SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCE AND TECHNOLOGY

THIRUVANANTHAPURAM, KERALA, INDIA

ANNUAL REPORT 1993-94

Annual Report
1993-'94

Sree Chitra Tirunal
Institute for Medical Sciences and Technology
Thiruvananthapuram-695 011
Kerala, India

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Cover: Statue of Sree Padmanabha Dasa Sree Chitra Tirunal Bala Rama Varma, Maharaja of Travancore, erected on the lawns of the Institute

HISTORICAL

The origins of the Institute reach back to 1973 when the Royal Family of Travancore gifted a multi-storeyed building for the people and the Government of Kerala resolved to develop the gift as the Sree Chitra Tirunal Medical Centre for medical specialities.

The Medical Centre was inaugurated by Shri P.N. Haksar in 1976 and the growth of a Biomedical Technology Centre followed quickly at the Satelmond Palace, Thiruvananthapuram.

The concept and achievement of uniting technology and medical sciences within a single institutional framework was regarded sufficiently important by the Government of India to declare it as an Institute of National Importance by an Act of Parliament in 1980. The Act lays down the objectives of the Institute to be the promotion of biomedical engineering and technology, demonstration of high standards of patient care and the development of post-graduate training programmes of the highest quality in advanced medical specialities and biomedical engineering and technology.

OVERVIEW

A review of the Annual Reports since the Institute became an institution of National Importance in 1981 makes it clear that it made significant progress in all the three areas of interest namely, the development of biomedical technology, maintaining high standards of patient care and setting up educational programmes of high quality. But the successful decade has posed new challenges for the Institute on all the three fronts. While the market for medical devices technology opened up in the country thanks to the pioneering effort of the Institute, its development has yet to attract serious attention from the industry which clings to the old practice of buying production technology. Given the decline in governmental funding for research and development, it is clear that the Institute can take its technology programme to a new and globally competitive level only to the extent it attracts the closest possible interaction with the industry. Much more remains to be done in this direction.

Turning to patient care, the agonising problem continues to be the wide and overwidening gap between what the Institute can offer on the one hand and the demand for specialised services on the other. The problem is aggravated by the rising prices of goods and services and the continual pressure for replacing obsolescent equipment for diagnosis and treatment. Here again, the Institute will have to develop innovative ways of resources management which will seek to reconcile a balanced budget with subsidised care for the low income groups. The Achutha Menon Centre for Health Science Studies which the Institute conceptualised is expected to study precisely such problems and evolve plans for action.

The training programmes currently offered by the Institute in super specialities conform to the basic pattern and standards of similar courses elsewhere in the country. The third objective of the Institute namely, the development of integrated programmes of training, is yet to be achieved. Over the years, the gap between the medical, engineering and social sciences has grown to such proportions that interdisciplinary communication has become increasingly difficult. Nevertheless the fact remains that medical science and practice are being increasingly moulded by the forces of technology and sociology which will ultimately determine the kind of tools and funds that the physician will receive. The Institute will therefore be obliged to redesign its programmes of training to produce a new breed of men and women who will be the inheritors of a joint culture.

Even as the Institute overcomes growing pains and forges ahead, fresh challenges appear on the road to the twentyfirst century. The call for innovative action is therefore loud and clear.

PATIENT CARE

Dr. (Maj) K.A. Hameed, BSc, MBBS — Medical Superintendent

Dr. D. Hariprasad, M.D. — Deputy Medical Superintendent

The demand for new registrations, especially for cardiac patients, continued to increase resulting in long waiting lists for diagnostic procedures and surgical interventions (Tables 1–14).

The computerised system for appointment for new as well as follow up cases, scheduling of sophisticated investigations like cardiac catheterisation and angiography and for the scheduling of surgical procedures was streamlined. To facilitate data entry, separate terminals were provided at strategic points like the medical records division, registration counters and the office of the medico-social workers.

The escalation of prices of drugs, consumables and medical devices necessitated revision of charges for various diagnostic and therapeutic procedures.

Recycling of funds collected from paying patients enabled the hospital to partly overcome budgetary constraints for procuring expensive disposables.

The patients' charging systems was under further upward revision by 25% in 1994–95 as compared with current year in order to meet the ever increasing cost of drugs, equipment and other materials. Detailed hospital statistics are given in the Tables.

A separate cash counter was added in the Setu Parvatibai Surgical Centre OPD area. Computerised billing systems for the out-patients and in-patients were made and independent computer terminals provided to all cashiers and for the cash section office. This facilitated speedy cash transactions for the patients.

Additional space was made available on the IVth Floor of the medical block for the expansion of the non-invasive laboratories for Neurology and for the installation of the new EEG and EMG machines.

In the OPD area of the medical block, one of the rooms, was modified by providing an attached toilet, for the use of breast-feeding mothers. This gave them the needed privacy and comfort.

Dr. Mohammed Ahad, Professor Emeritus, School of Nursing, East Carolina University, U.S.A., visited the Institute in connection with the launching of a project for improving the standards of education, practice, research in nursing and for the publication of nursing journals in the Southern states of India including Kerala.

Doctor-patient correspondence by means of letters, which was found to be effective, was still practised and it helped in perceiving the necessity for the personal attendance of patients in review/follow up clinics and reduced the unnecessary follow up visits of patients. Periodical meetings of the epilepsy patients and their parents or relatives with the medical officer in charge

were regularly held to give them guidance about domiciliary management.

The Hospital Management Council met monthly to review the hospital performance in terms of quality assurance in patient care, infection rate, prolonged hospital stay of patients, death rate, etc.

The monthly meetings of all the ward sisters were also held regularly as in the previous years for evaluating the quality of patient care, the management of wards by the Sisters and Nursing supervisors, and narration and discussion of selected articles of interest from the nursing journals as part of in-service education of the nursing staff.

Dr. Hariprasad participated in the World Health Organisation funded workshop held in April, 1993 at the National Institute of Health & Family Welfare, New Delhi to identify the training needs for launching a one year Post-graduate Certificate Course in "Hospital Management through distance learning".

Table 1

Waiting period for various services

Activities			*Waiting period*
A.		Registration for Cardiology Patients	2 months
B.	1.	Coronary angiogram	2 years
	2.	Cardiac catheterisation	4 years
	3.	Balloon angioplasty for coarctation of aorta	4 months
	4.	Balloon valvotomy of pulmonary valve	8 months
	5.	Balloon valvotomy of mitral valve	1 year
	6.	Electrophysiological study	10 months
C.	1.	Neurosurgery admission	2 to 3 months

Table 2

Waiting periods for various income groups

	A	*B1*	*B*	*C & D*
1. DVR	2.5 yrs	2 yrs	1 yr	1 yr
2. AVR	3 yrs	3.5 yrs	1.5 yrs	1.5 yrs
3. MVR	8 yrs	6 yrs	2.5 yrs	2.5 yrs
4. CC	3 yrs	1.5 yrs	Nil	Nil
5. ASD	8 yrs	10 yrs	4.5 yrs	6 yrs

DVR – Double valve replacement; AVR – Aortic valve replacement
MVR – Mitral valve replacement; ASD – Atrial septal defect
CCHD – Complex congenital heart disease

Table 3

Patient information system
Statistical analysis from 01.04.1993 to 31.03.1994

Item Name	*CM*	*CS*	*NM*	*NS*	*NR*	*TS*	*Total*
New cases	5860	0	2327	1173	23	582	9965
Admission	1742	1001	803	923	0	848	5317
Re-admissions	278	500	91	140	0	96	1105
Discharge + Death	1743	1005	810	920	0	857	5335
Deaths	80	86	56	44	0	22	288

Table 4

Service and sex-wise classification from 01.04.1993 – 31.03.1994

Outpatient	*M*	*F*	*Mch*	*Fch*	*Total*
CM	2565	1507	870	918	5860
NM	1213	715	224	175	2327
NS	620	426	68	59	1173
TS	417	142	11	12	582
NR	14	6	2	1	23
TOTAL	4829	2796	1175	1165	9965

Table 5

Age-wise analysis from 01.04.1993 – 31.03.1994

Outpatient	*M*	*F*	*Total*	*%*
0 – 10	1018	1020	2038	20.45
11 – 20	725	666	1391	13.96
21 – 30	744	706	1450	14.55
31 – 40	843	604	1447	14.52
41 – 50	1030	442	1472	14.77
51 – 60	976	309	1285	12.90
61 – 70	502	172	674	6.76
71 & above	166	42	208	2.09
TOTAL	6004	3961	9965	100.00

Table 6

Paying and non-paying analysis from 01.04.1993 to 31.03.1994

Outpatient	*M*	*F*	*Total*	*%*
A	818	687	1505	15.10
B1	1557	1124	2681	26.90
B	1094	707	1801	18.08
C	199	136	335	3.36
D	2336	1307	3643	36.56
TOTAL	6004	3961	9965	100.00

Table 7

Religion-wise analysis from 01.04.1993 – 31.03.1994

Outpatient	*M*	*F*	*Total*	*%*
Christian	1350	938	2288	22.96
Hindu	3585	2343	5928	59.49
Muslim	1069	678	1747	17.53
Others	0	2	2	0.02
TOTAL	6004	3961	9965	100.00

Table 9

Service and sex-wise classification
from 01.04.1993 – 31.03.1994

Inpatient	*M*	*F*	*Mch*	*Fch*	*Total*
CM	774	441	310	218	1743
CS	383	211	210	201	1005
NM	429	251	70	60	810
NS	435	330	78	77	920
TS	424	294	53	86	857
TOTAL	2445	1527	721	642	5335

Table 10

Age-wise analysis
from 01.04.1993 – 31.03.1994

Inpatient	*M*	*F*	*Total*	*%*
0 – 10	655	575	1230	23.02
11 – 20	362	362	724	13.57
21 – 30	401	412	813	15.24
31 – 40	412	322	734	13.76
41 – 50	532	237	769	14.41
51 – 60	509	159	668	12.52
61 – 70	224	76	300	5.62
71 & above	67	30	97	1.82
TOTAL	3162	2173	5335	100.00

Table 11

Paying and non-paying analysis from 01.04.1993 to 31.03.1994

Inpatient	*M*	*F*	*Total*	*%*
A	672	523	1195	22.41
B1	723	518	1241	23.27
B	546	377	923	17.31
B2	3	4	7	0.13
C	172	132	304	5.68
D	1046	619	1665	31.20
TOTAL	3162	2173	5335	100.00

Table 12

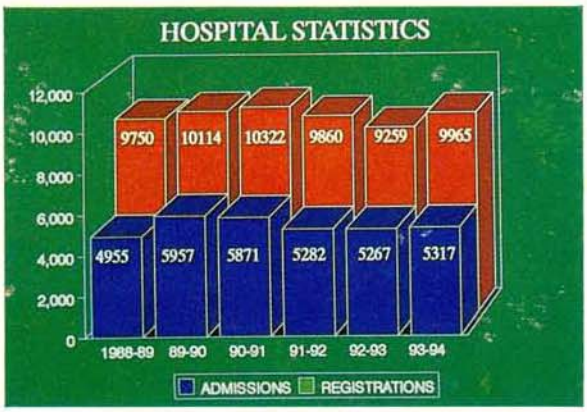
Religion-wise analysis from 01.04.1993 – 31.03.1994

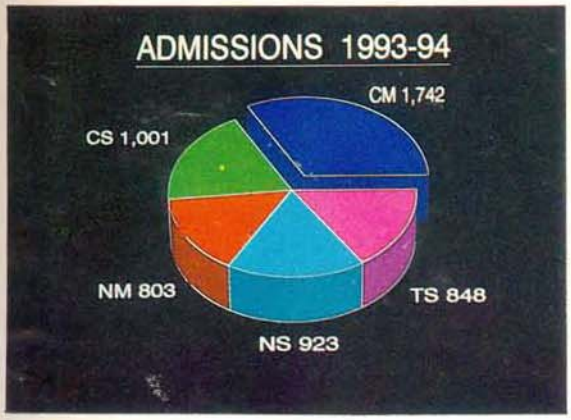
Inpatient	*M*	*F*	*Total*	*%*
Christian	641	488	1129	21..07
Hindu	1990	1304	3294	61.77
Muslim	530	379	909	17.01
Others	1	2	3	0.06
TOTAL	3162	2173	5335	100.00

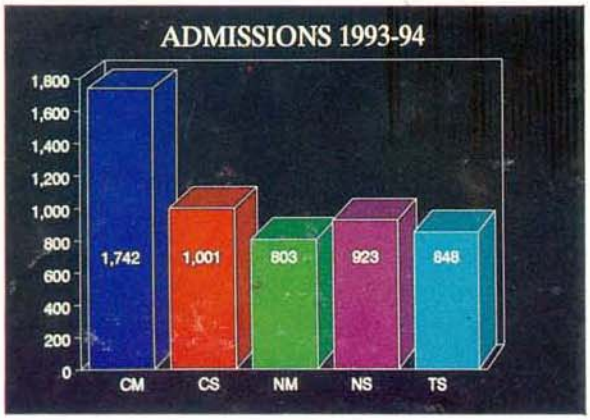
Table 13

Geographical analysis from 01.04.1993 — 31.03.1994

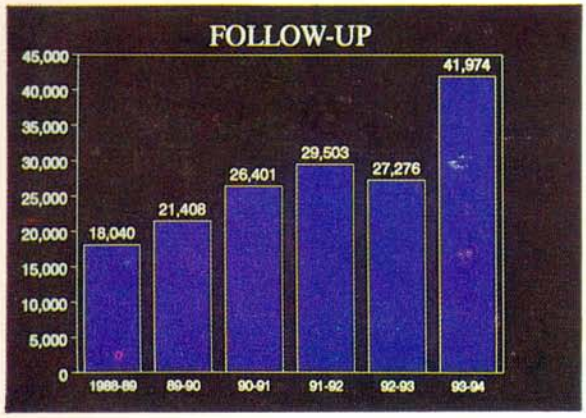
Inpatient	*M*	*F*	Total	%
Trivandrum	593	415	1008	18.90
Quilon	361	267	628	11.78
Alleppey	262	177	439	8.23
Pathanamthitta	189	120	309	5.79
Kottayam	166	119	285	5.34
Idukki	72	39	111	2.08
Ernakulam	237	178	415	7.78
Trichur	280	198	478	8.96
Palghat	142	95	237	4.44
Malappuram	191	111	302	5.66
Calicut	163	98	261	4.89
Wyanad	13	12	25	0.47
Kasargode	25	15	40	0.25
Cannanore	105	93	198	3.71
Lakshadweep	7	6	13	0.24
Other States	356	230	586	10.95
TOTAL	3162	2173	5335	100.00







CS – Cardiac Surgery CM – Cardiac Medicine
NM – Neuro Medicine TS – Thoracic Surgery
NS – Neuro Surgery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15,000
10,000
5,000
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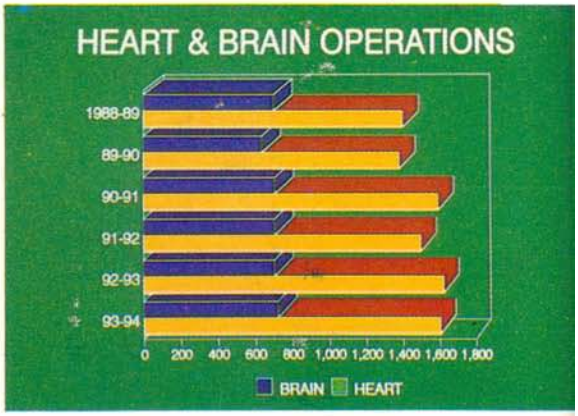
1988-89
89-90
90-91
91-92
92-93
93-94


