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Proposal for

A Centre for Fundamental Research

in

Biological Sciences

Tata Institute of Fundamental Research
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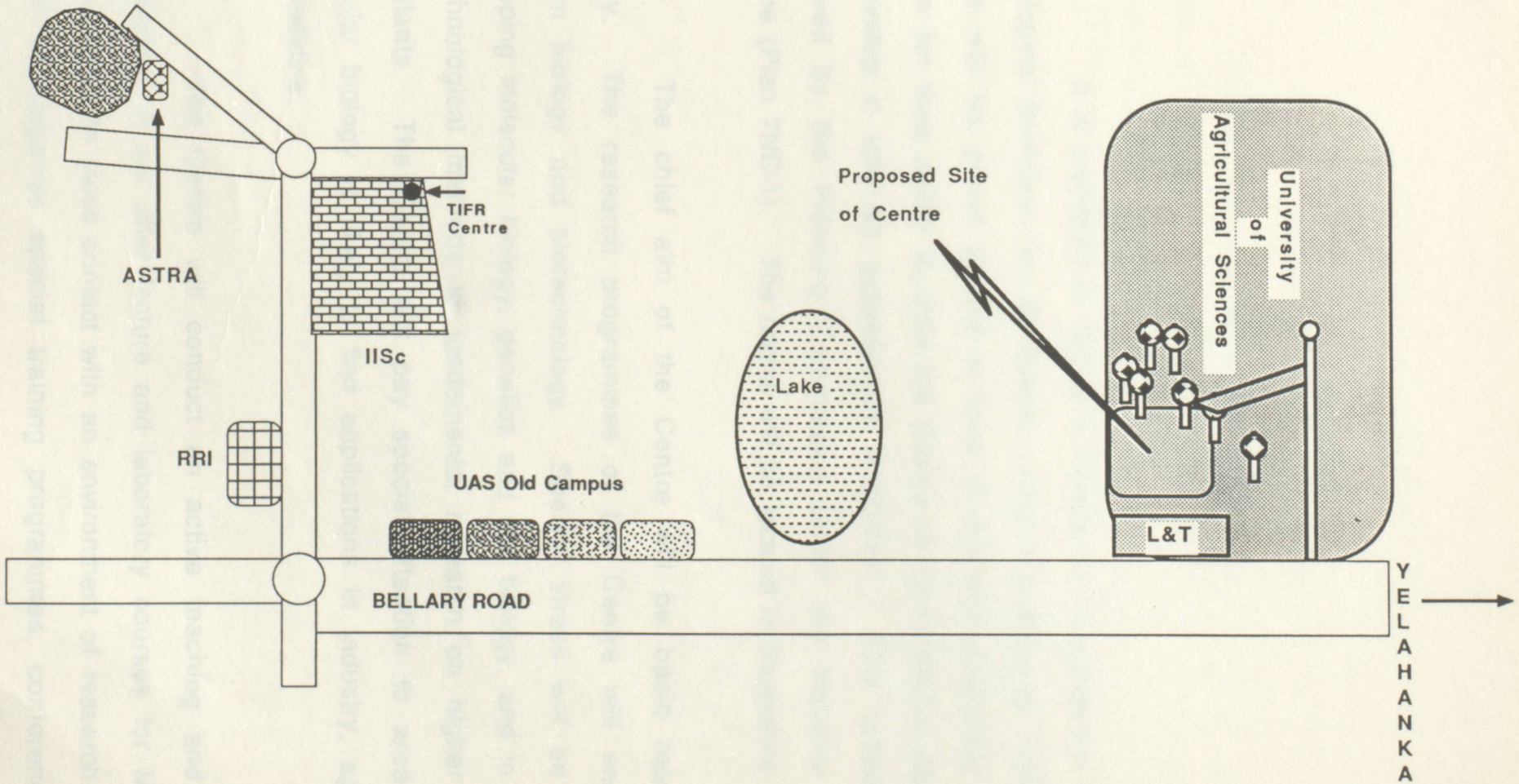
Schematic map of the UAS and its environs



1. Summary

It is proposed to set up a Centre for Fundamental Research in Biological Sciences at Bangalore under the aegis of T.I.F.R. The Centre will be grown around a core of talented scientists specially chosen for their ability to lead the Centre in its formative period, and to develop it into an autonomous institution. This proposal was approved by the Planning Commission under the National Centres Scheme (Plan 7NC-1). The centre will be located in Bangalore.

