

REPORT OF THE REVIEWING COMMITTEE 1955

Page No.	Para No.	Line in the para	Correction
6	24	8	Correct "thrfore" to "therefore"
18	86	7	Correct "ncumbents" to "incumbents"
19	92	4	Correct "health" to "healthy"
20	95	5	Correct "deteriment" to "detriment"
20	98	5	Delete "work" after "pilot plants"
28	136	2	Correct "Ramakrishnan" to "Ramakrishna"
29	139	1	Correct "Senjeeva" to "Sanjiva"
30	144	4	Delete "," after "electrolytic"
30	146	4	Correct "1955" to "1954"
30	146	5	Correct "1955" to "1954"
31	148	7	Correct "4 students were" to "one student was"
32	154	3	Correct "D.N. Banerjee" to "B. N. Banerjee"
34	161	4	Correct "N. Sreenivasiah" to "M. Sreenivasaya"
37	174	7	Correct "C.T. Austin" to "G.T. Austin"
44	211	1	Correct "seen" to "seem"
45	221	3	Correct "1947" to "1945"
47	225 (c)	2	Correct "G.H. Kent" to "C.H. Kent"
53	262	9	Correct "Physology" to "Psychology"
54	267	2	Correct "V.T. Kale" to "G.T. Kale"
57	Statement III(c)	2	Correct "charities" to "Charities"
59	Do.	1	Correct "trust" to "Trust"
67	Appendix II	Last line	Correct "Ciw" to "Civ"

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**REPORT**  
of the  
**REVIEWING COMMITTEE**  
of the  
**INDIAN INSTITUTE OF SCIENCE**  
**BANGALORE**

1955

**GOVERNMENT OF INDIA \* \* MINISTRY OF EDUCATION**

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## CONTENTS

PAGE

Chairman's letter to the Visitor .. .. .	(i)
Constitution of the Reviewing Committee and Terms of Reference	1
A brief outline of the procedure of work adopted by the Reviewing Committee .. .. .	2

### SECTION I

#### GENERAL APPROACH AND SUMMARY OF PRINCIPAL PROPOSALS

Proposed increase in Number of Students .. .. .	4
Increase in the Technical Resources of the Institute .. .. .	5
General Appraisal of Work of Departments .. .. .	6
Choice of subjects for research .. .. .	8
Relations with Industry .. .. .	8
Organisation and Administration .. .. .	10

### SECTION II

(1)

#### WORK OF THE HIGHER AUTHORITIES OF THE INSTITUTE

The Court .. .. .	12
The Council .. .. .	13
The Senate .. .. .	13
The Faculties .. .. .	13
The Director .. .. .	14

(2)

#### MEASURES RELATED TO STUDENTS

Conferrals .. .. .	15
Scholarships and Stipends .. .. .	15
Student Amenities .. .. .	16
Student Gymkhana .. .. .	17
Employment Board .. .. .	17
Condition of Admissions .. .. .	17
Fees .. .. .	17

(ii)

(3)

PAGE

**MEASURES RELATED TO STAFF**

Appointments .. .. .	18
Salary Scales .. .. .	18
Research Assistant .. .. .	19
Amenities for Staff—	
(i) Accommodation .. .. .	19
(ii) Private practice .. .. .	20
(iii) Administrative responsibility of Professors .. .. .	20
(iv) Researches financed by outside Bodies .. .. .	20
(v) Pilot Plant Work .. .. .	20
(vi) Co-operation with other Institutions .. .. .	21

(4)

**DEVELOPMENT AND REORGANISATION OF TECHNICAL FACULTIES OF THE INSTITUTE**

Central Stores Organisation .. .. .	21
Department of Industrial and Production Engineering .. .. .	22
Central Instruments and Services Laboratory .. .. .	23
Central Glass Blowing Shop .. .. .	24
Central High Vacuum Service Unit .. .. .	24
Central Workshop .. .. .	25

(5)

**MISCELLANEOUS**

Maintenance of Buildings, Roads, etc. .. .. .	26
---	----

**SECTION III**

**WORK AND DEVELOPMENT OF INDIVIDUAL DEPARTMENTS AND SECTIONS**

Department of Physics .. .. .	27
Department of General Chemistry .. .. .	29
Department of Organic Chemistry .. .. .	30
Department of Biochemistry .. .. .	32
Section of Fermentation Technology .. .. .	34
Section of Pharmacology .. .. .	35
Department of Chemical Engineering .. .. .	36
Department of Metallurgy .. .. .	38

	PAGE
Department of Electrical Communication Engineering ..	39
Department of Internal Combustion Engineering ... ..	40
Department of Power Engineering .. .. .	45
Department of Aeronautical Engineering .. .. .	51
Section of Economics and Social Sciences .. .. .	53
Department of Applied Mathematics .. .. .	53
Library .. .. .	54
Journal of the Institute .. .. .	55

## SECTION IV

## FINANCIAL POSITION

Recurring Receipts and Expenditure from 1948-49 to 1954-55 ..	57
Normal annual Receipts and Payments for the last 3 years ending March 1956 .. .. .	58
Non-recurring Expenditure 1947-48 to December 1955 .. ..	59
Recommendations affecting the Recurring expenditure of the Institute .. .. .	60
Recommendations for Non-recurring expenditure .. ..	62
Summary of Receipts and Payments .. .. .	63

## APPENDICES

## APPENDIX I

A—List of members of the Court and Council whose views were obtained through correspondence .. .. .	65
B—List of persons other than the members of Court, Council and Staff whose views were obtained through correspon- dence .. .. .	65
C—List of persons interviewed by the Committee .. .. .	65

## APPENDIX II

List of schemes sponsored by outside bodies at the Insti- tute 1955-56 .. .. .	66
---	----

## APPENDIX III

Industrial Gas turbines .. .. .	68
---------------------------------	----

## APPENDIX IV

Estimate of equipment required for the Central Glass Blow- ing Shop .. .. .	70
--	----

PLANNING COMMISSION

NEW DELHI

*27th April 1956*

FROM

Dr. J. C. Ghosh,  
Member, Planning Commission,  
(Chairman, Reviewing Committee,  
Indian Institute of Science, Bangalore).

TO

The President of India,  
New Delhi.

MR. PRESIDENT,

I have the honour to forward herewith the Report of the Reviewing Committee appointed in terms of Government of India Resolution No. F. 8-16/55, T. I., dated the 30th September 1955, to examine the working of the Indian Institute of Science, Bangalore.

I have the honour to be,  
Mr. President,  
Your obedient servant,

J. C. GHOSH

*Chairman.*

**REPORT OF THE REVIEWING COMMITTEE OF THE INDIAN  
INSTITUTE OF SCIENCE, BANGALORE**

1. We, the members of the Reviewing Committee of the Indian Institute of Science, Bangalore, have the honour to submit our report.

2. The Committee was appointed by the President of India in his capacity as the Visitor of the Institute, and in exercise of the power vested in him under Regulation 27.1 of the Scheme for the Administration and Management of the properties and funds of the Institute. The Committee consisted of:—

Dr. J. C. Ghosh, D.Sc., F.N.I. Member, Planning Commission, New Delhi .. .. Chairman.

Sir Harry Ralph Ricardo, F.R.S., Consultant to the Government of U. K. .. .. Member.

Prof. C. F. Powell, F.R.S., N.L., Professor of Physics, University of Bristol, U. K. .. .. Member.

Dr. S. R. Sen Gupta, Ph.D., M.I.E., Director, Indian Institute of Technology, Kharagpur .. Member.

Mr. M. Hayath, M.I.E., (Electricity), Central Water and Power Commission, New Delhi .. Member.

Mr. D. V. Narasimham, B.Sc., Asstt. Educational Adviser (Tech.) Ministry of Education, Government of India, New Delhi .. .. Secretary.

3. The terms of Reference to the Committee were:

(1) To review the working and development of the Institute with special reference to the objects clause in the present scheme, and, if any changes are considered desirable, to make recommendations in the light of the developments in the country with special reference to the Five Year Plans; in particular:—

(i) to report on the progress made in all new departments at the Institute;

(ii) to examine the work of each department in respect of;

(a) the extent and quality of research work; and

(b) the development of team work in research;

(iii) to examine the work of the Library;

(iv) to consider the formation and grouping of sections within the various departments, and the extent of co-operation and co-ordination amongst the various departments; and



- (v) To make recommendations in regard to the possibilities of further effective collaboration among sections and departments in their research activities.
- (2) To report on the working of the Court, the Council, the Senate, the Faculties and other bodies of the Institute, and to examine the present scheme for the administration and management of the Institute.
- (3) To examine the working conditions in the various departments with special reference to pay scales, staff requirements, working expenses and provision of scholarships, and to make recommendations conducive to the more effective working of the departments.
- (4) To recommend measures for closer co-operation and co-ordination between the Institute, the Indian Institute of Technology, Kharagpur and other institutes of a similar status, Universities and other scientific and technological institutions both within and without the country.
- (5) To consider the policy of the Institute in respect of its conferments.
- (6) To examine the policy of the Institute in respect of pilot plants and proto-type work.
- (7) To consider the financial position of the Institute in the light of the Committee's own recommendations.
- (8) To advise generally on any matter which in the opinion of the Committee is of importance to the Institute.

4. After a preliminary meeting of the Committee, a circular letter was addressed to all the members of the Court, Council and Senate of the Institute, and other eminent scientists and educationists, inviting them to comment on the working and progress of the Institute during the period under review (1948—55). Their views were sought, in particular, on the policy of the Institute in respect of its conferments, and on measures which would empower it to award its own degrees. A list of the members of the Court and Council who responded to this invitation is given in Appendix I-A.