HEART & BRAIN OPERATIONS
1988-89
89-90
90-91
91-92
92-93
93-94
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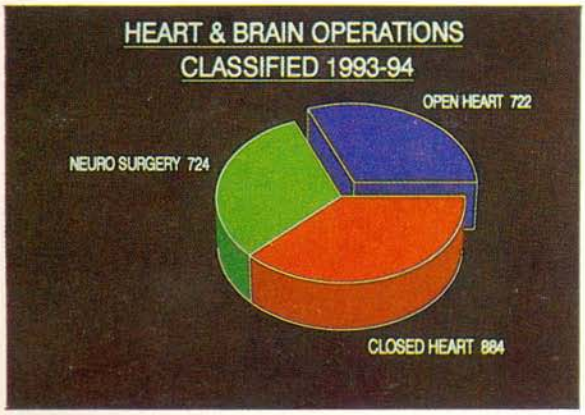
BRAIN
HEART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CLASSIFIED 1993-94
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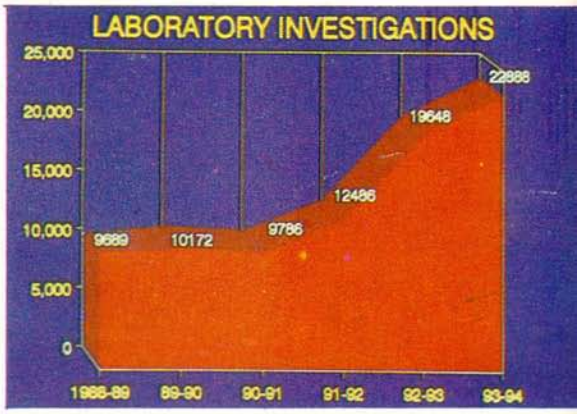
NEURO SURGERY 724
CLOSED HEART 884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20,000
15,000
10,000
5,000
0
9689
10172
9786
12486
19648
22988
1988-89
89-90
90-91
91-92
92-93
93-94

Table 14

Comparative statement of registration and discharge and its percentage of variation

New Registration

	A	B1	B	C	D	TOTAL
1991 — 1992	751	3332	2446	618	2533	9680
1992 — 1993	1320	1925	2571	520	2923	9259
1993 — 1994	1505	2681	1801	335	3643	9965

New Registration in %

	A	B1	B	C	D
1991 — 1992	7	34	25	6	26
1992 — 1993	14	20	27	5	31
1993 — 1994	15	27	18	3	36

Total Discharges

	A	B1	B	C	D	
1991 — 1992	1335	1062	1468	352	1084	5301
1992 — 1993	1188	1021	1321	368	1361	5259
1993 — 1994	1195		930	304	1665	5335

Total Discharges in %

	A	B1	B	C	D
1991 — 1992	25	19	27	6	20
1992 — 1993	22	19	25	7	26
1993 — 1994	22	23	17	5	31

Medico Social Work

Medico social workers continued to provide service to both patients and their relatives, and played a cohesive role in hospital administration. Their role in generating income through proper financial assessment of the patients, coordinating the appointment system for new registration and MRI scan, blood donor motivation and doctor-patient correspondence were particularly noteworthy.

Medical social workers provided training for the students from the Department of Medical and Psychiatric social work of the Chatrapadi Shahu Central Research Institute, Maharashtra and the Loyola College of Social Sciences, Trivandrum.

Shri. Jayachandran attended a training programme in Mental Health organised by the Department of Psychiatry, Medical College, Trivandrum.

Medical Records

Sri. P.K. Krishnamurthia Pillay, M.A. Senior Medical Records Officer

This section extended its services to all the clinical and non clinical departments of the Institute. Out of the 2,50,000 charts preserved in the MRD, 67077 charts were retrieved during the year for the purposes mentioned in the Table. This represented an increase of about three times over the previous year.

Table 15

Charts retrieved during the year

1.	Follow up clinics	:	41974
2.	Correspondence of patients	:	13417
3.	Analytical and retrospective studies	:	6113
4.	Audit purposes	:	60
5.	Updating entries in computer	:	2013
6.	Pruning of charts	:	3500

The MRD assisted the doctors in their correspondence with patients for collecting postoperative follow up data and compiling the results.

On-line computerisation of new registration and admissions were fully implemented. Similarly, the lists of patients availing cardiac catheterisation and coronary angiography were entered into the computer. Admission lists for catheterisation and surgery were prepared with the help of the computer system and these were used for communication with the waiting patients regarding their admission dates, holiday appointments and postponements, if any. Computerised follow up appointment register is now being used to distribute daily list of appointments to the Heads of Departments.

Daily visits to the wards by the SMRO and his staff helped in the prompt rectification of deficiencies in the patient charts and the consequent filing of records in the wards. In addition, monthly statistics on diagnosis, death and prolonged stay were supplied to the hospital management committee.

The MRD also organised regular educational programmes for doctors and medical records personnel from other institutions on modern methods of computer assisted keeping of medical records.

Table 16

Important Statistics

New registration	:	9986	Cardiac catheterisation	:	742
Follow up	:	41974	Coronary angiography	:	332
Admission	:	5317	PTCA	:	32
Discharges	:	5306	X-rays	:	14190
Death	:	289	Cerebral angiogram	:	284
Open heart surgery	:	722	Aortogram	:	284
Closed heart surgery	:	884	Myelogram	:	66
Neurosurgery	:	724	Balloon angioplasty	:	51
CT Scan	:	4239	Embolisation	:	32
MRI	:	1764	Miscellaneous	:	76

Medical Illustration

Sri. P.J. George	Chief Technician
Sri. Joy Abraham	Artist (on long leave)

High quality artwork, projection slides and photographs were prepared for over 90 scientific papers published during the year and for papers presented at various national and international fora.

The recent acquisition of a computer generated slide making machine significantly improved the quality and clarity of the multicoloured slides, texts and charts prepared by the division.

Nursing Services

Smt. Vijayamma Harikrishnan, B.Sc. (Nursing), M.A. — Nursing Superintendent (From (13–1–'94)

Smt. Rosamma Edwards, R.N., R.M., PNA, — Deputy Nursing Superintendent

As in the previous year, the nursing service continued to provide excellent care to the patients in the Institute despite staff shortage and the perpetual problem of experienced nurses leaving for greener pastures. In addition to the activities associated with nursing the sick, the ward sisters and staff nurses enthusiastically helped the nursing instructor in teaching and training the post basic nursing students.

"SCTIMST Nursing Manual" is currently under preparation with contributions from all the nursing staff.

Dr. M. A. Ahad, Professor Emeritus, School of Nursing, East Carolina University, USA visited the Institute in December 1993 and addressed the nurses and the nursing students.

Post-graduate and graduate students in nursing from Fr. Muller's College of Nursing, Mangalore, Colleges of Nursing of Vellore and Trivandrum, RAK College of Nursing, New Delhi, Regional Cancer Centre and a few other institutions underwent short periods of training at the Institute.

Ward Sisters Chinnamma John, B. Chellamma, Aleyamma Joseph and Shyamala attended a short term course on nursing management, organised by Indian Society of Health Administrators, Bangalore.

Staff Nurse Padmaja Devi took the initiative to organise in the Institute a "Personal Development Programme" conducted by the faculty of the Institute of Management in Government. The course, currently coordinated by the Nursing Superintendent not only became a success but also promised a marked impact on the professional performance and interpersonal relationship of all category of staff.

Physiotherapy

Smt. M. Meenakumari, B.Sc., DPT

The rehabilitation work of the unit was aimed at achieving early independence in the activities of daily living of the hospital inpatients with active and passive physiotherapy. In addition, out-patients were also given physiotherapy using the specialised equipments available in the unit.

The number of patients treated by physiotherapy during 1993–94, was as follows.

Cardiac surgery	5388
Thoracic surgery	3634
Neurosurgery	7132
Neurology	6811

The unit also contributed to the teaching and training of Post-Basic Nursing course students in physiotherapy and rehabilitation.

Clinical Engineering

Sri. R. Mohan Das, M. E.	Biomedical Engineer
Sri. K. Vijayakumar, BSc. (Eng)	Assistant Engineer
Sri. Koruthu P. Varghese, BSc. (Eng), PG Dip (Computer)	Assistant Engineer
Sri. Mohanlal, BSc. (Eng)	Assistant Engineer
Sri. Madhusoodanan Pillai, BSc (Eng), PG Dip. (Computer)	Junior Engineer

As in the previous year, the division was involved in the maintenance of hospital biomedical engineering systems and utilities as well as the procurement, testing and commissioning of new diagnostic and therapeutic equipments.

Sri. Koruthu Varghese successfully designed and fabricated a ventilator high-low pressure alarm which could be attached to simple ventilators without such facility, thus improving their safety aspect. A patent claim was made for the above system.

Sri. Koruthu also obtained a patent for a portable CO_2 analyser system.

R & D work is continuing on (1) apnea and sleep analyser (2) a brain dipole localization (3) an alarm annunciator for processors (4) an expert system for ventilator pattern recognition and wave form selection and (5) development of a microprocessor based infusion pump.

Sri. Koruthu won the award for the best theme paper in the Kerala Science Congress.

Sri. R. Mohandas visited G. E. Medical systems training centre at Milwaukee, Wisconsin.

Sri. Mohandas was appointed Chairman of the Graduate Board of Studies in Engineering of the Cochin University of Science & Technology and also as a member of the Academic Council.

Computer Division

Smt. G. Geetha, M. Tech (Comp. Sci) System Manager

System support involved software development for user departments encompassing Medical Records, Accounts, Administration, Stores, Pharmacy, Blood Bank, Microbiology, Typing Pool, Medical Illustration and Library.

Medical Records section was updated with enhanced terminal and printer facilities, computerised appointments, apart from extending such facility to new registrations.

Medical Illustration was provided with necessary software facility for the preparation of slides for the faculty.

The Blood Bank completed automation in data processing.

Purchase section computerised the purchase procedures from indenting stage to the placement of orders.

System expansion included the purchase of PCs for Blood Bank, Microbiology, Telex, Library and separate terminals and printers for the MRD, Surgical Block and Medico social worker. On the software side, additional features for PF card printing, and reimbursement monitoring were added to the existing Account's software. Printing of the Microbiology reports for the wards was also introduced.

Software awareness was enhanced by short in house courses for 6 batches. Lunch time briefing classes continued towards this end.

Smt. G. Geetha won the Institute award for "Services".

Public Relations

T. V. Hemalatha B. Sc., LLB, DJ, Public Relation Officer

Public Relation Section was responsible for the publication of the quarterly house magazine, booklets for creating public awareness and information brochures about the Institute. In addition, the section co-ordinated the visits of scientists and other eminent persons to the Institute, arranged local hospitalities for the guests to the Institute and helped maintain good public relations with the general public and media persons. It also organised the first meeting of the Alumni Association and lent assistance in the conduct of various conferences and meetings at the Institute.

BIOMEDICAL TECHNOLOGY WING

Dr. R. Sivakumar, B. Tech., Ph.D. Head

The Biomedical Technology Wing increased its pace of activities in a focussed manner and the build-up of facilities, increase in the personnel and the budget were based on specific programmes. These may be broadly divided into:

1. Technologies under commercialisation
2. Generation of technology for products developed
3. Products under development.

In this context, technology is defined as demonstrated expertise with documentation in making a certain number of devices, quantity of materials etc., as per international standards. There are a number of developmental activities in this phase like packaging, sterilisation, scale-up and cost containment. In order to maintain R&D leadership in the changed economic scenario, an attempt was made for consolidating and expanding expertise in specific areas like Bio-compatibility (Toxicological evaluation and Material-Tissue interaction), Experimental surgery for testing devices and implants, Sterilisation, Clean room technology etc. This is relevant to the critical issue of quality assurance of biomedical devices in the broader context of imparting reliable and high quality health care at an affordable cost.

TECHNOLOGY STATUS

a. Technologies under commercialisation:

Pilot production of the Chitra heart valve was taken up by the TTK Pharma Ltd., at the "Technology Proving Facility" (TPF) of the BMT Wing, the commissioning of the regular production plant being set up at Bangalore. This was to ensure a continuous supply of the valves to meet the user's demand generated subsequent to the successful multicentric clinical trials. Approximately 350 valves were produced and distributed so far among six centers all over the country for clinical trials.

The 'Bone wax' technology was also ready for commercial production subsequent to its satisfactory clinical trial at the Hospital Wing. It is now in the process of being licenced to M/s. T.T.K. Pharma Ltd; who showed interest in this technology. The licence agreement is to be signed shortly.

The pilot plant production of the hydrocephalus shunt, "CEREDRAIN" continued to make progress. An extension of the period for pilot production by another year was approved at the request of Hindustan Latex Limited, who had sponsored the scale-up project. Further extension till May '94 was granted to ensure the continuous supply of shunts till their production got under way. The review meeting on the multicentric trials indicated satisfactory results from the users, and the product demand indicated an encouraging trend. The commercial production plant of the licencee M/s. Hindustan Latex Ltd. at Aakulam neared completion and its commissioning was likely to take place in early 1995.

b. Generation of technology for products developed:

Dental composites encompassing (i) chemically cured type (used for both bonding and restorative applications) and (ii) visible light cured type (used for restorative applications) entered the stage of technology development. Subsequent to the finalisation of parameters related to shelf life, design of packaging and delivery methodology, technology on dental materials would be offered to promising entrepreneurs.

Ophthalmic sponge made from biocompatible polyvinyl acetal was another product which entered the stage of technology development. Favourable response was received from Dr. S.S. Badrinath, Vision Research Foundation, Madras on its clinical use. The laboratory scale production of the material was taken up for supply for clinical trials.

Vascular grafts developed by the Institute in collaboration with SITRA, Coimbatore was awaiting the approval of the Ethics Committee for clinical trial.

c. Products under development

Development of needle electrodes for neurologic applications, biocompatible hydroxyapatite and its variants for applications in dental and orthopaedic fields made substantial progress.

In another project, Glass ionomer cement was under development in collaboration with Prof. William's Group in the University of Liverpool.

ACADEMIC PROGRAMMES

Dr. K. Mohandas, Dean
Dr. G.N.A. Nair, Registrar (upto 31–10–'93)

Sri. G. S. Bhuvaneswar submitted his thesis on "Design Optimisation of the Chitra Tilting Disc Heart Valve Prosthesis". The thesis which was guided by Dr. T.S. Prahlad, Project Director, Aeronautical Development Agency is under evaluation.

Admission to Post Doctoral Courses

The nationwide response, admissions and course-wise demand are shown in Tables.

Table 17

Nationwide response and admission

State/Union Territory	*No. applied*	*No. admitted*
Andhra Pradesh	49	3
Assam	3	2
Bihar	3	—
Gujarat	18	3
Jammu & Kashmir	2	—
Karnataka	25	2
Kerala	101	6
Madhya Pradesh	5	—
Maharashtra	18	1
New Delhi	17	—
Orissa	1	1
Pondicherry	7	1
Punjab	4	—
Rajasthan	8	—
Tamil Nadu	53	2
West Bengal	6	1
Uttar Pradesh	11	—
Haryana	2	1
Himachal Pradesh	1	—

Table 18

Course	*Applicants*	*Admissions*
D.M. Cardiology	156	4
D.M. Neurology	20	3
MCh. Cardiovascular & Thoracic Surgery	48	3
MCh. Neurosurgery	40	4
PDCC Anaesthesiology	46	6
PDCC Radiology	14	3
Vascular surgery	8	0

The demand for short term training/ observership in various Departments/Divisions is shown in Table 19.

