technology, SCTIMS&T
Dr. C.C. Kartha	Studies on pathological features of endomyocardial fibrosis	Dr. S. Sriramachari Addl. Director-General, ICMR, New Delhi (Under External Teacher Scheme)
Miss Molly Thomas	Study of the differential diagnosis of rheumatic fever and rheumatic heart disease in particular relation to Streptococcal Coxsackie B Virus and Myeloplasma pneumoniae infections	Dr. J. Shanmugam, Associate Professor of Microbiology SCTIMS&T

Training and retraining opportunities for academic and technical staff

The Institute approved a scheme for deputing faculty members and technical staff from various disciplines for training in specialised techniques in centres abroad or within the country. Under this scheme Dr. C. C. Kartha and Dr. V. V. Radhakrishnan of the Division of Pathology were selected for training in cardiac electron microscopy and neuropathologic techniques during 1985 at the National Institute of Health Bethesda and Harvard University Medical School, Boston respectively. A

special feature of this scheme was the insistence that the training programme was confined to the acquisition of skills and knowledge in a specialised technique or techniques which were keenly sought by the respective Departments of the Institute. The operation of this scheme over a five year period could therefore be expected to inject a substantial doze of new ideas and techniques into the scientific and academic life of the Institute.

Under the training programme, three technicians were deputed to the PGI, Chandigarh for training in biochemistry, microbiology and pathology leading to M.Sc. degree.

Training facilities: Staff from other institutions

Opportunity for short term training in various techniques and disciplines were sought by faculty members, students, nurses and technicians from several teaching and private institutions which are mentioned in departmental reports. The Institute responded favourably to such requests and charged no fees for such training.

In-service Education

Mrs. Lyla Mathew who returned from the CMC Vellore after obtaining Masters degree in nursing organised inservice training programmes which were suitably structured to meet the needs of the nursing staff. A course was also organised on administrative, financial and audit procedures for the office staff with senior officers of the Institute as the teaching faculty.

DEPARTMENTAL REPORTS

HOSPITAL WING

Department of Anaesthesiology

Dr. K. Mohandas, MD	Associate Professor
Dr. V. Padmanabha Iyer, MD	Associate Professor
Dr. R. C. Rathod, MD	Assistant Professor
Dr. Annapurna Rout, MD	Assistant Professor
Dr. H. D. Waiker, MD	Lecturer
Dr. K. Muralidhar, MD	Lecturer
Dr. N. S. Kodandaram, MD	Lecturer
Dr. A. K. Babar, MD	Candidate for post-doctoral certificate
Dr. P. K. Neema, MD	-do-

The anaesthetic management of cardiac and neurosurgical operations and invasive diagnostic procedures grew substantially in volume with the expansion of the hospital. The major anaesthetic procedures of over 1200 could however be smoothly carried out, thanks to the addition of new equipment including ventilators and anaesthetic machines and the effective deployment of available staff.

In collaboration with the Central Food Technology Research Institute, Mysore, Dr. Rathod continued the evaluation of a new intravenous fat emulsion for prolonged nutritional support. The preliminary results were encouraging in terms of nontoxicity and caloric supply in canine trials which were expected to continue.

Title of Project	—	Development of Intravenous lipid formulation for parenteral alimentation.
Investigator	—	R. C. Rathod, SCTIMS & T.
Funding	—	Central Food Technology Research Institute, Mysore.
Duration	—	3 years
Status	—	Ongoing; Canine survival without ill effects upto 3 weeks demonstrated.

The visitors to the Department included the following experts from abroad:

Dr. Om Prakash, Head, Department of Anaesthesiology Erasmus University, Rotterdam.

Prof. B. Johnson University of Lund, Sweden

Prof. M. Klein, Head, Department of Anaesthesiology, University of Pittsburgh USA.

The visitors presented papers at a seminar which was organised by the Department on 'Critical care and cardiac anaesthetic management'. The Seminar attracted a record number of 154 delegates from the region. Members of the academic staff contributed scientific papers at various national meetings and workshops.

Dr. L. J. Chandrasekhar, Assistant Professor of Anaesthesiology, Jawaharlal Institute of Postgraduate Medical Education & Research, Pondicherry spent three months in the Department for gaining specialised experience as a nominee of the National Academy of Medical Sciences, New Delhi.

Division of Biochemistry

Dr. K. Subramonia Iyer, Ph.D. Associate Professor
Mrs. Santha A. George, M.Sc. Lecturer
Dr. N. Jayakumari, Ph.D. -do-

Clinical chemistry which had always formed a major component of the activities of this Division met the virtual doubling of demand for investigations by using the autoanalyser. The addition of a new ABL3 blood gas analyser to the analytic equipment extended the capability for blood gas analysis to include plasma bicarbonate, total CO₂; base excess, oxygen saturation and oxygen content. The facility for additional data acquisition proved to be useful for the investigative work of other Divisions as well.

The major research activity of the Division centred on the interactions between serum proteins and materials used for storage of blood and blood products.

Project	—	Studies on the interaction between human serum proteins and man-made materials commonly used as implants and storage devices.
Principal Investigator	—	K. Subramonia Iyer
Funding	—	Department of Science & Technology
Duration	—	3 years
Status	—	Ongoing. Preliminary study of enzyme activities of serum before and after incubation with storage materials demonstrated a few major differences. Electrophoretic studies showed conformational changes in certain conjugate proteins on prolonged storage.

In the previous year, an abnormal protein had been reported by the Division in the sera of patients with endomyocardial fibrosis which is a problem of interdisciplinary study at the Institute. Current effort related to the characterisation and identification of the protein which had already been isolated.

Division of Blood Transfusion Service

Dr. P. A. Jayaprakash, MBBS, DIBT
Dr. Jaisy Mathai, MBBS, DCP
Dr. P. V. Sulochana, MBBS

Chief Blood Transfusion Officer
Junior Blood Transfusion Officer
Junior Blood Transfusion Officer

The Division responded to the increased volume of surgical procedures by boosting blood donations by 34% and the supply of blood components by over 100%. Forty plasmapheresis procedures were carried out for neurologic patients in a collaborative clinical study with the Department of Neurology. The routine tests such as grouping, HBs Ag screening and compatibility tests also showed similar increase over the previous year's level.

The Division of Blood Transfusion grew substantially by the liberal addition of floor area which accommodated expanded facilities for the collection and processing of blood and for the improvement of donor comfort. The blood transfusion service also became a round the-clock service during the year.

The Division continued its intensive participation in the Chitra blood bag project and took a major part in its multicentric trial and the subsequent organisation of an investigators' meeting in Trivandrum to discuss its comparative results. In a

second collaborative project, the Division worked closely with the Division of Pathophysiology in the development of haemoglobin solution as a blood substitute.

The visitors to the Blood Bank included Prof. J. G. Jolly, Brig. R. N. Datta, Dr. Mrs. Bharucha, Dr. A. Nanu and Dr. Narmada who had taken part in the multicentric trial of the Chitra blood bag system.

Efforts continued as in previous years to expand and update the voluntary donor panel which largely sustains the transfusion service of the Division.