5. We assembled in Bangalore on 31st December 1955, and during the course of our review we obtained the views of eminent scientists, educationists, members of the Council, the Director, Members of the Staff, and representatives of students, through correspondence, personal interview and informal discussions. Appendix I-B gives the list of persons, other than the members of the Court, Council, and staff, who responded to the circular letter and gave their opinion about the work of the Institute, while Appendix I-C gives the names of persons interviewed.

6. We met the Senate on the 10th January, and discussed the memorandum presented by it. We met the Council on 13th January at Bombay, and some of its members again on 5th February at Bangalore. We inspected the various departments of the Institute, the library, and the Central Workshop, and visited the students' hostels and gymkhana.

7 The authorities of the Institute supplied the Committee with the following documents:—

- (i) Brochure of the Institute (1938—48) giving a historical note on its origin and development.
- (ii) Notes from Heads of Departments/sections on the progress and work of the Departments/Sections during the period under review.
- (iii) Court Proceedings (1948—55).
- (iv) Council Minutes (1948—55).
- (v) Finance Committee Minutes (1948—55).
- (vi) Annual Reports (1948—55).
- (vii) Regulations and byelaws of the Institute.
- (viii) Budget of the Institute (1955-56).
- (ix) Financial statements of Capital and other expenditure from 1948 to date.

8 We wish to express our grateful thanks to the authorities and members of the staff of the Institute for the kindness and courtesy shown to us, and for the opportunities afforded to become acquainted with the various aspects of the work of the Institute; and to all those who have taken so much trouble to help us acquire information which has broadened our outlook and been of service to us in our work.

9 We are greatly indebted to the Secretary of the Committee, Mr. D. V. Narainham, Assistant Educational Adviser (Technical) to the Government of India for his able assistance in various ways, especially in the preparation of the report. We record with great pleasure our high appreciation of the manner in which he carried out his duties and assisted our relations with all concerned.

J. C. GHOSH,  
*Chairman*

HARRY RALPH RICARDO,  
*Member*

C. F. POWELL,  
*Member*

S. R. SEN GUPTA,  
*Member*

M. HAYATH,  
*Member*

## SECTION I

*General Approach and Summary of Principal Proposals*

10. Any present discussions on the development of scientific institutions in India must proceed from the fact that the five-year plans envisage a great increase in the scope of industry, power production and other aspects of the national economy; that these developments involve much greater employment of science than in the past; and that, clearly recognising the role which they are to play, the Government of India has shown itself a willing and generous patron of science and technology. It is of great importance for the welfare of science in India that these favourable conditions are maintained. It is therefore very desirable that it should be manifest that the great expenditure on the Institute, made hitherto from private and public funds, is fully justified.

11. Our investigations have led us to the view that the coming quinquennium should, broadly speaking, be a period of consolidation in which these facilities already provided are more fully employed. With this in view, we suggest that, compared with past practice, more of the available funds should be spent on students and staff, and less on buildings and equipment.

12. The Egerton Committee was of the opinion that the Institute should continue to develop as a higher technological institute, principally occupied with post-graduate teaching and research. We have examined its implications in the new situation which has developed in the seven years since the last reviewing committee met.

*Proposed increase in Number of Students*

13. The technical and industrial development of India makes necessary the training of large numbers of scientists and technologists of all types. The provision of most of these highly trained personnel, many of whom will ultimately fill posts of responsibility, is the duty of the institutes of higher learning and technology.

14. The Institute is now only one of a few which will contribute to this end, but it is unique in India in two ways: First, in that the Institute is exceptionally well provided with equipment and accommodation. Indeed, there are to-day few similar institutions in Europe or America where the available floor space for each student is as large as it is in Bangalore. Secondly, a wide variety of disciplines are represented within it; other Indian institutes of similar standing are more specialised in their interests.

15. These considerations give particular importance to the question of the numbers of students being trained in the Institute on the one hand; and on the other, to the questions of co-operation and co-ordination among different departments within the institute to which our attention was directed in our letter of reference (see L. R.; I, iv and v).

16. Knowing the needs of the country, and the exceptional facilities existing in the Institute, we were rather distressed to find that in nearly all departments the number of new students has tended to decline in recent years, and we had the general impression that the Institute is relatively empty.

17. We have reached the conclusion that there are two principal reasons for the failure of the Institute to expand. First, the value of the scholarships offered has not been sufficient to attract enough young people of ability; and secondly, the nature of the academic conferments of the Institute are unconventional, and their value not understood, either by employers or by prospective students.

18. The capital investment already made in the various departments has been so large that it would be a false economy not to provide additional funds which will ensure that the facilities for research thus created are fully employed by the types of young and talented men and women best able to profit by them.

19. In considering plans for increasing the number of students, a distinction must be preserved between different departments. In some disciplines, the need for trained personnel is already so great that they can be immediately absorbed by industry or government institutions. In others, such as Physics, there is not, at the moment, a serious shortage, but judging by the experience of other countries, an acute need will arise in the course of a few years. If men are not trained in such disciplines now, great difficulties will be met in providing them for industry and education when the need arises; but if they are trained in substantially greater numbers than at present, and we think this would in general be a wise course, it may be necessary for special provision to be made for their useful employment in the early years of their careers.

20. The advantages of increasing the numbers of students are not confined to the fact that the expensive technical facilities would thereby be more fully utilised. We believe that the whole tone of the Institute would be greatly improved if there were many more young people actively engaged in training and research within its walls.

21. With these considerations in mind, we have recommended substantial increases in the number of students in most departments, together with certain financial and other provisions necessary to make the proposals effective. We have also made recommendations for changes in the nature of the conferments by the Institute. The Institute will only flourish if it attracts a considerable proportion for the most able young people in India, and provides an atmosphere conducive to their intellectual development and technical training.

#### *Increase in the Technical Resources of the Institute*

22. In considering the plans for expansion of the different departments, we suggest that it would be timely to give particular emphasis to the following considerations.

In the past, most instruments of research have been imported into India from abroad. Few were made within the country and, in the absence of a developed industrial base, even the primary materials from which they might have been constructed were often not readily available. These features have led to a situation in which there is a tendency to think of research in terms

of taking observations with conventional instruments rather than of developing new instruments and methods. We believe, that, at the present time, there are substantial reasons for giving particular attention to the latter, especially from the point of view of strengthening and widening the general scientific resources of the country.

23. The experience of Europe and America shows that, apart from a brilliant and isolated special fields of investigation, a country can be scientifically strong only if it is served by a strong industrial base; and that the industrial base cannot grow effectively, in modern conditions, unless it is properly supported by an adequate educational system which trains technicians and research workers of good quality and in sufficient numbers.

24. A number of factors contribute to this result, two of which may be cited in illustration. In a country without modern industry, if equipment is purchased abroad, repairs and replacements can usually be secured only after long delays. Such delays can be very detrimental to the progress of an investigation and to the morale of the investigators. Secondly, an investigator will commonly not be able to call upon the special skills and experience available in an industrially advanced country for the solution of particular problems—his technical resources are therefore correspondingly restricted. Reliance upon instruments purchased abroad, produces an attitude towards them more remote and less resourceful than if an investigator is himself directly concerned with their design and construction.

25. These considerations have led us, in a number of instances, to recommend provision for special facilities for instrument design and construction—for the extension of the technical resources of the Institute,—rather than for the purchase of instruments abroad. Thus, we have recommended that sections for glass-blowing and for instrument-making should be established. It seems to us essential that, in view of the development of the wireless industry in India, there should be a number of institutions fully equipped for the most advanced practice in glass-blowing and high-vacuum technique. Such practice is of great importance for a wide-range of modern researches, including several being pursued in the Institute. Some of the personnel trained in these methods will eventually become available for the industry.

#### *General Appraisal of Work of Departments*

26. Descriptions of the work of individual departments are given in a later section, but it will be convenient here to make a few general remarks:

Our terms of reference direct attention to the important question of collaboration, and this bears on the work of the Institute in a number of ways. In the first instance, it is important in considering the plan of work in a particular department. In Europe and America, there has been a marked change in this respect in the past thirty years. At the beginning of this period, experiments were commonly carried out by scientists working individually or in small groups. In some laboratories with established schools of research, these experiments formed parts of a single pattern of investigation; in others, they were unrelated to one another.

27. In the years which have followed, there has been a marked tendency for collaboration to increase. This has sometimes followed from the greatly increased complexity of instruments and techniques; because of these complexities, an effective collaboration has to be established in order to make an important contribution. But even when it has not been called for by technical considerations, collaboration has often been found advantageous by increasing the weight of the attack on a problem, and the corresponding speed of advance.

28. The urge towards collaboration varies widely among the different sciences, but we have formed a clear impression that in several departments of the Institute there has been a tendency for too many subjects to be studied by people working individually, and that there would now be considerable advantages in reducing the range of interests. We suggest that there should be a conscious effort to concentrate more people on a smaller number of the most promising subjects. This will permit a much greater concentration of effort and a better chance of making a substantial contribution.

29. The growth of collaboration brings with it certain difficulties in relation to the award of higher degrees. Traditionally, for example, the award by Universities of the Ph.D. degree has called for a thesis in which the contributions of a candidate to the advancement of knowledge can be clearly distinguished, and his capacity for original investigation assessed. When work is done in collaboration, a difficulty arises that it is frequently not easy to distinguish the precise contributions, especially of ideas and innovations, of the individual members of a team. Ideas may occur in the course of, or as a result of discussions to which many of the members may have contributed, so that the assessment of individual capacity is made more difficult.

