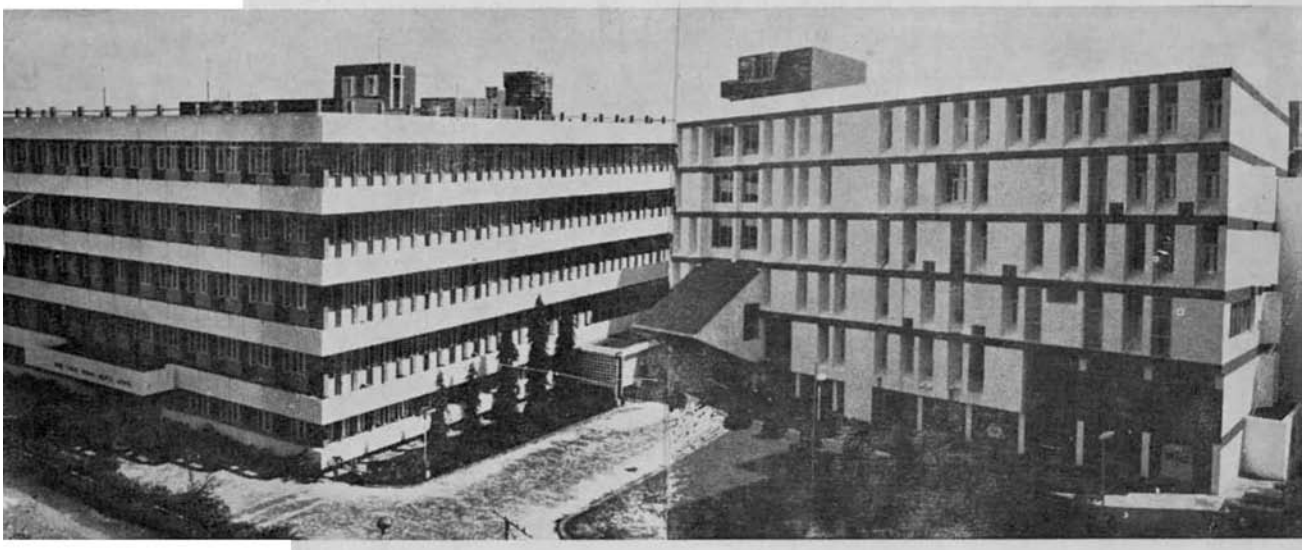
Sree Chitra Tirunal Institute for
Medical Sciences and Technology
Trivandrum-695011 Kerala



Annual Report 1985-'86

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1985-'86

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

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OVERVIEW

The Institute witnessed steady and balanced progress during 1985–'86 in the development of hospital services, medical technology and postgraduate training which had constituted its triune mission.

The allround growth in patient services not only influenced hospital statistics for the year but also signified improved quality of care. Thanks to the doubling of surgical services, patients with the major exception of those awaiting valve replacement had no longer to wait for more than 3 months for cardio vascular surgery which included procedures for all forms of complex congenital cardiac anomalies in children and adults, endomyocardial fibrosis, valvar dysfunction, coronary artery and aortic diseases. The weaker sections of the population continued to claim the lion's share of the hospital services with 35% receiving patient care totally free of charge. This was made possible in spite of escalating costs by careful attention to budgeting which ensured that for every rupee spent 41 paise went for items directly relating to patient care, 44 paise for salaries and 15 paise for services related to patient care such as electricity and water supply. (Fig. 1)

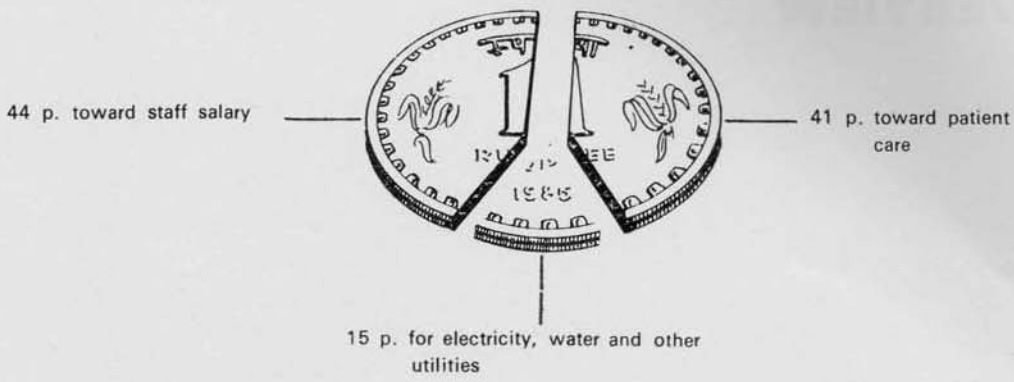

Fig. 1 Rupee Expenditure

Another significant trend emerged in patient care with the increasing and successful use of nonsurgical intervention procedures such as balloon septostomy, angioplasty and the embolotherapy for intracranial AV malformations. No wonder a steady increase could be seen in the number of patients from distant parts of the country who approached the hospital for diagnosis and treatment which was offered by the Institute regardless of the location or income status of patients.

The over-riding concern for patient care did not retard medical research which witnessed the establishment of an Advanced Centre for Endomyocardial fibrosis during the year under the aegis of the Indian Council of Medical Research. The advent of a myocardial cell culture model in the new unit provided a new stimulus for ongoing studies which had already given geochemical clues to the genesis of endomyocardial fibrosis. An interdisciplinary team spared no effort to contribute to the studies and to the resolution of problem of endomyocardial fibrosis which constitutes a regional problem of considerable importance.

While the Biomedical Technology wing continued to lay primary emphasis on developing and refining technologies for a prosthetic heart valve and oxygenator, it broke new ground by undertaking a survey of the national demand for medical devices whose importance had won insufficient, attention in the country earlier. The survey revealed that the annual demand for medical devices exceeded 350 crore rupees and that they impinged on virtually every department of patient care. The results of the survey were significant in so far as they emphasised the economic potential and pervasive applications of medical devices in hospitals. An equally important activity of the Biomedical Technology Wing was the continued support it extended for the impending commercial production of the Chitra blood bags.

The postgraduate training programmes could claim to have reached maturity in so far as several degree holders of the Institute obtained consultant appointments in reputed institutions in the country during the year. The nation-wide increase in the number of applications for admission also testified to the success of the academic endeavour of the Institute.

SURVEY OF MAJOR PROGRAMMES

i. HOSPITAL SERVICES

Medical Superintendent:

Dr. (Maj.) K. A. Hameed, MBBS
AAMO: Dr. D. Hariprasad, MBBS
(on study leave)

Outpatient & Inpatient services

Given the status of the hospital as the major referral centre in cardiology and neurology for a population of over 25 million, it was not surprising that the volume of patient services continued to rise. This was reflected in the registration of new patients, admissions, investigations and surgical procedures. While the registration increased by 10% over 84–85 (Fig. 2) the corresponding percentage of increase for admissions was 20% (Fig. 3). Similarly investigative and surgical procedures rose by 18% and 25% respectively during 85–86 and demonstrated the high degree of utilisation of the additional hospital capacity of Sethu Parvati Bayi Surgical Centre (Fig. 4 & 5).

The pressure of numbers did not spare the follow up system which was restructured in the form of a series of special clinics to improve the quality of follow up studies and teaching. In addition to the pre-existing clinics for epilepsy, pain, pace-maker, paediatric cardiology, cardiac-surgery and neurosurgery, new ones were added for hypertension, coronary artery disease, cardiomyopathy, rheumatic heart disease and stroke. An exercise was also begun for introducing a problem oriented approach to the collection of follow up data.

Medical Records

As in previous years, the Medical Records Division serviced the out-patient and inpatient services and efficiently met the increasing demand for patient data, statistical bulletins, income assessment, reimbursement and other services.

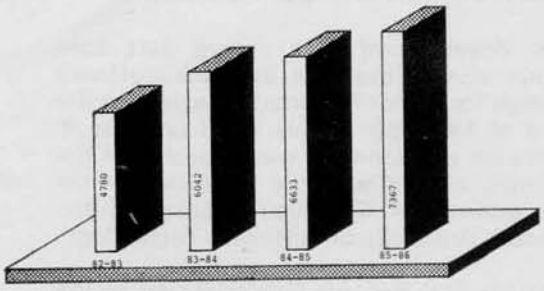

Fig. 2 Out patient registration

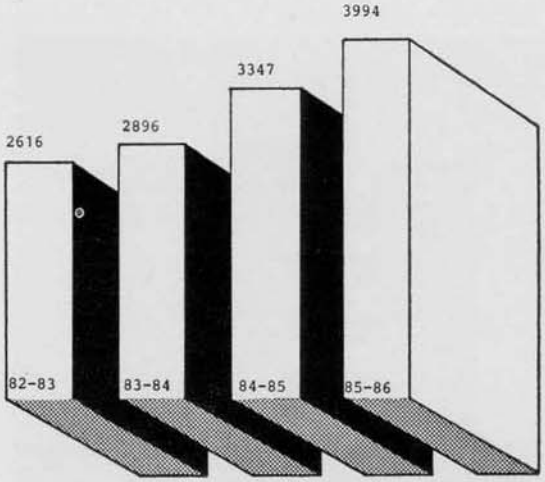

Fig. 3 Admissions

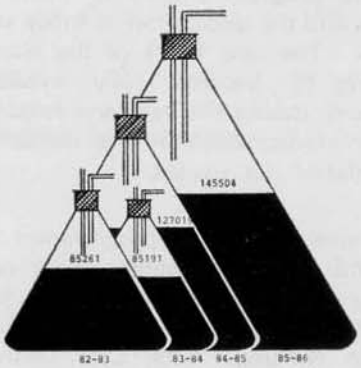

Fig. 4 Lab Investigations

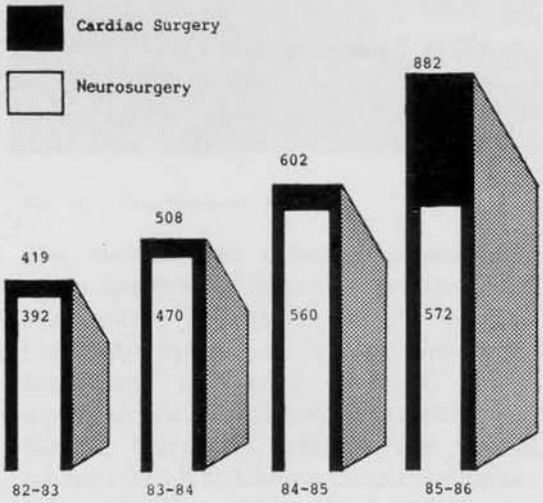

Fig. 5 Operative procedures

As the old records numbered 11,500 the problem of storage space confronted the Division which arranged for several consultations and discussions on the optimal method of storage for old records. As a result of these discussions, guidelines were prepared for the "thinning' of charts five years after the admission of patients. It was also decided to transfer the judiciously extracted data to microfiche/microfilm for which a private firm was identified.