The chief aim of the Centre will be basic research in biology. The research programmes of the Centre will encompass modern biology and biotechnology. Special stress will be laid on developing molecular biology, genetics and cell biology, and in applying biotechnological methods to fundamental research on higher animals and plants. The Centre will pay special attention to areas where molecular biology is likely to find applications in industry, agriculture and medicine.

The Centre will conduct an active teaching and training programme. It will offer lecture and laboratory courses for M.Sc and Ph.D students in close contact with an environment of research. The Centre will organize special training programmes, conferences and workshops in rapidly developing areas of modern biology for the benefit of biologists in the country.

In the following pages, the general philosophy underlying the proposal is explained. A phased programme for the growth of the Centre over the next six years (1989-1995) is outlined.

The proposal involves an outlay of Rs. 18 crores. About Rs. 1.5 crores will be spent in 1989-90 in acquiring the site and setting up temporary laboratories in Bangalore. An expenditure of Rs. 16.5 crores in the 8th Plan (1990-95) is envisaged.

Summary of Financial Outlay
1989-1995

Cost of Land and Development	1.5 crores
Equipment and Facilities	4.5 crores
Laboratories	4.5 crores
Housing and Hostel	2.5 crores
Recurring Expenses	5.0 crores
TOTAL	18 crores

Phased Plan of Expenditure

Period	Financial Outlay	Projections	
7th Plan	1.5 crores	Centre will be constituted and temporarily located in T.I.F.R. Centre building in the I.I.Sc. campus Bangalore.	1989-90
		Site in the University of Agricultural Sciences will be acquired. Temporary laboratories will be constructed.	
		First appointments of staff will be made.	
8th Plan	16.5 crores	Main laboratories will be constructed and equipped.	1990-95
		Housing for staff and students will be built.	
		Centre will grow to a size of about 130 employees.	

2. Introduction

During the past 40 years major advances in biological sciences have taken place. The main impetus for this development has come from fundamental discoveries in molecular biology. With the newly gained knowledge of the genetic organization of living systems and of the dynamics of gene action, the foundations for a deeper understanding of hitherto unexplained biological phenomena have been laid. The impact of these advances is spreading to other areas of biology of which our understanding is, at present, incomplete. Such areas include, the genetic organization of higher plants and animals, development and differentiation of multicellular organisms and the functions of the brain. It may be safely predicted that the coming decades will see major discoveries in biology no less crucial than those made in the molecular biology of the recent past.

Modern developments in biology have opened up entirely unsuspected prospects for the application of genetic techniques towards the fulfillment of a variety of human needs. Recombinant DNA has brought us to the threshold of an entirely novel kind of agriculture and industry. The prospective applications of new biology have given rise to a new field of endeavor called biotechnology. The role that biotechnology can play in the development of our own country has been widely recognized. Biotechnology requires a firm base of knowledge

and skill in contemporary molecular biology. If India has to make a successful entry in this field, it must develop a strong foundation of basic research in modern biology.

The Tata Institute of Fundamental Research was one of the first Institutions in India to set up a Molecular Biology Unit in its Physics Faculty. The Molecular Biology Group at T.I.F.R. has concentrated upon genetics of microorganisms and higher animals and plants. Members of this group have applied genetic analysis to developmental biology and neurobiology. The T.I.F.R. group has established a high international reputation and has a rich experience of developing interdisciplinary research.

A proposal to set up a Centre for Biological Research through T.I.F.R. was made in the 7th Plan. The Planning Commission has approved the proposal to set up a Centre for Fundamental Research in Biological Sciences under the National Centres Scheme (7NC-1). The Centre will be grown around a group of scientists some of whom will be drawn from the Molecular Biology Unit and some that will be newly appointed. A core group of founding scientists has been identified. The Centre will function as an autonomous unit under the aegis of T.I.F.R in the initial phases of its growth. During this stage, T.I.F.R. will provide the necessary umbrella to protect and nurture the Centre. In due course, the Centre will become self-sustaining and independent.

3. Location

The Centre will be located in Bangalore. The climate of Bangalore is attractive and conducive to productive work throughout the year. The city possesses the necessary industrial and technical infrastructure and culture, and is well-connected by air and railway to major cities of India. A number of scientific institutions are located in Bangalore and the city has a rich potential for establishing and sustaining a vigorous scientific community with a cosmopolitan outlook.