30. We believe, however, that these difficulties should not be allowed to stand in the way of forms of collaboration when the development of scientific investigation makes them desirable. Whilst taking all appropriate steps to safeguard its standards, an examining body should be prepared to modify its regulations, if necessary, to take account of the changing conditions of scientific work. It may also be remarked that the director of a group of young research workers can often find a number of smaller problems, closely related to his main theme, which may serve as exercises for individual students, sufficient to test their capacity to overcome difficulties when working alone. Such a minor investigation may be submitted as part of a thesis, in addition to matter describing more important work done in collaboration.

31. There has, it appears, been little co-operation between the different departments of the Institute. To rectify this situation, a number of projects have been suggested by the Senate which would involve a collaboration between members of several departments; these include proposals for work on atomic reactors, on gas turbine power production, on servomechanisms, on electronic computation and on materials.

While there is much to be said for collaboration between departments, and we should like to see it develop, the experience of other countries suggests that there are certain dangers in planning ambitious research in the absence of

practical experience in the subject. Large scale research projects, which appear at first sight reasonable and attractive, and on which large expenditure is made, have often proved sterile and unprofitable in practice. In our view the proper course is usually to approach a new subject in a modest way. It can be liberally supported when a body of key people have been assembled round it who have shown in practice that the project is one of promise.

32. To allow for the financial support of promising new developments, we have recommended the provision of a large grant to be placed at the disposal of the Director, some of which may be utilised for this purpose.

In order to encourage friendly contacts between members of different departments, we have recommended the provision of certain amenities within the Institute.

#### *Choice of subjects for research*

33. The character of subjects chosen for research has an important bearing on the work of the departments. Particularly at the present stage of Indian development, a wise choice in this matter is of great importance. The need is to build up a well trained body of technical personnel, well grounded in methods of research, and confident in their ability to solve concrete problems. In order to serve this end, it is desirable that the research activities undertaken should, if brought to a successful conclusion, represent a substantial contribution to the subject. But we would attach particular importance to the work being well done and brought to a successful conclusion.

34. In research, success cannot be guaranteed, but we would prefer to see problems of such a character chosen for investigation that, given the available resources in men and materials, there is a high probability of a successful outcome. Young men benefit by overcoming difficulties and bringing work to a successful conclusion, and a sure way of undermining the morale of any organisation is to make it attempt problems beyond its capacity. We, therefore, suggest as a general principle for consideration, but to which there may be exceptions—(a) a limitation of the investigations of a department to a few well-considered themes; (b) organisation of groups of researchers for the attack on these problems, who work in collaboration and who are thoroughly familiar with the basic experimental resources of the subject, and technically equipped to enlarge them, if necessary. We may emphasise that we regard it as particularly important in India, at the present time, that research students in all departments should be provided with ample opportunities to get practical experience in all the mechanical arts employed in the work. It would be difficult to over-estimate the importance of students making things themselves.

#### *Relations with Industry*

35. From its first beginnings, the aim of the Institute has been to contribute to the development of industry in India, and this has frequently been reaffirmed. In this connection, it is a matter of urgent importance to improve the mutual understanding between scientists in industrial establishments on the one hand, and those in academic research institutes, on the other. If there

is a proper integration in this respect, the common resources of knowledge and experience are available to both; otherwise much valuable time and money may be wasted through a lack of co-ordination. Such connections, personal and organisational, form the nervous system of the body scientific of a country, and its health and strength play a decisive part in the effective functioning of the whole organisation.

36. It is quite understandable that the practice of different departments of the Institute in this respect is widely different. Some have found adequate fields of research in fundamental scientific studies which have grown out of, and are closely related to, practical problems arising in industry. In others, related to which there has hitherto been no industry in India, or it has only lately been established, few or only remote connections have existed. In view of the great advantages which can follow, we believe that heads of departments should take pains to promote close relations with industry whenever it appears appropriate. It is a common experience in other countries that such connections do not arrive automatically but have to be worked for. Industrialists without practical experience of the value of research, tend to regard it as intellectual exercise with no serious interest for men of affairs. On the other hand, academic scientists often take too little pains to make clear in simple terms the practical consequences which may follow from their work.

37. As a step towards improvement in the connections between science and industry in India, we suggest that as a general rule, a head of a department should ensure that a part of the effort on research in his department should be devoted to a subject with a clear bearing on problems facing an Indian industry, and that the work should be discussed from time to time with representatives of that industry.

38. In some instances, it may be possible to find suitable subjects, of a long-range character, in problems of interest to the Council for Scientific and Industrial Research (C.S.I.R.), The Atomic Energy Department, the Indian Council for Medical Research, the Indian Council for Agricultural Research, or other research organisations. Such investigations could take the form of sponsored research, the cost of which would be met by the interested organisation.

39. Since the Institute is responsible, together with other educational establishments, for training the technical personnel for industry; it should expect to receive support from industry. Such support may take a wide variety of forms, but, as an illustration, we may cite an example concerning the Power Engineering Department.

40. Difficulties have recently been met in finding men of sufficient experience on the staff of this department, and approaches were made to a number of power-engineers to persuade them to assist by giving courses of lectures. A common reply was that they felt unable, at this stage in their career, to return to their books. In fact, of course, nothing would be of more educational value for the students of this department than a few talks from such men, dealing with the practical problems with which they are faced, and how they are meeting them.



41. As a practical step in improving the relations between the Institute and scientists in industry, we propose (see § 241 and § 242), that a number of symposia and residential study courses should be held in Bangalore on carefully chosen topics, on the model of those held in Kharagpur and elsewhere. Further we make certain proposals for the improvement in the amenities of the Institute which would assist in the organisation of such courses; (see § 94).

42. In view of the great importance of a close connection between the Institute on the one hand, and Government Departments and Industry on the other, we think it should be one of the principal duties of the Director to be well-acquainted with all the main lines of scientific development in the country; (see also § 99).

#### *Organisation and Administration*

43. We have considered the organisation and administration of the Institute, and have suggested a number of modifications designed to serve the principles set out above. In particular, we have proposed a number of changes in the composition of the Court and Council which are designed to improve the relations of the Institute with the Universities, Industry, Central Research Institutes and Departments of Government. We have also recommended a certain delegation of responsibilities by the Senate to the Faculties, in order to lighten the burden on the Senate, and to allow the Faculties a useful field of activity.

44. We have also considered the responsibilities of the Director and have reached the conclusion that the time has come when this office should be separated from that of the Head of a Department:—

For some years, the responsibilities of the Director have been rapidly increasing. He now has a heavy load of day-to-day administration; he should be deeply involved in the public relations of the Institute; we are now proposing that he should have the responsibility for the Central Instruments and Services Laboratory and that he should have at his disposal substantial sums designed to further developments of projects of timeliness and promise, as they appear within the different departments. This requires that he should be well acquainted with the work of all the departments, and should know the individual members of the lecturing staff. We believe it is also very desirable that he should be closely acquainted with the principal problems associated with the development of education and industry within the country, and this would make desirable his membership of several national committees.

45. It seems to us that it is unreasonable to expect a single person to discharge all these responsibilities adequately, and at the same time to act as professor in a department, and engage very actively in research. Certainly, it would seem almost impossible for him to have an active and creative interest in his own researches, and also to be able to devote serious attention to the development of the Institute as a whole.

46. In these circumstances, we suggest that, like the Vice-chancellor of a University, the Director of the Institute should be relieved of the responsibilities of a department so that he may be able to spend more time on more general

duties the successful discharge of which are vital for the life and progress of the Institute. We think it would be appropriate for the Director to be a man of established scientific reputation and wide scientific interests, no longer *seriously* concerned with his career as a scientist, but deeply interested in the progress of science and industry within India. Such a man would find his reward in the success of his colleagues, which would owe much to his timely encouragement and support.

47. We have received a number of complaints, from the heads of departments and others, that the forms of administration are unduly cumbersome. It has been suggested that the work involved takes up so much of a Professor's time that his academic and research work suffers. This problem is now met in scientific institutions throughout the world, and there are, in our opinion, two aspects to be considered. In the first place, most scientific institutions are now such complex organisations, with such large budgets, that proper estimating and other features of good house-keeping cannot be avoided. It seems to us, however, that it should be possible for a professor to delegate much of the detailed administrative work necessary for the successful operation of his department to the senior members of his staff; they can gain much from the experience, and there would be a corresponding relief to the professor who would be left with the final responsibility.

48. In addition, however, it has been suggested to us that it should be possible to make simplifications in the rules and procedures operating within the Institute, so that the administration may be more flexible, and in this connection, we have made a number of concrete suggestions. We are also in agreement with the view that the rules and procedures relating to such matters as financial control, recruitment, promotion etc., which are adapted to Government departments, or to industrial organisations, are not appropriate for an institute of research and higher learning. This matter is within the competence of Council of the Institute, and we suggest that it is the appropriate body to consider the question and to take necessary action.

## SECTION II

*Work of the higher Authorities of the Institute**The Court*

49. The principal responsibilities of the Court are to review the activities of the Institute annually, and to ensure that the Institute retains close connections with Science and Industry throughout the country. Another of its important functions is to consider and make recommendations to the Visitor, or to the Council, on matters relating to the aims, administration and finances of the Institute.

50. We have gathered the impression that in recent years, members of the Court have not all taken a sufficiently lively interest in the affairs of the Institute. Further, it appeared to us that the Institute has not been in sufficiently close touch with the Universities and Industry. We believe this may be partly due to inadequate representation of the Universities and Industry on the Court.

51. Recently, the Institute has failed to attract enough students of high quality. We believe that this is partly due to the fact that the work of the Institute, and the facilities existing in it, are not sufficiently well known to the students and staff of the Universities. A wider representation of the Universities on the Court may, in our view, improve this situation. We, therefore, suggest that there should be at least one representative from the Universities in each of recognised Regions of the country. In addition, there should be a representative of the University Grants Commission on the Court. It is desirable that the University representatives should be technical or scientific experts.