The development of a patient data base made slower progress and the software design for a pilot run was incomplete at the end of 1985–86. More rapid progress in software development was expected in the coming months with the assistance of the Department of Computer Science of the Cochin University of Science & Technology.

The Medical Records Officer served as the convener of the newly set up Medical Audit Committee which met monthly to review the hospital performance in terms of infection rate, prolonged stay, deaths and other indices of patient care. The membership of the committee included the heads of all clinical departments.

Nursing Services

Despite the yearly drain of 30 or more nurses to other countries, the nursing services made progress thanks to fresh recruitments and the dedication of those who stayed on. The new block of the Nurses Hostel (Fig. 6) became fully available for allotment during the year and removed the earlier inadequacies in the residential accommodation for nurses.

The inservice education programmes for cardiac and neurologic nurses were conducted by Mrs. P.P. Saramma and Mrs. Lyla Mathew who had received their M.Sc. degrees in Nursing. Mrs. Lyla Mathew won the rolling shield for the best paper at the Neuro Nurses Satellite conference in Patna.

Two M.Sc. students from the RAK College of Nursing, New Delhi visited the Institute for a month for field experience.

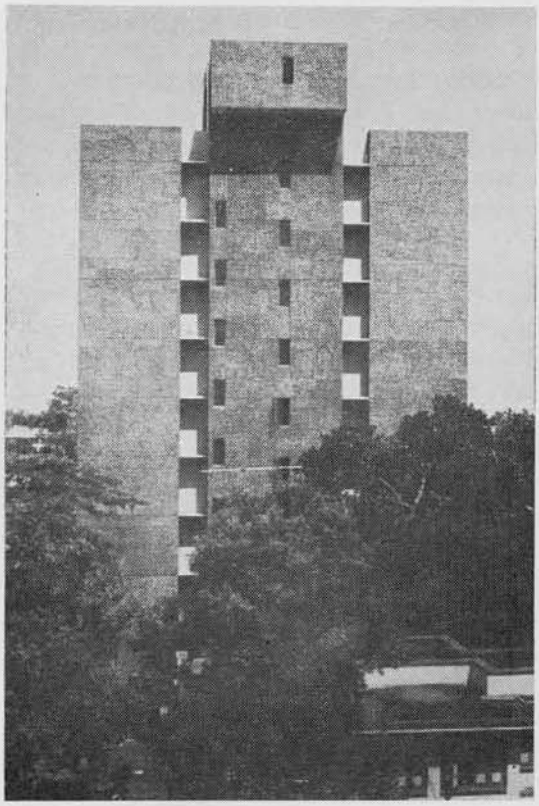

Fig. 6 Nurse's Hostel – Annexe

Clinical Engineering

The maintenance activities covered the entire spectrum of electrical, electronic and mechanical equipment in the hospital including control of spares inventory, supervision of service contracts, break-down service and preventive maintenance. Mr. R. Mohandas underwent a special course at the ATL training Centre, Singapore for servicing the ultramark–8 Echocardio-graph which had been purchased during the year.

ii. BIOMEDICAL TECHNOLOGY WING

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

While the thrust of earlier years for the development of devices and technologies produced tangible results such as the blood bag and disposable oxygenator, the year under review was notable for the emergence of a new trend which emphasised the other links of the technology chain which could be classified under survey of demand, development of the production technology of a proven prototype and continuing consultancy and technical support to enterpreneurs during commercial production. The trend could be exemplified by the record of the Biomedical technology Wing in relation to a survey of the devices market, development of production technology for the oxygenator and support for the manufacture of blood bags which represent these three phases in the evolution of technology.

As the market is the principal determinant of technology development, the demand for nonpharmaceutical products including devices has been systematically assessed by several industrialised countries with global estimates ranging upto 3.5 billion dollars. As a similar study was called for in India, a survey of the domestic market for medical devices was carried out by the Technology Transfer cell with instructive results. The range of applications of devices and their current annual demand of over 350 crores clearly underlined the need for stepping up the present efforts and investment for the development of biomedical technology in the country.

Another phase in the evolution of technology where valuable experience was gained related to product development which

differs in several important respects from the development of a successful prototype. The lessons were particularly applicable to the Variflo oxygenator which had already won a National Award and proved its excellence as a gas exchange device. In translating the proto-type to acceptable batches for clinical use, several steps were introduced for standardisation of fabrication techniques, quality assurance, inspection and ease of production on a commercial scale.

While the University – industry linkage does raise controversial issues, there could be little dissent from the view that a scientific laboratory is obliged to support the transfer of its technological output for productionisation. Viewed in this perspective, the variegated support including the deputation of technical personnel for the commercial production of the Chitra blood bag system was as instructive to the Institute as it was beneficial to the industry.

iii. EDUCATIONAL PROGRAMMES

Registrar: Shri V. Narasimhan, M.Sc.

Postgraduate admissions

The training programmes of the Institute continued to remain popular and evoked increasing response (Fig. 7)

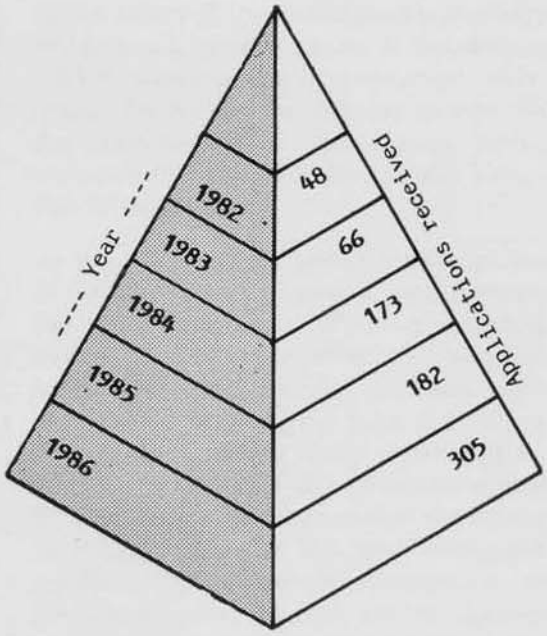

Fig. 7 Yearly growth in applications for post graduate courses

The statewise breakup of 305 applicants to various postgraduate courses is shown in Table–1.

Table–1

State/Union Territories		*Number applied*
Andhra Pradesh	:	59
Assam	:	1
Bihar	:	16
Chandigarh	:	2
Delhi	:	14
Gujarat	:	9
Haryana	:	5
Jammu & Kashmir	:	4
Karnataka	:	29
Kerala	:	25
Lakshadweep	:	1
Madhya Pradesh	:	48
Maharashtra	:	26
Orissa	:	4
Punjab	:	4
Rajasthan	:	20
Tamil Nadu	:	17
Uttar Pradesh	:	11
West Bengal	:	10

Details as to the number of candidates selected against the number of applicants is given in Table–2.

Table–2

Course	*No. of Applicants*	*No. selected and joined*
DM Cardiology	135	3*
DM Neurology	22	3*
M.Ch. Cardiothoracic Surgery	58	2

Course	No. of Applicants	No. selected and joined
M.Ch. Neurosurgery:		
3 year	11	1
5 year	47	1
Postdoctoral certificate in Anaesthesiology	23	2
Postdoctoral certificate in Radiology	9	2

* One candidate sponsored.

The statewise distribution spectrum of students as on 31st March 1986 is given in Fig–8.

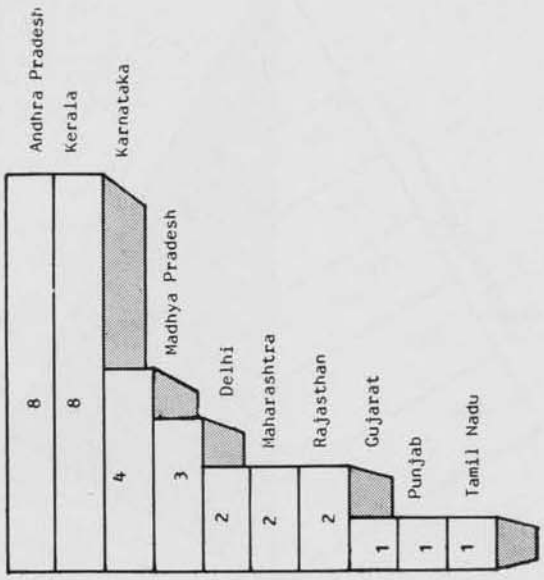

Fig. 8 Statewise distribution of applications for postgraduate courses

Postgraduate examination:

In the DM and M.Ch. examination held in December 1985 all the candidates were declared successful except one in neurology. The successful candidates are listed in Table–3.

Table–3

Name of Candidate	*Degree*	*Speciality*
S. Gobisankar R. Krishnan K. Venugopal	DM	Cardiology
C.P. Shrivastava KSVK Subba Rao H.L. Subba Rao	M.Ch.	Cardiovascular thoracic surgery
N. K. Ravisubramanya	DM	Neurology

The names of candidates who successfully completed the postdoctoral certificate courses in December 1985 are given in Table No. 4.

Table–4

Name of the candidates	*Speciality*
Dr. A. K. Babar Dr. P. K. Neema	Cardiovascular and Neurosurgical Anaesthesia
Dr. A. K. Gupta	Cardiovascular and Neuro Radiology.

A restructuring of the training programme with greater participation by the staff was made and as per regulations prescribed for DM and M.Ch courses, the postgradute students were posted for a short duration of 1–2 months to other teaching institutions such as AIIMS, New Delhi, NIMHANS, Bangalore and GB Pant Hospital, New Delhi. The extramural postings proved useful to the candidates.