Department of Cardiology

Dr. K. G. Balakrishnan, MD, DM, FACC	Associate Professor
Dr. C. G. Venkitachalam, MD, DM	Associate Professor
Dr. R. Subramaniam, MD, DM	Assistant Professor
Dr. Thomas Titus, MD, DM, MNAMS	Assistant Professor
Dr. Jagmohan Tharakan, MD, DM	Lecturer
Dr. R. Krishnan, MD	Candidate for DM
Dr. K. Venugopal, MD	-do-
Dr. S. Gobisankar, MD	-do-
Dr. K. Srinath, MD	-do-
Dr. Geevar Zachariah, MD	-do-
Dr. M. Srinivasan, MD	-do-
Dr. M. F. Gopinath, MD	-do-
Dr. Shailendra Singh, MD	-do-

The clinical services of the Department were marked by a marginal increase in new registrations and the reorganisation of patient reviews in the form of special clinics for pacemaker, rheumatic heart disease and other clinical groups. While in-patient services and special investigations remained virtually at previous years level, a rapid rise occurred in the percentage of coronary artery studies which increased by 50%. The

year also saw the introduction of special interventional procedures such as Rashkind balloon septostomy for infants with transposition of great arteries. The cardiac catheterisation laboratory carried out an average of three haemodynamic studies per day and the laboratories for echocardiography and stress test remained even busier.

Consequent on the transfer of cardiac surgical service to the Setu Parvati Bayi Surgical Centre, additional beds and laboratory space became available to the Department. Given the new bed strength of 42 and centrally airconditioned additional rooms for locating laboratories, the department was poised for a phase of rapid growth during the Seventh Plan period. The major facilities proposed for addition included cardiac nuclide angiography and a special angiographic unit which could provide for digital subtraction technique.

The research activities of the Department involved active collaboration with the Division of Pathology in investigating the role of heredity in endomyocardial fibrosis and the prognostic significance of pulmonary vascular changes in tetralogy of fallot. Guidance was given also to the projects of DM students who studied problems such as the correlation of oesophageal balloon pressure with left atrial pressure under experimental conditions.

Dr. P. J. Varghese, Prof. of Cardiology, George Washington University, Washington visited the Department and gave a lecture on thrombolytic therapy in acute myocardial infarction and Dr. Ranganath Nayak from the St. John's Medical College,

Bangalore underwent training in echocardiography.

Dr. Balakrishnan became a Fellow of the American College of Cardiology and presented a paper at the Fifth Asian Conference of Cardiology at Bangkok.

Dr. Shailender Singh was awarded Jamsetji Tata scholarship for the DM Course and Dr. Subramaniam extended his period of training in paediatric cardiology in Green Lane Hospital, Auckland by one more year.

Department of Cardiothoracic Surgery

Dr. M. S. Valiathan, Ch.M. (L'Pool), FRCS(Edin), FRCS(Eng) FRCS(C), FACC, FAMS, FNA, FASc.	Professor
Dr. M. P. Mohan Singh, FRCS(Eng) FRCS(Edin)	Associate Professor
Dr. K. S. Neelakantan, MS, M.Ch.	Assistant Professor
Dr. R. Sankarkumar, MS, M.Ch.	Assistant Professor
Dr. A. K. Shrivastava, MS, M.Ch. MNAMS	Lecturer
Dr. K. G. Shyamakrishnan, MS, M.Ch.	Lecturer
Mr. D. Ranjit, BE	Perfusionist
Dr. C. P. Shrivastava, MS	Candidate for M.Ch.
Dr. K. S. V. K. Subba Rao, MS	-do-
Dr. H. L. Subba Rao, MS	-do-
Dr. Baljitkumar Sharma, MS	-do-
Dr. A. B. Bhoyar, MS	-do-
Dr. Prakash, MS	-do-
Dr. Suresh G. Rao, MS	-do-
Dr. J. T. Tolia, MS	-do-

A milestone in the growth of cardiovascular and thoracic surgery was the full commissioning of the Setu Parvati Bayi Surgical Centre which offered four operating rooms, six intensive care beds and fortytwo beds for ward service and intermediate care from June 1984. These

facilities were fully used in raising the weekly number of open heart and other cardiac procedures to ten and six respectively. Simultaneously a 26 bed unit of the Department with its own operating and recovery rooms was organised in the original hospital block to develop pulmonary and oesophageal surgery. These developments expanded and improved patient services significantly and provided new stimuli and direction for the cardiothoracic endeavour at the Institute.

The surgical record as in previous years was marked by the preponderance of rheumatic valvulitis which accounted for the majority of open and closed heart operations. Intracardiac repair of congenital heart defects and coronary artery bypass procedures also increased significantly in number. In continuing the programme of palliative surgery for endomyocardial fibrosis, the Department developed one of the largest series in the world of endocardectomy and valve replacement with results comparable to those reported from France, Brazil and Ivory Coast.

The Department continued its intensive involvement in the development of a rigid shell oxygenator with an integral heat exchanger and the Chitra valve which were expected to enter clinical trial towards the end of 1985. The participation of the staff and M.Ch. trainees in the series of complex experiments at the BMT Wing for the development of cardiovascular devices became a regular feature during the year.

Dr. Bos of Erasmus University, Rotterdam and Dr. Charles Hufnagel, Professor Emeritus of Georgetown University, Washington, visited the Department and addressed the staff and students on cardiovascular topics.

Division of Microbiology

Dr. J. Shanmugham, Ph.D.
Dr. Ashalatha Nair, MD.
Mr. M. Ravindranath, B.Sc.
Miss. Molly Thomas, M.Sc. DMV.

Associate Professor
Lecturer
Scientific Assistant
—do—

The diagnostic workload in bacteriology increased by approximately 45% over the previous year's level and included newly introduced tests such as anaerobic bacterial culture. To accommodate the expanding programmes in diagnostic bacteriology and research, the Division was also provided with additional laboratory space. Apart from a Ph.D project on the immunologic basis of rheumatic heart disease the main research project related to the role of viruses in the causation of pancreatitis in Kerala.

Project	—	Viral study of chronic pancreatitis.
Principal Investigator	—	V. Balakrishnan, Professor of Gastroenterology, Medical College Hospital, Trivandrum.
Co-Investigator	—	J. Shanmugham
Funding	—	ICMR
Status	—	Completed

Dr. Shanmugham presented two papers at the Sixth International Congress of Virology at Sendai and delivered an invited lecture on the serological study of Hepatitis B virus infection in South India

at the Third International Symposium on Viral Hepatitis in Tokyo. As a Scientist selected under the INSA–French Academy exchange programme, he visited and lectured at important centres of microbiological research in Paris, Lyon, Toulouse, Lille in France and the WHO Reference Centres at Leuven, Munich and Prague.

Mrs. Beena Panicker from Cochin University and Mrs. Roshen from the Regional Research Laboratory received short-term training in microbiologic techniques.

Department of Neurology

Dr. Vimla Virmani, MA(Psy), FRCPE, FAMS	Visiting Professor
Dr. P. K. Mohan, MD, DM	Assistant Professor
Dr. John Tharakan, MD, DM	Lecturer
Dr. A. B. Taly, MD, DM	Lecturer
Dr. N. K. Ravisubramanya, MD	Candidate for DM
Dr. K. Venkateswarlu, MD	–do–
Dr. Chetan Trivedi, MD	–do–
Dr. G. M. Wali, MD	–do–
Dr. Abdul Majeed, MD	–do–
Dr. K. S. Sunil Kumar, MD	–do–

In terms of beds, laboratory space and other facilities, the Department grew in size with the shifting of neurosurgical services to the Setu Parvati Bayi Surgical Centre. The new patient registrations and followup visits rose to 4591 and 6310 from 2538 and 3000 respectively of previous year's figures. Even though two lecturers left during the year, the patient services not only did not decline but also saw the introduction of special clinics for epilepsy, stroke and pain on a weekly basis. Additional clinics were planned with the prospective filling up of vacancies for staff positions.