52. We have stated our view that the Institute should be involved in long-range projects of material benefit to the country. This requires an intimate contact with Industry, so that the Institute may be well acquainted with the problems facing industry, and may anticipate those likely to arise in the future. We feel that the present representation of organized industry by only three members on the Court is inadequate to fulfil this objective. We suggest that each important industrial region in the country should send a representative. Industry in Mysore should also be more closely associated with the Institute, and for this purpose, additional representation should be made.

53. We understand that formerly all proposals for new developments were initiated or considered by a Joint Standing Committee of the Court and Council. In our view, such a body could render effective and valuable guidance, and ought to be revived.

54. The Court meets only once a year, and that for one day only. Most of the members do not, therefore, have opportunities to gain enough first-hand knowledge of the working of the various departments to enable them to contribute effectively. We suggest that the Institute should have an open week before the annual meeting of the Court, during which the Institute may be visited, both by members of the Court and the General Public.

*The Council*

5. The present constitution provides for 17 members, including 3 nominees of the Central Government, and 2 representatives of the Indian Universities. In view of the increasing participation of the State in Industry, and the desirability of the Institute being associated with the research programme of the Central Ministries, we feel there is a need for greater representation of these Ministries on the Council of the Institute. This need would, in our view, be met by having 4 representatives of the Governments, instead of three only, as at present.

6. We are recommending elsewhere in the report that the Institute should be empowered to grant degrees. This may imply closer co-operation with the University Grants Commission. We, therefore, suggest that the present representation of the Universities on the Council by two members should be reduced to one. This member should be elected by the Inter University Board, and the other should be replaced by a representative of the University Grants Commission.

7. It was represented to us by the Senate that the Faculties should be abolished, and that, in place of the two Deans of Faculties, four Professors should be included in the Council. We do not support the abolition of faculties. There are already three members of staff on the Council—the Director and the two Deans—and this representation should, in our view, be adequate.

8. As a measure for simplifying the financial procedure, we suggest that he grant for the working expenses of a department should be accounted for under only the headings, (a) Apparatus and Equipment (b) Consumables and contingencies. The amounts allocated for study tours etc., may be transferred to the General Heading, and the requirements of each Department in this respect should be decided by the Director.

9. We are in general agreement with the powers of the Council under the present scheme; some changes in the regulations and bye-laws may be necessary, however, if all our recommendations are adopted.

*Senate*

10. We find the present Constitution satisfactory and recommend no change. In regard to the functions and duties of the Senate, however, we recommend some delegation of its duties to the Faculties as shown below.

The Senate should, however, continue to prescribe rules and regulation for the awards of the Institute, whatever form these may take.

*Faculties*

11. It is generally agreed that the Faculties have found little useful activity in the past quinquennium, and this has led to suggestions for their abolition. We agree with the Council's view that the Faculties, as the only bodies on which

the voice of the younger members of the staff can be heard, should be kept alive and made active. Delegation to the Faculties of some of the duties now performed by the Senate would help to achieve this objective.

62. All academic matters relating to departments in a Faculty should be initiated in the Faculty, and recommendations sent to the Senate. The admission of candidates is the proper function of the Faculties; this duty, now performed by the Senate, should be transferred to them. The Faculties should also be given the responsibility of recommending the names of examiners for appointment by the Senate. The Assistant Registrar may be appointed Secretary to the Faculty ex-officio. The Registrar has many responsibilities, and delegation of some of them to the Assistant Registrar would be desirable.

### *Director*

63. We have felt it necessary to indicate in Section I, some of our views on the duties and responsibilities of the Director, and of the desirability that he should not have the additional burden of running a department.

64. In an Institute like that at Bangalore, where much of the effort is directed towards research, it is not possible to anticipate and provide for all contingencies; the most important discoveries are frequently those least expected. Occasions will therefore arise when it is desirable to give prompt and substantial assistance to a new development; the possibility of doing so may then decide whether an opportunity is seized or lost. For the timely assistance of new projects arising from research in the Institute, we recommend that a special fund should be established, disposable at the discretion of the Director. An annual amount of Rs. 1 lac which may, in due course, be raised to 2 lacs in our view, be adequate for this purpose. When he makes a discretionary grant the Director should report his action to the Senate and the Council, at their next meetings.

65. In certain departments, we have found that Assistant Professors are not given sufficient freedom and facilities to develop those lines of work for which they have a special aptitude. In such cases, the Director should assess the desirability of sanctioning discretionary grants, and take action accordingly. This presupposes that the Director has personal knowledge of the work and ability of each member of staff.

66. It should be the duty of the Director to ensure that any member specially selected or trained by the Institute for developing a particular activity is given facilities to continue that activity, and that he is not directed to other work, except with the approval of the Senate or Council.

67. According to the present regulations, the Director is the appointing authority in respect of Group II staff. He is also, therefore, the competent authority to terminate the services of such staff. In order to protect the interests of members of staff of this category, we recommended that the Director should report to the Council cases of acceptance of resignations, and the causes which led to such resignations.

*Measures related to Students**Conferments*

68. Most of the persons with whom we discussed the question expressed the view that the academic conferments of the Institute should be similar in form to those of Universities and other institutes of higher learning; *i.e.* Ph.D., and Sc., in the Science Faculty; and B.Tech., M.Tech., Ph.D. and D.Sc., in the Engineering Faculty. It is generally believed that one of the main reasons for the falling rate of admissions to the Institute in recent times is the fact that the significance and value of the present conferments, such as diploma, associationship etc., are not appreciated and recognised by employers and prospective students.

69. Earlier, when Universities had not the necessary facilities for advanced work and research, the Institute had an effective monopoly of promising young men. With the growth of research departments in the Universities, however, the students are tending to remain in their parent Universities for further studies and research, especially, as they prefer the more conventional higher degrees which they can thereby gain.

70. As an important step towards ensuring that the excellent facilities of the Institute should be more fully utilised, we strongly recommend that immediate steps should be taken to empower the Institute to confer degrees, either by separate legislation, or by declaring it to be an Institute of National importance under the University Grants Commission Act.

*Scholarships and Stipends*

71. Another important reason for the inability of the Institute to attract the young men from the Universities in sufficient number is the lack of an adequate number of scholarships of sufficient value. After graduation, it is generally not possible for parents to support a student for an additional period of three years, for post-graduate training or research. Unless supported by scholarships, the young people, though anxious for further training, prefer to remain at the institutions near their homes, rather than to become a heavier burden on their parents by going to Bangalore. If the Institute is to be filled with promising young people, we consider that, in addition to a change of policy on conferments, scholarships should be offered to the extent of 80% of the students admitted for post-graduate research and training; and that the value of these scholarships should be sufficient to meet all the normal expenses of the scholar. We believe, however, that for courses in Power, Internal Combustion and Aeronautical Engineering, all the students admitted should be offered scholarships.

72. We suggest that research students in the Science Faculty should have scholarships tenable for 3 years of the value of Rs. 150 p.m. in the first year, 175 p.m. in the second, and Rs. 200 p.m. in the third. In the Engineering Faculty, for the post-graduate courses and research work, we suggest that the scholarships should be of the value of Rs. 200 tenable for a period of two years.

73. In principle, it seems to us desirable that the value of scholars for Science and Engineering graduates should be equal. Nevertheless the posed differences have been forced upon us by the need to attract a sufficient number of able students to post-graduate engineering courses, on the one hand and the need to make the corresponding scales for research students in Science commensurate with those operating in Universities and other institutions of higher learning on the other. For similar reasons, we have suggested that all post-graduate students in engineering should receive scholarships, as compared with only about 80% in the case of science graduates. We suggest that the position should be reviewed after 5 years.

74. We understand that there are some research scholarships endowed to the Institute by outside bodies, and that their value is lower than those recommended above. We suggest that a request should be made to donors to increase the value of such scholarships. If, however, for any reason, the donor is not prepared to respond, the value of the scholarship should be augmented from the scholarship fund of the Institute.

#### *Student Amenities*

75. We have inspected the students hostels, which have accommodation for about 275 students. Owing to the falling rate of admission, this accommodation appears to be ample for immediate needs. A few rooms are vacant, although it has been made obligatory for a scholar to stay in a Hostel. If the proposed increases in accommodation are approved, and are successful, the success in securing accommodation for another 100 students will have to be provided.

76. We have visited the hostel kitchens and dining halls, and suggest that the kitchens should be electrified. This would eliminate smoke, and contribute to cleaner kitchens and dining halls. Since electric power in the Institute is cheap, the electrification of the Kitchens should be economically sound.

77. We understand that breakages of crockery are very heavy and involve much expenditure on replacement. We, therefore, suggest that stainless steel articles should be adopted. We also recommend the introduction of a cafeteria system in the mess. This has proved very successful and economical at the Indian Institute of Technology, Kharagpur. The number of mess servants could thus be reduced, and wastage avoided.

78. The mess servants of the students' hostel are Institute employees whose wages are higher than the locally prevailing rates. In addition, there is no difference between the wages of cooks and servants, and this it has been suggested to us, has resulted in a deterioration in the cooking. We suggest that as suitable vacancies arise in other departments of the Institute, they should be filled by employees from the mess; and that the students mess-committee should be asked to employ mess servants on their own terms.

79. The room used as a vegetarian dining-hall was planned as an auditorium, and is not suitable for its present function. We suggest that if, in due course, a new hostel is erected, a dining hall for vegetarians should be included in it. The present room could then be reconverted for use as an auditorium, for entertainment and social functions, at a cost of about Rs. 30,000.