Ph.D. Programmes:

The scheme offered to the staff for internal registration for Ph.D. degree continued to be popular and four new registrations were made during the year (Table–5)

Table–5

Name of Staff Member	*Thesis area*	*Guide*
Mrs. Lissy Kalliyanakrishnan	Studies on mechanisms and modulations of platelet aggregation	Dr. M. Jamaluddin, Scientist in-charge Thrombosis research unit of the Institute.
Sri. V. Kalliyanakrishnan	Studies on polymer grafts for Biomedical application	Prof. Joseph Francis, Head, Dept. of Polymer Sciences & Rubber Technology, University of Cochin.
Mrs. Prabha D. Nair	Polymer alloys for biomedical applications	Dr. V.N. Krishnamurthy, Group Director, VSSC, Trivandrum.
Sri. K. Sreenivasan	The Mobility of Physiological fluid components in the polymeric devices.	Dr. K.V.C. Rao, Head, Chemicals group, VSSC, Trivandrum.

Training and retraining opportunities for academic staff

During 85–86, two faculty members were deputed by the Institute for special training abroad. Dr. C. C. Kartha received training in cardiac electron microscopy in the laboratory of Dr. Victor Ferrans, National Institute of Health, Bethesda, USA for a period of three months. Dr. V.V. Radhakrishnan was similarly deputed for special training in neuropathology to the Department of Prof. Richardson, Harvard Medical School, Boston for a period of six months.

Dr. K. Mohandas, Prof. of Anaesthesia took sabbatical leave to spend a year in the Department of Anaesthesia, Guy's Hospital London. Dr. K. Subramonia Iyer proceeded on sabbatical leave for doing research for a year at the Rockefeller University, New York.

Training facilities for the staff of other institutions

The Institute continued to provide training without charging fees to staff members from other medical institutions from time to time. The details are given in the departmental reports.

Continuing Education programme

In an effort to share its experience with the medical fraternity, the Institute organised two continuing educational programmes on 'Recent advances in Cardiac and Neuro Sciences, and on 'Cardiovascular and cerebrovascular diseases' in August 1985 and February 1986 respectively. The response to the courses from the general practitioners of the region was encouraging.

Study visits by administrators

The Institute was visited by teams of officers in the administrative cadre of Governments during their educational course at the Institute of Management in Government. They evinced keen interest in the administrative practices and management techniques in vogue at the Institute.

Nursing education

The nursing staff organised a two day conference for nurses in the region as part of the Programme in nursing education. The topics covered included Coronary heart disease, Coronary artery bypass surgery, Atlantoaxial dislocation and Epilepsy with special emphasis on nursing aspects.

In-service education

Mrs. Saramma returned from RK College of Nursing, New Delhi after obtaining Masters degree in nursing and played an important role in improving the inservice educational programmes for nurses.

Conferment of Diplomas

For the first time since the commencement of the Act, the degrees of the Institute were confered on the successful outgoing candidates in a simple function on 24 February '86. The President of the Institute in his brief address stressed the special responsibility resting on the graduates of the Institute "to demonstrate to the world that progress in medical science need not be followed by its dehumanisation and that the powerful winds of technology need not uproot patient care from the soil of compassion."

DEPARTMENTAL REPORTS

HOSPITAL WING

Advanced Centre for the Study of Endomyocardial fibrosis (Sponsored by the Indian Council of Medical Research)

Prof. M.S. Valiathan, Ch.M., F.R.C.S., (Edin & Eng) F.R.C.S. (C), F.A.C.C., F.A.M.S., F.A.Sc., FNA.	Head of the Centre
Dr. C.C. Kartha, MD	Assistant Professor of Pathology
Dr. Renuka Nair, Ph.D.	Lecturer Pathology
Mr. M. Shivakumar, M.Sc.	Senior Research Officer
Dr. Prabha Nini Gupta, MD	Research Officer

Consistent with the growing stress on non-communicable diseases, the IndianCouncil of Medical Research established an Advanced Centre for the study of endomyocardial fibrosis at the Institute on 1-7-85. Approved for funding for five years, the Advanced Centre was expected to study the problem of endomyocardial fibrosis intensively and develop a myocardial cell culture model for investigating the pathogenetic factors in the disease. At the conclusion of the study period, the Advanced Centre could be expected to offer a new understanding of endomyocardial fibrosis and evolve a new unit for cellular cardiology at the Institute.

During the year, Dr. M. R. Das, Deputy Director of the Centre for Cellular and Molecular Biology, Hyderabad assisted the Institute in organising a new labo-

ratory and training Dr. Renuka Nair for myocardial cell culture work. Mr. Shivakumar, a biochemist and Dr. Prabha Nini Gupta, MD, in general medicine and ICMR talent scholar, joined the Centre to contribute to the diverse aspects of the experimental protocol which had been finalised in consultation with Dr. Robert L. DeHaan, Director, Programme in Cardiac Cell Function, Department of Anatomy and Cell Biology, Emory University School of Medicine, Georgia.

During the short period since the organisation of the laboratory, methods were standardised for the collection of human foetal heart and its dissection, isolation of myocytes and the preparation of media.

Department of Anaesthesiology

Dr. K. Mohandas, MD (on sabbatical leave)	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	Assistant Professor
Dr. K. Muralidhar, MD	Lecturer
Dr. M. Shahani, MD	Lecturer
Dr. D. Saxena, MD	Lecturer
Dr. S. Bhanumoorthy, MD	Candidate for post-doctoral certificate
Dr. S. K. Deshpande, MD	–do–

The Department provided responsive support to the growing volume of neurosurgery and cardiac surgery which registered a marked jump in cardiac procedures to 882 from 602 of 84–85. Anaesthetic services were also made available for the new thoracic unit which performed over 200 surgical procedures in the Department of Cardio-thoracic Surgery during the year. As in previous years, anaesthetic coverage

was provided whenever necessary for investigative procedures in cardiology and radiology and for the emerging practice of intervention radiology.

Apart from their total involvement in patient care in the operating rooms and intensive care units, the staff of the Department pursued diverse research interests. Dr. Rathod completed the first phase of the experimental evaluation of the intravenous lipid formulation which had been developed by the Central Food Technology Research Institute, Mysore. Dr. Padmanabhan collaborated with Mr. Bhuvaneshwar of the Division of Artificial Internal Organs in the development of a simple, effective and low cost humidifier adaptable to diverse models of artificial ventilators.

In addition to offering training for the post-doctoral Certificate Course, the Department accepted MD students in Anaesthesia from the Medical College, Trivandrum for short term observational postings.

Dr. Mohandas who was appointed Professor of Anaesthesiology proceeded for a year to the Guy's Hospital, London for gaining additional experience in paediatric cardiac anaesthesia.

Division of Biochemistry

Dr. K. Subramonia Iyer, Ph.D. (on sabbatical leave)	Associate Professor
Mrs. Santha A. George, -M.Sc.	Scientist
Dr. N. Jayakumari, Ph.D.	Lecturer

In view of the continuing increase in the number of investigations in clinical biochemistry a decision was made to set up a new and expanded laboratory incorpora-

ting clinical biochemistry with additional equipment and manpower. Scheduled to go on stream within a few months, the new laboratory was expected to streamline and update clinical tests and significantly improve the efficiency of inpatient and outpatient services.

The main research effort of the Division was focussed on the interaction between human serum proteins and artificial materials.

Dr. Iyer left on sabbatical leave for a year to take up a research position at the Rockefeller University, New York.

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 certain major differences. Electrophoretic studies showed conformational changes in conjugate proteins on prolonged storage.

Division of Blood Transfusion Service

Dr. P.A. Jayaprakash, MBBS, DIBT	Chief Blood Transfusion Officer
Dr. Jaisy Mathai, MBBS, DCP	Junior Blood Transfusion Officer
Dr. P.V. Sulochana, MBBS	Junior Blood Transfusion Officer

The addition of a full-time medico-social worker to the staff provided a new impetus to the voluntary donor motivation programme which involved social agencies

more extensively than in previous years. With the assistance of organisations such as the Kerala Association for Non-Formal Education and Development a fresh effort was made to spread the message of voluntary blood donation among the public and to provide guidance for the formation of blood donor clubs. These efforts contributed in no small measure to the success of the Division in meeting the greatly increased demand for blood from the Surgical Departments of the Institute.

Apart from providing whole blood, blood components were provided for over 500 procedures and therapeutic plasma pharesis carried out for 34 neurologic patients. The Division also responded to the emergency calls for cryoprecipitate from other institutions which lacked the facilities for blood component separation.

The research effort of the Division continued to focus on the development of chitra blood bag system which underwent extended clinical trial successfully. Collaborative work with the Division of Pathophysiology also made progress in relation to the preparation and standardisation of haemoglobin solution.

Dr. W.J. Lockyer and Dr. Anstee of the National Blood Transfusion Service of U.K. visited the laboratories and held detailed discussions on the status of the development of Chitra blood bag system.

Department of Cardiology

Dr. K.G. Balakrishnan, MD, DM, FACC MNAMS	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. M.V. Joseph Joy, MD, DM	Lecturer
Dr. K. Srinath, MD	Candidate for DM
Dr. Geevar Zachariah, MD	–do–
Dr. M. Srinivasan, MD	–do–
Dr. M.F. Gopinath, MD	–do–
Dr. Shilendra Singh, MD	–do– (Tata Scholarship)
Dr. A. Nageswara Rao, MD	–do–
Dr. Asha Rajan, MD	–do–
Dr. K.K. Haridas, MD	–do–

The patient service in terms of out-patient visits, investigations and cardiac catheterisation procedures showed an average increase of 25% over the previous year and necessitated the restructuring of followup visits in the form of a series of special clinics. The procedures which were successfully introduced or extended in collaboration with the Division of Radiology included atrial septostomy, pulmonary valvulotomy and peripheral angioplasty with balloon catheters. The addition of an ATL-Ultra mark 8 echo-cardiograph and AV sequential pacemaker was responsible for a substantial increase in the number of non-invasive and cardiac conduction studies.

Dr. Subramaniam rejoined the Department after an absence of two years at the Green Lane Hospital, Auckland, New Zealand where he had received special training in paediatric cardiology. The Department accepted a doctoral candidate from the National Institute of Mental Health & Neuro Sciences, Bangalore for carrying out a study on the 'psychological aspects of young patients following myocardial infarction'.