As meningitis constituted a major clinical problem in the experience of the Institute, work was jointly carried out with the Divisions of Pathology and Microbiology for the development of a rabbit model for the disease. The active participation of DM trainees in the collaborative research programme was encouraged.

Prof. Foster of the Department of Neurology, University of Newcastle upon Tyne and Prof. David Whitteridge of the Oxford University visited the Department and addressed the staff and students. Dr. (Mrs.) P. N. Wadia conducted a short course on electromyography during her visit to the Department.

Two postgraduate students of psychiatry from the University of Calicut were given short term training in neurology.

Department of Neurosurgery

Dr. Damodar Rout, MS, M.Ch.	Associate Professor
Dr. R. N. Bhattacharya, MS, M.Ch.	Assistant Professor
Dr. Ajay Sharma, MS, M.Ch. MNAMS	Assistant Professor
Dr. B. K. Mishra, MS, M.Ch., MNAMS	Lecturer
Dr. Bharat Mittal, MS, M.Ch.	Lecturer
Dr. B. A. Chandramouli, MBBS, M.Ch.	Lecturer
Dr. Rajeev Sharma, MS, M.Ch.	Lecturer
Dr. A. K. Gehlot, MBBS	Candidate for M.Ch.
Dr. K. N. Krishna, MBBS	-do-
Dr. A. K. Purohit, MS	-do-
Dr. M. P. Haroon, MBBS	-do-

Neurosurgical programmes underwent a major expansion with the opening of the Setu Parvati Bayi Surgical Centre. The new physical resources included three operating rooms, twelve intensive care beds and forty-four ward beds besides an area for intermediate care. The patient

services registered a corresponding increase as shown by the number of neuro-surgical procedures which reached 560 during the year. With the co-operation of the referring hospitals, efforts were made to place selective emphasis on the surgery of intracranial vascular lesions and cranio-vertebral anomalies which are prevalent in the region.

The Department had a busy programme of clinical and experimental research which involved active co-operation with other Departments.

Project	— Radiological exploration of the craniovertebral region in the surgical management of craniovertebral anomalies.
Principal Investigator	— D. Rout
Co-Principal Investigator	— V. R. K. Rao
Funding	— Indian Medical Research Society, Bombay
Duration	— 3 years
Status	— Completed

Dr. Rout was coinvestigator in another project on the role of hyaluronidase in experimental cryptococcal infections of Central Nervous system with a view to its possible clinical application. In collaboration with the Division of Artificial Internal Organs, the Department also formulated a project on the development of a hydrocephalus shunt for external funding.

Dr. John Foster of the University of Newcastle Upon Tyne visited the Department during the year and Dr. Syed Ali,

Senior resident, AIIMS New Delhi spent a week in the Department as part of his M.Ch Training programme.

The faculty members presented papers at several national conferences and work shops. Dr. Ajay Sharma and Dr. B. K. Mishra obtained Membership of the National Academy of Medical Sciences. Dr. B.K. Mishra proceeded on a Commonwealth Fellowship to U. K. for one year.

Department of Neurochemistry

Dr. Debkumar Basu, Ph.D.	Professor
Dr. P. S. Appukuttan, Ph.D.	Lecturer
Mrs. K.I. Annamma, B.Sc.	Scientific Assistant
Mr. G. Suresh Kumar, M.Sc.	Candidate for Ph.D
Mr. Farhat Azimkhan, M.Sc.	-do-
Miss. Sarasija, M.Sc.	-do-
Mrs. V. Jyoti V. Nair, M.Sc.	-do-
Mr. E. G. Abraham, M.Sc.	-do-
Mr. Madhusudhan Nambiar, M.Sc.	-do-

Preliminary studies on three lysosomal enzymes, Beta-galactosidase, alpha-mannosidase and Beta-hexosaminidase, were carried out as their significance in health and disease had long been recognised.

Beta-galactosidase: The enzyme has two forms both containing SH groups which are essential for biological function. Other biologically important groups in its structure are aminogroups and carbohydrate side chains. pH changes affect the molecular form of the enzyme with some protection afforded by NaCl. at lower concentrations.

Alpha-mannosidase: This enzyme contains SH groups which are nonessential

and is competitively inhibited by Swainsonine, a plant alkaloid. The carbohydrate side chains in its structure are essential for the biological function of the enzyme which cleaves both $\alpha - 1,2$ and $\alpha - 1,3$ linkages to monosaccharide.

Beta-hexosaminidase: This enzyme can be separated into two forms by heat treatment as well as by ion-exchange chromatography. SH groups, amino-groups and carbohydrate side chains are essential for its function.

Biochemical studies on Endomyocardial fibrosis

Among other research activities, the Division contributed to the interdisciplinary investigations on endomyocardial fibrosis and observed higher amounts of GAG and collagen per gram of dry weight in diseased samples as compared to controls. Antibody raised in rabbit against eosinophil basic protein was fluorescein labelled and tested on diseased cardiac tissue samples which showed no effect other than reduced

Project - 1	—	Structural studies on Lysosomal enzymes.
Principal Investigator	—	Debkumar Basu
Co-Investigator	—	P. S. Appukuttan
Funding	—	Council of Scientific and Industrial Research, New Delhi.
Duration	—	2 years
Status	—	Completed

binding of collagen to GAG. It was observed that fluorescein labelled jack fruit seed agglutinin strongly bound to human heart muscle and that the heart muscle membrane contained a new galactoside binding protein which is being studied further.

Project - 2	—	Structure of Enzymes, the Role of their carbohydrate side chains and their interaction with lectins.
Principal Investigator	—	Debkumar Basu
Co-Investigator	—	P. S. Appukuttan
Funding	—	Department of Science & Technology, New Delhi.
Duration	—	3 years
Status	—	Ongoing

Division of Pathology

Dr. V. V. Radhakrishnan, MD	Associate Professor
Dr. C. C. Kartha, MD	Assistant Professor
Dr. S. Sandhyamoni, MD	Lecturer
Dr. R. Renuka Nair, Ph.D	Lecturer
Mrs. Annamma Mathai, M.Sc.	Scientific Assistant

Support for patient services received substantial emphasis in the activities of the Division as shown by the yearly figures of over 40,000 clinico-pathological tests, 570 surgical specimens and 115 frozen sections for tissue diagnosis and 96 autopsies. These investigations played an

important role in maintaining the quality of hospital services and providing valuable material for postgraduate teaching.

The research activities of the Division related to idiopathic, generalised arteriopathy; electron microscopy and dermatoglyphic analysis in endomyocardial fibrosis; and the effects of antiepileptic drugs on lymphocyte culture.

An atomic absorption spectrophotometer was acquired by the Division which had depended on other institutions for trace element analysis during the previous years. The new laboratory planned to study the role of geochemical factors in the pathogenesis of cardiac and neurologic problems which are particularly common in Kerala.

Dr. C.C. Kartha was deputed to spend three months in the laboratory of Dr. Victor Ferrans, Head, Ultra Structure Branch, National Heart, Lung and Blood Institute, Bethesda, USA to gain special experience in cardiac electron microscopy.