The Karnataka Government has promised to provide suitable land for building the Centre and to give it all assistance. The University of Agricultural Sciences has offered a 20-acre site in its campus at Bangalore for the Centre. This is an ideal location. Being close to the Indian Institute of Science as well as the ASTRA Research Centre, the location of the Centre in this area will permit maximal interaction between the Centre and these institutions. The Centre expects to develop fruitful academic linkages with the University of Agricultural Sciences and the Indian Institute of Science.

4. Objectives

The principal aim of the Centre will be to conduct fundamental research and teaching in areas of biology at the frontiers of knowledge. A strong school of basic research in modern biology in India is of vital interest to the country. Such a school will improve the quality of biological research in the country and is of crucial importance for the success of applied research. Biotechnology demands scientific talents and skill of the highest order.

We intend to follow the prescription of Dr.Homi Bhabha in growing the Centre around outstanding individuals and not according to a rigidly preconceived plan. The research plans of the Centre must reflect the choice of the individuals around whom the Centre will be grown as well as the changing scene in biology. At this stage only a broad outline of the objectives can be given.

(a) *Research*

Modern biology is moving in two distinct directions. On the one hand, the urge to understand the physical basis of biological phenomenon, is continuously pushing biology towards molecular and atomic sciences; on the other hand a deeper understanding of molecular biology has created the necessary conditions for attacking afresh the

outstanding higher-level problems of biology. We propose to develop, at the Centre, a broad-based programme of research, dealing with all levels of modern biology. An outline of this programme is as follows:-

I. *Molecular biology and cell biology:*

Biochemistry and biophysics, microbial genetics, immunology and cell biology.

II. *Developmental Biology:*

Embryonic development, differentiation and morphogenesis of multicellular animals and plants.

III. *Neurobiology:*

Molecular neurobiology, structure and function of nervous system, neurogenetics, computational neurosciences.

IV. *Other areas:*

Animal behaviour, ecology, theoretical biology.

The above programme has a hierarchical structure. At the base is a strong foundation in molecular and cellular biology upon which all areas of modern biology must rest. At the next level, the Centre will address itself to the biology of higher organisms, specially to the development and behaviour of multicellular animals and plants and in

relating complex biological phenomena to biochemistry, cell biology and neurophysiology. Finally, future progress in biology will come from extending the understanding achieved at lower levels to yet higher levels such as ecology, behaviour and evolution.

Present day biology is highly interdisciplinary. It requires a close interaction of ideas and techniques from diverse fields including physics, chemistry, engineering and mathematics. A recent example of a highly successful interdisciplinary approach to biology is Computational Neuroscience where a combination of ideas from mathematics, computer science and neurobiology has led to important advances in brain research. The Centre will strive to create optimal conditions for interdisciplinary interaction through an appropriate choice of scientists and research projects.

The relationship between basic research in modern biology and its application for practical needs is very close. The ideas and techniques used in biotechnology emanate from molecular biology, and a strong scientific base in molecular biology is a necessary condition for successful application of biotechnology. For the successful control and prevention of many communicable diseases prevalent in India, it is necessary to understand the life cycle and biology of the parasites that cause these diseases. Similarly, the application of biotechnology to agriculture and forestry needs research on plants that are important to India. Although the primary objective of the Centre will be basic research, the Centre will pay due attention to practical utility in choosing research areas. It will give special importance to the molecular biology of plants and the study of parasitic protozoans.

(b) *Training of scientists and teaching programmes:*

An essential part of the Centre's functions will be education and training of young scientists. The Centre will thus strive for a close integration of teaching and research. The research scholars at the Centre will work towards Ph.D or other post-graduate degrees. For the purpose of awarding degrees, the Centre will create necessary linkages with Universities and other educational institutions. Teaching through laboratories and lecture courses will be obligatory for the academic staff of the Centre.

The Centre will offer specialized short term courses for researchers from Universities and other institutions in India. Biology is developing so rapidly that it has become increasingly difficult for scientists working far from the main centres of research to keep abreast of new developments. A system of advanced laboratory courses can play a key role in modernizing Indian Biology. We envisage the Centre as an institution for advanced training which will catalyze the growth of new biology in India and other countries of Asia.

The Centre will have a vigorous visitors programme, and will accept guest researchers and visiting scientists from Universities and other institutions. It will provide specialized high technology facilities and equipment to scientists from other institutions where these facilities may not be available.

5. Composition and Staff

The Centre is planned to have a total strength about 400 persons at its maximum. It will be started with a relatively small nucleus and grow gradually from this to an optimal size. In this process we hope to gather a distinctive group of devoted scientists who will have established their credentials in this country and will have the necessary self confidence and pragmatic abilities to succeed under our conditions. Creative scientists are not easy to find and the growth of the Centre must necessarily be gradual.