A team of senior cardiologists led by Prof. Yuri N. Belenkov, Deputy Director, USSR Cardiology Research Centre visited the Institute in March and conducted a seminar on the current status of cardiology in the USSR. Other prominent visitors to the Department included Professors M. Mukharlyamov and V.N. Orlov from the Soviet Union.

Dr. K.G. Balakrishnan was appointed Professor of Cardiology.

Department of Cardiothoracic Surgery

Dr. M.S. Valiathan, Ch.M. (L'pool), FRCS(Edin), FRCS (Eng) FRCS(C) FACC, FAMS, FNA, FASc.	Professor and Head of the Department.
Dr. M.P. Mohan Singh, FRCS (Eng) FRCS (Edin)	Professor
Dr. K.S. Neelakantan, M.S. M.Ch.	Assistant Professor
Dr. R. Sankarkumar, MS, M.Ch.	Assistant Professor
Dr. K.G. Shyamakrishnan, MS, M.Ch.	Lecturer
Dr. M. Unnikrishnan, MS, M.Ch.	Lecturer
Dr. Aruna Kashyap, MS, M.Ch.	Lecturer
D. Ranjit, BE	Perfusionist
Dr. Baljitkumar Sharma, MS	Candidate for M.Ch.
Dr. A.B. Bhoyar, MS	–do–
Dr. Prakash, MS	–do–
Dr. Suresh G. Rao, MS	–do–
Dr. J.T. Tolia, MS	–do–
Dr. Rajendra Prasad, MS	–do–
Dr. S.R. Krishna Manohar, MS	–do–

The Department achieved a three fold increase in the performance of open heart and other cardiac procedures which totalled 882 during the year. The increase in the volume of services made it possible to minimise or eliminate the waiting period for cardiac operations for all patients except those awaiting valve replacement.

The Department took a far-reaching step in subspecialisation during 85–86 by opening a new sub division for Thoracic and Vascular surgery in the original hospital building. Set up with 24 beds, 6 postoperative beds and two operating rooms, the Thoracic and Vascular Division carried out an average of 4 surgical procedures per week during its first year of existence. The substantial increase in the volume and range of cardiothoracic and vascular surgery was not only directly beneficial to patients but was no less promotive of surgical training and teaching.

As in previous years, the research effort of the Department was principally concerned with the development of cardiovascular devices. Following the approval by the Institute's Ethics Committee, the rigid shell cardiotomy reservoir and disposable oxygenator entered early clinical trial which was expected to continue throughout 1986 prior to their multicentric evaluation. The staff of the Department played an important role in the development of a sheep model for the successful longterm evaluation of the Chitra tilting disc valve as an essential pre-clinical requirement.

The establishment of an Advanced Centre on Endomyocardial Fibrosis by the Indian Council of Medical Research under Prof. Valiathan forged close links in biomedical research between the surgical group and the Division of Pathology. As the programmes of the Centre involved myocardial cell culture, trace element studies and other similar techniques, a new possibility for excursions in surgical biology was opened for the Department of Cardiothoracic Surgery.

Dr. John Cleland, Senior Consultant Cardiac Surgeon, Queen's University, Belfast visited the Department and gave lectures on his experience with the St. Jude prosthesis and coronary artery bypass surgery. Dr. John F. Dark, Senior consultant in Cardiothoracic Surgery, from Manchester paid a one week visit to the Institute on behalf of the British Council and delivered lectures on carcinoma of the oesophagus, Omniscience valve and the evolution of cardiothoracic surgery in the United Kingdom.

Dr. V. Nandakumar, Associate Professor of Cardio Thoracic Surgery, Calicut Medical College, spent part of his Betts Fellowship and Dr. Diglikar and Mr. Surya Prakash Rao visited the Department as Ethicon Fellows of the Association of Thoracic and Cardio-vascular Surgeons during the year. Two M.Ch. candidates from the Jayadeva Institute of Cardiology, Bangalore spent a period of one month to observe the practice of cardiac surgery and the status of ongoing research programmes.

Dr. Mohan Singh was appointed Professor of Cardiothoracic Surgery.

Professor Valiathan received the 1985 Rameshwardas Birla National Award in Medical Sciences.

Division of Microbiology

Dr. J. Shanmugham, Ph.D.	Associate Professor
Dr. Ashalatha Nair, MD.	Lecturer
Mr. M. Ravindranath, B.Sc.	Scientific Assistant
Miss. Molly Thomas, M.Sc., DMV.	–do–

The diagnostic work in bacteriology increased by 30% over the previous year following the commissioning of the Sethu

Parvati Bayi Surgical Centre. Apart from suckling mice inoculation and embryonated egg inoculation, BHK 21 cell line, Influenza A and Mumps virusess were procured and maintained for viral diagnosis. The new tests introduced included Anti-CHo anti-body technique for rheumatic heart disease.

Dr. J. Rotta, Director of WHO Regional Reference Centre for Streptrococci, Prague visited the Division. Dr. Shanmugham participated in several national symposia on Hepatitis B–virus infections, streptococcal infections and resistance and was a collaborative organiser of the Second National Workshop at Madras on the Serologicalmarkers of hepatitis B virus infections. He became a member of the American Society for Microbiology, European Society for Clinical Microbiology and French Microbiology Society.

Project	—	Study of Single Radial Haemolysis in gel (SRHG) technique; Comparison of Human Viruses and Different Animal Erythrocytes in Assessing the Specificity and Sensitivity.
Principal Investigator	—	J. Shanmugham
Co-Investigators	—	M. Ravindranath
	—	Molly Thomas
Funding	—	Indian Council of Medical Research
Duration	—	Two Years
Status	—	Ongoing.

Department of Neurology

Dr. P.K. Mohan, MD, DM	Associate Professor
Dr. John Tharakan, MD, DM	Assistant Professor
Dr. C. Sarada, MD, DM	Lecturer
Dr. Muralidharan Nair, MD, DM	Lecturer
Dr. Chetan Trivedi, MD	Candidate for DM
Dr. G.M. Wali, MD	–do–
Dr. Abdul Majeed, MD	–do–
Dr. K.S. Sunil Kumar, MD	–do–
Dr. T.A. Subramanian, MD	–do–
Dr. Sanjeev Thomas, MD	–do–
Dr. Lekha Bhaskaran, MD	–do–

In spite of the relatively small size of the faculty, the Department was able to run its patient services smoothly and introduce improvements such as special clinics for Epilepsy, Pain and Stroke thrice a week. The addition of a computerised system for the study of evoked potentials heightened interest in electro-physiology and its use for investigating the nervous system in health and disease.

The main research interest of the Department related to clinical and experimental meningitis which was studied jointly with the Divisions of Pathology and Microbiology. The members of the faculty took full part in the teaching programme for DM for postgraduate students.

Prof. James W. Lance from Australia visited the Department and held discussions with its students and staff.

Dr. P.K. Mohan attended the Second Neuro-physiology Workshop at Jaslok Hospital and Dr. John Tharakan received the E. Merck medal for his paper on 'immuno-histological studies in acute infective polyneuritis' at the annual conference of Neurological Society of India.

Department of Neurosurgery

Dr. Damodar Rout, MS, M.Ch.	Professor
Dr. R.N. Bhattacharya, MS, M.Ch.	Assistant Professor
Dr. B.K. Mishra, MS, M.Ch. MNAMS	Lecturer (on leave)
Dr. Rajeev Sharma, MS, M.Ch.	Lecturer
Dr. R.C. Mishra, 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–
Dr. Sarala Menon, MS	–do–
Dr. Satish Krishnan, MBBS	–do–

A relatively small faculty notwithstanding, the Department witnessed a steady increase in the number of neurosurgical procedures a large proportion of which were major intracranial operations. While special attention was paid to the development of microsurgical work, a new trail was blazed in partnership with the Department of Radiology by introducing therapeutic embolisation for inoperable cerebral arterio-venous malformations during the year.

The Department established its first major link with the technology programmes of the Institute by entering into a collaborative project on the development of an indigenous hydrocephalus shunt system. The project was expected to produce a low cost shunt of high reliability which enjoys great demand in the country.

Dr. Don M Long, Professor & Chairman of Neurosurgery, Johns Hopkins Hospital, USA served as a Visiting Professor for a week in November '85. Apart taking part in neurological procedures, he addressed the students and staff on subjects of neurosurgical interest.

Dr. Rout was appointed Professor of Neurosurgery.

Project	—	Development of an indigenous viable hydrocephalic shunt system
Principal Investigator	—	D. Rout
Co-Investigators	—	G.S. Bhuvaneswar
		A.V. Ramani
Status	—	Ongoing

Prof. Rout gave a guest lecture at the Madurai Medical College on cerebral angiomatous malformations.

Dr. B.K. Mishra, Lecturer in Neurosurgery, extended his leave to spend an additional year for advanced training at the Department of Neurosurgery, Edinburgh.

Division of Neurochemistry

Dr. Debkumar Basu, Ph.D.	Professor
Dr. P.S. Appukuttan, Ph.D.	Lecturer
Mrs. K.I. Annamma, B.Sc.	Scientific Assistant
Mrs. V. Jyoti V. Nair, M.Sc.	Candidate for Ph.D.
Mr. E.G. Abraham, M.Sc.	–do–
Mr. Madhusudhanan Nambiar, M.Sc.	–do–

In structural studies on glycoproteins and their interaction with lectins, the membrane-bound-galactose-binding proteins of bovine and human hearts and normal human placenta were investigated. The protein of heart muscle was found to be in three different forms by affinity electrophoresis. Furthermore rabbit antibody to placental galactose-binding protein cross reacted with the same proteins of normal

and developing human heart, brain, kidney, liver, skeletal muscle and bovine heart muscle. Investigations to identify the native receptor of the same proteins are currently in progress.

An α–galactosidase enzyme which co-exists with α–galactose–specific lectin in jack fruit seed was purified and characterised. It was found to bind specifically the Ig A fraction of human immunoglobulin. This lectin was subsequently commercialised by Pierce Chemical Co., USA who acknowledged the original contribution from this laboratory.

In ongoing studies on endomyocardial fibrosis an immuno-fluorescence probe using rabbit antibody to eosinophil basic protein was developed for detecting eosinophil infiltration in the endomyocardial tissue of patients. The serum of patients was also investigated to determine whether any glycoproteins had a pathogenetic role in endomyocardial fibrosis.