Project - 1	—	Role of hyaluronidase in experimental cryptococcal infection of CNS for evaluating its possible application in clinical practice.
Principal Investigator	—	V. V. Radhakrishnan
Co-Investigator	—	D. Rout
Duration	—	3 years
Funding	—	Indian Medical Research Society, Bombay
Status	—	Completed

Project – 2	—	Biochemical and pathological Studies on Endomyocardial Fibrosis
Principal Investigator	—	C. C. Kartha
Co-Investigator	—	P. S. Appukuttan
Funding	—	Lady Tata Memorial Foundation, Bombay
Duration	—	Two years
Status	—	Ongoing

Department of Radiology

Dr. V. R. K. Rao, MD	Associate Professor
Dr. Ravimandalam, MD	Assistant Professor
Dr. P. N. Jayakumar, MD	Lecturer
Dr. Richard Sequeira, MD	Lecturer
Dr. Arun Kumar Gupta, MD	Candidate for post-doctoral Certificate

While cardiac radiological procedures stabilised at previous year's level, a new out-patient X-ray unit was opened for out-patients in the Setu Parvati Bayi Surgical Centre. The procedures carried out are listed below:

Cardiac Catheterisation	808
Neuro-angiography	229
Myelography	178
Ventriculopathy	27
Catheter studies (neuro)	126
Air Myelography	12
Tomography	43
Plain X-ray	10368
CT Scan	3664

It was noted that the introduction of CT Scan facility had considerably reduced

the number of conventional radiological procedures. 55% of the CT Scan examinations were carried out for patients from other institutions. An automatic film processor was added to the CT Scan unit during the year.

The major interest in research centered on interventional techniques for intracranial vascular malformations which constitute a clinical problem of importance. Apart from seeking external funding for a study on this problem, the Division made progress in collaboration with Hindustan Latex in the design of detachable and calibrated mini-balloons. While efforts were made to identify an appropriate monomer agent for embolotherapy and its toxicologic evaluation, the development of a sheep model for aneurysm studies was undertaken in collaboration with the Vivarium of the Institute.

Surg. Lt. Cdr. P. S. Sethumadhavan of Indian Navy joined the Department for a period of six months for training in CT Scan.

BIOMEDICAL TECHNOLOGY WING

Head

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

Department of Biomaterials Science

(i) *Laboratory for Technical Evaluation of Biomaterials:*

Dr. M. Jayabalan, Ph.D.	Scientist
Mr. K. Sreenivasan, M.Sc.	Scientific Officer
Mrs. Prabha D. Nair, M.Sc.	Scientific Officer

The research activities of the Division involved various analytical techniques for the characterisation of biomaterials under different experimental conditions. The major activities are summarised below:

a) *Biodeterioration of PVC:* This phenomenon was studied under laboratory weathering conditions and was observed to be due to the migration of additives to the surface and subsequent microbiological attack of the surface. Whereas a smooth surface undergoes mild biodeterioration, a textured surface undergoes severe change which is accelerated by the migration and crystallisation of lubricant in the textured surface. Migration of additives and biodeterioration were investigated by attenuated total internal reflectance spectroscopy (ATIR) and photomicrography. These studies also demonstrated that surface brittleness is due to the drainage of plasticiser and its migration to the opposite smooth surface.

b) *Effect of molecular conformation on material properties:* PVC samples were subjected to ATIR studies to assess the conformational sites at surfaces. It was

observed that tacticity at polymer surface has significant influence on the surface adhesion/adsorption of cells and proteins.

c) *Studies on carboxy-methyl cellulose*

Cross-linked sodium carboxymethyl cellulose (XNaCMC) and water soluble uncrosslinked sodium carboxymethyl cellulose (NaCMC) are nontoxic materials which are used in catamenial devices and as sizing materials for polyester yarns. It was found that they exhibit common thermal properties and that Na CMC has unique rheological properties which are essential for its processing for biomedical applications.

d) *TGA studies on Vit. B₁₂ coenzyme model complexes*: These studies were undertaken to determine the effect of transligand on thermal stability which affects enzymatic reactions. Cobalt (III) model complexes Br CO (Diacetyl monoxime iminatodiacetyl monoximate imino benzene 1, 6) L were subjected to different heating rates and sample sizes. The transligand L was varied with bromine, imidazole, methylimidazole, pyridine and triphenyl phosphine. The thermal stability of these complexes were found to depend on steric factors. The decomposition of the complexes except triphenyl phosphine complex at the heating rate of 20°C/min. was associated with the formation of a knot at the point of completion of inflection of the thermogram. This novel observation was attributed to the transition from high energy six coordinated Co (III) species to low energy five coordinated CO(II) species with increase in weight and decrease in temperature at the knot.

These studies represent the thermal characteristics of the model complexes which may be compared with Vit B₁₂ coenzyme for theoretical or experimental investigation.

e) *Effect of sterilisation on biomaterials:*

Polyester texturised yarn used for fabricating vascular grafts were subjected to different methods of sterilisation i.e. Gamma irradiation at 2.5 Mrads; autoclaving at 121°C and 20 pSi for 15 mts and dry heat sterilisation at 180°C for 60 mts. UV, IR spectral analyses, and determination of molecular weight, viscosity, solubility and swelling value were carried out to investigate the changes in polyester under the sterilisation conditions. ATIR was also used to investigate surface oxydation by dry heat and Gamma irradiation. Mechanical properties of the sterilized and control samples were also determined in these studies.

The Division offered its analytical services to various laboratories. These included, in particular, the determination of the burst strength of implanted polyester fabrics and the washing cycle for polyester yarn to remove carboxymethyl cellulose, analyses of additives used in the Chitra blood bag, detection of silicone resin coating present on the inner surface of an imported blood bag and the analysis of an adhesive used in the fabrication of the rigid shell oxygenator. Analytical support was also provided to the Division of Polymer Technology in their project on the development of improved radiation sterilisable PVC formulations for biomedical applications. PVC materials were characterised before and after radiation and their chemical, physicochemical and mechanical properties studied to evaluate radiation stability.

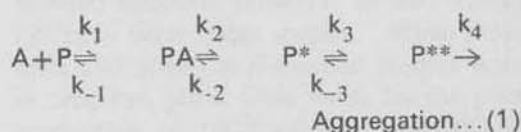
Dr. Jayabalan visited the Department of Polymer Science at Gandhiji University, Kottayam and gave lectures on bio-materials, plastics technology and polymer rheology.

(ii) *Laboratory for Thrombosis Research:*

Dr. M. Jamaluddin, Ph.D.
Mrs. Lissy Kalyanakrishnan, M.Sc.

Scientist
Scientific Assistant

A theoretical foundation for studying qualitative aspects of platelet behaviour has been laid. Platelet aggregation has been formulated, for the first time, as a steady-state kinetic phenomenon as shown in equation (1)



where A stands for the agonist, P for discoid platelets, P* and P** for their two spheroidal forms, with membranous protrusions, and with long pseudopods, respectively, formed during platelet activation; the k's represent the rate constants of the various steps.

An equation relating the rate of platelet aggregation (r) to the agonist concentration was derived

$$r = R (A/S_{0.5})^h / 1 + (A/S_{0.5})^h \dots (2)$$

where R is the maximum value of r, at a given platelet concentration, and infinite A; S_{0.5} is operationally the value of (A) at which r = 0.5R, and h is the Hill coefficient, a measure of cooperativity.

Employing the platelet aggregation assay previously developed in the laboratory, it was found that platelet aggregation by various agonists followed equation (2), satisfactorily.

Adenosine and ATP have been found to be mutually exclusive modifiers of platelet aggregation by ADP.