80 The Engineer of the Institute informs us that the cost of minor structural changes for the introduction of the cafeteria system, provision of stainless steel articles in place of crockery, electrification of the kitchen, and provision of two refrigerators, would be about Rs. 50,000. We recommend that this amount should be provided for the improvement of the present Hostel amenities.

#### *Student Gymkhana*

81 Both students and staff are members of the Gymkhana, but we learned with regret that there is little contact between them outside working hours. We hope that necessary steps will be taken to rectify this situation. The financial resources of the gymkhana appeared to us inadequate; we recommend that the students contribution should be fixed at Rs. 20 per annum, and that the Institute should contribute an amount equal to that provided by the students.

#### *Employment Board*

82. The previous reviewing Committee recommended the establishment of an Appointments Board to assist the students in finding employment. While we agree that this is a desirable feature in a University, with its many faculties, it seems to us unnecessary at Bangalore, with its much smaller number of students. In our view, assistance in gaining suitable employment should be given to students by the Heads of their Departments. We suggest that this responsibility may help in maintaining a close contact between Industry and the Departments of the Institute.

#### *Conditions of Admissions*

83. We recommend that in future the Institute should not train students for the M.Sc. degree in science subjects. Admissions to the Science Faculty should be restricted to candidates with M.Sc. and higher degrees. It should then be unnecessary to provide regular formal lectures in the Science Departments. Seminars, however, should be conducted, and practical instructions given in research techniques. Seminars by the staff on subjects pertaining to their fields of research should constitute the principal teaching activities of each department.

84. Candidates with the best qualifications on paper, do not necessarily take the correct approach to research work; we, therefore, suggest that after preliminary selection, candidates should be interviewed by a Committee consisting of the Head of the Department concerned, and one or two members of staff.

85

85. It was represented to us that research students should not pay fees, they are now required to do under a recent decision of Council. If a large number of scholarships of adequate value are established, as we now recommend, we see no objection to the levy of small fees. Students pursuing any prescribed course of study should be charged fees similar to those prevailing at comparable institutions.



*Measures related to the Staff**Appointments*

86. Normally, appointments to senior posts are made on a permanent basis and under existing conditions in India, this is the only satisfactory arrangement. We understand, however, that when the Power Engineering Department was created, certain appointments were made on a contract basis. Although the Council has already taken steps to convert the posts to permanent ones, we feel that there is urgent need to declare these posts permanent, and to confirm incumbents who have given satisfactory service for more than 3 years..

87. According to the current regulations, it is necessary to advertise a vacant post. In several instances, deserving and meritorious candidates among the members of the staff were available. The Council could not, however, show any automatic recognition of their worth by promoting them to the vacant higher places. We suggest that the Council should be free to decide, in each individual case below that of professor, whether it shall advertise a particular post, or fill it by internal promotions; we recommend that the Council should constitute a Promotion Committee consisting of two or three Professors of appropriate faculty, and two outside experts nominated by the Council.

88. We suggest that in making an appointment, either by selection from outside or promotion from within, it is desirable that the Selection Committee should recommend a candidate unanimously. In the case of divergencies of opinion, the case may be referred to other experts.

89. It has been represented to us that when a post is advertised, an junior member of the existing staff appointed, his salary has always been fixed at the minimum of the scale. On the other hand, when outside candidates with similar qualifications have been appointed, they have often been given several advance increments, as a necessary measure to secure their services. This naturally led to internal tensions; the amenities provided by the Institute have often proved sufficient to induce members of staff to remain, but palpable inequalities naturally lead to discontentment. We, therefore, recommend that whenever a post is advertised, and a junior member of the staff selected for a higher post, his pay should be fixed at a level in the scale comparable with that which he might have expected to receive, had he been appointed as an outside candidate.

*Salary Scales*

90. Following the recommendations of the last Reviewing Committee, the salary scales were recently revised, and we are satisfied, in general, that they are in accordance with the scales of similar institutions in India. In a few cases, minor differences do exist. The scales at the Indian Institute of Technology, Kharagpur, for example, are in some instances higher than those in this Institute. On the other hand, the Institute offers certain other advantages, chief of which is the fact that the retirement age is sixty instead of fifty-five as in a Government Institute like the one at Kharagpur.

91 In the present period of rapid scientific and industrial expansion of the country, almost every organisation requiring the services of qualified and experienced personnel has difficulty in finding suitable men. As a result, a number of posts at the Institute are lying vacant. We understand that a similar situation prevails at Kharagpur. We do not believe that this problem can be met merely by increasing the salary scales. While salary scales are important, financial considerations alone will not always attract a person to a position in an Institution of this standing, and retain him thereafter. We understand that this question is engaging the attention of the All India Council for Technical Education, and the University Grants Commission.

#### *Research Assistants*

92 Representations from research assistants were made to us that their posts should be made permanent. There are now two categories of Research Assistants—Junior and Senior—and appointments to both are made on tenure. We appreciate the view that it is not health for a research organization to be loaded permanently with unsuitable members. A candidate should not be promoted to the grade of Senior Assistant, however, unless he possesses the appropriate doctor's degree, and has had some considerable experience in research; his suitability for such a career should then have been sufficiently tested. If, therefore, sufficient care is exercised in filling the posts of Senior Research Assistant, they should be made permanent after 3 years of service. This would remove the existing uncertainty among the Senior Assistants, and would be conducive to better work. The conditions of service of Junior Assistants should not, however, be changed.

#### *Amenities for staff—Accommodation for staff*

93 It has been represented to us that the Institute should provide members of the staff with residential accommodation near the Institute. The existing accommodation for all categories of staff, is very inadequate. In a research institution like that at Bangalore much of the research work will be carried on outside the hours prescribed for the administrative staff; the technical and academic staff will often be called upon to work for long hours, and unusual times, and it is a great advantage if they can be housed near their places of work. We, therefore, recommend that the Government of India should grant the Institute an interest bearing loan, repayable in a period of 33 years, for the construction of staff quarters near the Institute, for all categories of the staff.

94 We have suggested elsewhere that alternative accommodation should be found for the Engineering Stores which at present occupy an area of 5,000 sq. feet. We suggest that the space so released should be used to provide a staff common-room and canteen. The cost would be about Rs. 10,000. This amenity is urgently required as a step towards promoting personal intercourse between members of the Institute staff and visiting Scientists and Technicians; we have stressed the great importance of such informal meetings in a previous paragraph. The provision of a staff common-room may also help to promote friendly contacts between members of different departments within the Institute. At present there appears to be little interest by the members of one department in the activities of another, and the important objective of establishing a variety

of scientific disciplines in the same campus, in order to benefit from the mutual interaction and support, is not achieved. We, therefore, suggest that staff common-room and canteen, in addition to providing lunch and tea for those who come from the city, may also serve one of the main aims of the Institute.

### *Private Practice*

95. We understand that as a result of recent changes in the private practice code, members of staff are no longer anxious to accept private consulting work. We suggest that it would be reasonable to take a liberal attitude on the question. The Director should decide what amount of private practice an individual can engage in without detriment to his normal duties.

### *Administrative responsibilities of Professors*

96. We found that much of the time of the Heads of the Departments is spent on routine administrative duties. For example, although the Central Store Organisation maintains all store accounts some departments duplicate this work as a check on that organization. We suggest that the Council and the Director might consider procedural simplification wherever possible. We also suggest that the Head of Department should delegate some of his routine responsibilities to the junior members of the staff. This will not only relieve him of much routine work but will also give the junior staff experience in administration.

### *Researches financed by Outside Bodies*

97. The Departments of the Institute have been carrying out work on some research projects sponsored by various bodies such as the Council of Scientific and Industrial Research, the Department of Atomic Energy, the Indian Council of Agricultural Research, etc. A list of such projects is given in Appendix II. While we support the view that sponsored research of this kind should be carried out, we feel that care should be taken to ensure that the normal activities of the Institute are not unduly disturbed thereby. We suggest that no proposal for sponsored research should be accepted without the concurrence of the Director, and that the Director should report acceptances to the Council.

### *Pilot Plant Work*

98. We have had requests from some Departments that funds should be provided for work on pilot plants. In our view, when the work of a department has reached the stage when experiments with a pilot plant become desirable, the necessary funds should be provided by the agency sponsoring the research. We suggest, further, that expensive work with pilot plants work should better be undertaken by the Central Pilot Plant Organisation, under the National Research Development Corporation or Industry, rather than by the Institute. If, however, the Director is satisfied that experiments requiring the construction of small pilot plants are desirable, and are likely to give important and useful results we suggest that he should support them by grants made from the discretionary funds at his disposal.

### *Co-operation with other Institutions*

99. The first of the four higher technological institutes which the Government of India proposes to establish has been functioning at Kharagpur for the last five years. It is expected that the second one, at Bombay, will soon be built, and the other two during the period of the Second Five Year Plan. We believe it is very desirable that a close collaboration should be established between these four institutes and that at Bangalore, particularly in the matter of co-ordinating plans for research. We, therefore, suggest that the Heads of Departments of these institutes should meet at least once a year, and that they should visit one another's laboratories. We suggest that such visits would help in promoting a co-operative and concentrated effort for the solution of important problems facing the country. We also suggest that the authorities of these institutions should consider ways and means of facilitating the exchange of teachers among them, as a way of giving mutual support and stimulation. Other measures related to the life and work of the staff are given in section II (§94), and (§95).

### *Development and Reorganisation of Technical faculties of the Institute* *Central Stores Organisation*

100. Before 1954, the Head of each Department was responsible for the purchase of the consumable stores, apparatus and appliances, required for his department. Subsequently, the Council decided that purchase and store-keeping should be centralised. This was done with a view to effecting a number of economies, including those associated with bulk purchase, reduction of staff and establishment, and through the introduction of simplified procedure. The departments were thus relieved of much routine work.