Prof. Basu served as a Visiting Professor in the Department of Biochemistry, University of Notre Dame for two months. Sri FA Khan and Smt. PN Sarasija who had worked earlier as Research Fellows were awarded Ph.D. degrees by the University of Aligarh and Kerala.

Project	—	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. Sandhyamani, MD	Lecturer
Dr. R. Renuka Nair, Ph.D.	Lecturer
Mrs. Annamma Mathai, M.Sc.	Scientific Assistant

The overall increase in the volume of patient services was reflected in the rise in the number of investigations in clinical pathology, surgical pathology, frozen section studies and immunopathology tests which collectively registered a 35% increase over 84–85 level. The autopsy rate continued to remain at 30%

The new additions to the range of investigations included histochemical techniques on cryostat cut muscle sections and single tease nerve fibre preparations and cytologic techniques for the rapid diagnosis of intra-thoracic neoplasms.

The research effort of the Division received a boost with the establishment of the Advanced Centre for Endomyocardial fibrosis which had attracted investigative attention earlier. The new facility sought to establish a myocardial cell culture model for probing the aetiopathology of endomyocardial fibrosis and for studying myocardial cell function in health and disease. The advent of techniques for myocardial cell culture, trace element analysis and ultrastructural study greatly enhanced the investigative potential of the Division during 85–86.

A close review of arterial tissues removed during reconstructive procedures in young patients revealed similarities in the histopathologic lesions with those reported

from Africa and suggested a possible nutritional basis for the 'arteritis'. Further studies based on this interesting observation were initiated with a view to the development of a suitable animal model.

During the year, Dr. Kartha was deputed to the Section of Dr. V.J. Ferrans, NIH Bethesda and Dr. Radhakrishnan to the Department of Prof. Richardson Harvard Medical School for training in cardiac electron microscopy and histochemical techniques for muscle biopsies. Dr. Kovacs Department of Neuro pathology, St. Michaels Hospital, Toronto visited the Division and gave a lecture on the ultrastructural and immunochemical aspects of pituitary adenoma.

Department of Radiology

Dr. V.R.K. Rao, MD	Associate Professor
Dr. Ravimandalam, MD	Assistant Professor
Dr. Arun Kumar Gupta MD	Lecturer
Dr. A. Balathimmaiah, MD	Candidate for post-doctoral Certificate Course
Dr. Sunil Kumar, MD	–do–

As in previous years, the routine work load of the division consisted of carotid angiography, four vessel angiography, myelography, air-myelography, cardiac angiography and CT Scanning. The referral of patients from other institutions for CT scanning continued to increase in number and confirmed its popularity. An exercise was begun in consultation with the computer Division for the storage, retrieval and analysis of radiological data.

The most important developments during the year were the increasing use of percutaneous transluminal angioplasty for

peripheral arterial occlusions and the super selective angiography and embolotherapy of intracranial arterio-venous malformations using IBCA. The latter technique which is illustrated in figs 9–14 is probably among the first such attempts in India.

Intervention radiology received major emphasis in the research efforts of the Division too. In a tripartite collaboration, the assistance of the chemical Group of Vikram Sarabhai Space Centre and Hindustan Latex was obtained for the development of 2–Hydroxy Ethyl Methylacrylate (HEMA) and latex mini-balloon for the embolotherapy of intracranial aneurysms. Prof. Luc Picard, Professor

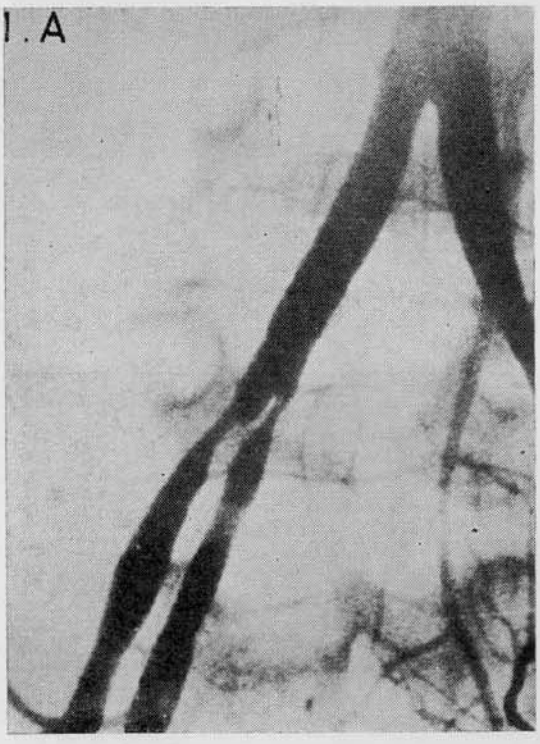

Fig. 9 Narrowed external & internal iliac arteries

Fig. 10 Inflated balloon in position

Fig. 11 Reopened arteries after angioplasty (PTA)

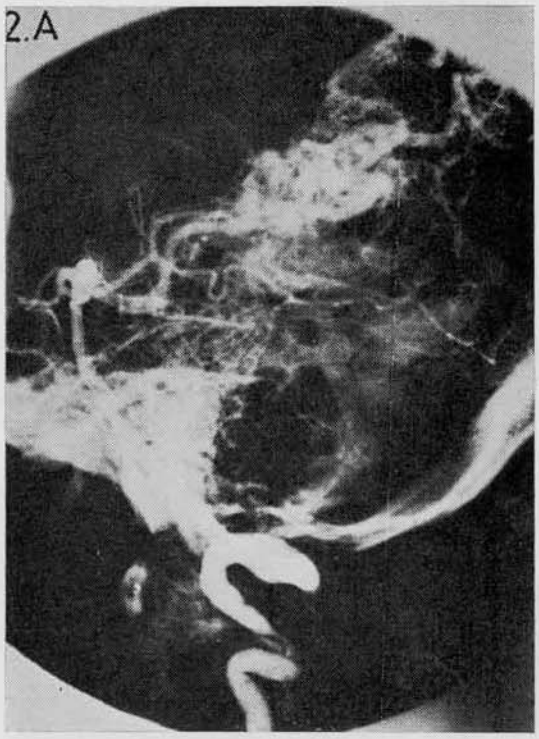

Fig. 12 Cluster of abnormal blood vessels in the brain (Arteriovenous malformation)

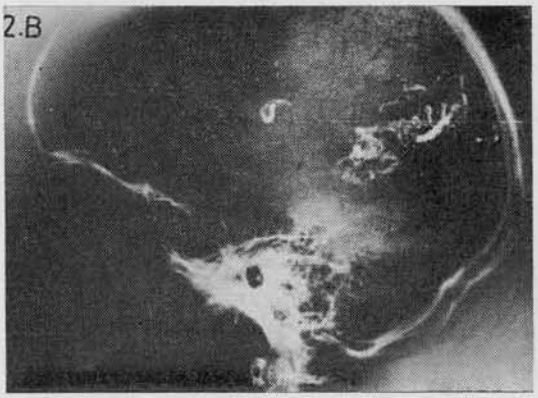

Fig. 13 Cast of the liquid substance (IBCA) in the core of the abnormality (AVM)

Fig. 14 Significant reduction of blood flow into AVM

of Neuro Radiology, Nancy, France visited the Department and gave lectures on intervention radiology and demonstrated balloon catheter techniques. Prof. P.C. Rajaram, Prof. of Radiology, Barnard Institute for Radiology, Madras served as a Visiting Professor and taught a course in cardiac radiology.

LCdr. V. Sethumadhavan of the Indian Navy underwent 6 months training in CT Scanning and two MD students in radiodiagnosis from the Medical College, Trivandrum spent a month for observing radiological techniques in the Division.

BIOMEDICAL TECHNOLOGY WING

Head:

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

Department of Biomaterials Science

(i) Division 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

As part of the ongoing studies on the effect of various methods of sterilisation on biomedical polymers, the effect of steam and gamma irradiation on polyvinylchloride (PVC) and polypropylene (PP) was investigated. It was observed that steam sterilisation could cause considerable variation in the migration characteristics of Di–2 ethyl hexyl phthalate (DEHP) and the molecular architecture of PVC. The degradative changes which increased with repeated autoclaving had their origin at the chain branches and extensive structural damage of PVC backbone. The structural damage was further reflected in short and long chain branches inducing variations in length and degree of chain branches. Multiple steam sterilisations were also noted to alter the micromorphology of PVC. The ATR spectral studies confirmed that the stereo-regularity and chain branching of sterilised PVC varied in covered and uncovered samples. DSC studies of sterilised samples indicated changes in glass transition temperature-, Tg, which was not in linear relationship with changes in syndiotacticity. Variation in the length of chain

branches was found to have a predominant effect over the variations in syndiotacticity and Tg. It was found that the changes, secondary to irradiation sterilisation, in the material properties of isotactic polypropylene were substantially nullified by the aging of the radiation sterilized plastic. In addition to the crosslinking and degradation which are induced by irradiation, an unusual branching was found to occur with aging. Mechanical properties of the aged polymer showed a recovery of molecular weight and in turn tensile strength and modulus as a consequence of the branching of chains. The chain branching manifested in increased toughness and decreased crystallinity of the aged polymer. Currently the response of polypropylene to flash sterilisation is being investigated.

A DST funded project was initiated during the year.

Preliminary studies were carried out on the mechanical properties of different types of muscle as the first step in developing suitable elastomers with matching properties. Work was also initiated on the diffusion of molecules of biological origin into polymers following implantation, and on the development of polymer alloys (IPN) for biomedical applications.

Dr. Jayabalan gave lectures on the challenge for high polymers in biomedical applications, surface modification of polymers, effect of sterilisation of PVC and other topics at the University of Madras. He also served as a Visiting Professor in polymer Science at the Gandhiji University, Kottayam where he guided the M.Sc. dissertation work of a candidate.

Project	—	Studies on material –tissue interface of experimental prosthesis of reconstructive surgery
Principal Investigator	—	M. Jayabalan
Funding	—	Department of Science & Technology
Duration	—	3 years
Status	—	Ongoing

(ii) Division for Thrombosis Research:

Dr. M. Jamaluddin, Ph.D.	Scientist
Mrs. Lissy Kalyanakrishnan, M.Sc.	Scientific Assistant

The major research effort related to further studies on the putative prostaglandin endoperoxide receptor haemoprotein which had been discovered earlier in this laboratory. A procedure to obtain the protein in better yield and purity was worked out and its antibody raised in rabbits. The antibody was used to ascertain the purity of the protein preparation and to demonstrate its modification by in vitro treatment with various platelet agonists, employing immuno diffusion techniques. Further work was in progress to validate the platelet aggregation assay and the kinetic formulation of the aggregation reaction which had been worked out in this laboratory.