I. *Academic Staff:*

The academic staff will consist of tenured and non-tenured faculty, Professors, Readers and Fellows and a relatively larger number of visiting staff including Research Scholars, Post Doctoral Fellows and Visiting Scientists. In order to ensure sufficient turn-over and avoid intellectual stagnation, the number of continuing (tenured) appointment in proportion to transient (non-tenured) academic staff will be kept at approximately 1:2.

II. *Scientific Staff:*

The supporting scientific staff will consist of several categories of scientific assistants and scientific officers. Nearly half of this

staff will also be employed on a short-term 3-5 years basis. During the period of their temporary appointment the scientific staff could work for a Master's degree or diploma.

Some of the supporting technical staff will be required for manning technical facilities and equipment. This staff will have continuing appointments and their numbers will be kept small.

III. *Administration and infrastructure:*

This will consist of general administration, accounts, purchase, maintenance, security and secretarial staff. In order to ensure effective and efficient administration it will be important to attract capable persons to senior administrative and supervisory positions by offering them attractive conditions of employment.

The total number of housekeeping and infrastructural staff will be kept small by giving contracts to outside agencies for services such as transport, security, canteen and maintenance. Agencies providing such services to institution are available in Bangalore. It is envisaged that the proportion of administrative and housekeeping staff will be about 25% of the total at the optimal stage.

Table 1 gives the projected staff structure of the Centre and its growth profile over the next 20 years.

Table 1

Staff profile of the Centre

	Academic staff		Scientific staff	Administration & housekeeping	Total
	Continuing staff	Temporary staff			
After 5 years (by 1995)	16	60	27	30	133
After 10 years	40	80	65	85	270
After 20 years	70	130	100	100	400

1. Detailed year-wise projection is given in appendix 1

2. Continuing staff includes Professors, Readers and Fellows. Temporary Academic staff include Research Scholars, Post-doctoral Fellows, Visiting Scientists and Trainees.

3. Scientific staff includes Scientific Assistants, Scientific Officers and Laboratory staff, Tradesman.

6. Laboratories

If the Centre has to work effectively at the frontiers of knowledge it must be equipped well. Its laboratories must be carefully planned and must provide essential facilities. Adequate supply of power and water has to be ensured. In order to carry out experimental work in molecular biology, the laboratories have to be dust-free and contamination free. This will require well-designed air conditioning to control temperature and humidity.

I. *Laboratory*

We propose to construct a laboratory of 90,000 sq. ft. in the first five years. About half of this space will be needed for individual laboratories and half for common facilities, lecture rooms, equipment rooms, library, dark rooms, culture rooms etc.

II. *Special facilities*

A modern biological laboratory needs a variety of infrastructural facilities for its work. These include culture rooms for cell and microbial culture, glass houses for plant research and animal houses, aviaries and aquaria. A good workshop and a glass shop is essential. It is important to develop a strong capability for maintenance and in house repair of equipment.

III. *Field station*

As the Centre will give special emphasis to plant molecular biology and genetics it needs adequate space for experimental fields. We propose to build an agricultural field station of about 100 acres within accessible distance from the Centre. The field station will also provide outdoor space for animal colonies, aviaries and aquaria.

Note: A list of major equipment and special facilities is given in Appendix V .

7. Housing

In order to attract the best scientists the Centre must provide conditions of work and living which are markedly better than the usual. It is important to provide attractive housing to the staff which is not too far from the laboratories.

A hostel for research scholars and post doctoral Fellows as well as a guest house for short term visitors are essential requirements. It is expected that land for housing will be available either on the proposed site in the University of Agricultural Sciences or close to it.

Note: An estimate of the cost of housing in the first phase is given in Appendix IV.

8. A plan for phased growth of the Centre at Bangalore

The radioastronomy group is vacating some space in the T.I.F.R. Centre in the campus of the Indian Institute of Science, Bangalore. It is proposed to start the Centre for Biological Research in the space that will be available in the T.I.F.R. Centre. The presence of a nucleus at I.I.Sc. will greatly facilitate the work on the Agricultural University site. The following plan of action is proposed.

I. Laboratory space in the T.I.F.R. Centre can be obtained by carrying out the necessary modification and furnishings in the Astronomy labs, at reasonable cost.