The kinetics of arachidonate-induced aggregation of gel-filtered platelets and their modifications by two antiplatelet drugs aspirin and imidazole have been investigated in some detail. Preliminary results suggest that aspirin may act as an activator or inhibitor depending on the concentration of arachidonate employed. This may lie at the root of the so-called "aspirin-dilemma" of anti-thrombotic therapy. Imidazole has been found to activate platelet aggregation.

A Hitachi model SCP 55H Automatic Preparative Ultra-centrifuge was added to the facilities.

Project	—	Blood Prosthetic Interactions
Principal Investigator	—	M. Jamaluddin
Funding	—	Board of Research in Nuclear Sciences (BARC)
Duration	—	Three years
Status	—	Completed

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

Two projects which continued to make progress were the development of a tilting disc cardiac valve prosthesis and a woven polyester graft.

a) *Chitra Heart valve*

The valve design was frozen following the choice of sapphire for disc fabrication and the development of an integral strut valve housing. This model gave hydraulic data which were superior to that of Bjork-Shiley valve in a pulse duplicator and showed excellent durability at 300 million cycles in wear tester studies. While these tests and sheep implantation studies were in progress, plans were made for the pilot production of 1000 valves during 85-86 for clinical trial.

Project	—	Development of tilting disc valve
Principi Investigator	—	G.S. Bhuvaneshwar
Co-Investigators	—	M.S. Valiathan O.S. Neelakantan Nair A.V. Ramani Arthur Vijayan Lal
Funding	—	Internal
Duration	—	4 years
Status	—	Design optimisation completed. In vitro tests completed. In vivo tests ongoing. Pilot production of 1000 valves undertaken prior to clinical trial.

b) *Woven arterial graft:*

This collaborative project made progress as indicated below:

Project	—	Development of a woven polyester graft
Principal Investigator	—	G.S. Bhuvaneshwar
Co-Investigators	—	M.S. Valiathan N.K. Seshan of SITRA, Coimbatore
Funding	—	Department of Science & Technology
Duration	—	3½ years
Status	—	Two years implantation data in porcine studies show excellent comparability to control (USCI) grafts. Chitra grafts are also being evaluated independently in animal implantation studies by Dr. Guidoin, Ph.D at Laboratory of Experimental Surgery, University of Laval, Canada. Clinical trial is expected in 1986.

(ii) *Division of Biomaterials Technology*

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

The Division undertook two research projects

1. Project	—	Evaluation of indigenous Stainless Steel materials for use as dental bands.
Principal Investigator	—	A.V. Ramani
Funding	—	ICMR
Duration	—	2 years
Status	—	Samples of required thickness obtained; A punch and die for specimen preparation and cutting designed; Trials for making a low cost spot welder in progress

2.	Project	—	Development of Carbon-Carbon composite as biomaterials.
	Principal Investigator	—	A.V. Ramani
	Collaborating Institution	—	National Physical Laboratory, New Delhi.
	Funding	—	Department of Science & Technology
	Duration	—	2½ years
	Status	—	Design of equipment completed and carbon samples obtained for preliminary evaluation.

The Division added an AB super laboratory furnace 1400°C with rapid heating and cooling facility to its equipment and made a beginning in developing basic bioglass formulations. It also collaborated with the Division of Artificial Internal Organs in the development of a cardiac valvular prosthesis. Apart from research and development activities, the Division contributed to hospital services by collaborating with other groups in the preparation and regular supply of sterilised gamma irradiated non-injectable crystalloids in double packs and the fabrication of a disposable chest tube drainage system.

(iii) Division of Biosurface Technology

Dr. Chandra P Sharma,
M. Tech., MS, Sc.D, MEBE
Mr, Thomas Chandy, M. Sc.

Scientist
Scientific Assistant

The research activities are summarised below:

1. In further studies on polymer/protein/platelet interaction at the interface, the

effect of persantine, aspirin – persantine combinations, aspirin – Vitamin C, certain amino sugars like glucosamine, galactosamine, and mannosamine, vitamins B₆ and E was systematically investigated. The nature of protein layer deposited at the interface was studied after desorbing and analysing the proteins electrophoretically. The kinetics of protein-surface interaction with various agents was investigated using ¹²⁵I Albumin and ¹²⁵I Fibrinogen from protein mixture. The preliminary observations showed enhancement of albumin binding or decreased fibrinogen concentration on surface with certain antiplatelet agents. A combination of Aspirin, Vit. C, Vit. B₆ and Vit. E (0.5 mg% : 1.5 mg% : 0.15 mg : 2 mg%) seemed to enhance blood compatibility by inhibiting fibrinogen-surface binding. Blood compatibility was also observed to be improved if the implant stored in glutaraldehyde was rinsed with Vit B₆ solution.

2. Fibronectin is a plasma glycoprotein which has biological functions including those relating to the adhesion of cells and fibrin to cell surfaces. The influence of human plasma fibronectin on platelet adhesion to an artificial surface with normal and thrombin activated platelets was studied. The role of fibronectin to modulate the kinetics of polymer-fibrinogen interaction in the presence and absence of thrombin was also investigated. It was observed that fibronectin significantly modifies polymer-platelet, protein-polymer interactions when thrombin is present in the medium. The role of this molecule would therefore seem important in platelet/protein and surface interaction when haemostatic process is in progress.

3. In another series of experiments, the effect of neomycin, gentamycin, penicillin-G, streptomycin and ampicillin on polymer-fibrinogen binding was studied using ^{125}I labelled fibrinogen. It was noticed that antibiotics inhibit fibrinogen - surface binding in variable degrees whereas lymphocyte infusion extends the surface - fibrinogen bonding beyond 2 hours of incubation. Antibiotics may bind to fibrinogen molecule and prevent its surface binding but they may modulate lymphocytemembrane and extend their absorption to polymer-substrate.

4. In attempting to simulate natural vessel wall, Prostaglandin E1 was immobilised in polyelectrolyte gelatin and albumin stock which has been bonded to biomer. The surface demonstrated very low platelet adhesion compared to a bare surface. This was thought to be due to the effects of albumin, gelatin, sulfamate or carboxylate groups of polyelectrolyte and PGE_1 .

The role of garlic in reducing surface - platelet binding was demonstrated using washed calf platelets.

Project: 1	—	Development and modification of biocompatibility of polyurethanes
Principal Investigator	—	C.P. Sharma
Funding	—	Department of Sciences and Technology
Duration	—	3 years
Status	—	Completed

Project: 2 — Development of new antithrombogenic polymer surfaces and their interaction studies with blood proteins at the interface.

Principal Investigator — C.P. Sharma

Funding — Board of Research in Nuclear sciences

Duration — Three years

Status — Completed

Dr. C.P. Sharma presented two papers at the Second World Congress on Biomaterials in Washington D.C, April 27–May 1, 1984 and chaired a session.

(iv) Division of Extracorporeal Devices

Mr. V.S. Venkatesan, BE Biomedical Engineer
Mr. Thampi Koshi, BE Scientific Officer

The main activity during the year was the invitro and exvivo evaluation of the rigid shell oxygenator which incorporated new design features such as cardiotomy reservoir and variable mode for paediatric/adult flow. This complex device passed 6 hour invitro trials and exvivo trials in sheep successfully and met other criteria which are internationally accepted for oxygenator function. Scheduled to enter pilot production, the device was expected to enter clinical trials in 1986.