Dr. Ghafoorunissa, Asst. Director, National Institution of Nutrition, Hyderabad received training in platelet aggregation assay in the laboratory.

Department of Biomedical Engineering

(i) Division of Artificial Internal Organs

Mr. G.S. Bhuvaneshwar, B.Tech., MS — Biomedical Engineer
Mr. C.V. Muralidharan, B.Tech. — Scientific Officer
Mr. R. Sreekumar, B.Sc. — Scientific Assistant

The prolonged effort for the experimental evaluation of the Chitra Tilting disc valve became successful during the year and provided routine long term survivors among sheep undergoing mitral valve replacement. While the valve function was found to be excellent in terms of hydraulic function, freedom from thromboembolism and quality of animal survival, the harvested samples at periodic intervals demonstrated the desirability for enhancing the surface hardness of the valve housing. This important contribution from invivo studies led to the substitution of titanium by Haynes alloy for the valve housing which consequently showed greatly improved results in engineering tests and further animal trials. The modifications in the valve housing were responsible for a delay in the clinical trial of the Chitra Valve which was, according to present indications, expected to take place in early 1987.

The polyester vascular graft project was completed in collaboration with the South India Textile Research Association as the two year period of observation of implanted grafts in pigs came to an end. The results confirmed that the graft compared favourably with the imported models in current use in terms of biocompatibility, calcification index, patency, loss of burst strength and other important parameters.

The Division entered a new field with the opening of a project in collaboration with the Dept. of Neurosurgery in the development of a Hydrocephalus shunt. Another linkage with hospital services was forged by the design of a low cost and reliable humidifier which was found very satisfactory by the Dept. of Anaesthesia.

Prof. K.B. Chandran of the Dept. of Biomedical Engineering, University of Iowa, visited the Institute and held discussions with the staff of the Division on his extensive experience with the study of the fluied mechanics in relation to cardiac valves. His lecture on the testing of heart valve prosthesis was topical and instructive.

(ii) Division of Biomaterials Technology

Mr. A.V. Ramani, B.Sc. (Chem. Tech.)
Mr. B. Ajit Kumar, B.Tech. Scientific Officer

Given its commitment to the preparation, evaluation and fabrication of nonpolymeric materials and coatings, the Division succeeded in developing a process for nitriding of titanium using a quartz tube furnace and IOLAR 1 purity nitrogen. Being an integral process the titanium nitride layer was found to resist peeling and to be extremely hard, golden yellow in colour and of excellent lubricity. (Fig. 15).

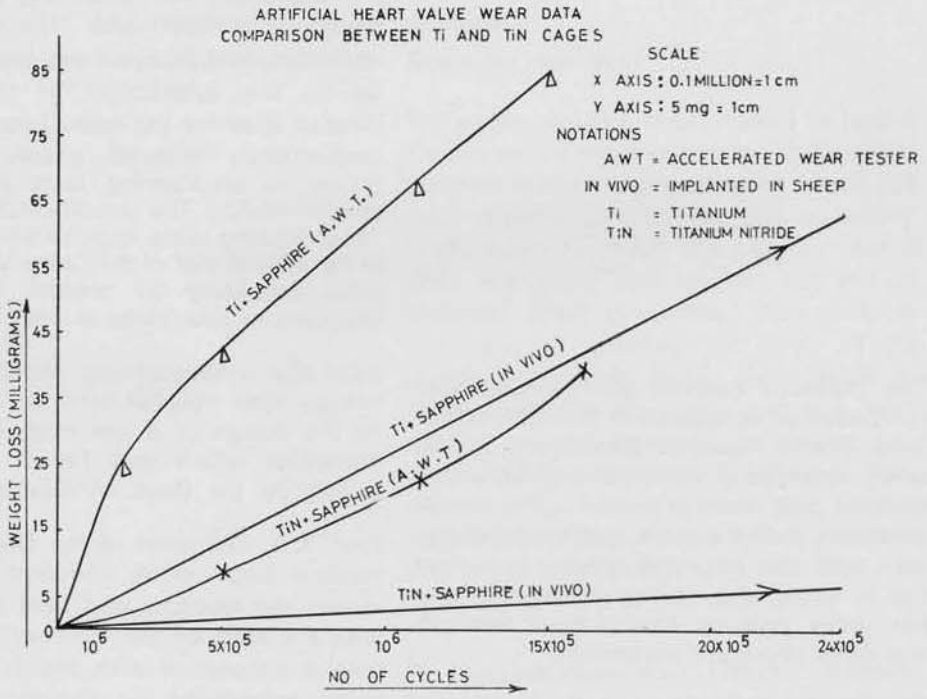

Fig. 15 Comparison of Ti and TiN Cages

This work was extended in collaboration with the Division of Artificial Internal Organs, National Aeronautic Laboratory, Bangalore and Indian Space Research Organisation for evaluating other wearresistant coatings such as nickel borides, silicon-carbide-nickel, chromium oxide and others on various subtrates for highly demanding applications. The Division took up the development of S.S. dental bands from indigenous materials as a project supported by the Indian Council of Medical Research.

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1. Project — Evaluation of indigenous Stainless Steel materials for use as dental bands

   Principal Investigator — A.V. Ramani

   Funding — ICMR

   Duration — 2 Years

   Status — Currently developing S.S, dental bands from indigenous material.

In another collaborative project, the evaluation of carbon-carbon composites for biomedical application was also initiated by the Division.

2.	Project	—	Development of Carbon-carbon composite as bio-materials
	Principal Investigator	—	A.V. Ramani
	Collaboration Institution	—	National Physical Laboratory, New Delhi
	Funding	—	Department of Science & Technology
	Duration	—	$2\frac{1}{2}$ years
	Status	—	Evaluating carbon-carbon composites for suitability as biomaterials.

(iii) Division of Biosurface Technology

Dr. Chandra P. Sharma M.Tech. MS. Sc.D., MEBE — Scientist

Mr. Thomas Chandy, M.Sc. — Scientific Assistant

As the three fractions of human fibrinogen vary in their response to platelet binding and aggregation, the fractions were separated by chromatography on DEAE cellulose and reacted with ADP stimulated calf platelets with an artificial surface. The affinity of these fractions to bind at the polymer interface from a mixture of serum proteins was also investigated using PAGE of the desorbed proteins from the surface. The studies showed that the cohesion of ADP stimulated platelets to the polymer substrate in the presence of the first and second fractions of fibrinogen was similar. The third fraction however showed an inhibition of platelet binding at the interface. The amount of albumin and fibrinogen absorbed to the surface was also similar for the first and second fractions

whereas the third fraction showed a drastic increase in albumin surface concentration and reduction in fibrinogen. The findings suggested that platelets adhered wherever they found adsorbed fibrinogen and that the reduced surface binding of platelets in the presence of the third fraction of fibrinogen might be due to its low affinity for binding with platelets or with the surface.

An attempt was made to analyse the role of CAMP in modifying protein polymer interactions using ^{125}I labelled albumin and ^{125}I fibrinogen as tracers. PAGE was also performed after desorbing the surface bound proteins using Triton X–100. The preliminary data suggested that CAMP enhanced the surface binding of albumin and reduced the fibrinogen surface concentration from a mixture of proteins.

In a study of antihypertensive and antianginal drugs which were reported to have antiplatelet activity, their role in modulating platelet–protein interaction at the polymer interface was investigated. The results suggested that most of the drugs inhibited the surface binding of platelets and reduced fibrinogen surface concentration. On the basis of these and other findings, an effort was on to evolve a unified concept of artificial surface-protein platelet interaction in the presence of mediators for the modulation of interfacial phenomena.

Developmental work continued on a kink resistant small diameter vascular graft ($<$ 5 mm) with multilayer of albumin and capacity to release CAMP. Immobilisation of other bioactive molecules on the graft surface was also investigated with varying degrees of success. A beginning was also made in developing artificial skin

from albumin immobilised collagenated surface of polyether urethane urea.

Funding was approved by the Department of Science & Technology for a new project.

Dr. R.E. Baier, Director, Health Care Instrumentation and Device Institute State University of New York, Buffalo visited the Department and held discussions with the scientists on projects of mutual interest under Indo–US programmes Dr. Baier, also inaugurated the newly formed Society for Biomaterials and Artificial Organs-India with a lecture on Biocompatibility of Materials on January 24, 1986. Dr. Sharma became the President of this Society.

Dr. Sharma attended second National Symposium on surfactants emulsions and Biocolloids on Dec. 22–24, '85 at IIT New Delhi and presented a paper on Albuminated surfaces with Cyclic CAMP Release: Blood Compatibility.

Project	—	Studies on improving synthetic Biomedical Membrane for Haemodialysis
Principal Investigator	—	C.P. Sharma
Funding	—	Department of Science & Technology, New Delhi
Duration	—	Three years
Status	—	Just approved

(iv) Division of Extracorporeal Devices

Mr. V.S. Venkatesan, BE Biomedical Engineer

Mr. V.S. Venkatesan, Dr. Arthur Vijayan Lal and Sri. Vijayan jointly received the Independence day Award from the National

Research & Development Corporation for the design and development of the Chitra Variflo Oxygenator. The new device won special praise for its innovative features such as an integral cardiotomy reservoir and flow control module for adult or paediatric application.

The Variflo Oxygenator as well as a rigid shell cardiotomy reservoir were approved by the Institute's Ethics Committee in January 1986 for clinical trial which was expected to take place throughout 1986.

The multicentric trial and transfer for commercial production of the devices was slated to follow the successful completion of their initial clinical trial at the Institute.

(v) A. Division of Research Toxicology

Dr. P.V. Vedanarayanan, B.V.Sc., Ph.D — Senior Materials Toxicologist
Dr. A.C. Fernandez, Ph.D. — Scientist

Thanks to the increase in the volume of tests for candidate materials, the Division of Toxicology was restructured during the year and a separate unit established for the routine screening of materials intended for biomedical applications. In the revised arrangement, the Division of Research Toxicology was charged with the responsibility for developing new concepts and techniques in toxicology in so far it applied to materials in medical engineering.