Table 19

Short term trainees in various departments/divisions

Anaesthesiology	12
Blood Bank	2
Cardiology	4
CVT Surgery	2
Microbiology	6
Neurosurgery	1
Radiology	31

Nursing Education

Smt. P.P. Saramma, MSc. (Nursing)	Nursing Tutor
Smt. Annakutty Joseph, RN, RM,	Ward Sister

The one year post basic nursing courses in Cardiovascular and Thoracic (CVT) nursing and Neuronursing entered their second year of inception. Eleven and six students successfully completed the CVT nursing and Neuronursing training respectively in December 1993.

Out of the 72 applicants, 10 students were selected for CVT nursing course and 8 for neuronursing course for the 1994 academic session. Six of the current batch are graduate nurses.

Diploma courses

In addition to the diploma courses in Cardiac Laboratory Technology and Operation Theatre Technology, new diploma courses were started in Advanced Imaging Technology and Neuro Technology. Duration of all the 4 courses was fixed as 2 years. A one year certificate course in Blood Banking Technology was also introduced from the current year.

The course-wise demand and admissions are shown in Table 20.

Table 20

Course-wise demand & admissions

Course	*No. of applicants*	*No. of admissions*
Diploma in Advanced Med. Imaging	39	2
Diploma in Cardiac Lab. Technology	275	2
Diploma in Neuro Technology	62	2
Diploma in Operation Theatre Technology	135	2
Certificate in Blood Banking Technology	268	2

National Science Day

The National Science Day was celebrated by conducting a study tour of the Institute's Biomedical Technology wing for the 11th standard students of the City's three leading schools. The students and teachers were given a tour of the various designing, fabricating and testing facilities of the wing, as well as experimental laboratories and the vivarium. The keen interest evinced by the students during the visit was an indication that the tour may have provided inspiration to potential scientific leaders among our school children.

Hospital Library

Smt. Prasanna Kumari. R., MA, MLISc. — Librarian cum documentation Officer Gr. 1.
Smt. Jayaprabha. S, BA, BLIS. — Librarian cum documentation Officer Gr. 2.

During the year under review, the library witnessed overall progress. The library services maintained their previous levels and high standards in supporting the academic and research programmes of the Institute. The library extended its services to the faculty, post-graduate students, and research scholars of other institutes in and outside Kerala.

Table 21

Distribution of membership category-wise

	92–93	93–94
1. Total members with borrowal facility	397	449
a. Faculty	73	77
b. Students	53	80
c. Paramedical staff & others	271	292
2. Faculty and students from other institutes with reading facility	710	848

A major event during the year was the upgrading of the NICNET facility for MEDLARS Access. For faster access and speedier retrieval of relevant information, the Library installed a V SAT Microearth station to establish a direct network link with the INDIAN MEDLARS CENTRE, National Informatics Centre, at New Delhi through NICNET. This facility enabled the library to provide dial up links to Biomedical Technology Wing library and Regional Cancer Centre library for interactive access to medline and other databases. The facility was a stepping stone for the library and information services of the Institute and extended a crucial service to all doctors and scientists of Kerala engaged in medical and biological education and research.

Collection

As in previous years, the collection development of the library continued to be under great pressure due to financial constraints and escalating cost of publications. During the year the library purchased 195 books, added 509 bound journals and subscribed to 200 journals. In addition nearly 80 journals and 144 books were received as gifts.

Subscription to Excerpta Medica Neurosciences on compact disk was made during the year to cover a period of ten years from 1984. The library commenced the services based on Current Contents Life Sciences on Diskette from April 1993 which greatly enhanced the service potential of the library.

Information Services

The Information Services of the library continued to show qualitative improvements with the application of state of the art information and communication technology. The services were reorganised on modern lines with a view to disseminating quickly and effectively the current literature resources published and unpublished all over the world. Circulation of the computer generated Monthly Additions Bulletin and fortnightly Current Contents Bulletin continued to be part of the library activity. The reprographic service showed decline during the year due to the inadequacy of the reprographic facility in the library. The information services like SDI service, indexing and abstracting services, literature search services, with the introduction of Current Contents Life Sciences on Diskette and Online search facility, proved very popular among the library users and registered significant progress as is evident from the Table 22.

The services from Online search facility of Medline and Aids databases through NICNET was made available to outsiders and the large number of requests for the services of this library bore testimony to the esteem with which the library is held by the medical community of the State.

Library Automation

Constant updating of the databases of books and periodical holdings continued as in previous years. Action was taken to computerise other activities of the library like the acquisition of books, serials control, membership and circulation of documents. The system is operational on a trial basis.

Table 22

Services	92–93	93–94
Reprographic service.		
No. of articles-		
Institute members	3840	2352
External requests	960	900
Selective Dissemination of Information (SDI) -		
No. of profiles	92	120
Abstracts retrieved from secondary sources	3200	8311
References retrieved from secondary sources	3800	6567
No. of literature searches	500	610

Prospects

Encouraged by the response to information services using MEDLARS databases, the library has made plans to provide comprehensive coverage in these services. A proposal is under consideration to link the Institute library to INTERNET for access to DIALOG and STN international and to provide E-Mail facilities.

Miss Teresa Dunn, Information Scientist from Liverpool University has joined the Institute Library as a visiting scientist to implement and train the library staff on on line searches of CAS, BIOSIS, EMBASE etc.

LIBRARY (BMT WING)

Smt. P. Jayasree Thankom, MA; MLI. Sc — Librarian-cum-Documentation Officer Gr. II

Library collection consists of books, backvolumes of journals, current journals, and special collection of Standards and Patents.

Books	:	7050
Backvolumes of journals	:	3778
Current journals	:	120

Around 150 patents and a few standards were added during the year.

Routine activities consisted of document acquisition, technical processing, documentation activities including bibliography compilation and reprography.

Patent search services and patent procurement services of the Office of the Patent Information System (Govt. of India), Nagpur were utilised by opening a Deposit Account during 1992–93 itself. Three patent searches were conducted and 150 patents purchased.

New SDI Service was introduced with the CURRENT CONTENTS-FLOPPIES in 3 sections :

i. Engineering Technology and Applied Sciences;

ii. Life Sciences;

iii. Physical-Chemical and Earth Sciences.

Old personal profile created for SDI service on CDS/ISIS database was modified to suit the Current Contents database, and the first bulletin was issued in February 1994.

Mr. N. Suresh, Library Assistant was sponsored for the XIV Training Course in Health Services Librarianship organised by the National Medical Library, New Delhi.

Students and faculty from various institutions made use of the library reference services and photocopy services. More than 1000 articles were photocopied in response to external requests during the year.

ACHUTHA MENON CENTRE FOR HEALTH SCIENCE STUDIES

Dr. V. Raman Kutty, MD, MPH, MPhil Associate Professor in Health Science Studies

Dr. Raman Kutty carried out independent projects in Epidemiology and Health Economics, besides providing consultation on study design and data analysis for research projects of other faculty. He was also involved in teaching programmes inside and outside the Institute.

Research projects in progress were:

1. "Health Sector Financing in Kerala" funded by UNICEF. Expected date of completion - Aug. 1994.
2. "Analysis of morbidity data from Kerala" funded by the UNDP Programme on human development. Expected date of completion –April 1994.

Dr. Raman Kutty also collaborated in:

1. Ongoing project at Regional Research Laboratory, Trivandrum - on Vitamin A status in children and the impact of crude palm oil.
2. "Health expenditure survey in 2 districts of Kerala" with Prof. PGK Panikar, CDS, Trivandrum.

Dr. Raman Kutty visited Tata Institute of Social Science, Bombay in October 1993 as faculty for a workshop on health economics. He also participated in the meeting of ICMR/ICSSR joint panel on health, at New Delhi in May 1993.

Shri Hari Kurup, M. Phil. student from Centre for Development Studies, Trivandrum is working on a case study of SCTIMST hospital as a model for pricing in public sector in health care, under direction from the Centre.

DEPARTMENTAL REPORTS

HOSPITAL WING

Department of Anaesthesiology

Dr. K. Mohandas, MD	Professor & Head
Dr. R.C. Rathod, MD	Additional Professor
Dr. (Mrs.) A. Rout, MD	Additional Professor
Dr. H.D. Waiker, MD	Additional Professor
Dr. Rupa Sreedhar, MD, Dip NB	Associate Professor
Dr. P.K. Neema, MD	Assistant Professor
Dr. G. Suresh, M.D.	Assistant Professor
Dr. G. Suresh, MD	Assistant Professor
Dr. Susmita Bhattacharya, MD	Assistant Professor
Dr. Pius K. Manavalan, MD	Assistant Professor
Shri. Ganapathy Potti	Scientific Assistant

Candidates for Postdoctoral Certificate Courses

Dr. Ramesh Giri, MD
Dr. Suresh, MD
Dr. Dash Prasanta Kumar, MD
Dr. Sardar Shaik, MD
Dr. Patel Vishal Vitthol, MD
Dr. Sreedevi, MD

Anaesthetic support was given to the following procedures.

Open heart surgery	722
Thoracic, vascular and closed heart surgery	884
Neurosurgery	724
Investigational radiological procedures	74
Interventional radiological procedures	57

3 Intensive care ventilators, 6 syringe infusion pumps and 10 pulse oximeters were added to the equipment.

A one-day CME programme was jointly organised with the Department of Anaesthesiology, Medical College, Trivandrum, at the Institute on 23–3–94.

Post-graduate students in Anaesthesiology from the University of Colombo (Sri Lanka), and Medical Colleges of Goa, Trivandrum, Kottayam, Calicut and Nagpur underwent short term training programmes in the Department during the year.

Dr. S. Gunawardane, President, College of Anaesthesiologists of Sri Lanka paid a short visit to the Department.

Dr. Mohandas attended the VIII Asean Conference on Anaesthesiology held at Bali, Indonesia. He was an invited speaker in the refresher course conducted along with the 1st Congress of the South Asian Confederation of Anaesthesiologists held at Dhakka, Bangladesh. Dr. (Mrs.) Rout attended the Xth International Congress of Neurological Surgery of the World Federation of Neurological Societies held from October 17 to 22 at Acapulco, Mexico and presented a paper on "Role of atenolol as a premedicant in Neurosurgery".

Division of Biochemistry

Dr. K. Subramonia Iyer, PhD	Additional Professor & Head (on sabbatical leave)
Dr. N. Jayakumari, PhD	Associate Professor
Mrs. Santha A. George, MSc	Scientist
Mr. B. Sasikumar, MSc	Scientific Assistant

The Central clinical laboratory provided investigative support to the hospital on a round the clock basis. Tha annual statistics of laboratory investigation is given in the table.

Table 23

1.	Clinical Biochemistry	55,956
2.	Clinical Pathology	84,227
3.	Blood Gases	23,330
4.	Electrolytes	62,554
	Total	2,26,067

There was an increase of 13% in biochemistry, 9% in pathology and 3% in electrolyte investigations over the previous year.

Dr. K. Subramonia Iyer left on sabbatical leave for an year to work on HbS, at the Department of Hematology at Albert Einstein College of Medicine, Yeshiva University, New York, USA.

Dr. Fairwell Thomas, PhD., Senior Staff Scientist from National Heart Lung and Blood Institute, Bathesda, USA visited this Division in February and delivered a talk on "Apolipoprotein metabolism in some familial diseases".

Research activity of this division is focussed on the oxidative injury in patients with coronary artery disease. In collaboration with the Department of Cardiology a study was conducted in patients during percutaneous transluminal coronary angioplasty to look for clinical evidence of free radical production under conditions of coronary occlusion and reperfusion. Free radical activity was determined indirectly by measuring its secondary peroxidation products as lipid peroxides. Preliminary study conducted in 15 patients demonstrated a rise of 10–35% in lipid peroxide at 1 minute after balloon deflation in 11 out of 15 patients. Based on this finding a detailed investigation was carried out in 10 more cases to monitor the sequence of changes in lipid peroxide after every balloon inflation upto three subsequent inflations. Maximum rise in lipid peroxide was noticed at 15 seconds after every balloon deflation and the percentage of increase from first to third deflation corresponds to 15–63%, 10–80% and 10–37%. After this initial peaking up the levels showed a continuous decline and return to the basal

value within 2 to 3 minutes. This transient rise of lipid peroxide observed is consistent with the concept that a burst of free radical formation occurs during ischemia/reperfusion.

Another study underway is the investigation of the effect of antioxidant vitamins, vit-C and vit-E, on oxidative damage to blood macromolecules in patients with CAD.

Division of Blood Transfusion Services

Dr. Jaisy Mathai, MBBS, DCP	Chief Blood Transfusion Officer
Dr. P. V. Sulochana, MBBS	Blood Transfusion Officer
Dr. S. Sathyabhama, MBBS	Blood Transfusion Officer

The Division continued to give round the clock service to the hospital. Though the blood donations during the year remained more or less the same as in the previous year, the blood components prepared and transfused reached 41% and 19% respectively. Thanks to the increased availability of components, services could be extended to nearby government institutions.

Service provided to neurological patients in the form of plasma exchange almost doubled over the previous year.

Research activities included:

1. study of cold agglutinins among surgical patients.
2. standardization of Low Ionic Strength Salt (LISS) solution in routine compatibility testing
3. study of atypical antibodies in donors and patients using proteolytic enzymes.
4. preparation of a guideline (Maximum Surgical Blood Order Schedule) for elective surgical cases for optimal use of blood and for cost containment in patient care.
5. study of the feasibility of Type & Screen method for hemotherapy.

A Personal Computer with printer was procured for the Division.

Joint collaborative research activity in progress included:—

1. small volume plasma exchange for Neurology patients.
2. intraoperative blood salvage for patients of Cardiovascular surgery department.
3. standardization of present day PVC bags for its suitability in platelet collection and storage and
4. effectiveness of plasma pheresis as a mode of treatment in sub acute and fulminant hepatitis patients.

The following important persons visited the Division:—

1. Shri. Patit Paban Pathak, Minister for Public Undertakings and Industrial Reconstruction, W. Bengal in connection with the proposal for setting up a blood banking facility in their state.
2. Dr. Sen Gupta, Project Director National AIDS Control Organisation (NACO) and Dr. Madhavan Nair S,

AIDS Programme Officer, State AIDS Cell, Kerala.

3. Dr. Zarin Bharucha, Chief Blood Bank Officer, Tata Memorial Centre, Bombay.

The following trainees underwent short training in the Division:—

1. Ten drug inspectors from the office of the Drugs Controller, Kerala, underwent 'orientation programme in modern blood banking technology'.

2. Ten doctors and ten technicians from health services of Kerala attended a programme of familiarisation in blood bank techniques.

3. Dr. Joy Thomas of Munnar Tea Estate Hospital and Dr. Mary Anne of Trichur Heart Hospital underwent training for one week.

Voluntary blood donation programme gained further impetus. The active participation of the NSS movement in blood donation was an added feature.

A one-year certificate course in Blood Banking Technology was started from this year.