Centre of Research Technology

Major Project of the Centre
of Research Technology

Project — Development of
Hard shell oxygenator

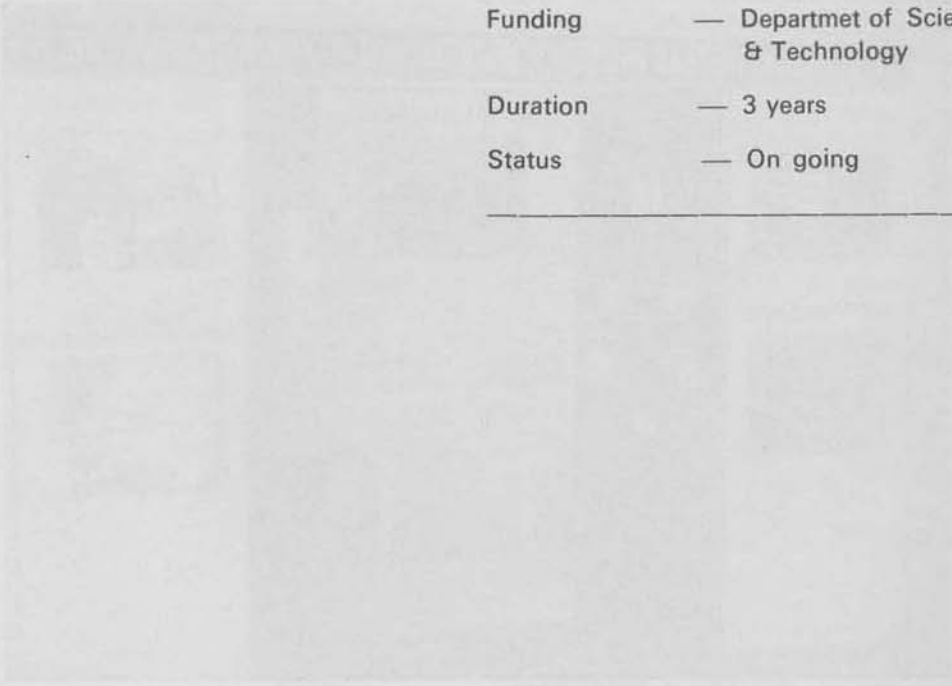
Principal Investigator — V. S. Venkatesan

Co-Investigators — M. S. Valiathan
— Arthur Vijayan Lal

Funding — Department of Science
& Technology

Duration — 3 years

Status — On going





A view of the Institute's exhibit at the Indian Science & Technology Exhibition, Moscow 1985.

(v) *Division of Polymer Technology*

Mr. S. N. Pal, M.Sc. Tech. Chemical Engineer
Mr. S. Kalyanakrishnan, M.Sc. Scientific Officer

As in previous years, the Division continued to produce and supply polymer components for the developmental projects of other groups.

The principal effort in research and development related to the Chitra blood bag which had undergone multicentric trials in the country. At a meeting of the investigators who took part in the trial in October 84, the Chitra blood bag systems were reported to be generally satisfactory and recommended for production with slight changes relating to the capacity of the bag, dimension of the transfusion port, use of ultra thin needles etc. A fresh batch incorporating these changes was subsequently made ready for use by the institutions which had carried out the multicentric trial. The Division continued to provide all technical inputs for the transfer of Chitra blood bag technology to the Peninsula Polymers private limited for commercial production.

Project	—	Development of improved radiation stable formulations for biomedical applications
Principal Investigator	—	S. N. Pal
Funding	—	Board of Research in Nuclear Sciences
Duration	—	3 years
Status	—	Work completed. Project to terminate in May '85.

As a contribution to patient care, a chest drainage tube with a relatively blood compatible lumen was developed and was expected to be supplied shortly on a regular basis to the Department of Cardiothoracic Surgery.

Mr. S. N. Pal visited West Germany, UK, USA, Japan and Taiwan for the selection of plastics machinery for M/s. Peninsula Polymers Pvt. Ltd. who are setting up a factory for the commercial production of Chitra blood bag systems. Dr. Natti S. Rao, visiting expert in High Polymer Engineering from FRG visited the Division and gave a lecture on 'Polymer processing of quality products.

The technical personnel of M/s. Peninsula Polymers Pvt. Ltd., underwent training in theory and job practice from December 84 for 4-5 months according to the memorandum of understanding between the company and the Institute. This arrangement also had the approval of the National Research & Development Corporation.

(vi) Division of Technology Transfer

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

The technology transfer activities grew in scope and volume.

As the Peninsula Polymers Pvt. Ltd. decided to shift the location of their factory and start commercial production of Chitra blood bags in Trivandrum, the Division was closely involved in the subsequent negotiations between the Company, Institute, KSIDC and NRDC. The work also included the preparation of detailed project reports, memoranda of

understanding regarding the training of personnel and use of equipment and other important documents. Mr. Vijayakumar served as a member of the Committee which had been setup jointly by the KSIDC and the Institute to review the commercial potential of devices being developed at the Institute.

The Division identified noninjectable crystalloids for laboratory scale production in view of its growing requirement and the difficulties in production at the Hospital Wing. As the current requirement averaged 3000 numbers of 500 ml bags per month, a custom designed, simple to operate and maintain production plant was setup to produce the bags. After successful evaluation of several thousand bags in the Hospital Wing, the plant was handed over to the Engineering services Division to supply the regular needs of hospital services.

The Division was actively involved in the arrangements being worked out between the Institute, manufacturers and the NRDC for the pilot production of the Chitra valve and Chitra rigid shell oxygenator prior to their commercial production. In co-ordination with the concerned Divisions, the major chapters of the document for the transfer of technology were completed as the first package to industry.

With reference to patents, nine design applications received registration certificates and two more fresh applications for devices were filed. Since the devices find multidisciplinary application, a common housemark to characterise the degree of quality behind them was also registered.

(vii) *Division of Tool Room & Engineering Services*

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

Tool Room Engineer

As in previous years, the routine activities of the Division were crucial to the performance of the BMT Wing in so far as they covered civil works, maintenance of equipment, control of panoramic batch irradiator and utilities and incinerator service. All these services continued to operate with a high level of efficiency as best indicated by the full utilisation of the gamma irradiation facility for research and the sterilisation of hospital disposables. The Division acquired a pyrogen free distilled water plant for the production of non injectable crystalloids and regularly supplied 3000 units per month to meet the demand of the Hospital Wing.

Support was provided to the Division of Artificial Internal Organs in the fabrication of valvular prosthesis and its life testing in a wear tester. Mr. Neelakantan Nair was closely involved with the transfer of valve technology for pilot production by M/s Tool Craft of Bangalore.

(viii) *Division of Materials Toxicology*

Dr. P. V. Vedanarayanan, B. V. Sc.,
Ph.D.
Mr. K. Rathinam, M. Sc.
Dr. A. C. Fernandez, Ph.D.

Senior Materials Toxicologist
Scientist
Scientist

As the main activity related to the evaluation of candidate materials for biomedical devices, the Division was restructured as two units to deal with non-traditional toxicologic tests and toxicological screening of materials respectively. Mr. Rathinam who received a course of

training in toxicologic evaluation and protocol at the Industrial Toxicological Research Centre, Lucknow took charge of the Unit for Toxicological Screening of materials from 1-1-85. The unit under Dr. Vedanarayanan continued its work on the development of tissue culture for possible application in toxicologic screening.