A project taken up during the year related to the immunologic response to bioimplants which was initially assessed by studying serum protein changes by PAGE in rabbits following subcutaneous implantation of material samples. In a series of experiments with PVC samples,

implantation seemed to result in reduction and changes in the gamma globulin fraction compared to controls who had only a sham operation. This approach was shortly being extended by a study of other implant materials and the addition of other immunologic techniques such as passive haema-agglutination, passive cutaneous anaphylaxis and compliment fixation test.

In another study, the haemocytes of periplaneta americana (Common Cockroach) were used as a possible tool for the evaluation of materials toxicity. The early results were encouraging and further work for developing the model was expected to continue.

Experimental work was undertaken for improving the technique for evaluating leachable moieties which are currently determined by ultra violet spectrophotometry. The alternate method was a combination of thin layer chromatography and spectrophotometry which seemed to give more reliable estimates of substances like DEHP in PVC samples.

Dr. Vedanarayanan served as a guide for Mr. Rathinam in his doctoral research project. He was appointed by the Government of Kerala as a member of a special committee to study of suitability of using polyethylene bags for packing arrack.

(v) B. Division of Toxicological Screening of Materials

Mr. K. Rathinam, M.Sc. Scientist
Dr. S. Bhaskara Rao, MVSc. Veterinary Surgeon

This newly created Division was the direct outcome of the greatly increased need for screening of candidate materials and stand-

TABLE 6
NAME OF DIVISIONS, NUMBER OF NON-STATUTORY AND STATUTORY TESTS CARRIED OUT

Name of the Division	*No. of materials*	*IM*	*Non-Statutory Tests*				*Mandatory Tests*				*Remarks*
			AOIT		*ICIT*						
			SCI	*CSO*	*SCI*	*CSO*	*Haemo lysis*	*Pyro-gen*	*Steri-lity*	*Saf-ety*	
A. **INTRA MURAL**											
Division of Bio-materials Technology	3	27	1	1	1	1	1				Acute oral toxicity of SS Materials
Division of Artificial Internal Organs	6	24	2	2	2	2	2				
Division of Polymer Technology	25		3	3	3	3	3	12	3	—	
Division of Extra Corporeal Devices	23		12	12	10	10	15	1	3	2	
Division of Patho-physiology	1							1		1	
Department of Radiology	5	19	1	1	1	1	1				
Technology Transfer Cell / Engineering Services	13								9		
B. **EXTRA MURAL**											
Bhor Industries Ltd., Bombay	1		1	1	1	1					Acute oral Toxicity studies on mice
TOTAL	77	70	20	20	18	18	22	14	15	3	

ardisation of tests which substantially determined the acceptance or otherwise of materials for biomedical application. Accordingly tests for materials and devices and format of reports were standardised according to internationally accepted protocols. The tests carried out during the year are given in Table 6.

The Division took up the responsibility for the breeding, management and supply of small laboratory animals for the experimental use of various research groups in the Institute including its own. Animal house facilities and assistance were also provided for ongoing studies on trace element effects on the rat myocardium and the development of artificial skin using polyetherurethane urea.

Sri. Rathinam assisted the technology transfer programme for the Chitra blood bag by suggesting test protocols and identifying accredited laboratories to carry them out during the phase of commercial production.

(vi) Division of patho-physiology

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

The marked increase in the service activities of the Division (Fig. 16) reflected the rising demand for biochemical, haematological and histopathologic examinations of samples from experiments conducted by several laboratories and scientific groups. Apart from meeting the demand cellulose acetate electrophoresis, spectrophotometric analysis for LDH, CPK and plasma haemoglobin and special histopathological staining for cryostat sections

were introduced as three new investigations during the year.

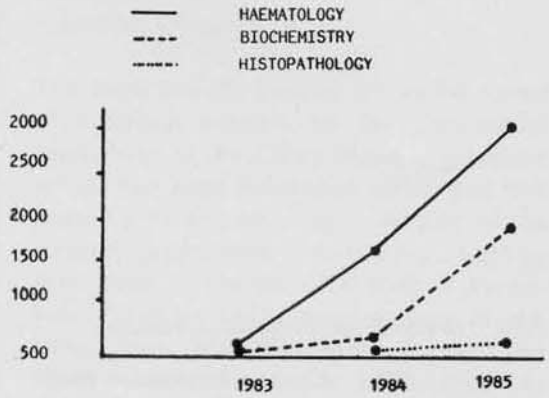

Fig. 16 Number of investigations in Pathophysiology

Considerable progress was made in the DST sponsored project on the preparation of haemoglobin solution. Stroma free haemoglobin solution was prepared several times and the preparation found to be characteristic of haemoglobin with a concentration of 9–11 grammes % by electrophoresis and spectrophotometry. It contained no blood group antigens and possessed no coagulant properties. Its electrolyte content and pH were also characterised and affinity for oxygen recorded. Methods for modifying the solution by polymerisation and pyridoxilation were standardised.

Project	—	Preparation and evaluation of suitable haemoglobin solution as a blood substitute
Principal Investigator	—	Mira Mohanty
Funding	—	Department of Science & Technology
Duration	—	$3\frac{1}{2}$ years
Status	—	Ongoing.

A special equipment was designed and fabricated with the assistance of Mr. A.V. Ramani for the controlled and gradual oxygenation and deoxygenation of blood and haemoglobin solution. The other equipment added during the year were a cryostat, freeze dryer, electrophresis apparatus, oncometer and double beam spectrophotometer.

Dr. Mira Mohanty became a coinvestigator in a project of the Division of Toxicological Evaluation of Materials on material tissue interface of experimental prosthesis in reconstructive surgery.

(vii) Division of Polymer Chemistry

Dr. A. Jayakrishnan, Ph.D.	Scientist
Mr. Chithambara Thanoo B.Tech.	Scientific Officer

Less than a year in existence, the efforts of the Division were concentrated on the setting up of a laboratory and the preparation of a grant application for a major research project. While progress was made in the purchase procedures for laboratory furniture, equipment, chemicals, a project proposal was written on the development of intraocular and contact lenses for submission to the grant agencies. Mr. Chithambara Thanoo joined the Division as Scientific Officer.

Given the rudimentary facilities, a research effort was made for the development of albumin micropheres for eventual use in drug targeting. Unlike the conventional methods which involve thermal denaturation of albumin in vegetable oils and cross linking, albumin micropheres in the 100 – 600° A range were developed by glutaradehyde crosslinking. The advantage of the albumin preparation would be its large surface area for very small weight and the enhanced coupling capacity for cytotoxic drugs. The assistance of the National Aeronautical Laboratory was sought for the characterisation of the size and morphology of albumin in the prepared samples.

(viii) Division of Polymer Technology

Mr. S.N. Pal, M.Sc., Tech.	Chemical Engineer
Mr. V. Kalliyanakrishnan, M.Sc.	Scientific Officer
Mr. M. Muralidharan, MS	Scientific Officer

The main activity centred on varied forms of technical support for the commercial production of the Chitra blood bag system which had been developed earlier and had passed a multicentric trial. As part of the support programme, on-the-job training was given to the technical staff of Peninsula Polymers Ltd., manufacturers of the blood bag, and assistance provided for them in laboratory scale production. In response to requests from other Divisions moulded components and other plastic accessories were supplied for research and development purposes. Collaborative support was given to the Department of Neurosurgery in their new project on the development of a hydrocephalus shunt.

Prof. Nikhil Sarkar, Head, School of Dentistry, Lousiana State University visited the Division and held detailed discussions with the Scientific Staff on the status of research in dental materials in the U.S.A.

(ix) Division of Technology Transfer

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

In view of the burgeoning demand in Indian hospitals, a market survey of disposables and medical implants was conducted by the Division. This was based on field work, interview with experts in different parts of the country and study of whatever data was available in relation to particular items. The result of the survey showed

the domestic demand for hospital disposables and medical implants to be Rupees 350 crores per annum with an annual growth rate of 10% (Fig. 17) The market survey filled an important lacuna in the indigenous efforts toward the development of a self-reliant biomedical technology.

As it was demonstrated that non-injectable crystalloids in plastic bags would remain sterile after one and a half years of irradiation and that significant growth rate in the consumption of non-injectable crystalloids existed in hospitals, the Division played a major role in preparing its knowhow package and offering detailed technical consultation on a non-exclusive basis for a small scale industry which had been identified by the Kerala State Industrial Development Corporation.

During the year a fresh patent application was filed for the rigid shell blood oxygenator - cum - cardiotomy reservoir and steps initiated for obtaining international patent protection for devices carrying unique features. In processing the patent applications and attending to hearings, the Division liaised with L.S. Daver & Co. of Calcutta who represented the Institute.

The participation of the Institute in the Moscow exhibition on the application of Science & Technology to improve health care and the U.S. exhibition on Festival of Science-India was largely due to the efforts of the Technology Transfer Division which designed and developed the display models.

As the pilot production of Chitra blood bags and tilting disc valves and the batch

production of rigid shell oxygenator com peted for the use of the clean room, the smooth operation of this facility was ensured by the Technology Transfer Division which also coordinated the production activities with the National Research and Development Corporation.

The demands of technology transfer of the blood bag to the Peninsula Polymers Ltd., were also fully met by the Division.

Mr. Vijaykumar was nominated as a member to represent the Institute in the medical instruments and appliances Sectional Committee of the Indian Standards Institution.