Department of Cardiology

Dr. K.G. Balakrishnan, MD, DM, FAMS, FACC	Professor & Head
Dr. J.M. Tharakan, MD, DM	Additional Professor
Dr. T. Titus, MD, MNAMS (Med.) DM	Additional Professor
Dr. V. Ramakrishna Pillai, MD, DM	Associate Professor
Dr. Ajithkumar V.K., MD, DM	Assistant Professor
Dr. Anil Bhat, MD, DM	Assistant Professor
Dr. N. Sivasankaran, MD, Dip. NB (Gen. Med); DM, Dip. NB (Cardiol)	Assistant Professor
Sri. K.N. Vijayasenan, BSc, DCCT	Scientific Assistant

Candidates for DM

1. Dr. Sudhamani, MD
2. Dr. P. Jyothi, MD
3. Dr. Ravi Narayanan, MD
4. Dr. V. Mohammed Najeeb, MD
5. Dr. N.P. Padmaja, MD
6. Dr. Gopi, MD
7. Dr. K.R. Shyamsunder, MD
8. Dr. Rajpal K. Abhaichand, MD
9. Dr. Sunil Baren Roy, MD
10. Dr. K. Latchumandas, MD
11. Dr. T. Sudhalakshmi, MD
12. Dr. P. Kader Muneer, MD
13. Dr. P.K. Joseph, MD

The number of new patients registered showed no significant change over the previous years. However the review of follow up cases showed a rise due to more number of patient with rheumatic heart disease and coronary artery disease reporting without prior appointment due to worsening of the clinical status while awaiting special procedures and surgical intervention. The number of cardiac catheterization procedures showed a slight increase despite the non-functioning and subsequent condemnation of the old equipment. The number of interventional procedures made steady progress with good results. The number of admissions increased due to the increase in the number of cardiac catheterization procedures and more sick patients with rheumatic valvular heart disease getting readmitted repeatedly. The noninvasive laboratories were put to maximum use to provide diagnostic services to the outpatient and inpatient population. The ambulatory monitoring facility had to be suspended during the last year due to equipment breakdown.

The natural history studies on Eisenmenger syndrome, primary pulmonary hypertension and Ebstein's anomaly of the tricuspid valve were completed. The project on the thrombolytic therapy for thrombosed prosthetic valves was also completed. The study on the natural history of hypertrophic cardiomyopathy is in progress.

An echocardiograph with colour doppler and transoesophageal probe (Hewlett Packard Sonos 1000) was procured for the Department.

The following joint collaborative research projects were in progress:

1. Study of free radicals due to reperfusion following PTCA – in collaboration with Division of Biochemistry.
2. Study of free radicals in patient with coronary artery disease and effect of antioxidant-Vit E and C on the level of free radicals–with Division of Biochemistry.
3. Serum level of Vit D derivatives in patients with calcified coronary arteries and coronary artery disease – with Division of Cellular and Molecular Cardiology.

Dr. K.G. Balakrishnan, Dr. J.M. Tharakan and Dr. Anil Bhat attended Fifth Asia Pacific Symposium on Cardiac pacing and Electrophysiology held on August 1–4, 1993 in Makuhari, Japan.

Dr. Tom Peters, USA visited the Department and gave a talk on "Radiofrequency ablation for supraventricular tachycardia, accessory pathway ablation, and mapping for ventricular tachycardias" on 10th December 1993.

Three trainees from Nanavati Hospital, Bombay, GKNM Hospital, Coimbatore and Medical College, Kottayam underwent short term training in the Department.

A workshop on PTCA was conducted at the Institute by Dr. Keyur H. Parikh, Fremont, California, USA on 10th January 1994.

Department of Cardiovascular & Thoracic Surgery

Dr. M.S. Valiathan	Professor & Head
Dr. M.P. Mohansingh, FRCS (Edin), FRCS (Eng)	Professor
Dr. K.S. Neelakandhan, MS, MCh	Additional Professor
Dr. R. Shankar Kumar, MS, MCh	Additional Professor
Dr. K.G. Shyamkrishnan, MS, MCh	Additional Professor
Dr. M. Unnikrishnan, MS, MCh	Associate Professor
Dr. Y.A. Nazer, MS. MCh	Associate Professor
Dr. Krishna Manohar, MS, MCh	Assistant Professor
Dr. S.K. Nair, MS, MCh	Assistant Professor
Sri. Thomas Maliakal	Scientific Assistant

Candidates for M.Ch. Course

Dr. T.M. Babu, MS
Dr. Avinash Dal, MS
Dr. T. Rameswar, MS
Dr. Ms. Rekha Matta, MS
Dr. R. Sunder, MS
Dr. Susanth Mukopadhyay, MS
Dr. Apurva Vaidya, MS
Dr. Srinivas Shenoy, MS
Dr. Sunil Dawka, MS

Total number of surgical procedures was 1606. Out of this 722 were open heart cases. The rest were closed heart (575), General Thoracic (185) and Vascular (124) procedures. The notable trend this year was the increase in the coronary workload. Arrhythmia surgery was successfully initiated during the year. 4 cases were done, with satisfactory results.

Efforts are continuing in developing an indegeneously designed large diameter polyester vascular prosthesis. Subject to Ethics Committee approval, clinical trials are scheduled to take place during the latter half of 1994.

The Chitra valve completed 3 years of multicentric trial, with 225 prosthetic implantation and showed good results. Its pilot production is in progress, by the TTK Pharma who expect the commercial productions to begin in 1995.

Dr. Shyamkrishnan completed his deputation to the Dept. of Paediatric Cardiac Surgery, under Dr. Roger Mee, in Australia and re-joined the Department. Dr. S.K. Nair rejoined the department after spending 3 months with Dr. Antunes in Portugal and one year under a Swiss scholarship with Dr. Turina in Zurich. Their return was expected to contribute to the development of expertise and sub specialisation in the departmental work.

The M.Ch. candidates from JIPMER, Pondicherry and Sanjay Gandhi P.G. Institute of Medical Science, Lucknow spent one month as observers in the Department.

Trainee perfusionists from Central Indian Institute of Medical Sciences, Nagpur and Baken Institute, Baroda are undergoing practical training in the Department.

Dr. Neelakandhan delivered the Dr. Godrej S. Karai oration on Vascular Surgery during the Annual Conference of the Indian Association of CVTS at Agra on 27.2.1994.

Dr. Valiathan was selected as the distinguished materials scientist for 1993 by the Materials Research Society of India. He gave the Gandhi Memorial Lecture at the Raman Research Institute and the Mellanby Memorial Lecture at the Central Drug Research Institute, Lucknow. He was awarded the Basanti Devi Amirchand Prize by the Indian Council of Medical Research.

Division of Cellular & Molecular Cardiology

Dr. C. C. Kartha, MD	Professor & Head
Dr. R. Renuka Nair, PhD	Scientist
Dr. K. Shivakumar, PhD	Scientist
Dr. John T. Eapen. PhD	Scientist
Dr. G. Radhakrishna Pillai, PhD	Research Associate
Ms. S. Rajasree, MSc	Senior Research Fellow
Mr. B. Prakash Kumar, MSc	Junior Research Fellow

This Division became the successor to the Division of Cardiomyopathy and brought together expertise in the application of a variety of techniques in understanding the causation and pathogenetic mechanisms of cardiovascular diseases in the tropics.

Currently, the efforts in the pursuit of a geochemical hypothesis for the causation of endomyocardial fibrosis (EMF) are focussed on (1) developing an animal model for the disease (2) delineating the cellular mechanisms of cardiac damage in magnesium deficiency and (3) studying the effects of the lanthanide, cerium on myocyte contractility.

Two experiments, one in rats and another in rabbits, to ascertain whether a chronic magnesium deficiency and prolonged administration of cerium would produce EMF, were completed. Histological studies in rabbits revealed endocardial and interstitial fibrosis in the hearts of two groups of animals viz. one which was fed a magnesium deficient diet and another which was fed a magnesium restricted diet and rare earth chloride. It appears that functional evaluations are necessary to observe whether the cardiac dysfunctional sequelae of the structural alterations are different in the two groups.

In rats, cerium was found to have a stimulatory effect *in vivo* on protein biosynthesis in the heart. The element was found to enhance the rates of trascription as well. Since it was shown earlier that at nanomolar levels cerium stimulates collagen synthesis in cardiac fibroblasts *in vitro,* the present observation suggested that cerium may stimulate collagen gene expression and contribute to its accumulation in the heart.

In a series of experiments using isolated rat papillary muscle, the effects of cerium on inotropic changes and their modulation by magnesium levels in the perfusate were recorded. A significant observation was that the effect of cerium in decreasing the force of contractility became irreversible when the perfusing medium was made deficient in magnesium. In order to define the structural basis for these functional changes, demonstration of cytoskeletal filaments and assessment of cyto-architecture are being attempted using immunocytochemical techniques.

An offshoot of the studies relating soil factors to EMF, investigations on the role of lanthanides in the causation of root (wilt) disease in coconut palms made good progress. These studies, being carried out at Kerala Agricultural University, Mannoothy, envisages (1) induction of root (wilt) symptoms in coconut palms by growing them in pot cultures with soils from disease affected areas, (2) estimation of the dynamics of cerium availability to the palms from the soil and (3) physiology of the diseased palms.

Following the observation that *Calotropics gigantea* (L) a shrub that grows abundantly in monazite sand accumulates rare earth elements, an experiment was initiated to evaluate the possibility that this plant can be used as a bioagent to scavenge lanthanides from the root zone of coconut palms.

The Indian Council of Medical Research extended the fellowship to Ms. Rajasree, considering the satisfactory progress of the work on Vitamin-D status in Kerala population. An interesting finding in her study was that the serum vitamin-D levels are significantly higher in adult men and women in Kerala compared to those in the population of Scandinavian countries and the United States of America.

Research projects:

1.	Title	:	Cellular basis of myocardial damage by cerium in magnesium deficiency
	Principal investigator	:	Dr. K. Shivakumar
	Co-investigators	:	Dr. C. C. Kartha, Mr. K. Rathinam, Dr. J.T. Eapen, Dr. P.T. Manoharan (IIT Madras)
	Funded by	:	DST, Government of India
2.	Title	:	Structural and functional changes in the myocardium due to suboptimal concentration of magnesium
	Principal Investigator	:	Dr. Renuka Nair
	Funded by	:	Roussel Scientific Institute, India.

An SP144 cell length monitor and strip chart recorder, AT 286 personal computer a video camera with television monitor and a video cassette recorder were purchased for contractility studies on isolated myocytes in culture.

Prof. H. D. Tandon, former Director, AIIMS, New Delhi and former President of The National Academy of Medical Sciences held discussions with the staff on the ongoing work on endomyocardial fibrosis.

Ms. Marione Matejka from the Institute fur Toxikologie, Karlsruhe, Germany spent six months in the division to get training in the technique of cardiac cell culture.

Ms. Radhika Ganesan and Ms. Anindita Bhattacharya, students from Department of Zoology, University of Pune had their summer research training programme in the division.

Dr. Kartha was admitted as a Fellow of Indian College of Pathology.

Division of Microbiology

Dr. J. Shanmugam, PhD	Additional Professor & Head
Mrs. Molly Antony, MSc., DMV	Assistant Professor
Mr. M. Raveendranath, BSc	Scientific Assistant
Mrs. K. Naseema, MSc (MLT)	Scientific Assistant

In addition to the laboratory services in Bacteriology, Virology and Immunology, IgG and IgM specific antibody detection against Herpes Simplex virus, Measles virus and Epstein-Barr virus were introduced this year. To understand the incidence of nosocomial infections and the pattern of antibiotic resistance, relevant microbiological data were retrieved and analysed from the computerised data base.

Coagulase negative Staphylococci were characterised for various species and in particular for Staphylococcus epidermidis. With viral antigens supplied by the National Institute of Virology (ICMR), Pune, sera of patients were tested for the presence of antibodies against Japanese encephalitis, West Nile and Dengue-2 viruses. The division indigenously produced highly potent Streptolysin-O and standardised the same for the detection of Anti-Streptolysin-O (ASO) in our patients with rheumatic heart disease.

In collaboration with scientists from the Biomedical Technology Wing, toxicity of Cobalt-Chromium alloy in He La cell lines was investigated.

The division organised a national workshop on "Advanced laboratory techniques for streptococcal infection" and a national symposium on "An update on streptococcal infection, rheumatic fever and rheumatic heart disease". Dr. A. K. Kapoor and Dr. Reba Chabra from the WHO Collaborating Centre for Streptococcal Studies, New Delhi and Dr. K. N. Brahmadathan from CMC, Vellore were also supervisors for the workshop.

One high speed refrigerated centrifuge – Remi make (Indian) was added to the equipments in the division.

Dr. Vasanthi Devanesam from the University of Peradeniya, Sri Lanka and Prof. Archana Ayyagari, Head of the Department of Microbiology at Sanjay Gandhi Institute of Medical College visited the Department.

Dr. J. Shanmugam was nominated as the member of the International working group in Tropical Virology with headquarters at Parkville, Australia and also as the member of the Editorial Board of a newly launched journal "Clinical Laboratory Digest".

Dr. J. Shanmugam organised a Workshop, a Symposium and a CME at National level and an International Conference of International Medical Sciences Academy.

Dr. J. Shanmugam was selected by the Indian National Science Academy (INSA) under the International Visiting Scientists Programme, to visit Microbiological Institutes/ Laboratories in Russia for four weeks.

Twenty-three persons were trained this year individually and in groups in Bacteriology, Immunology, Tissue Culture and Virology.

Department of Neurology

Dr. Bindu T. Desai, MD	Professor (till Dec. 1993)
Dr. K. Radhakrishnan, MD,DM, MNAMS	Professor & Head
Dr. C. Sarada, MD, DM	Associate Professor
Dr. Muraleedharan Nair, MD, DM	Associate Professor
Dr. Sanjeev V. Thomas, MD, Dip NB, DM	Assistant Professor
Dr. Asha Vijayaraghavan, MD, DM	Assistant Professor
Dr. P.A. Suresh MD, DM	Assistant Professor

Candidates for DM Course

Dr. A.R. Bhat, MD
Dr. B. Santhosh Kumar, MD
Dr. S.D. Nayak, MD
Dr. Abdu Rahman, MD, Dip NB
Dr. Thomas John, MD (Paed)
Dr. Gigy V. Kuruttukulam, MD
Dr. Atri Chakraborty, MD

The volume of clinical service and academic activities remained at the same level as in the previous year. A number of research projects were undertaken by the faculty during this year.

Dr. C. Sarada collaborated in the study on "CNS Vasculopathy of Non atherosclerotic Aetiology – A clinico-pathological Study" with Dr. Sandhyamoni of the Division of Pathology of the Institute. This was part of the intensive research programme for studies on the various aspects of mucoid vasculopathy, funded by the Department of Science and Technology. She also collaborated with the Theoretical Physics Division of Physical Research Laboratory Ahmedabad on the project "Dynamical modelling of the higher functions of the brain as inferred from evoked response in Encephalograms", funded by the Department of Science and Technology. Dr. Muraleedharan Nair, Associate Professor who was relieved for one year on a secondment scheme for setting up Neurology Department in a private sector hospital rejoined the Department on 1–2–1994. He started descriptive studies on "Motor Neuron Disease" and "Stroke in the Young".

Dr. Asha started a series of studies on Parkinson's disease and the clinical spectrum of Parkinsonism of young age onset received special attention. Through a control design, she attempted to define the clinical, pharmacotherapeutic response and outcome of older versus younger parkinsonism.

Dr. P.A. Suresh initiated work on "A comparative study of the Role of Free Radicals in Transient Ischaemic Attacks, Completed Stroke and Migraine" in collaboration with the division of Biochemistry of this institute. He continued to work on the project "Linguistic Study of Communicative Disorders – An Interdisciplinary Study" in collaboration with the International School

of Dravidian Linguistics funded by the Education department, Government of Kerala; and worked on "Correlative study of structural alterations of brain anatomy in aphasic patients – a CT and MRI study" in collaboration with the Department of Radiology. The research project on "Thyroid function abnormalities in epilepsy – its impact on neuro-psychological performance and seizure control of patients" by Dr. Sanjeev Thomas funded by the State Committee on Science and Technology is scheduled for completion this year.