Toxicologic tests were carried out during the year on PVC formulations for Chitra blood bag and component materials for the new rigid shell oxygenator which passed the battery of tests.

Mr. Rathinam attended a WHO training course on Chemical Safety in industry from 5-17 March at Lucknow.

(ix) Division of Patho-Physiology

Dr. Mira Mohanti, MD	Scientist
Mrs. T. V. Kumari, M.Sc.	Scientific Officer

The service activities grew in volume and consisted of biochemical and haematological tests during and following the *in vivo* trials of Chitra valve, vascular graft and oxygenator. Histopathological reports were also regularly provided on tissue samples submitted by the Divisions of Toxicology (material implants), Internal organs (vascular graft at year) and vivarium (organs from necropsy).

The Division added a Nikon binocular microscope with microphotographic attachment, Shandon tissue processor and other equipment to its laboratory which became fully established during the year.

The major research project related to the development of haemoglobin solution.

Project	—	Preparation and evaluation of stable haemoglobin solution as a blood substitute
Principal Investigator	—	Mira Mohanti
Funding	—	Department of Science & Technology
Duration	—	3½ years
Status	—	All equipment and consumables ordered; some received. Procedures for the preparation of a crystalline stroma free haemoglobin solution from human blood standardised and samples prepared.

(x) *Division of Vivarium*

Dr. Arthur Vijayan Lal, B. V. Sc. Veterinary Scientist
 Dr. Bhaskara Rao, M. V. Sc. Veterinary Surgeon

The Vivarium was reorganised during the year and given the added responsibility for the supervision of small animals facility which had been administered by the Division of Materials Toxicology earlier. The small animals included albino mice, rabbits, rats and guinea pigs.

The routine activities consisted as before of the humane care and management of animals, quarantine, and the protection of animals against rabies, canine hepatitis, distemper and leptospirosis by the administration of polyvalent vaccine. Animals were preconditioned for procedures as per established norms and supplied in response to requests from the Divisions of Neuro-Chemistry, Microbiology, Toxicology, Artificial Internal Organs, Extracorporeal devices, Anaesthesiology and Pathophysiology. Most of these Divisions besides

SCIENTIFIC PUBLICATIONS

The first publication was by Dr. J. S. Burdett, M.D., and Dr. J. S. Burdett, M.D., in the Journal of Biomedical Materials Research, Vol. 1, No. 1, 1967, pp. 1-10. This was a review of the literature on the use of polyethylene glycol in the preparation of biocompatible polymers.

Vascular Graft

Thrombosis and Biosurface Technology were also supplied liberal blood samples from different species for investigative work.

The projects which called for major surgical inputs from the Division related to the development of the Chitra vascular graft, tilting disc valve, rigid shell oxygenator and parenteral alimentation.

Woven Polyester Chitra vascular grafts and controls were implanted in the thoracic aortic position in pigs for longterm studies. In over 100 implants, one year and two year data became available in 20 and 8 animals respectively which showed virtually identical findings for Chitra grafts and controls in terms of patency and healing characteristics.

Tilting disc valve

Efforts were continued through the year to obtain long term survivals in sheep with the valve in the mitral position. In common with several other investigators, this was found to be difficult even though the short term survival studies showed excellent valve function. Accordingly it was decided to adopt the approach of Borrie who had placed tissue valves in the main pulmonary artery position for longterm studies.

Rigid shell oxygenator

In vitro evaluation of the rigid shell oxygenator for six hours using five or more soft shell units in series as deoxygenators was carried out with satisfactory results prior to the exvivo evaluation of the device in sheep. These studies are continuing.

Parenteral alimentation

The lipid formulation supplied by Central Food Technology Research Institute was evaluated in dogs by continuous intravenous infusion and measurement of various metabolic parameters. The formulation was also subjected to toxicologic screening.

Drs. Arthur Vijayan Lal and Bhaskar Rao presented papers at national meetings of veterinary scientists.

SCIENTIFIC PUBLICATIONS

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3. Appukuttan P.S., Basu D. Binding site Amino Acid Residues of Jack Fruit Seed Lectins: Chemical Modification and Protein Difference Spectral Studies. *J.Biosci.* (accepted for publication)
4. Appukuttan P.S. Basu D. Four identical sub units in Jack Fruit Seed. Agglutinin offer only two saccharide binding Sites—FEBS letters (accepted for publication)
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ADMINISTRATIVE BODIES

INSTITUTE BODY

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Director,
Indian Institute of Chemical Biology,
4, Raja Subodh Mullick Road,
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2. Dr. D. B. Bhist, (Ex-officio)
Director General of Health Services,
Nirman Bhavan, New Delhi
3. Dr. K.P. Bhargava,
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Lucknow
4. Mr. G. Chatterjee (Representative of
Union Ministry of Finance)
Financial Adviser,
Department of Science & Technology
New Delhi
5. Dr. V. R. Gowariker,
Director,
Vikram Sarabhai Space Centre
Trivandrum.
6. Sri. Habeeb Mohammed (Ex-officio)
Vice Chancellor, Kerala University,
Trivandrum.
7. Shri O. J. Joseph,
Member of Rajya Sabha,
No. 1153/1, Subhash Nagar,
Vallakadavu, Trivandrum.
8. Prof. P. J. Kurien (Till 12/84)
Member of Lok Sabha,
P. O. Vellikulam, Alleppey
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302, Sector 35A, Chandigarh
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Ministry of Health (Representative of
Union Ministry of Health & Family
Welfare), New Delhi
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Secretary Health, Govt. of Kerala,
Trivandrum.
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Director,
National Institute of Virology, Pune
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Minister of State for External Affairs
Government of India, New Delhi
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Head, Biomedical Technology Wing
Sree Chitra Tirunal Institute for
Medical Sciences & Technology,
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Visiting Professor
Raman Research Institute, Bangalore.
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20. Dr. N. H. Wadia,
Director of Neurology
Jaslok Hospital and Consultant
Neurologist, J. J. Group of Hospitals,
Bombay
21. Prof. Yash Pal (Ex-officio)
Secretary to Government of India,
Department of Science & Technology
New Delhi

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Department of Science & Technology
New Delhi
2. Director-General of Health Services
(Ex-officio)
Government of India, New Delhi
3. Dr. S. Vasudev
Chairman
State Committee on Science & Technology,
Government of Kerala
4. Prof. S. Ramaseshan,
Visiting Professor,
Raman Research Institute, Bangalore
5. Dr. N. H. Wadia,
Director of Neurology,
Jaslok Hospital and Consultant
Neurologist, J. J. Group of Hospitals,
Bombay
6. Director
(Ex-officio)
Sree Chitra Tirunal Institute
7. Head
(Ex-officio)
Biomedical Technology Wing of
Sree Chitra Tirunal Institute
8. Dr. D. K. Basu,
Professor of Neurochemistry
Sree Chitra Tirunal Institute

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Director, Institute of Chemical Biology,
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KEM Hospital, Bombay

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

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Professor of Cardiology, PGI,
Chandigarh

Prof. D. K. Basu,
Sree Chitra Tirunal Institute

Dr. Damodar Rout,
Associate Professor,
Sree Chitra Tirunal Institute

Dr. M. P. Mohan Singh,
Associate Professor,
Sree Chitra Tirunal Institute

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

Head, Biomedical Technology Wing of
the Institute.