II. In addition to a few members of the Molecular Biology Group that will join the Centre, a set of applications from candidates who are at present abroad have been screened and reviewed. Some outstanding candidates have been identified. The first appointments to the Centre can, therefore, be made as the Council's approval has been obtained. Some of the scientists can move to Bangalore before the end of 1989.

III. As soon as the agreement with the University of Agricultural Sciences is reached, steps may be taken to construct or rent temporary

buildings for laboratories and essential residential accommodation. Additional space for the Centre will thus become available in 1990, which can be used for laboratories and a residential hostel.

Purchase of equipment and recruitment of staff can continue while the plans for the permanent laboratories are being finalized.

IV. The administrative staff for the project may be appointed so that work on developing the infrastructure at the Bangalore site can be taken up. The architectural plans for the permanent laboratories and housing may be finalized. Work on the construction of permanent buildings can thus begin in 1990-91.

V. Scientists recruited for the Centre will be provided laboratory facilities either in Bangalore or at T.I.F.R. so that they remain scientifically active while growing their groups. Additional space for this purpose is being created in a hutment laboratory at T.I.F.R.

VI. It will be necessary to provide residential accommodation for staff in Bangalore. The Centre may lease the required number of apartments for this purpose.

Suggested Plan of Action

1989-90	Equip laboratory in the T.I.F.R. Centre at I.I.Sc. Make first appointments to academic and administrative staff. Move one or two groups to Bangalore. Acquire the Agricultural University site initiate action for the development of infrastructure at the site.
1990-91	Develop infrastructure at the Agricultural University site. Acquire and furnish temporary buildings for additional laboratory space and hostel. Continue recruitment of staff. Transfer more groups to Bangalore. Finalize architectural plans for the campus; start construction of the main building.
1991-94	Continued recruitment of groups in Bangalore. Completion of campus buildings. Installation of equipment and facilities.

9. Conclusion

What we have in mind was expressed pithily by Abraham Flexner when he proposed the creation of the Institute of advanced study in Princeton. Flexner suggested that the Institute "..... should be small, that its staff and students or scholars should be few, that the administration should be inconspicuous, inexpensive and subordinate, that the member of the teaching staff, while freed from the waste of time involved in administrative work, should freely participate in decisions involving the character, quality and direction of its activities, that living conditions should represent a marked improvement over contemporary academic conditions..... that its subjects should be fundamental in character and that it should develop gradually.....".

During the past thirty years, there has been a considerable and welcome expansion of research activity in India. In biological sciences much of the growth has been confined to agricultural and applied biomedical research. In proposing the setting up of the Tata Institute of Fundamental Research, Dr.Bhabha observed that "if much of the applied research done in India today is disappointing or of very inferior quality, it is entirely due to the

absence of a sufficient number of outstanding *pure* research workers who set the standards of good research....". In this respect the biological sciences in India are further behind the physical sciences. Meanwhile, recent advances in molecular biology and biotechnology have led to rapid changes in all of biology. The lag between Indian biology and international biology is likely to widen further unless active steps are taken to bridge this gap. We hope that the T.I.F.R. Centre for Biological Research will serve to reduce this lag.

Appendix I

Projected staff till end of 8th Plan

	7th Plan		8th Plan			
	89-90	90-91	91-92	92-93	93-94	94-95
1. Academic staff						
Professors Readers Fellows	5	7	10	12	14	16
Visiting Scientists	-	2	4	6	8	10
Post doctoral Fellows	1	2	2	6	6	10
Research Scholars	2	10	14	20	30	40
TOTAL	8	21	30	44	58	76
2. Scientific staff						
Senior	2	4	6	8	10	12
Junior	2	3	8	10	12	15
TOTAL	4	7	14	18	22	27
3. Administration & housekeeping						
Senior	2	3	4	5	7	10
Junior	2	4	8	10	12	20
TOTAL	4	7	12	15	19	30
TOTAL STRENGTH	16	35	56	77	99	133

Appendix II

Projected Expenditure 1989-1995 at 1989 prices in lakhs of Rs.