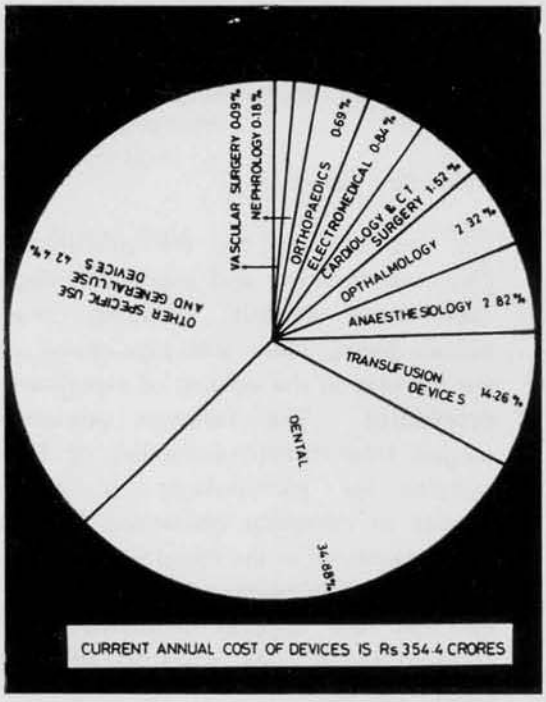

Fig. 17 Medical devices–percentage of speciality requirements

(x) Division of Tool Room & Engineering Services

Mr. O.S. Neelakantan Nair, B.Sc. (Engg.) — Tool Room Engineer

The routine activity covered a broad field and included maintenance of electrical and mechanical equipment, fabrication of special purpose machinery, mould making and prototype fabrication for other Divisions. The degree of utilisation of the Tool Room machinery increased greatly over the previous year.

In the pilot production of the Chitra Valve, the Tool Room Division played an important role by establishing the production technology.

Mr. Neelakantan Nair was deputed as a project officer on special duty to M/s. Peninsula Polymers Ltd., to assist them in the speedy implementation of the blood bag project.

(xi) Division of Vivarium

Dr. Arthur Vijayan Lal, B.V.Sc. — Veterinary Scientist

The responsibility for the procurement, care, management and preconditioning of experimental animals including sheep, calves, goats, dogs and pigs grew with the increase in the volume of experimental procedures. The research procedures ranged from simple collection of blood samples for immunologic or platelet studies to complete operations such as the replacement of the mitral valve in sheep under cardiopulmonary bypass. Table 7 indicates the support extended by the Division for a wide spectrum of studies during 85–'86.

Table 7
Experimental support to research projects

Study	*Investigating Division*	*Animal model*
1. Parenteral lipid formulation	Anaesthesiology	Dog
2. Variflo Oxygenator	Extra corporeal devices Cardiac Surgery	Sheep
3. Chitra Valve	Artificial internal organs Cardiac Surgery	Sheep
4. Miniballoon for intracranial vascular intervention	Radiology	Dog
5. Experimental aneurysm for intervention techniques	Radiology	Sheep
6. Woven graft	Artificial internal organs Cardiac Surgery	Pig

In addition to the procedures listed in Table 7 assistance was also provided to postgraduates from clinical Departments in the execution of their short - term research projects. A measure of the success of the Division was the request from other countries for the evaluation of newer cardiac valves in the sheep model which had been perfected over the years (Fig. 18)

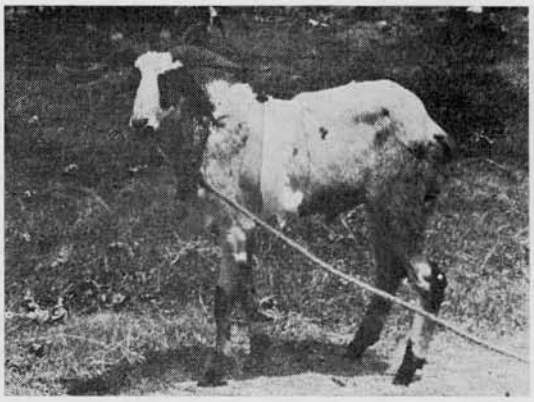

Fig. 18 Sheep with Chitra valve in mitral position– first post-operative day.

Dr. Arthur Vijayan Lal shared the Independence Day Award from the National Research & Development Corporation for the Chitra Variflo Oxygenator.

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Jaslok Hospital and Consultant,
Neurologist, J. J. Group of Hospitals,
Bombay

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KEM Hospital, Bombay

Prof. R. M. Varma,
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Prof. P. S. Bidwai,
Professor of Cardiology, PGI,
Chandigarh

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Professor,
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Construction Engineer,
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A member to be co-opted by the Director as and when necessary

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High Court of Kerala, Ernakulam

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Head of the Department of Aquatic Biology, University of Kerala

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BMT Wing of the Institute.

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

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Director, VSSC, Trivandrum.

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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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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 Supdt. of the Institute

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

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Director (Chairman)

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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

Technology Development Committee

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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

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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, Shertallai, Alleppey
	St. Thomas Mission Hospital, Kattanam, Alleppey
	S.H. Hospital, Alleppey
	Taluk Hospital, Mavelikara
	Taluk Hospital, Chengannur
	GEMS Hospital, Mavelikkara
	P.M. Hospital, Mavelikkara
	St. Andrews Hospital, Chengannur
	St. Thomas Mission Hospital, Malakkara, Chengannur
	Govt. Hospital, Haripad
	Govt. Hospital, Kayamkulam.
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
	Vimala Mission Hospital, Chemperi
	Govt. Hospital, Kanhangad
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, Mookkannoor
	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, Kadaplamattom
	Sree Krishna Nursing Home, Cochin
	Sudheendra Medical Mission, Ernakulam
	George Tharakan Hospital, Alwaye–1
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
	Govt. Hospital, Chenganacherry
	Govt. Hospital, Vaikom
	Mandiram 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

	Sunny Memorial Hospital, Kozhencherry
	Christian Medical Centre, Pathanamthitta
	District Hospital, Kozhencherry
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
	St. Joseph's Hospital, Anchal
	Dr. Nair's Hospital, Quilon
	Jayabharatham Nursing Home, Punalur
	Oznam Eye Centre, Quilon
Trivandrum	
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	General Hospital, Trivandrum
	Govt. Hospital, Peroorkada
	Govt. Hospital, Parassala
	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
	Dr. Govindan's Hospital, Trivandrum
	Military Hospital, Pangode, Trivandrum
	Al-Arif Hospital, Ambalathara, Trivandrum
	Kalyan Hospital, Aryasala, Trivandrum
	Regional Cancer Centre, Trivandrum
	HQ SAC(u) AF, 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
	Elite Mission Hospital, Trichur
	Lal Memorial Hospital, Irinjalakuda
	Bishop Alappatt Hospital, Trichur
Wynad	Assumption Mission Hospital, Sulthan Batheri
	Good Shepherd Hospital, Vythiri

OTHERS – Statewise

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Goa	Mormugeo Port Trust
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	Kasturba Medical College, Manipal
	Medical College Hospital, Mangalore
	St. John Medical College Hospital, Bangalore
	Dr. Adappa Memorial Nursing Home, Mangalore
	St. Marthas Hospital, Bangalore
New Delhi	Patel Chest Institute, New Delhi
Pondicherry	JIPMER, Pondicherry
Tamil Nadu	Balasundaram Hospital, Nagercoil
	Bensam Hospital, Nagercoil
	Chandran Hospital, Marthandam
	Catherine Booth Hospital, Nagercoil
	Casmer Hospital, Manalikkara
	Jaysekharana 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
Railway Headquarters Hospital, Madras
Vijaya Hospital, Madras
Medical College Hospital, Coimbatore
Kuppuswamy Naidu Memorial Hospital, Coimbatore
General Hospital, Madras
Medical College Hospital, Tirunelveli
Vadamalayam Hospital, Madurai
Deepam Nursing Home, Virudhu Nagar

ABROAD

Rashid Hospital, Dubai, UAE
Marfaq Hospital, Abudhabi
Ministry of Health, Abudhabi
Hamad General Hospital, Doha
Ministry of Health, Oman
Ministry of Health, Libya.

ALUMINI PAGE

1. Dr. R. Sankarkumar (M.Ch. CVTS., Mar. 1984) appointed Assistant Professor in the Institute.

2. Dr. M.V. Joseph Joy (DM. Cardiology, Mar. 1985) appointed Lecturer in the Institute.

3. Dr. K. Suresh (DM. Cardiology, Mar. 1985) appointed Assistant Professor in the Medical College, Trivandrum.

4. Dr. (Mrs.) C. Sarada (DM. Neurology, Mar. 1985) appointed Lecturer in the Institute.

5. Dr. Anand Kumar (DM. Neurology, Mar. 1985) appointed Tutor in the Medical College, Trivandrum.

6. Dr. M. Unnikrishnan (M.Ch. CVTS. Mar. 1985) appointed Lecturer in the Institute.

7. Dr. K. Venugopal (DM. Cardiology, Dec. 1985) appointed Assistant Professor in the Medical College, Trivandrum.

8. Dr. Ravi Subramanya (DM. Neurology, Dec. 1985) appointed Assistant Professor in the Kasturba Medical College, Manipal.

9. Dr. KSVK Subba Rao (M.Ch. CVTS., Dec. 1985) appointed Associate Professor in JIPMER, Pondicherry.

10. Dr. H.D. Waiker (PDCC Anaesthesiology, Mar. 1983) appointed Assistant Professor in the Institute.

11. Dr. H. L. Subba Rao (M Ch., CVTS, Dec. 1985) Assistant Professor in CVTS at JJM Medical College, Davanagiri.

12. Dr. C. P. Shrivastava, (M.Ch., CVTS December 1985) Cardiac Surgeon, National Heart Institute, New Delhi.

13. Dr. S. Gobisankar, (DM., Cardiology Dec. 1985) Cardiologist, Government General Hospital, Pondicherry.

14. Dr. P. K. Neema, (Certificate in Anaesthesia, Dec 1985) Consultant Anaesthetist at Shree Mahavir Hospital, Surat.

15. A. K. Babar, (Certificate in Anaesthesia Dec. 1985) Consultant in Jaslok Hospital, Bombay.

16. Dr. R. Krishnan, (DM Cardiology, Dec. (1985) Civil Asst Surgeon, Consultant Cardiologist, Trichy.

17. Dr. K. Venkateswarlu, (DM. Neurology, July 1986) Tutor Department of Neurology, K. G. Hospital, Vishakapatanam.

18. Dr. S. M. Upadhyae (Certificate in Anaesthesiology Dec 1984) Asst. Anaesthetist, Tata Memorial Hospital, Bombay.

19. Dr. A. K. Gupta (Certificate in Radiology, Dec 1985) Appointed Lecturer in the Institute.

20. Dr. N. S. Kodandaram (Certificate in Anaesthesia, Dec 1983) Asst. Prof., MS Ramiah Medical College Bangalore.

21. Dr. VE Tambe (Certificate in Anaesthesia Dec 1984) Asst. Anaesthetist, HN Hospital, Bombay.

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