Building Committee

Director (Chairman)

Health Secretary,
Government of Kerala

Construction Engineer,
VSSC, Trivandrum

Head, BMT Wing of the Institute

Financial Adviser & Chief Accounts Officer
of the Institute

A member to be co-opted by the Director
as and when necessary

Ethics Committee

Honourable Justice Shri K. Sukumaran,
(Chairman)

High Court of Kerala, Ernakulam

Director of the Institute

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

Prof. N. Balakrishnan Nair,
Jawaharlal Nehru Fellow &
Head of the Department of Aquatic
Biology, University of Kerala

Dr. M. Jamaluddin, Scientist,
BMT Wing of the Institute

Dr. C. G. Venkitachalam,
Associate Professor of the Institute

Finance Committee

Director (Chairman)

Dr. V. R. Gowarikar,
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)

Junior Staff Selection Committee

Medical Superintendent of the Institute

Head, Biomedical Technology Wing
of the Institute

V. Narasimhan,
Registrar of the Institute

Dr. C. G. Venkitachalam,
Associate Professor of the Institute

Miss Saramma Abraham,
Nursing Suptdt. of the Institute

A representative of the Academic wing of
the Institute nominated by the Director

Senior Staff Selection Committee

Director (Chairman)

Dr. N. H. Wadia,
Director of Neurology,
Jaslok Hospital and Consultant
Neurologist, J. J. Group Hospital
Bombay.

Head,
Biomedical Technology Wing
of the Institute

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

An expert from outside the Institute
nominated by the President.

A Professor of the Institute nominated
by the President

Technology Development Committee

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Prof. S. Ramaseshan,
Visiting Professor,
Raman Research Institute, Bangalore

Prof. C. N. R. Rao,
Director, Indian Institute of Science,
Bangalore.

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

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

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

Head, BMT Wing, of the Institute.

Dr. P. V. Vedanarayanan,
Senior Materials Toxicologist,
BMT Wing of the Institute.

Shri G. S. Bhuvaneshwar,
Biomedical Engineer,
BMT Wing of the Institute.

HOSPITALS REFERRING PATIENTS

KERALA STATE – Districtwise

Alleppey

District Hospital, Alleppey.
Government Hospital, Nooranad
Medical College Hospital, Alleppey
S.N.M.M. Hospital, Alleppey
St. Thomas Mission Hospital, Alleppey
S.H. Hospital, Alleppey
Taluk Hospital, Mavelikara
Taluk Hospital, Chengannur

Calicut

Nirmala Hospital, Calicut
Medical College Hospital, Calicut
P.V.S. Hospital (P) Ltd, Calicut

Cannanore

District Hospital, Cannanore
Dr. Kannan's Hospital, Cannanore
Koyili Hospital, Cannanore
Vimla Mission Hospital, Chemperi

Ernakulam

City Hospital, Cochin
Gautham Hospital, Cochin
Janatha Clinic, North Parur
Kunhali's Nursing Home, Cochin
Lisie Hospital, Ernakulam.
Little Flower Hospital, Angamally.
Mar Augustine Golden Jubilee Hospital,
Mookkannor.
Medical Trust Hospital, Ernakulam.
MOCM Hospital, Kolencherry
Paul Mary Hospital, Cochin.
Port Trust Hospital, Cochin.
Samaritan Hospital, Alwaye.
Santhinikethan Hospital, Moovattupuzha.
St. Joseph's Hospital, Kothamangalam.
St. George Mount Hospital,
Kadaplammattom.
Sree Krishna Nursing Home, Cochin.
Sudheendra Medical Mission, Ernakulam.

Idukki

District Hospital, Idukki.
Holy Family Hospital, Muthalakodam.
Mount Sinai Hospital, Thodupuzha.
St. John's Hospital, Katappana.

Kottayam

Carithas Hospital, Kottayam.
Good Samaritan Hospital, Kottayam.
Holy Family Hospital, Kottayam.
K.V.M.S. Hindu Medical Mission Hospital,
Kottayam.
Medical College Hospital, Kottayam.
M.G.D.M. Hospital, Kottayam.
St. George Mount Hospital, Kottayam.

Malappuram

District Hospital, Manjery.
Taluk Hospital, Tirur.

Palghat

District Hospital, Palghat.
Palat Memorial Hospital, Palghat.
Railway Hospital, Olavakkot.
7th Day Adventist Hospital, Ottappalam.
Taluk Hospital, Ottappalam.

Pathanamthitta

District Hospital, Kozhencherry.
G.K. Hospital, Tiruvalla.
Govt. Hospital, Tiruvalla.
Marthoma Medical Mission, Ranni.
NSS Medical Mission, Pandalam.
People's Clinic, Pathanamthitta.
Pushpagiri Hospital, Tiruvalla.
St. Paul's Hospital, Kadampanad South.
Thiruvalla Medical Mission, Tiruvalla.

Quilon

Benziger Hospital, Quilon.
District Hospital, Quilon.
Deen Hospital, Quilon.
ESI Hospital, Asramam.
Holy Cross Hospital, Quilon.
Janatha Clinic, Quilon.
St. Paul's Hospital, Quilon.
Taluk Hospital, Karunagapally.
Upasana Hospital, Quilon.

Trivandrum

Cosmopolitan Hospital, Trivandrum.
General Hospital, Trivandrum.
Govt. Hospital, Peroorkada.
Govt. Hospital, Parasala.
Medical College Hospital, Trivandrum.
Nirmala Hospital, Trivandrum.
Sree Ramakrishna Mission Hospital,
Sasthamangalam, Trivandrum.
Taluk Hospital, Chirayinkil.
Taluk Hospital, Neyyattinkara.
Taluk Hospital, Nedumangad.
VSSC, Medical Division, Trivandrum.
W&C Hospital, Trivandrum.

Trichur

Agrasala, Kodungallore.
Amala Cancer Institute, Trichur.
Balya Children's Hospital, Veliyannur.
C.A.M. Hospital, Olarikara.
Dhanya Hospital, Chalakudy.
District Hospital, Trichur.
District Co-operative Hospital, Trichur.
Guruvayoor Polyclinic, Guruvayoor.
I.V.G.A. Hospital, Chalakudi.
J.M.M. Hospital, Trichur.
Mar Augustine Golden Jubilee,
Mookkannur.
Medical College Hospital, Trichur.
St. Joseph's Hospital, Choondal.

Wynad

Assumption Mission Hospital,
Sulthan Batheri.
Good Shepherd Hospital, Vythiri.

OTHERS – Statewise**Assam**

Gauhati Medical College, Gauhati, Assam.

Karnataka

Jayadeva Institute of Cardiology, Bangalore.
Kasturba Medical College, Manipal.
Medical College Hospital, Mangalore.
St. John Medical College Hospital,
Bangalore.

Pondicherry

JIPMER, Pondicherry.

Tamil Nadu

Balasundaram Hospital, Nagercoil.
Bensam Hospital, Nagercoil.
Chandran Hospital, Marthandam.
Catherine Booth Hospital, Nagercoil.
Casmer Hospital, Manalikkara.
Jayasekharan Hospital, Nagercoil.
Jawahar Hospital, Nagercoil.
Kunnath Hospital, Padanthalumoodu.
Kanyakumari Medical Mission CSI Hospital,
Neyyoor.
Letha Nursing Home, Nagercoil.
Mathias Hospital, Nagercoil.
Merlin Hospital, Nagercoil.
William's Clinic, Nagercoil.

U.P.

Politangj Hospital, Majhola, Pilibhid Dist.

West Bengal

N.R.S. Medical College, Calcutta.

ABROAD

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