Head	7th Plan 89-90	8th Plan 90-91.	91-92.	92-93.	93-94.	94-95.	TOTAL
1. Capital							
Land and development		75	25	25	15	10	150
*Construction Lab & housing	40	166	256	156	46	36	700
Equipment	70	70	90	50	40	40	360
Facilities & utilities	20	18	8	8	18	18	90
TOTAL	130	329	379	239	119	104	1300
2. Recurring							
Expendables	3	8	10	12	30	40	103
Power & water	2	4	6	15	20	30	77
Library	2	3	4	5	6	6	26
Service contracts	-	2	3	6	10	15	36
Salaries	2	15	41	56	57	65	236
Travel	1	2	3	4	6	6	22
TOTAL	10	34	67	98	129	162	500

*Total laboratory costs = 450
Total housing costs = 250

Appendix III

Built up area and construction cost

Built up area:	
16 groups, 1500 sq ft/group	24,000 sq ft.
Common Laboratories, Services and facilities	19,000 sq. ft
Library	7,500 sq. ft.
Auditorium	5,000 sq. ft.
Lecture rooms (4 x 1000 sq. ft)	4,000 sq. ft.
Canteen	2,000 sq. ft.
Laboratory Prep room and washing facilities	3,000 sq. ft.
Workshop	5,000 sq. ft.
Other facilities	4,000 sq. ft.
Office space for administration etc. (100 x 100)	10,000 sq. ft.
Toilets and washrooms (5 x 500)	2,500 sq. ft.
Corridors, Lobby etc.	4,000 sq. ft.
	90,000 sq. ft.

Cost of construction @ 500/sq. ft. - Rs450 lakhs.*

*This cost is estimated because of specialized requirements for recombinant DNA work.

Appendix IV

Housing

@Rs355 per sq.ft. Furnished hostel and guest house @ Rs.500 per sq.ft.

1. Academic and Administrative Staff
   - Type E1 — 2200+269 sq. ft.
   - Type E — 1500+200 sq. ft

2. Academic and Administrative Staff
   - Type D — 900 sq. ft.

3. Supporting Staff
   - Type C — 600 sq. ft.

4. Students Hostel — 300 sq. ft.

5. Efficiency apartments for post-doctoral fellows and married students — 450 sq. ft.

6. Guest House (Furnished) — 450 sq. ft.

Type	Units	Area	Cost (in Rs. Lakhs)
E1	4	9,876	35
E	8	13,600	48
D	10	9,000	32
C	6	3,600	13
Hostel	40	12,000	60 (Furnished)
Studio apartment	16	7,200	36(Furnished)
Guest House	12	5,400	27 (Furnished)
TOTAL	96	60,676	Approx. 250

Appendix V

Cost of Equipment

		Cost (Rs. lakhs)
1.	**Molecular Biology**	
	Centrifuges, Spectrophotometers, Fluorometers, Gas Chromatographs, HPLC, Miscellaneous equipment for physical chemistry and biochemistry	95
2.	**Recombinant DNA Research**	
	Sequencers, Synthesizers and Analyzers for proteins and nucleic acids	100
3.	**Developmental Biology**	
	Microscopes, Electron Microscope, Microdissection and Culture equipment, Deep Freezers, Refrigerators, BOD incubators	55
4.	**Neurobiology**	
	Oscilloscopes, Electrometers, Signal processing equipment and miscellaneous equipment for neuroanatomy, neurophysiology and behavioural experiments	40
5.	**Computers**	
	Computer, peripherals and software	40
6.	**Special facilities**	
	Culture rooms, Controlled temperature rooms, Containment facilities	30
	TOTAL	360

Appendix VI

Cost of Facilities and Utilities (Rs. lakhs)

1.	Diesel generating sets	15.0
	Building for above	5.0
2.	Power transformer	3.0
	High tension breaker	2.0
	Low tension distributor, ancillaries	8.0
	Transformer room, cellar, panels etc.	3.0
3.	Air conditioning plant, buildings, cooling tower etc.	30.0
4.	Liquid Nitrogen plant	13.0
5.	Sewage disposal	4.0
6.	Bore wells	3.0
7.	Overhead and sump tanks, water storage	2.0
8.	Vehicles	2.0
	TOTAL	90.0

Appendix VII

Approximate Yearly Salary Expenditure during 1992-93

Academic Staff	**Rs. Lakhs**
Professors	
Senior Visitors	
Readers	35
Fellows	
Post doctoral Fellows	
Students	
Administrative and Housekeeping	
Senior	
Junior	6.0
Scientific staff	
Senior	
Junior	15.0
	56.0

Appendix VIII

Yearly expenditure on Service Contracts (1992-93)

Head	People	Annual bill (Rs. lakhs)
Security	10	1.0
Gardening	4	1.0
Canteen and Kitchen	5	1.0
Waste disposal	3	1.0
Transport	3	0.5
Rental charges for vehicles		1.00
Material for landscaping		0.5
	TOTAL	6.00