101. The Central Organisation consists of a Purchase Section under the control of the Registrar, a Store Account Section, and a store-keeping section under a Chief Store Keeper.

102. In their Memorandum, the Senate suggested that there should be a return to the old system, and that the stores organisation should be decentralised. We have discussed this question with the Heads of Departments, both individually and collectively and have examined the present system of purchase, accounting and store-keeping.

The majority of the Heads of Departments recognise the benefit of a properly organised central stores. It appears to us, however, that their faith in the present organisation was shaken by its inability to render prompt service soon after it was established. The Heads of Departments agree, however, that the service has been improving, and we believe that if the procedures could be simplified, and irritation and delay thus avoided, the organisation could function smoothly and effectively. It would then relieve the Departments of much routine work, and enable them to concentrate on their more important responsibilities. We, therefore, consider that reversion to the old system would be a retrograde step.

103. For strengthening the Central Stores Organisation, we recommend additional clerical staff of which details are given in Section IV—Statement IV. We also suggest that the post of the Chief Store Keeper should be converted

into that of a Stores Officer. The store-keeping and purchase section can be placed in charge of the Stores Officer, under the overall supervision of the Registrar or Assistant Registrar.

104. We have suggested elsewhere that a new building should be constructed for Organic Chemistry; see (§153) this will make available about 10,000 sq. ft. of floor space in the present Chemistry block. We suggest that (a) the Engineering Stores, at present housed in the Physics building, and (b) the Chemical Stores, already in the Chemical block, but in a different part of the building should be moved into the space made available by the removal of the Organic Chemistry department to its new building. These changes will serve the following purposes:

1. They will make available space in the Physics building which can be used for a staff canteen and common room; see (§ 94);
2. They will allow room for expansion of the departments of Inorganic and Physical Chemistry; and
3. They will bring together the Chemical and Engineering stores, and will ensure that both are close to the departments which are most dependent upon them.

#### *Department of Industrial and Production Engineering*

105. Recently the Government of India has sanctioned funds for the Institute to organise post-graduate courses in Foundry Engineering, Industrial and Production Engineering, and Industrial Administration. It is proposed that these courses should be given in the Mechanical Engineering Section of the Power Engineering Department. In our review of the work of this Section we have pointed out that, by taking in all these additional courses, the primary function of that section—namely, the training of Power Engineers—might be adversely affected. We, therefore, recommend that a new department of Production and Industrial Engineering should be created; and that the proposed course should be transferred to that department. The Central Workshop, which is now under the Mechanical Engineering Section, and the proposed Instrument Section, should also be placed under this new department; see (§ 112) and (§ 107)

106. For the institution of the courses, sanction has already been given to the creation of the posts of 1 Professor, 1 Assistant Professor, and other junior and group II staff; and also for a non-recurring grant of Rs. 4,00,000 for building and equipment. Provision for working expenses of Rs. 16,000 annually has also been made. After the establishment of the Department, the financial position may be reviewed in the light of practical experience. We have suggested in (§ 264) that the Section of Economics and Social Sciences should give assistance to this Department in the teaching of relevant subjects.

107. The previous Reviewing Committee recommended the establishment of an Instrument Section. We reiterate the need for such a section, and suggest that it should be attached to the new Department of Production and Industrial Engineering. The primary function of this section should be to develop and manufacture instruments and appliances required by the various Departments

of the Institute. We understand that the establishment of this section is now under consideration of the Ministry of Education in the Government of India, and we recommend that early steps may be taken for its implementation.

*Central Instruments and Services Laboratory*

D8. Modern researches using tracer techniques, infra-red spectrometers, electron microscopes, etc., require very expensive equipment, and several of these items have been asked for by more than one department. At the present stage in the development of the Institute we do not, in general, consider it necessary or desirable that such expensive equipment should be duplicated. We believe that it can be more effectively and skillfully employed when in the charge of trained technicians in a Special Section.

D9. With the above considerations in view we recommend the establishment of a Central Instruments and Services Laboratory to be under the control of the Director and equipped with the following instruments:

“..... Electron Microscopy, Photo-micrography, infra-red Spectrometer, tracer-technique equipment, X-ray powder analysis, and Electron diffraction.....”

10. This Central Instruments and Services Laboratory should employ its instruments for making measurements and observations on material supplied by the different departments of the Institute. It should permit workers of different departments to use the instruments, when this is appropriate, with the help of the expert technical staff of the laboratory. The laboratory should be in the charge of a Senior Scientific Officer, who should be a physicist with a good background of electronics. He should be of the rank of an Assistant Professor, in the scale of Rs. 600—1,000. The instruments should be operated and maintained by well trained Technical Assistants. While members of the laboratory should work in close collaboration with the research workers of the departments they may undertake research on their own initiative *only* with the permission of the Director.

11. Apparatus which is already available in the Institute *e.g.* equipment for tracer technique, Electron microscope, infra-red spectrometer etc., should be transferred to the Central Instruments and Services Laboratory. We recommend an additional non-recurring expenditure of Rs. 2 lacs for the purchase or manufacture of other equipment, as it may be necessary. We also recommend the appointment of eight Technical Assistants for the operation of these instruments.

112. We recommend that the Central Instruments and Services Laboratory should be built up steadily during the next quinquennium, the recommended staff being engaged as the need for them becomes apparent with the development of the laboratory and its work. For work on tracer techniques, the Central Instruments and Services Laboratory will need two rooms for work with high level, and one for low-level radiation; a small laboratory for organic chemical synthesis of radio active compounds, and another for preparation of samples, and radiation assay. Some minor equipment, in addition to that already secured from the T.C.M., will also be needed.

113. The laboratory for tracer techniques should be a part of the Central Instruments and Services Laboratory, and should be in charge of a qualified Chemist, designated Scientific Officer, specially trained for this work. We recommend that he should be placed in the scale of a lecturer *i.e.* Rs. 350—850.

#### *Central Glass Blowing Shop*

114. We received requests from several departments for additional glass-blowers, and for equipment to manufacture glass-ware. These needs should now be met, by establishing a well-equipped glass-blowing shop under the charge of the Senior Scientific Officer of the Central Instruments and Services Laboratory. The new shop should be part of the central facilities serving the needs of the Institute as a whole. The departments which need them should retain the small facilities for glass-blowing which they already possess, in order to meet day-to-day need.

115. The new glass-blowing shop should be equipped to produce the wide range of glass apparatus needed in different departments. It should, therefore, be provided with glass-blowing lathes, cutting and grinding machines, annealing ovens, and more conventional tools. We consider that provision of a capital grant of Rs. 1,40,000 should be sufficient for this purpose. We recommend that the posts of a Principal Glass-blower and one Senior Glass-blower should be sanctioned, in addition to the existing staff of one Senior and one Junior Glass-blower. We also recommend that the Senior Glass-blower should, if necessary, be sent to a good glass-blowing shop for further experience.

116. The glass-blowing shop should be given an annual grant of Rs. 3,500 for working expenses. Individual departments should be charged the cost of glass used in the production of apparatus, but not that of labour etc. We suggest that the facilities in this shop should be utilised to train apprentices. Men skilled in scientific glass blowing will shortly be urgently required in several industries in India.

#### *Central High Vacuum Service Unit*

117. The production and measurement of high vacuum is a specialised branch of technology, requiring considerable experience; the provision of a central high-vacuum unit would give important support to those departments which need it as a service.

118. We, therefore, recommend that a unit should be established with equipment for producing high vacuum, with leak detectors, vacuum indicators and evaporating unit, and other accessories, at an initial cost of about Rs. 30,000.

119. The unit should be in charge of a Scientific Officer in the scale of Rs. 350—850 with one laboratory assistant, and it should be located in the Instruments and Services Laboratory, under the general supervision of the Senior Scientific Officer. A recurring expenditure of Rs. 3,000 per year would be necessary for working expenses.

120. We suggest that a new building should be constructed to house the Central Instruments and Services Laboratory, including the Central Glass-blowing Shop and the High Vacuum Service Unit. The Tracer Technique Section requires a floor space of 4,500 sq. ft., and the glass-blowing and high-vacuum service units require about 2,000 sq. ft. and 1,000 sq. ft., respectively. The other instruments, electron-microscope, etc., should be provided for each. The new building with an area of 10,000 sq. ft. should be located near the Central Workshop. It is estimated to cost together with fittings and services, about 1·5 lacs of rupees.

### *The Central Workshop*

121. The Central Workshop has not always been able to render the service and assistance which was expected of it by the departments. Further, the demands upon it, and the importance of its role are likely to increase greatly if our suggestions are adopted that instruments and much equipment should be designed and constructed within the Institute.

122. In view of its increasing responsibilities, we have carefully examined the operation of the Central Workshop and suggest a number of changes to make it more efficient:—

We believe that the location of the workshop within the Mechanical Engineering Section of the Power Engineering Department is unsatisfactory, and we recommend that it would be brought under the direction of the new Department of Production and Industrial Engineering, the creation of which we have recommended in this report.

123. The Workshop is adequately equipped for general mechanical operations, but it needs a few precision machine tools. We are strongly of the opinion that in general, money is better spent on such machines, which contribute to improving the technical facilities of the institute for constructing its own apparatus and equipment, rather than on the purchase of scientific instruments from abroad.

124. The workshop staff in Group II needs strengthening and concrete recommendations are given in Section IV—Statement IV. The scales of pay of the Foreman and Mechanics are low, and we recommend that these be brought into line with those which operate in the Indian Institute of Technology, Kharagpur.