A series of descriptive and analytical epidemiological studies were being developed in the field of stroke, epilepsy, parkinsonism and other neuro degenerative disorders.

Dr. Sanjeev Thomas left for National Institute of Health, Bethesda Mary land, USA on a fellowship in Epilepsy starting from March 1994. He will be attending and presenting a paper on "Neuro-imaging studies in eclampsia" in the American Academy of Neurology meeting at Washington DC. He attended the 20th International Epilepsy Congress at Oslo, Norway in July 1993.

A 16 channel EEG machine with facility for polygraphic recording started functioning in the department from February 1994. This model has special facility for ECG and respiratory monitoring. The Mayo Clinic System of EEG diagnostic classification is being modified to suit the reporting of EEG records.

The Department started a training programme for neuro-technicians and the first batch of two students joined during the year. In addition to gaining practical knowledge in the recording of EEG, EMG, NCV and EP, these students initiated research projects. Miss Doney is trying to define "Breath rhythm and its neuroradiological correlates in patients following Neuro-surgical Interventions". Miss Nandini is studying the clinical correlates of normal and abnormal EEG responses to photic stimulation.

Dr. NH Antia, Chairperson, the Foundation of Research in Community Health was the guest of the Department in August 1993. He delivered lectures on "From Leprosy to Community health, a Plastic Surgeon's Journey" and "Peripheral neuropathy in Hansen's disease". Dr. D. Ram Ayyar, Professor of Neurology, University of Miami, Florida USA visited the Department in November 1993 and gave lectures on primary muscle diseases of various aetiologies. Professor Michael Swash, Director of Neurosciences, Royal London Hospital, London, UK visited the Department in January 1994 and spoke on "Motor Neuron Disease" and "Evaluation of cases of sphincter dysfunction". Dr. Robert Daroff, Professor and Chairman, Department of Neurology, University Hospital of Cleveland, Ohio, USA spoke on "Ocular Movement Disorders" and "Headache".

Speech Pathology & Audiology Unit

Smt. S. Maya, MSc. Speech Therapist

312 patients with hearing problems and 295 patients with speech and language problems were evaluated during the year under review. More than 1500 speech therapy sessions were arranged for patients with developmental and acquired language disorders.

The following activities were currently in progress:

1. Linguistic analysis of communicative disorders – an interdisciplinary study.

2. Correlative study of structural alterations of brain anatomy in aphasic patients – observations using CT/MRI analysis.

3. Programmed language analysis and rehabilitation of subjects with disorders of communication by poly-model approach.

Dr. Prathibha Karanth, Head of the Department of Speech Pathology, All India Institute of Speech and Hearing, Mysore visited the Speech Pathology unit.

A new coding system for English alphabets with potential application in the language development of mentally retarded, and linguistically handicapped patients was developed by Dr. P.A. Suresh, Mrs. S. Maya and Mr. Koruth P. Varghese. These models are made in three dimensional blocks and are being applied in speech and language rehabilitation.

Department of Neurosurgery

Dr. Damodar Rout, MS, MCh, FAMS	Professor and Head
Dr. B.K. Misra, MS, MCh, Dip NBE	Additional Professor
Dr. Suresh Nair, MCh	Associate Professor
Dr. R. Krishna Das, MCh	Assistant Professor
Dr. M. Bhaskara Rao, Dip. NBE	Assistant Professor
Dr. P.P. Bishnu, MS, MCh	Assistant Professor

Candidates for M.Ch

Dr. Rajesh Shishoo, MS
Dr. Muralidhar Pai, MS
Dr. Rajneesh Kachhara, MS
Dr. N.I. Kurian, MS
Dr. Sumit Deb, MS
Dr. Girish Menon, MBBS
Dr. Yashesh Dalal, MS
Dr. Puduru Sai Sudarshan, MS
Dr. Dibanath Chakraborthy, MS
Dr. Sonal Thakker, MBBS

With the existing facilities and increasing referrals of more and more complex intracranial surgical problems, the volume of operative work showed only a marginal rise compared to the previous years (Table 24). The overall operative mortality rate was 3.4%. Surgery for intracranial aneurysms and arteriovenous malformation continued to increase and formed 20% of the total surgical procedures, being the highest annual record till date.

Table 24

Aneurysms	121 (106 patients)
Arteriovenous malformations	39
Meningiomas	68
Gliomas	57
Acoustic neurinomas	31
Other cranial nerve neurinomas	6
Intra ventricular tumours	21
Cerebellar tumours	29
Pituitary adenomas	54
Craniopharyngiomas	17
C V junction anomalies	43
Spinal tumours	38
Other spinal lesions	58
Miscellaneous	154

The multicentric clinical trial of "CERE-DRAIN", the Chitra hydrocephalus shunt system was completed with the final meeting of the participants from six centres including AIIMS, New Delhi; CMC, Vellore; KEM Hospital, Bombay; NIMHANS, Bangalore; NIMS, Hyderabad and PGIMER, Chandigarh. The results of clinical trials showed that the performance of the "CERE-DRAIN" hydrocephalus shunt was comparable to any other internationally available standard device and the complication rates were low. The feedback from the users indicated the need for a smaller valve chamber for use in children and the elimination of "sticking" of the slit valve.

Research Project

Title	:	Multicentric trial of Chitra hydrocephalus shunt system for clinical evaluation.
Principal investigator	:	Dr. D. Rout
Funded by	:	Dept. of Science & Technology, Govt. of India.
Status	:	Completed

A new project to study the "Effect of urokinase and papaverine on chronic vasospasm in an animal model of subarachnoid haemorrhage" was sanctioned by the Dept. of Science & Technology, Govt. of India during the year.

Research project

Title	:	Effect of urokinase and papaverine on chronic vasospasm in an animal model of subarachnoid haemorrhage.
Principal investigator	:	Dr. B. K. Misra
Co-investigators	:	Dr. Santosh Joseph Dr. Mira Mohanty Dr. G. Arthur Vijayan Lal Dr. Annie John Dr. D. Rout
Funded by	:	Dept. of Science & Technology, Govt. of India.
Duration	:	3 years

In collaboration with the Divisions of Vivarium and Pathology, the experimental projects "Effects of intravenous and oral glycerol in an experimental model of raised intracranial pressure and its comparison with mannitol" in canine model and "Role of AgNORs in the evaluation of intracranial gliomas and meningiomas" were carried out by the post-graduate students.

Prof. Rout participated as guest speaker in the III Indo-European Congress on neurosciences at Salzburg, Austria and in the seminar on "Neurosurgery update for young neurosurgeons in Asia" at Toyota, Japan. In the X International Congress of Neurological Surgeons at Mexico, he participated in seminars on "Surgical management of giant intracranial aneurysms" and "Management of intraventricular tumors" besides presenting a paper on "Intra operative rupture of cerebral aneurysms: outcome" and chairing a scientific session on "Interventional and imaging neuroradiology". He was conferred "Diploma in Laser am Nervensystem" at Karl-Franzens University, Graz. He was Visiting Professor to Johns Hopkins Hospital, Baltimore; Barrow Neurological Institute, Phoenix, Arizona; Henry Ford Hospital, Detroit, Michigan; University of Graz, Austria; Fujita Health University, Toyoake, Japan; Shinshu University, Matsumoto, Japan and Hyogo Brain and Heart Centre at Himeji, Japan where he lectured on various topics in neurosurgery.

Dr. B.K. Misra participated as a delegate in the symposium "Neurosurgery update for young neurosurgeons in Asia" held at Toyota, Japan and in the X International Congress of the Neurological Surgeons at Mexico where he presented papers on "Hearing preservation in surgery of large acoustic neuromas" and "Trans-callosal approach to anterior and mid third ventricular tumours". He was visiting faculty to Texas Technical University and Hyogo Brain and Heart Centre at Himeji, Japan.

Dr. Suresh Nair participated in the First Asia Pacific workshop on "Minimally invasive neurosurgery" at Singapore and was a visiting faculty at West Mead Hospital, Sydney.

Dr. Satish Krishnan resigned to take up an assignment abroad.

Post-graduate students in neurosurgery from NIMHANS, Bangalore and CMC, Vellore visited the Department for short periods as observers.

Division of Neurochemistry

Dr. P. S. Appukuttan, Ph.D — Additional Professor
Smt. K. I. Annamma, B.Sc. — Scientific Assistant

Endogenous glycoprotein receptors in human grey matter for galactose-binding protein (lectin) were detected on Western blots using peroxidase-labelled lectin. The glycoproteins consisted of subunits of molecular mass 47kDa, 56kDa, 100kDa, 151kDa and 186kDa.

Using a^- and B^- anomers of galactosides and naturally occurring glycoproteins and polysaccharides of known sugar structures, it was established that brain 14 kDa galactose binding lectin binds a–galactoside as much as or sometimes more than B–galactoside–specific. These results were confirmed using a–galactoside–specific enzymes. Since many infective microorganisms as well as metastatic tumor cells possess a–galactosidic surface molecules, this observation suggests that the lectin may be crucial in tissue anchorage of such invading cells.

To study the physiological function of galactose-binding mammalian lectin, its interaction with the ubiquitous and multifunctional basement membrane glycoprotein laminin was examined. Lectin in brain and heart co-purified with laminin. Also, the binding of lectin to laminin could be reversed only with the simultaneous presence of high salt and sugar concentration. These results indicate a pivotal role for laminin in lectin function.

Another observation of great significance to the physiological role of lectin in brain tissue is that they bind to brain gangliosides. This binding, demonstrated by affinity electrophoresis as well as hemagglutination experiments, is sugar-specific unlike the binding of albumin to gangliosides. Trials with individual gangliosides revealed that GT1b, GD1b, GM2, GM1 and GD1a are recognized by bovine brain lectin in the decreasing order of affinity.

Towards developing an ELISA for human serum anti-a-galactoside antibody (anti-Gal), a covalent conjugate of bovine serum albumin and melibiose was prepared, which could be immobilized on plastic microtitire plates and recognized by anti-Gal.

A multiphor II Electrophoretic Transfer Apparatus was purchased for the Division.

Two students of M.Sc. (Zoology) course of the University of Poona spent one month in this Division to complete their research dissertation.

Research projects

1.	Title	:	Galactose-binding lectins and endogenous lectin-binding glycocongugates of mammalian brain: their structure and interactions in normal and tumour-affected tissue.
	Principal investigator	:	Dr. P. S. Appukuttan
	Co-investigator	:	Dr. Dekumar Basu
	Funded by	:	Dept. of Science & Technology, Govt. of India
	Duration	:	4 years
	Status	:	Completed on 10–10–'93
2.	Title	:	ELISA for human serum anti-a-galactoside antibody and its epitopes in tissues.
	Principal investigator	:	Dr. P. S. Appukuttan
	Co-investigator	:	Dr. Jaisy Mathai
	Funded by	:	Dept. of Science & Technology, Govt. of India
	Duration	:	3 years
	Status	:	Ongoing

Division of Pathology

Dr. V.V. Radhakrishnan, M.D.	Professor & Head
Dr. (Mrs.) S. Sandhyamani, M.D.	Additional Professor
Mrs. Annamma Mathai, M.Sc.	Scientific Assistant

The routine activities carried out during the year for the hospital services are shown below.

Histopathology	850
Frozen sections	289
Muscle biopsies	41
Routine immunological tests	1400
Autopsies	39

The ongoing research on "Mucoid vasculopathy" made considerable progress during the year 1993–94. Based on the project report, the Department of Science and Technology, Govt. of India sanctioned a second research project to investigate the biochemical characteristics of mucoid vasculopathy in human and experimental materials.

Research project

Title of the project	:	Studies on mucoid vasculopathy in Kerala
Principal investigator	:	Dr. (Mrs.) S. Sandhyamani
Funded by	:	Department of Science & Technology
Duration	:	3 years
Status	:	Ongoing

Besides, an attempt was being made to correlate the clinical and radiological features in patients with peripheral vascular diseases, coronary artery disease and strokes with the lesions seen in mucoid vasculopathy.

Autopsy studies have indicated that mucoid vasculopathy could be a common manifestation of an acquired metabolic disorder "Connective tissue mucopolysacharoidosis" and that it could be associated with vascular and tropical diseases (goitre, cardiomyopathy, chronic pancreatic atrophy etc.) prevalent in Kerala. Further studies to validate this is in progress currently.

Dr. S. Sandhyamani won the following awards for her research work during the current year.

1. Dr. S. S. Misra award of the National Academy of Medical Sciences (1992–93).

2. Amrut Mody Unichem award of the Indian Council of Medical Research (1992–93).

3. SCTIMST Institute award for Science.

Dr. V. V. Radhakrishnan and Mrs. Annamma Mathai were awarded the Chaturwedi Ghanashyam Das Jaigopal Prize of the ICMR for their original work on immunology of infectious diseases.

Prof. H. D. Tandon, Retired Director, AIIMS, New Delhi visited the Division and held extensive discussions with Dr. V. V. Radhakrishnan and Dr. S. Sandhyamani on the research work being carried out and on the future direction and reorganization of the Division.

The Division continued to provide teaching and training to post-doctoral students from the Institute as well as post-graduate students in Pathology from other Institutions.

Department of Radiology

Dr. K. Ravimandalam, M.D.	Additional Professor & Head
Dr. A. K. Gupta, M.D.	Additional Professor
Dr. Santhosh Joseph, D.M.R.D., M.D.	Associate Professor
Dr. N. Madhavan Unni, D.M.R.D., M.D.	Associate Professor
Dr. A. Srinivasa Rao, M.D.	Associate Professor

Table 25

Routine Procedures done in 1993–94

Plain X-rays	14190	
CT scans	4239	(SCTIMST Pts. – –2501) (Outside Pts. – 1738)
MRI scans	1764	
Invasive procedures (Diagnostic)		
Cerebral angiograms	284	
Aortograms & peripheral arteriograms	284	
Myelograms	66	
Miscellaneous	76	
Interventional procedures		
Balloon angioplasty	51	
Pre-op balloon occlusion (vascular surgery)	4	
Embolisation	32	

The film digitiser developed under the project funded by the Department of Electronics, Government of India, underwent initial trials. Its functions were demonstrated to a group of Radiologists from other Institutions (RCC & MCH) in Trivandrum. The equipment was exhibited at the 47th annual congress of the Indian Radiological and Imaging Association at Cochin and attracted the attention of several senior Radiologists.

Work on laser ablation of the disc for the treatment of intervertebral disc prolapse is underway.

MR angiography software package was purchased, which enabled the angiographic visualization of blood vessels without the use of contrast media.

Patent application was filed for a double umbrella occluder device for transcatheter interventional applications.

The development of a Digital Radiography System (Picture Archival System) in collaboration with ER & DC, Trivandrum made progress.

Dr. A.K. Gupta and Dr. Santhosh Joseph visited the United States to receive application training in MRI during October–November.

Dr. Ravi Mandalam attended the International Congress of Radiology at Singapore in January.

Prof. Anne G. Obsorne, Professor of Neurology, University of Utak visited the Department in February and delivered three lectures.

Radiologists from the Medical Colleges of Trivandrum and Vadodara, JIPMER, Pondicherry and Advanced Medical Care, Trichy underwent short term training in the Department.

BIOMEDICAL TECHNOLOGY WING

Materials Testing Laboratory

Dr. R. Sivakumar B.Tech (Metallurgy) Ph.D. (Materials Sci)	Head
Dr. K. Sreenivasan Ph.D.	Scientist
Sri. B. Ajithkumar M. Tech	Engineer
Dr. T. Ramachandran Ph.D.	Scientist
Sri. Niranjan D. Khambete B.E. (Instn.) M. Tech. (Bio-Med Engg.)	Scientist
Dr. P. R. Harikrishna Varma Ph.D.	Scientist
Dr. Annie John Ph.D.	Post Doctoral Fellow
Sri. S. Vijayan B.Sc.	Scientific Assistant

This laboratory was restructured for the development, characterisation and testing of biomaterials.

The transmission Electron Microscopy (TEM) unit became fully operational and work was done on soft tissues with various implants (Copper, Silicone Rubber, Glass, Ceramic and Delrin), retrieved vascular grafts and blood platelets. Methods for decalcification of hard tissue (bone and teeth) for observation under TEM were standardised.

The Scanning Electron Microscopy unit (SEM) was also regularly used and the techniques for coating of biological samples and low voltage high resolution viewing were streamlined. Supportive work was done for various divisions for surface topographic and morphological studies. Mr. B. Ajitkumar, Scientist, BMT Wing went to Hitachi, Tokyo, Japan for special training on various aspects of biomaterial and biological sample preparation and viewing.

Analytical facilities like IR-Spectroscopy, HPLC, DTA/DSC and Instron Mechanical testing facility were extended to other divisions of the Institute and several external research organisations on a chargeable basis.

A laboratory was set up and maintained for the synthesis of Bio-ceramics and Glass materials. Work was initiated in developing procedures for the preparation and characterisation of tricalcium phosphate and hydroxy apatite powders with controlled particle characteristics. Studies on the preparation and characterisation of Calcium alumino fluorosilicate glass for class-ionomer restorative filling applications are going on. The initial work was carried out with help of DMRL, Hyderabad.

A Cyclodextrin based novel polymer

capable of interacting with clinically relevant molecules like steroids was developed. Simple and effective techniques were formulated to incorporate silver component on the surfaces of polyvinyl chloride, silicone, latex and polyurethanes with a view to develop materials for anti-microbial applications. A liquid chromatographic method was devolved to estimate the residual ethylene glycol in ethylene oxide sterilised polymers.

In the project on the development of electrodes for neurophysiological applications, identification and procurement of candidate materials were completed. The standardisation of assembly procedure made progress.

Research project

Name of the Project	:	Development of Electrodes for Neurophysiological applications
Principal investigator	:	Dr. R. Sivakumar
Principal Co-investigator	:	Shri G.S. Bhuvaneshwar
Funding	:	Dept. of Science & Technology
Duration	:	Two years
Status	:	Ongoing

The Laser group was involved in developing clinical applications of the technology in patients.

Dr. R. Sivakumar was nominated as a member of the Material Science Committee of the Board of Research in Nuclear Sciences, DAE, Government of India, for a three year period (1994 to 1996).

Sri. B. Ajith Kumar went to USA to work with Dr. William Kolf University of Utah, on a BOYSCAST fellowship of the Government of India.

Division of Thrombosis Research

Dr. M. Jamaluddin, Ph.D.	Scientist
Dr. Lissy Kalliyanakrishnan, Ph.D.	Scientist
Dr. V. S. Sugunan, Ph.D.	Research Associate
Smt. Ancy Thomas, M.Sc.	Scientific Assistant

Research project

Title	:	"Mechanisms and Modulations of Platelet Activation and Aggregation".
Principal investigator	:	M. Jamaluddin
Funding agency	:	DST
Duration	:	4 years
Status	:	Ongoing

The conventional view that the calcium ionophore, A23187, activates platelets by its ionophoric action of transporting Ca^{2+} ions across the platelet plasma membrane cannot explain recent experimental results. Investigations showed that A23187 dose dependently acted on platelets (in the absence of Ca^{2+} ions) to induce shape change reactions converting platelets into a form (forms) competent to aggregate on the addition of Ca^{2+} ions. The induction of aggregation by Ca^{2+} was dependent on the A23187 concentration used, and the maximum rate of aggregation showed apparent positive co-operativity with $h = 2.4$ suggesting the requirement for a minimum of 3 molecules of A23187. This is inconsistent with the ionophoric mode of action of A23187. The Arrhenius activation energy of A23187 induced shape-change reactions was also inconsistent with the ionophoric mode of action. This and other aspects of the problem are under investigation.

The use of 1-Fluro-2, 4-dinitrobenzene (FDNB) and 2', 2' - dithiobis- (5-nitropyridine) (DTNP) in platelet physiology were introduced for investigating the role of sulphydryls of special reactivity or accessibility, in platelet activation. Such sulphydryls have been found to be important for platelet activation (shape-change reactions) by thrombin, arachidonic acid, thromboxane analogues and H_2O_2.

Sodium arsenite and Cl^{2+} ions, well-known reagents for vicinal dithiols, were also introduced in investigating their role in platelet activation. Vicinal dithiols have been found to be important for platelet activation (shape-change reactions) by arachidonate, thromboxane analogues, and H_2O_2 but not thrombin or A23187. Cl^{2+} ions were found to inhibit shape-change and aggregation reactions of A23187.

Further evidence was obtained in support of our previous suggestion that H_2O_2 activates platelets primarily by acting at the putative thromboxane receptor and subsequently at the protein kinase C. Vicinal dithiols accessible to arsenite but not to Cl^{2+} were important for platelet activation by H_2O_2 and arachidonic acid. An antioxidant therapeutic strategy against thrombosis, is indicated.

Arrhenius activation energy (Ea) of platelet activation by various agonists was investigated. Ea for shape-change reactions of unactivated platelets was in the neighbourhood of 15 Kcal/mol-Ea for aggregation was 5–7 Kcal/mol higher, indicating a membrane diffusion or similar process intervening between shape-change and aggregation. The rate limiting step was under investigation.

Prior activation of platelets by suboptimal doses of some agonists, reduced Ea values for some other agonists. It is suggested that Ea measurements may be used to detect activated platelets (in some pathological conditions or as a result of contact with prosthetic devices).

It was shown that platelet aggregation by some agonists is characterized by apparent positive co-operativity. We have now found that apparent positive co-operativity characterizes inhibition of platelet activation by inhibitors of protein phosphotyrosine phosphates (Phe, Tyr, Zn^{2+} ions and pervanadate). Thus protein tyrosine phosphorylation dephosphorylation could be a site of co-operativity. Another site appeared to be that involved in Ca^{2+} interaction. Experimental and theoretical methodologies have been worked out to obtain and analyse co-operative kinetic data.

Data obtained in our laboratory and those reported in the literature support the view that the sequential shape-change and interaction model of platelet aggregation proposed by us can explain all known aspects of platelet activation. The results provide new strategies for the detection of activated platelets as well as for antiplatelet therapy.

With the help of the Blood Bank, studies were done to standardize the storage of platelet concentrates at 22 $\pm$ 1°C. Platelet storage bags are required to have good pliability and gas permeability for the maintenance of cell viability and function. The storage also require continuous agitation. There were two aims for the study.

1. To test the suitability of the agitator fabricated in the Tool Room at BMT Wing.
2. To analyze the possibility of platelet concentrate storage in PENPOL PVC whole blood bags. Both morphological and biochemical lesions of the stored platelets were studied for over

a period of 72 h of storage. Morphological and ultra-structural alterations of stored platelets were analysed using scanning and transmission electron microscopes. The biochemical and functional parameters studied included, PCO_2, PO_2, pH, platelet count, aggregatory response to various agonists, LDH leakage, MDA generation, hypotonic shock response etc. From the data obtained it was concluded that platelets could be stored in PENPOL bags atleast for 48 h without much functional damage.

Platelet specific B-thromboglobulin was purified to homogeneity from fresh human platelets and rabbits were immunized with this antigen. Antibodies will be used for the assay of B–TG released during platelet activation. We are also attempting to raise anti–GP IIb/IIIa (platelet membrane proteins) to study the loss of these proteins from platelets due to biomaterial interaction.

A Chronolog whole Blood Platelet lumi aggregometer was installed in the Division which can study platelet aggregation in whole blood, platelet rich plasma (PRP) or when suspended in buffer. This equipment can also analyze dense granule secretion and calcium mobilization simultanneously with platelet aggregation. A software which can collect and store the analysis data is linked to a computer through Aggro link, and the data may be retrieved and printed at any time.

The calf serum prepared from the newborn calves with the help of vivarium was found to be comparable with Sigma Fetal Calf serum. The growth, cell division and contraction of myocardial cells were studied by Dr. Renuka Nair, Division of Cellular and Molecular Cardiology, using the serum supplied from our laboratory.

A collaborative project for platelet transfusion for cancer patients was initiated in collaboration with the Regional Cancer Centre and Blood Bank of our Institute.

Dr. Jamaluddin was nominated to the Bioscience group to plan biological experiments for the 14th Antarctic expedition.

Division or Artificial Internal Organs

Sri. G.S. Bhuvaneshwar, M.S. Biomedical Engineer
Sri. C.V. Muraleedharan, M.Tech. Engineer
Sri. R. Sreekumar, B.Sc. Scientific Assistant

The Division completed the pilot production of 350 clinical quality Chitra Heart Valves and the technology transfer to M/s. TTK Pharma. Valve production facilities were subsequently leased to M/s TTK Pharma, for pre-commercial production. The Division co-ordinated this activity and training of their personnel in maintaining quality standards. A major part of technology transfer documentation of the valve was completed.

Development work towards a new design of Chitra Heart Valve prosthesis with respect to hydrodynamics of the device was completed. Further work of prototyping the new design and in vivo/in vitro evaluation are planned for the next two years.

The Division continued to interact with the Technology Proving Facility on the pilot production of hydrocephalus shunts. Control software for computerized quality assurance system for the classification of the shunts was developed in the Division. Since neurosurgeons using the Chitra shunts expressed the need for a paediatric valve, a suitable smaller flushing valve was designed.

The vascular graft programme was revived in collaboration with the South India Textile Research Association (SITRA), Coimbatore. The Division was involved in the co-ordination of this activity covering qualification of new batches of yarn and graft samples.

Dr. David Katz, Visiting Scientist from Queen Mary College, London worked in the Division for designing an artificial hip joint prosthesis suitable for Indian patients. A test jig for measurement of stress distribution of the femoral component was set up and preliminary studies were carried out.

Sri. N. Krishnamurthy, third year BE (Biomedical Engg) student from the Osmania University, Hyderabad worked in the Division as visiting summer fellow of the Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR). During his tenure, he reviewed the techniques of intraocular pressure measurement.

An important addition of equipment is Intel 80486 based Engineering Workstation with NISA III finite element analysis software package for both static and dynamic analysis. The system is capable of handling isotropic materials, anisotropic materials, anisotropic materials like bone and composite structures like FRP. The system will initially be used for the structural analysis of the artificial heart valve cage and the optimization of its design.

Sri. Bhuvaneswar and Sri. Muraleedharan were selected by National Research and Development Council (NRDC) for Invention Awards.

Division of Biosurface Technology

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

Dr. Thomas Chandy, Ph.D. — Scientist

Sri. Mr. P.R. Hari, B.Sc. — Scientific Asst.

The principal cause of the failure of bioprosthetic heart valves fabricated from glutaraldehyde pretreated bovine pericardium (GBP) is calcification. The mineralization of GBP in an extra circulatory environment with various drugs and the possible methods of prevention via metal ions was examined. It seems, the presence of ethyl alcohol, pentothal and xylocaine in calcium phosphate solutions, variably inhibited GBP calcification. Metals like Fe^{3+} ions and Mg^{2+} ions and their ionic combinations also substantially inhibited GBP mineralization.

Chitosan – polyethylene glycol (chit-PEG) interpenetrating network (IN) was synthesised by crosslinking different ratios of chitosan with PEG. The IPN demonstrated high swelling functions at acid pH and an optimum chit-PEG gel was selected. The gel was loaded with heparin to improve its antithrombotic properties. It seems, this novel chit-PEG-Hep gel may be an excellent matrix for pH sensitive insulin release, or for growing mammalian cells for an artificial organ.

Ferric Chloride was incorporated in a chitosan matrix, for prolonged delivery. The in vitro release profile of $FeCl_3$ from chitosan beads was monitored as a function of time. The $FeCl_3$ loaded beads were modified with liposome with a final surface coating with albumin. Such beads demonstrated a slow and constant delivery of ferric ions throughout a period of 30 days. The beads were highly blood compatible also, due to surface modifications. Similarly, protamine sulfate was also loaded to chitosan matrix to get a slow delivery system.

The development of adsorbents for the treatment of patients suffering from immune disease is still in its infancy. Therefore the development of selective adsorbents for the removal or decrease of immunoproteins from plasma is of great importance. Three polymers viz; chitosan, PVA and polyacrylamide which are non toxic and biocompatible were used for immunoprotein adsorption studies. In addition to this, hydroxyapatite was also used to study the immunoprotein adsorption. Modification of these polymer beads significantly increased the selective adsorption of plasma proteins especially immunoproteins. IgG is the immunoprotein which is absorbed more by all the three polymer matrices. There is an increased adsorption of the complement component C_3 also. Among these three polymer beads, chitosan beads proved to be more effective. Hydroxyapatite beads also behave somewhat similarly. Further studies on these columns are being carried out.

Chitosan hydroxyapatite/HA paste was evaluated for compressive strength and

dissolution in physiological solution for its possible use in orthopaedic applications. Chitosan/HA pellets have a yield strength comparable to the compressive strength of porous HA blocks of porosity 55%. Another application where the chitosan/HA paste may be useful is as an alternative to HA granules for bone filling. The advantage of a hardening paste may be to ensure that the bone replacement material remains in the location where it was implanted. Another application is the use of the paste for filling bone defects caused by screws for internal fracture plates.

Sri. Jossy John, M.Pharm student from the college of Pharmaceutical Sciences, Trivandrum completed his research project on transdermal delivery of an antihypertensive drug, captopril from a chitosan – PEG matrix.

Poster entitled "Protein/Platelet adsorption onto polymer substrates: Effect of magnetic field" presented in the symposium on Magnetism in Materials conducted by the subject group of Magnetic Materials of MRSI in connection with its 5th annual General Meeting held at RCI, Hyderabad on February 6, 1994 bagged the BEST POSTER AWARD.

A UV – Visible spectrophotometer, (Shimadzu, Japan), was added to the Division, through DBT funding.

Research project

Title	:	Development of blood compatible functional polymers as selective adsorbents for protein bound antigens during hemoperfusion.
Principal investigator	:	Dr. Chandra P. Sharma
Principal Co-investigator	:	Dr. Thomas Chandy
Status and duration	:	Ongoing (for 3 yrs from Jan. 1992)
Funding Agency	:	Dept. of Biotechnology (DBT)

Dr. C.P. Sharma delivered the MRSI gold medal lecture at the Annual meeting of Material Research Society of India at Hyderabad.