125. One of the main difficulties experienced by the Workshop in giving prompt service to the departments has been the absence of its own stock of ordinary engineering materials. At present, a department is required to supply the material for a given job by indenting on the Central Stores at the same time that it delivers the work order, and this procedure causes unnecessary delays. We suggest that the Workshop should be given a permanent stock of materials. The appropriate size of this stock may be determined from the experience of the past two or three years. This would permit the workshop to use materials from its own stock, and later to replenish them by indenting on the Central Stores.



126. The workshop may charge the cost of material to the departments, but not that of labour. The workshop organisation should be given an additional clerical post as shown in Statement IV of Section IV.

*Miscellaneous*

*Maintenance of Buildings, Roads, etc.*

127. The main roads of the Institute have all become very dusty owing to the great increase in motor traffic. This is becoming a general nuisance, and interferes with the work, particularly of the science departments. We recommend that all the main roads should be black topped; and that others, less used should be repaired. The Institute Engineer estimates that these operations would cost Rs. 65,000. We suggest that this amount be sanctioned and work taken in hand immediately.

128. It has been represented to us by the Institute Engineer that the funds allocated for the maintenance of buildings have always been inadequate. In the 1955-56 budget, the provision for repairs to buildings was Rs. 117,000 and for the maintenance of roads and grounds Rs. 7,000. While the climatic conditions of Bangalore are so favourable that the burden of maintenance is not heavy, we believe that, in view of the large number of buildings, a more liberal allocation would be a wise measure. We suggest an allocation of Rs. 30,000 for annual repairs; and Rs. 1,20,000 for quadrennial repairs to buildings and roads.

## SECTION III

*Work and development of individual Departments and Sections**Department of Physics*

129. During the period under review, the department of Physics has gradually been transferred to the present buildings, the work of removal taking place, in stages, in the period from 1951 onwards, and being completed in April 1955. During this period, the department has been directed by Prof. R. S. Krishnan. As a result of recommendations by the Egerton Committee, the staff has been increased, so that it now consists of one professor, one assistant professor, two lecturers, one senior and two junior assistants.

130. The number of students in the department during the period under review has varied between ten and sixteen, all of whom are trained in research. In general, the subjects studied lend themselves to work by individual students, and independent research has been encouraged. In addition, senior members of the staff give lectures and symposia on the subjects of special study of the laboratory. Recently, difficulties have arisen in attracting enough research students of good quality, and it is suggested that, as with other departments, this is due to the nature of the awards of the Institute, and to the small value of the available scholarships.

131. The department has specialised for many years on studies of spectra and crystal physics, and it can now claim to be a leading school in these subjects. This general field of work includes the following—

Scattering of light, Raman spectra, X-rays and crystallography, elastic properties of solids, crystal growth, thermal properties of crystals, infra-red spectroscopy, magnetism, ultra-sonics, physical mineralogy and radio-activity.

132. It is an important feature of the work of the department that, whilst its researches are of a fundamental character (long-term research), several of its special fields of study are likely to become of great importance for the development of a number of important industries in India. Thus, the growth of a variety of crystals is essential for the support of the principal field of research of the Institute. But, in addition, it is a technique of great importance for the radio and electronics industries, for it is necessary in the production of a very important class of crystalline semi-conductors, such as silicon, germanium, lead telluride, and others.

As a second illustration, the work on crystal growth and supersonics establishes the techniques which are required for the production of piezoelectric crystals, for use in Communication Engineering, ultrasonic oscillators, etc.

Briefly stated, we believe that several of the fields of research of the department are likely to provide a valuable source of technical personnel, and specialised skills, which will be of great importance for the future of industry in India; and we suggest that ways and means should be found for their support.

133. The standing advisory committee on physics, in reporting on the development of the department, visualised the continuation of work on the present fields of study, and the initiation of investigations in related fields which would throw additional light on the main field. With this aim in view, they recommended expenditure designed to modernise and supplement the existing equipment of the department. The most important items of the proposed expenditure relate to—

(A) the provision of a liquid helium apparatus. The object of this equipment is to permit the important work on the properties of crystals to be extended down to much lower temperatures than have hitherto been available in the Institute .. .. .	Cost Rs. 2 lacs.
(B) New apparatus for optical and X-ray spectrography, in order to modernise the technical equipment in these subjects .. .. .	Cost Rs. 6·3 lacs.
(C) Magnets for experiments in magnetic resonance	Cost Rs. 2 lacs.
(D) Crystal growth .. .. .	Cost Rs. 0·5 lacs.
(E) Ultra-sonics Rs. 0·9 lacs, and general laboratory equipment .. .. .	Cost Rs. 0·75 lacs.
Total .. .. .	<u>Rs. 12·5 lacs</u>

134. We believe that studies in most of these fields should be supported because of their intrinsic interest, and their bearing on industry and technology; but such a large expenditure can hardly be justified when considered in relation to the size of the Department, and the number of students. We suggest that an important part of the facilities asked for could be produced within the Institute at a much smaller expense, especially if the Central Instrument Section and the Glass-blowing Shop are successfully established, and if the number of students in the department is increased. Thus, we suggest that the hydrogen and helium liquifiers should be fabricated within the Institute. Magnets and associated equipment for the work on paramagnetic resonance might also be built.

135. Further, we suggest that in view of their great technological interest and importance, it would be appropriate to ask for support from other bodies for the work on crystal growth and ultra-sonics, and an application should be made to the C. S. I. R.

136. The work on acoustics at present being carried out in the Telecommunications Department, under Assistant Professor Ramakrishnan is an investigation in pure physics, and is closely related to several of the problems being studied in the Department of Physics. There would be important advantages in transferring this work to the Physics Department, where ample space could be made available, and we suggest that this should be done.

137. For support of work on optical and X-ray spectroscopy, and for general laboratory equipment, we recommend an expenditure of Rs. 2 lacs during the next quinquennium. In addition, we suggest that the liquid hydrogen

and helium programme should be supported to the extent of Rs. 1 lac. This, it is estimated, would permit the construction of the helium liquifier of the Simon type. The extension to the second stage, involving the construction of the Kammerlingh-Onnes type of liquifier, should be considered in the light of the success of the earlier work, and the results obtained with it.

138. For the further strengthening of the department, we recommend the appointment of one lecturer, who should be a specialist in magnetism, and an increase in the number of research students by six, all of whom should be scholars.

#### *Department of General Chemistry*

139. Dr. B. Senjeeva Rao, the Nizam Professor of Inorganic and Mineral Chemistry was in charge of this department until December 1950 and he was followed in this post by Dr. K. R. Krishnaswamy who was appointed in May 1952. In the intervening period, Dr. S. K. Bhattacharya acted as Professor and Head of Department.

140. Throughout the period under review, the department has concentrated on research, limiting teaching to lectures on those special topics of advanced chemistry which have a bearing on the subjects of research of the students. Students were also given preliminary training in research techniques. During the period, 75 students were admitted to the department; 12 of them were awarded the Ph. D., and 8 the M.Sc. degree, by different Universities, whilst 18 students obtained the Associateship of the Institute. Most of the students who left the department have obtained suitable employment, either in scientific organisations of the Government, or in industrial concerns. There has, however, been a progressive decline in the number of students admitted annually.

141. The department has undertaken research on a wide variety of subjects and its members have published 107 papers. The main lines of research were—

- (1) reactions involving high-pressure techniques; (2) absorption studies on catalysts; (3) physico-chemical studies of surfaces; (4) studies of colloids; (5) dielectrics; (6) electro-chemistry; (7) polarography; (8) utilisation of mineral resources; (9) fertilisers; (10) general inorganic chemistry; (11) differential thermal analysis; (12) inorganic complexes and (13) analytical methods.

In addition, the department has done useful work on (1) ultrasonics; (2) vinyl plastics; (3) beneficiation of minerals; (4) chlorination of rubber and (5) acetic acid, acetic anhydride and ethyl alcohol in a programme sponsored by the C.S.I.R.

The All India Council for Technical Education has made a grant for research in "Technical Gas Reactions and High Pressures", which is to be carried out in the department. A proposal for an investigation on silicones has been submitted to the Plastic Research Committee, Indian Standards Institution, Delhi.

142. It has been proposed that the Department should in future be known as the Department of Inorganic and Physical Chemistry, to indicate its full scope; we agree with this suggestion. The programme of work proposed for the next five years envisages a capital expenditure of Rs. 6.5 lacs, and contemplates undertaking researches in a wide variety of fields. A post-graduate course in modern analytical chemistry has also been proposed.

143. We reiterate the view expressed by the members of the Eegerton Committee who wrote—“...The creation of the National Chemical Laboratory and other Laboratories, in the post-war period, will no doubt tend to alter the scope of the work of this section of the Institute, and it will be advisable to focus attention on fewer investigations, and to pursue these more intensively...”. Accordingly, we recommend that research should be confined to the following topics—

- (a) Chemistry of minerals of economic importance, and of the rare earth elements, including their beneficiation.
- (b) Studies in modern analytical chemistry, including electro-analytical and physico-chemical methods.
- (c) Quantum Mechanics, molecular structure in relation to physical properties and catalytic reactions.

144. We suggest that the staff of this department should be in constant touch with that of the Department of Metallurgy, with a view to avoid duplication. At present, a certain degree of over-lapping is evident. For instance electroplating, electrolytic separation of metallic elements, and beneficiation of ores, need not be subjects of study in both Departments. Active and fruitful collaboration in a big project, rather than independent investigation of small problems should be aimed at.