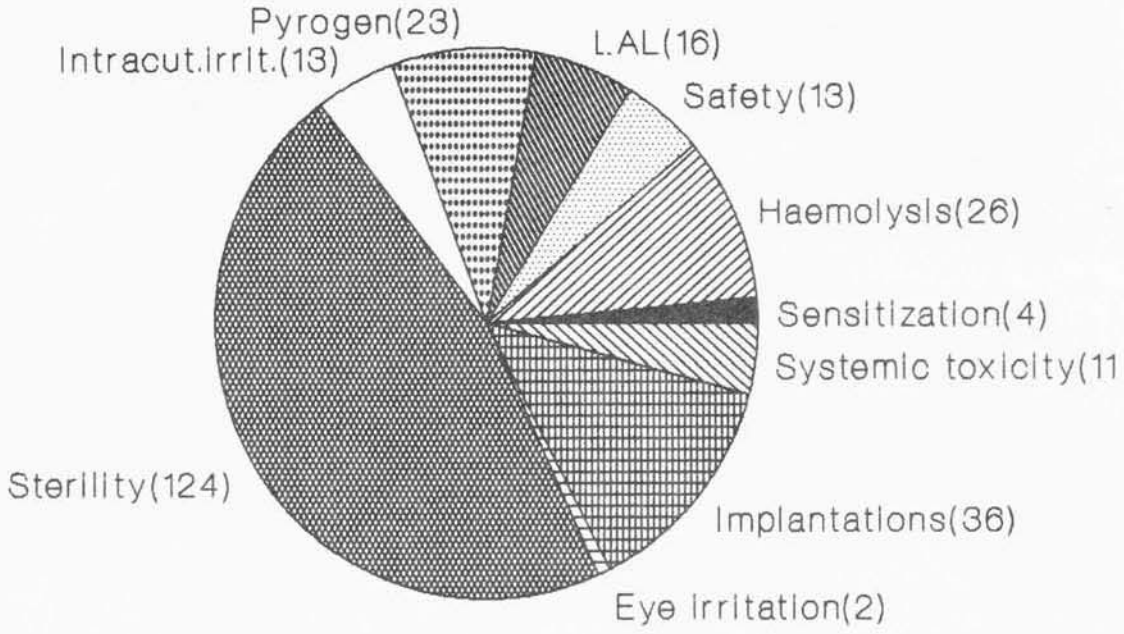
Division of Non-Traditional Toxicology

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

Validation experiments were initiated to confirm the results and reproducibility of the experimental protocols used in the studies on immunogenicity of implant materials and completed them successfully.

From among the primary cultures standardised earlier, lymphocyte culture was chosen for further studies. Chromosome pattern of normal peripheral lymphocytes of rabbits was studied. Primary cultures of lymphocytes thus standardised were used to study whether short term exposure of lymphocytes to biomaterial extracts can induce significant aberration in the chromosomes. These experiments are underway.

No.of tests carriedout during 93-94



Nos.in Paranthesis denote No.of tests

Division of Toxicological Screening of Materials

Sri. K. Rathinam, M.Sc. Scientist
Sri. P.V. Mohanan, M.Sc. Scientific Assistant

Toxicological safety and biocompatibility studies of candidate materials intended for the fabrication of various intra and extra corporeal devices, and the mandatory biological studies on finished devices as per international standards like ASTM, BIS, ISO and USP, remained the main functions of the Division. Besides these tests, the main effort during the year focussed on sterility tests and the tests to assess haemolytic potential. The Division was also engaged in the quality control monitoring (Sterility) of the Technology Proving Facility (TPF). In addition to these tests, viability testing of B. subtilis bacteria as a part of quality control programme of TPF was carried out. The bacterial colony count using blood agar for evaluating viable micro organisms in devices was carried out routinely. Figure 3 depicts the various tests carried out by the Division during the year. The materials screened include hydroxy apatite, titanium and chromium-cobalt-molybdenum-silicon alloy. PVA hydrogel ophtalmic sponge developed by the Polymer Division was also tested.

Cytotoxicity studies in vitro (cytocompatibility) using mast cells were standardised and done routinely.

The Division attained the capability to carry out in vivo and in vitro cytogenetic studies to evaluate chromosomal aberrations, micronucleus lesion and teratological changes. It was decided to initiate the in vitro mutagenecity test using bacteria–i.e. the Ame's test.

The Division initiated a collaborative study with the Division of Polymer Chemistry on the bioavailability of theophylline from glutaraldehyde cross linked casein microspheres following oral administration in rabbits.

Prof. (Dr). P.K. Seth from Industrial Toxicology Research Centre, Lucknow visited the division.

Sri. Joselly George from Amala Cancer Hospital, Trichur received training to perform micronucleus and chromosomal aberration tests.

Division of Pathophysiology

Dr. Mira Mohanty, MD (Path.)	Scientist
Dr. T.V. Kumari, Ph.D.	Scientist

The research activities in the Division included:

1. tissue culture studies on cell-material interaction using macrophages;
2. evaluation of tissue response to pure titanium, surface modified titanium and carbon films implanted in long bones of dogs, hydroxyapatite and chitosan coated hydroxy apatite in jaw bones of dogs and light cured BIS–GMA material in canine teeth;
3. studies on soft tissue response to materials such as casein and polysaccharide beads, hydroxyapatite and tricalcium phosphate, bovine dura mater and fascia lata along with ferric chloride beads and
4. assessment of the effects of laser on skeletal muscle.

Research projects

Project title	:	"Elucidation of mechanisms of toxicity of haemoglobin"
Principal investigator	:	Dr. T.V. Kumary
Co-investigators	:	Dr. Mira Mohanty, Sri. K. Rathinam
Funding agency	:	Indian Council of Medical Research
Status	:	Ongoing
Duration	:	3 years

Other activities comprised of haematological and biochemical studies in small animals subjected to oral toxicity testing and in sheeps implanted with Chitra Heart Valve.

An inverted phase contract microscope, Elisa Reader, and CO_2 incubator were installed in the Division which moved to a new location with additional floor space.

Dr. T.V. Kumary returned from the U.K. where she had spent 10 months at the Department of Clinical Engineering, Royal Liverpool Hospital on a Leverhulme Commonwealth Visiting Fellowship.

Dr. Mira Mohanty was admitted as a Fellow of the Indian College of Pathology.

Polymer Division

Dr. M. Jayabalan, Ph.D.	Scientist
Dr. Prabha D. Nair, Ph.D.	Scientist
Miss. P. P. Lizymol, M.Sc.	Scientific Asst.

Research and development programmes towards technology development were the major activities of the Division.

Due to the increasing demand and high cost for hollow fiber haemodialyzer used in patients with end stage renal disease, the indigenous development of a haemodialyzer device was started. The most important task associated with this development is identification and specification of hollow fibers, preparation of potting compound, potting of hollow fibers and the design of the dialyzer housing. Cuprophan (Regenerated cellulose) hollow fibers with specification required for ultrafiltration rate and diffusive permeability of vitamin B_{12} for high clearane of solute with adequate ultrafiltration were procured. These fibers were cleaned to remove the filling liquid before potting. A two-component potting compound based on dicyclohexyl methane diisocyanate was developed as an important substitute. Curing time and haemolytic potential were considered for selecting the correct potting compound. Potting compounds prepared with triols and cured with hardener resulted in a tough and blood compatible cured product. This formulation was used for potting hollow fibers. Transparent hollow cylinders moulded from polycarbonate and closely matching with the dimensions of the experimental dialyzer housing were procured. Required quantity of hollow fibers was taken up for potting under centrifugal rotation. The process of potting was standardised. Binding and integrity of hollow fibers were checked using a travelling microscope. The design of the dialyzer end caps and model device were taken up.

In continuation of the earlier programme on process development of leaching-free poly (vinylchloride) materials for biomedical applications, chemical modification of PVC films and tubes using an alphatic polyurethane resin was taken up considering the demand and need for such PVC materials. The modified PVC materials were cleaned using ultrasonic cleaner and tested for haemolysis and leaching of additives in solvents such as liquid paraffin and hexane and also in blood. The haemolytic potential of the modified material is very low and within the acceptable limit indicating blood compatibility. The maximum weight loss of modified PVC films and tubes in various media is as follows:

Table 26

Percentage weight loss of PVC material

Media	*Modified PVC*	*Unmodified PVC*
A. Films		
1. Blood	0.288	1.2301
2. Hexane	1.455	24.3000
3. Liquid paraffin	0.235	11.2000
B. Tubes		
1. Blood	0.0581	0.2318
2. Hexane	8.9200	23.0160
3. Liquid paraffin	1.5233	3.5466

The weight loss of modified PVC material in blood stored at 4°C for 19 days is very low which clearly indicates the stability of the material with the flexibility and transparency remained unaltered. This process development is a simple process which can be adopted for bulk preparation of modified material at industrial level without involving much machinery. Steps are being initiated for filing an Indian patent for this process development.

The programme on the modification of polystyrene plasticwares for biomedical applications such as cell biology, virology and other diagnostic applications was continued. Modification of plates and microspheres for possible uses in the bioreactor for production of anchorage dependent cells which can produce interferon with an inducer was taken up. Experiments with interferon inducer is in progress with collaboration of Divisions of Biosurface Technology and Microbiology.

The programme on the development of polymeric ophthalmic products was continued. An inexpensive ophtalmic sponge with properties comparable to expensive imported sponge has been developed using totally indigenous chemicals. This sponge which is to be used chiefly in cataract surgery, is lint-free and useful for absorbing blood and tissue fluids at the operation site. The sponge is nonirritant and biocompatable. As the sponge was accepted

by the surgeons of Shankara Netralaya, Madras, the patent for the product was filed Related products which are in various stages of development include corneal light shield, eye drain kit, instrument wipe and vitreous substitute.

An electronic analytical balance was added to the equipments of the Division.

Dr. Jayabalan received "Thangam Vasudevan award" (Medal Citation) for the best research paper in biomedical sciences for the year 1993 awarded by the Indian Association of Biomedical Scientists.

Research projects

Name of the project	:	Studies on the development and biodegradation of polyurethane blends for medical applications.
Principal investigator	:	Dr. Prabha D. Nair
Funding agency	:	Kerala STEC
Duration	:	2 years
Grant	:	Rs. 20,000/-

Division of Polymer Chemistry

Dr. A. Jayakrishnan, Ph.D.	Scientist
Dr. P. Ramesh, Ph.D.	Scientist
Sri. M.C. Sunny, A.I.C.	Scientific Assistant

The major activities of the Division continued to be centered around the DST supported project on controlled release of drugs from casein microspheres and on the DBT sponsored Technology Mission Programme on controlled release of vaccines from biodegradable polymeric matrices.

Research projects

1.	Title	:	Studies on controlled release of anti-fertility vaccines using biogradable polymeric matrices.
	Principal investigator	:	Dr. A. Jayakrishnan
	Funded by	:	Dept. of Biotechnology
	Duration	:	3 years
	Status	:	Ongoing
2.	Title	:	Preparation and evaluation of casein microspheres as drug carriers.
	Principal investigator	:	Dr. A. Jayakrishnan
	Funded by	:	Dept. of Biotechnology
	Duration	:	3 years
	Status	:	Ongoing

Continuing the efforts on crosslinked chitosan spheres as a delivery vehicle for vaccines, work was initiated in collaboration with the National Institute of Immunology (NII) on antibody response to Diphtheria Toxoid (DT) loaded chitosan spheres. The non-toxic and biocompatible nature of crosslinked chitosan spheres was demonstrated in vivo in a rat model for one year. It was seen that the biodegradation of glutaraldehyde crosslinked chitosan spheres was not complete even in a one year period. Compared to the uncrosslinked material which is reported to have an in vivo life span of about two months, the cross linked materials prolonged life in vivo opened up the possibility of using this material as a long acting drug delivery vehicle. Collaborative work with the NII group has shown that anti–DT antibodies generated from DT loaded chitosan spheres was rather steady though low for a 5 month period without much peaks and troughs compared to DT given on alum control in a rat model. It was also demonstrated that crosslinked chitosan spheres are good carriers for the prolonged delivery of small molecular weight drugs such as mitoxantrone, an anti-cancer agent, progesterone and oral drugs such as diclofenac sodium. Work is being continued on this problem. Side by side, the potential of polycaprolactone and polycaprolactone/polylactic acid blends are also being investigated for the prolonged delivery of macromolecules.

In the DST project on casein spheres, it was demonstrated that crosslinked casein could be used as a carrier for oral drugs and proteolytic enzymes present in the digestive tract do not degrade the material. This surprising finding was further confirmed by delivering an oral drug such as theophylline in a rabbit model. Peak serum concentrations were well within therapeutic limits compared to the free drug given orally. The possibility of using crosslinked casein as an oral drug delivery vehicle is expected to generate considerable interest in view of the fact that milk protein is an integral part of daily diet universally. Investigating the biodegradability of casein spheres in vivo in a rat model showed that the glutaraldehyde crosslinked casein spheres are not completely degraded in vivo in six months. Thus, compared to crosslinked albumin spheres the in vivo life of crosslinked casein is about three times. It is believed that this finding may initiate further active research in the milk protein since it offers the opportunity as a potential drug carrier for prolonged periods in vivo.

A new programme on metallised polymer films was initiated in the laboratory with a view of giving a thin silver coating on catheters particularly urinary catheters tp prevent hospital associated infections. Metallised films of various polymers were prepared in the laboratory and the adhesion between such films and the catheter is being investigated at present.

Consequent to a recent commercial interest in the double umbrella occluder device for ASDs and VSDs developed in the laboratory in collaboration with the Department of Radiology a few years ago, an Indian patent application was recently filed on the device.

Smt. Valsamma Thomas, M.Pharm student from the College of Pharmaceutical Sciences, Medical College, Trivandrum joined the Division for carrying out her project work.

Division of Polymer Technology

Dr. S.N. Pal, M.Sc. (Tech), Ph.D.	Engineer (on deputation to Hindustan Latex Ltd)
Dr. V. Kalliyana Krishnan, M.Sc., Ph.D.	Scientist
Sri. Roy Joseph, M.Sc., M.Tech.	Scientist

Research Activities in the Division related to dental composites, glass ionomers, bone cement, bone wax and the development of an endotracheal tube model.

One of the main problems of dental composites is short shelf life mainly due to tropical weather conditions of the country. The problem is more prevalent with self curing materials due to the presence of tertiary amine activator which tends to lose its activity over a period of time at higher temperatures. Modified formulations were developed for self cure materials which showed good working and setting times and retention of properties upon storage at even 37°C after five months of storage. The results were comparable with those which were stored at 8°C and at room temperature (28°C).

In another study, the effect of amine activator on the properties of self curing dental composites was investigated.

In self curing dental composites, the working and setting times depend upon the quantity and type of amine accelerator and peroxide initiator used in the system. For dental applications, the quantity of amine has to be maintained at a minimum level for reasons of toxicity. The type and amount of amine which gives a suitable working and setting time are important for developing a clinically suitable composite. By keeping the initiator concentration constant, the activator concentration was varied and the effect on mechanical properties was studied. It was concluded that the concentration of tertiary amines in chemical curing dental composite is important and critical. While dimethyl para toluidine was found to be the most active 2,2' para tolylimino diethanol was found to be more useful from the storage point of view.

Aging studies were conducted on self cured and visible light cured composites. The life of a dental composite is very much dependent upon the oral environment. The environment may vary drastically depending on the food habits and oral hygiene of the individual. The physical properties of dental composites have been known to be dependent upon the nature of the resin matrix, filler particles and the resin matrix interface. The effect of storage of self and light cured composites in citrate buffer, lactate buffer, PBS, distilled water and saline were studied. The solubility and solvent uptake were monitored for specific periods of storage. The changes in mechanical properties such as compressive strength, diametral tensile strength and microhardness were also monitored. The effect of sample thickness

upon the water sorption characteristics were also studied.

Animal trials of the visible light curing system was also completed successfully.

Work on the glass ionomer project made good progress. Copolymers of acrylic acid with itaconic acid and maleic acid were synthesised successfully and characterised. These polymers were then treated with glass powder supplied by Materials Testing Lab and they were found to form cements with good working and setting times, meeting international specifications.

For the development of bone cement materials, synthesis of homopolymer Poly (methyl methacrylate) (PMMA) and copolymers of PMMA and polystyrene (PMMA–co–PS) with varying styrene content were carried out by suspension polymerisation technique. These polymers of fine bead shape were characterised by particle size analyser for particle size distribution, by spectroscopy for chemical group analysis, by gel permeation chromatograph for molecular weight distribution, by viscometry for determination of molecular weight, by differential thermal analysis for thermal behaviour and by melt flow index for flow properties. Studies such as effect of styrene in doughing time, setting time, exotherm, compressive strength, intrusion, water sorption, estimation of residual monomer content were carried out on bone cement based on these polymeric beads. All the properties studied were highly comparable with the values stipulated for control acrylic beads used for bone cement and well within the recommended limits. The development of PMMA and PMMA–co–PS copolymers have potential applications in orthopedic and cranioplastic applications and may be taken up for further studies.

Other activities in the Division included the supply of sterile drapes to the Dept. of Neurosurgery, moulding of tonometry cups, milling and moulding of components for hydrocephalus shunts and purification of BIS–MGA. Development of composites with different shades is also in progress.

Dr. Nicolas Jedynakiewicz and Dr. Nicolas Martin, Department of Clinical Dental Sciences, University of Liverpool, spent a week and gave a series of talks on applications of CAD/CAM in restorative dentistry, dental adhesives and glass ionomer cements in the Biomedical Technology wing. They also outlined the current status of dental research in the United Kingdom.

M.Tech. students, Ms. M.A. Fancy and K.A. Jessy and B.Tech students Ms. Leny Mathew and Ms. K. K. Sreeja from Cochin University of Science & Technology successfully completed their project work in the laboratory during the current year. M.Tech students Ms. M. K. Prasanna and Sri. J. Sreekumar from the same university are currently doing their M.Tech project work in the division.

Technoprove facility

Sri. G. S. Bhuvaneshwar, M.S. Engineer in charge
Sri. D. S. Nagesh, M.Tech. Engineer

The pilot plant production of Hydrocephalus shunt under the sponsorship of M/s. Hindustan Latex continued during the year and the target of 2000 numbers were finished.

Following a request from HLL for the continued supply of the device, the project was extended for another six months from December 1993. This phase is ongoing.

The multicentric clinical trial of shunt was completed at seven centres and the final meeting was conducted on 26/2/1994. The overall performance of the device was rated as good by all centres.

The development of a computer controlled, automated multi channel test system was completed and satisfactorily put into operation.

The technology transfer documents are under preparation and expected to be completed soon.

Documentation Cell

Sri. D. Ranjit, B.E., Engineer

The work related to the Institute's Technology Transfer licence agreements, intellectual property rights and the co-ordination of various inter-disciplinary activities of the Institute were managed by the Documentation Cell. In particular, work was done on the drafting and holding mutual discussions with prospective licencees on the technology transfer licence agreements related to:

i. "The Hydrocephalus Shunt" between SCTIMST and M/s. Hindustan Latex Ltd, Trivandrum and

ii. "Bone Wax" between SCTIMST and M/s. T.T.K. Pharma Ltd, Madras.

Arrangements were made by the Documentation Cell for the organisation of the Third Indo-U.K. Symposium on "Bio-Medical Technologies: Development to Transfer", held in January 1994.

The patent activities of the Institute was co-ordinated by the Documentation Cell in liaison with the concerned divisions. New patents were filed on dental materials, biocompatible sponge, hydroxyapatite, anaesthetic equipment alarm device, radiological device and biological polymers. The current status of the Institute's patents is as listed below:

Patents sealed	=	8
Designs held	=	11
Patents filed & pending	=	20

The Science & Technology Parliamentary Consultative Standing Committee held its meeting in October 1993 and Mr. Ranjit represented the Institute and co-ordinated the Institute's participation for this meeting.

Technology transfer documents related to the heart valve, hydrocephalus shunt, bone wax and dental materials were prepared, in co-ordination with the concerned divisions for distribution to the Licencees.

A centralised computer facility is maintained by the Documentation Cell for the common use of the staff of the BMT Wing.

Division of Engineering Services

Sri. O.S. Neelakantan Nair, B.Sc. (Engg)	Engineer
Sri. K.P.R. Bhas, Dip. (Electrical Engg)	Junior Engineer

This division fabricated samples of femoral joint for hip prosthesis, completed the batch production of 10 sets of high pressure syringes, designed and developed indigenous platelet agitator machine for Blood Bank, fabricated samples for haemoperfusion column, provided design and fabrication help for developing needle electrode concentric aligning fixture and designed and developed assembly fixture for artificial heart valve.

A new building for electrical, sanitary and air-conditioning maintenance was completed and the respective sections started functioning there. Modifications including partitioning, air-conditioning and electrical wiring were made for the new laboratory of Division of Pathophysiology.

In order to take up detailed design work for product development one new Engineer Sri. Ramesh Babu was recruited with design and mould making experience. He was deputed to Sigma manufacturing consultant at Poona for short time training in the field of Process Engineering and Jigs & Fixture design.

Routine activities of the division include maintenance of electrical supplying system, air-conditioning system, sanitary arrangements, panbit and maintenance of faculty hostel and incinerator.

Sri. Neelakantan Nair was selected for Invention Award by the National Research and Development Council (NRDC).

Vivarium

Dr. G. Arthur Vijayan Lal, BVSc — Veterinary Scientist
Dr. S. Bhaskara Rao, MVSc — Veterinary Scientist

The routine activity of the Division included

i. breeding, care and management of laboratory animals like rabbits, rats, mice guinea pigs, calves, sheep, goats, pigs and dogs

ii. providing laboratory animals, organs, tissues, blood etc. to the user departments and

iii. extending experimental, surgical and technical expertise in the evaluation of biomaterials and devices to various departments.

The Division extended its help in

i. the development of dog and rabbit models for endomyocardial fibrosis,

ii. guided tissue regeneration studies in the mandible of dogs,

iii. studies on calcification of bovine pericardium, fascia lata and dura matter implants in a rat model

iv. evaluation of hydroxy apatite and chitosan as dental periodontal alloplasts

v. developing animal models for polymyositis and steroid induced myopathy in rabbits and rats and

vi. evaluation of transdermal delivery of specific anaesthetics in rabbits.

A group of 55 undergraduate students from Gujarat Veterinary College visited the vivarium.

Dr. Bhaskara Rao presented a paper on "Xylazine anaesthesia in laboratory animals" at the annual symposium of Indian Veterinary Society. The paper was adjudged as the "BEST PAPER" in biomedical research category and won him the *Wistar Award*. He also won a gold medal and award for his lecture on "Human – Animal interactions".

A Report on The Third Indo-UK Symposium held on January 3–4, 1994

The Third Indo–UK symposium on "Medical Technologies – Research and Development to Technology Transfer" had 15 invited speakers and 35 participants. The theme was chosen in tune with the need for the development of medical technologies at an affordable cost. The symposium provided a platform wherein the various critical issues involved in the technology transfer in the U.K. and India were highlighted. The perceptions of R & D scientists and engineers, medical personnel and the industry were brought out clearly. This would enable a closer interaction and working together towards common goals. There was an active participation, through formal and informal discussions, by the delegates representing different R & D institutions and device industries.

From the link point of view, this symposium has paved the way to work out developmental programmes with technological implications on a collaborative basis. This is relevant in view of the changing economic scenario in India and the rest of the world.

A list of speakers and their subjects of presentation is given below:

1.	PROF. RAMASESHAN Chairman, Peninsula Polymers Ltd. Trivandrum.	Keynote address.
2.	PROF. D.F. WILLIAMS Department of Clinical Engineering University of Liverpool, U.K.	Technology transfer in medical devices.
3.	DR. M.D. NAIR Senior Executive Director, SPIC, Pharmaceuticals Division, Madras.	Technology transfer in India – an Industry point of view.
4.	DR. JULIA C. SHELTON Interdisciplinary Research Centre (IRC), Biomaterials, Queen Mary & Westfield College, London, U.K.	The development of novel system in orthopaedics.
5.	DR. R. SIVAKUMAR SCTIMST, Trivandrum.	Medical Device – Our technology goals.
6.	DR. S.N. PAL Hindustan Latex Ltd., Trivandrum.	Blood Bag project implementation.

7.	SHRI. A.V. RAMANI T.T.K. Pharma Ltd. Bangalore.	Importance of quality assurance & certification in medical devices manufacture.
8.	SHRI. G.S. BHUVANESHWAR SCTIMST, Trivandrum.	Impact of design and materials on performance of heart valve prosthesis.
9.	DR. NICK JEDYNAKIEWICZ University of Liverpool, U.K.	From industry to the patient, safely and ethically.
10.	DR. KALLIYANAKRISHNAN SCTIMST, Trivandrum.	Development of dental composites.
11.	DR. DAVID KATZ IRC, London, U.K.	Design of hip joints.
12.	DR. C.P. SHARMA SCTIMST, Trivandrum.	Chitosan – biomedical applications.
13.	DR. MIRA MOHANTY SCTIMST, Trivandrum.	Role of biological evaluation in medical technologies.
14.	DR. A. JAYAKRISHNAN SCTIMST, Trivandrum.	Hydrogel materials for medical applications.
15.	DR. M. JAYABALAN SCTIMST, Trivandrum.	Relevance and need for polyurethanes.

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ADMINISTRATIVE BODIES (1991-'96)

INSTITUTE BODY

President : Sri. Nani A. Palkhivala

1. Prof. P.S. Bidwai
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2. Prof. R.N. Chakravarti
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3. Dr. A.K. Mukherjee (Ex-officio)
Director General of Health Services
Government of India
New Delhi.

4. Sri. S.V. Giri (Ex-officio)
Secretary to the Government of India
Department of Education
Ministry of Human Resources
Development, Shastri Bhavan,
New Delhi.

5. Sri. Gopalkrishna Pillai (Ex-officio)
Secretary to the Government of Kerala
Department of Health and Family Welfare
Thiruvananthapuram.

6. Dr. Gunawant Rambhau Sarode
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7. Prof. Indira Nath,
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8. Sri. S.B. Krishnan, (Ex-officio)
Joint Secretary & Financial Adviser
Ministry of Science and Technology
(Department of Science & Technology)
Technology Bhavan
New Delhi - 110 029.

9. Prof. R. Kumar
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10. Sri. Kodikunnil Suresh
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11. Dr. P. Rama Rao, (Ex-officio)
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12. Dr. K. Rama Rao,
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13. Prof. R. Ravikumar (Ex-officio)
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14. Prof. D.V. Singh
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15. Dr. R. Sivakumar (Ex-officio)
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18. Dr. M.S. Valiathan (Ex-officio)
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19. Dr. J.V. Vilanilam (Ex-officio)
Vice Chancellor
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20. Dr. N.H. Wadia
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GOVERNING BODY

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1. Dr. M.P. Mohansingh
   Professor of CVTS
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   Thiruvananthapuram - 695 011.

2. Dr. A.K. Mukherjee (Ex-officio)
   Director General of Health Services
   Government of India.

3. Dr. P. Rama Rao (Ex-officio)
   Secretary to the Govt. of India
   Ministry of Science & Technology
   (Dept. of Science & Technology)
   Technology Bhavan
   New Delhi - 110 016.

4. Prof. R. Ravikumar (Ex-officio)
   Chairman
   State Committee on Environment,
   Science & Technology
   Government of Kerala
   Thiruvananthapuram.

5. Prof. D.V. Singh
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6. Dr. R. Sivakumar (Ex-officio)
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7. Dr. M.S. Valiathan (Ex-officio)
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   Sree Chitra Tirunal Institute
   Thiruvananthapuram - 695 011.

8. Dr. N.H. Wadia
   Director of Neurology
   Jaslok Hospital and
   Consultant Neurologist
   JJ Group of Hospitals
   Bombay.

STANDING COMMITTEES

Academic Committee

Director of the Institute (Chairman)

Dr. K.G. Balakrishnan
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Sree Chitra Tirunal Institute
Thiruvananthapuram.

Dr. B.S. Das
Professor of Neurosurgery
National Institute of Mental Health & Neurosciences, Bangalore.

Prof. Indira Nath
Professor of Biotechnology
All India Institute of Medical Sciences
New Delhi.

Dr. K. Mohandas
Professor of Anaesthesia
Sree Chitra Tirunal Institute
Thiruvananthapuram.

Dr. Placid Rodriguez
Director
Indira Gandhi Centre for Atomic Research
Kalpakkam, Tamil Nadu.

Dr. G.B. Parulkar
Professor of Cardiovascular & Thoracic Surgery & DEAN (Retd.),
K.E.M. Hospital, Bombay.

Dr. C.P. Sharma
Scientist, Biosurface Technology
Sree Chitra Tirunal Institute.
Thiruvananthapuram.

Dr. R. Sivakumar
Head, BMT Wing, Sree Chitra Tirunal Institute
Thiruvananthapuram.

Prof. J.V. Vilanilam
Vice Chancellor, Kerala University
Thiruvananthapuram.

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Construction Engineer
Vikram Sarabhai Space Centre,
Thumba, Thiruvananthapuram.

Prof. R. Ravikumar
Chairman, State Committee on
Environment, Science & Technology
Government of Kerala.

Dr. R. Sivakumar
Head, Biomedical Technology Wing
Sree Chitra Tirunal Institute
Thiruvananthapuram.

Mr. P. Vijayakrishnan
Financial Adviser & Chief Accounts Officer
Sree Chitra Tirunal Institute
Thiruvananthapuram. (Convener)

Finance Committee

Director of the Institute (Chairman)

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Joint Secretary & Financial Adviser to the
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Mr. P. Vijayakrishnan
Financial Adviser & Chief Accounts Officer
Sree Chitra Tirunal Institute
Thiruvananthapuram. (Convener)

Junior Staff Selection Committee

Medical Superintendent (Ex-officio)
Sree Chitra Tirunal Institute
Thiruvananthapuram.

Head BMT Wing (Ex-officio)
Sree Chitra Tirunal Institute
Thiruvananthapuram.

Three nominees of the President

A Representative of the Academic Staff of the Institute nominated by the Director.

Senior Staff Selection Committee

Director of the Institute (Chairman)

Prof. P.S. Bidwai
Chief Cardiologist & Senior Research Consultant
Central India Institute of Medical Sciences
Nagpur.

A nominee of the Secretary
Department of Science & Technology
Government of India,
New Delhi.

An expert from outside the Institute nominated by the President.

Head, Biomedical Technology Wing (Ex-officio)
Sree Chitra Tirunal Institute
Thiruvananthapuram.

A Professor from the Institute.

Technology Development Committee

Director of the Institute (Chairman)

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Chairman
Atomic Energy Regulatory Board
Bombay.

Dr. A. Jayakrishnan
Scientist, Sree Chitra Tirunal Institute
Thiruvananthapuram.

Prof. R. Kumar
Professor of Chemical Engineering
Indian Institute of Science
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Dr. S.N. Pal
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Dr. S.R. Rajagopal
Emeritus Scientist
Materials Science Division
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Dr. K. Rama Rao
Director, II
Defence Research and Development Laboratory
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Dr. R. Sivakumar
Head, Biomedical Technology Wing,
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Technology Transfer Committee

Dr. S. Varadarajan (Chairman)
New Delhi.

A Senior Officer of the DST
(Nominated by the Secretary, DST)

Mr. C. Venugopal
Technology Transfer Division
VSSC
Thiruvananthapuram.

Mr. A.K. Nair
Kerala State Industrial Development Corporation,
Thiruvananthapuram.

Head (Ex-officio)
Division of Technology Transfer
Sree Chitra Tirunal Institute.

Expert Nominee (in case of devices)

Principal Investigator
(for specific devices)

FA & CAO of the Institute (Ex-officio)