145. The present staff consists of 2 Professors, 1 Assistant Professor, 4 Lecturers and other junior staff. The vacant post of Professor of Physical Chemistry should, we suggest, be filled by an expert in Chemical Kinetics and Thermodynamics. We recommend the creation of the additional posts of Assistant Professor for studies in quantum mechanics, and 1 Senior Research Assistant for work on X-Rays and electron diffraction. Additional accommodation, with an area of 2,000 sq. ft., together with furniture should be provided at a cost of Rs. 50,000. Alternatively, the Department should be allowed to expand into a part of the building now occupied by the Organic Chemistry Department which should be transferred to a new building; see (§153). Additional equipment worth about Rs. 1 lac would be adequate to support the proposed programme of research. The grant for working expenses to the Department should be increased to Rs. 32,000 per year. With these increased facilities, the Department should be in a position to train 28 Research students of whom 20 should be given scholarships.

#### *Department of Organic Chemistry*

146. This is one of the oldest departments of the Institute. During the period under review, the post of head of the Department has been filled successively by Prof. P. C. Guha until July 1952; by Dr. B. H. Iyer who was acting Head until 31st January 1955 and by Dr. K. D. Banerjee since 1st February, 1955.

147. The main activity of the Department consists in preparing students for higher degrees. Immediately after admission, students are given intensive training in advanced practical organic chemistry, and made familiar with the latest techniques. In addition, lectures are given on recent advances in specialised fields of organic chemistry. A number of requests for information, training, assistance, or analysis of samples, from industry and private parties, has been received, and the work has been undertaken whenever possible.

148. For the period 1948—52, the average annual number of admissions to the department was 10. From that year onwards, there was a rapid decline in the number of applications, and in the current year, 1955-56, only two students have been admitted.

During the period under review, 12 students of the department obtained the degree of Ph.D., and 3 students that of the M.Sc. from various Universities; 4 students were awarded the fellowship, and 18 students the associate-ship of the Institute.

149. Research activities of the Department have been continued on (a) oils and fats, (b) essential oils and (c) synthetic drugs. The problems of the complete utilisation of Indian Turpentine oil, and the conversion of Carene to Menthol, have been studied. A modified process for the synthesis of paludrine has been evolved. Interesting work on the synthesis of steroids, and the mechanism of organic reactions, has been started under the guidance of the new Professor Dr. D. K. Banerjee.

During the period under review, 171 papers have been published on a wide diversity of subjects studied in the Department.

150. The Department proposed a programme of research work for the next quinquennium involving a capital expenditure of about Rs. 3 lacs, and with corresponding increases in the recurring expenditure. The fields of investigation proposed were (a) synthetic drugs, (b) synthetic steroids, (c) essential oils and (d) theoretical organic chemistry.

In the field of synthetic drugs, preliminary studies have indicated that the alanine derivative of I.N.H. is active against the streptomycin resistant strain of tubercular bacilli. It is intended to study the activity of this drug, and of the amino-acid derivatives of I.N.H., in more detail. In the field of synthetic steroids, a stereo-specific synthesis of the female sex hormone, oestrogen, has been achieved, and the method has also led to a preparation of the male sex hormone, testosterone. This work will be developed to provide practical methods for the synthesis of steroids.

151. We are of the opinion that the work on essential oils should continue only as a project under the auspices of the Essential Oils Committee of the C.S.I.R. The Departmental staff should concentrate their research work on synthetic drugs, synthetic steroids, and organic reactions of theoretical significance.

152. The present staff of the department consists of 1 Professor, 11 Assistant Professor, 2 Lecturers, and other staff. We recommend the addition of a Lecturer who is conversant with the revolutionary changes which the classical theories of Organic Chemistry are undergoing because of the impact of modern ideas on the valence-bond. If a lecturer with the requisite qualifications is not available, the post may be converted into that of an Assistant Professor.

153. The Department is rather inadequately housed, having 8666 sq. ft. of office accommodation, and 9581 sq. ft. of working space much dispersed and scattered. We suggest the transference of this Department to a suitably planned new block of buildings providing a working space of 14,000 sq. ft. A sum of Rs. 3.0 lacs should be adequate for this purpose. A part of the present accommodation can then be released to the Inorganic and Physical Chemistry Department, and the remaining utilised for Engineering Stores.

A sum of Rs. 70,000 for equipment would, in our view, be adequate for the proposed activities of the Department. We also recommend that an additional post of Laboratory Assistant should be sanctioned. The annual working expenses of the Department may be increased to Rs. 25,000. With these additional facilities, the Department should be in a position to train 22 Research students at any one time, of whom at least 16 should be given scholarships.

#### *Department of Biochemistry*

154. Prof. K. V. Giri was appointed as Head of the Department from 1950 and has directed it since that date. Prior to Prof. Giri's appointment Mr. D. N. Banerjee had acted as Head of the Department.

The Fermentation Technology and Pharmacology Sections were part of the Department of Biochemistry till June 1953. Thereafter, they were given independent status under the Director; a happy collaboration continues, however, between these two sections and the Department of Biochemistry.

In compliance with the recommendations of the Egerton Committee, the Cyto-genetics Unit was transferred from the Department of General Chemistry to this Department. During the period under review, technological equipment for studies of food-stuffs have been transferred to the Central Food Research Institute, Mysore.

155. The main activities of the Department have been (a) research on fundamental problems, and (b) the training of students in technical methods and research. The principal subjects of research have been enzymes, antibiotics, food and nutrition, vitamins, plant biochemistry, sanitation biochemistry with special reference to the role of protozoa in sewage purification and cyto-genetics.

The department has developed new techniques in chromatography; these are now in constant use in this laboratory, and they have been employed in several laboratories abroad. A very interesting and simple electrophoretic technique has recently been developed for the separation of high molecular compounds such as proteins and polysaccharides.

156. For the period 1948—55, the average number of students admitted annually to the department was 10, in the current session it has fallen to only 5. Of 68 students admitted to the department in the period under review, one student obtained the D.Sc. degree; 41 the Ph.D. degree; and 13 the M.Sc. degree of various Universities. In addition, 12 were awarded the Associateship, and one the fellowship of the Institute. A non-recurring expenditure of nearly Rs. 2,64,000 was made on buildings and Rs. 3,49,000 was spent on equipment.

157. The Department expressed the intention to carry out research in the next quinquennium in the following fields—

1. Food and Nutrition; Spectroscopic investigations on vitamins.
2. Biosynthesis of vitamins.
3. Nutritive value of heated oils.
4. Intracellular distribution of vitamins.
5. Cytogenetics, development of strains of yeast, and study of their biochemical characteristics, detailed biochemical studies on the types of yeast evolved in the cytogenetics laboratory.
6. Enzymes.
7. Carbohydrates; enzymes related to carbohydrate metabolism.
8. Proteins; a long-range research programme on proteins using electrophoretic and chromatographic methods.
9. Biochemical Techniques—Studies to improve techniques, and to apply them to current problems under investigation are to be continued on a long-range basis.
10. Sanitation Biochemistry—fundamental aspects of sewage purification, with special reference to biochemical studies of protozoa.
11. Antibiotics—general survey of the occurrence of antibiotics in plant materials.
12. The tracer technique laboratory is in the process of being organised with the assistance of T.C.M. Part of the equipment has now arrived, and it is hoped to set up the laboratory in the course of a few months. Experiments will be started using radio isotopes as an important new experimental resource.

158. The original section of food technology has now become in effect, section of Vitamin Biochemistry. It is well to recognise the fact, and we believe it would now be wise to give up general studies on food and nutrition. We, therefore, recommend concentration of studies on the following subjects—

Development of new biochemical techniques of separation and their application to long-range studies of proteins and carbohydrates; enzymes, with special reference to carbohydrate metabolism; continuation of studies in Sewage purification; cytogenetic studies of yeast and other micro-organisms and Vitamin Biochemistry.



159. The department has made modest estimates of its requirements for work during the next 5 years. We recommend that a combined animal house for the use of the Department of Biochemistry, and the sections of Pharmacology and Fermentation Technology, should be set up. This animal house should be built in two separate sections, one for healthy, and the other for infected, animals. For this purpose, Rs. 40,000 should be sufficient for the house, cages, etc. and a kitchen. We also recommend that two animal house attendants should be appointed.

160. The requirements of the department for the experiments with trace techniques have been dealt with under the Central Instruments and Service Laboratory; see (§112, §113 and §120).

We recommend an amount of Rs. 40,000 for equipment and the appointment of an additional Laboratory Assistant. The working expenses of the Department should be increased to Rs. 36,000 per annum.

The Department should make provision for 32 research students, of whom 25 should be awarded scholarships.

#### *Section of Fermentation Technology*

161. This section was first established in the department of Pure and Applied Chemistry in January 1942. In 1948, it was transferred to the Department of Biochemistry; and, in 1949, into a house provided for it in a new building. Mr. N. Sreenivasiah, Assistant Professor, was in charge of this section until June 1952. From then until June 1953, the section practically ceased to function. Dr. J. V. Bhat was appointed in June 1953, when the section was given independent status under the Director.

162. The laboratory has been devoted almost exclusively to research, and regular courses of lectures have been given; but, for the benefit of the research students, occasional lectures on special topics, and a set of practical exercises have been held.

Hitherto, 11 students have received conferments through their work in the laboratory. Of these, two obtained the M.Sc., and four the Ph.D., degrees of Universities, and six students were awarded the Associateship of the Institution. At present, three students are working in this section.

163. Since 1948, the section has been occupied with a number of research projects, some as part of its own programme, and some on behalf of Government and other bodies. Among others, the following problems have received attention—

- (1) Cultures of lactate bacilli for the microbiological assays of vitamin and aminoacids; (2) micro-organisms for the production of riboflavin; (3) Nitrogen-fixing organisms in soil; (4) studies on alcohol-tolerant yeasts, and recovery of alcohol from distillery washes; (5) studies on *Torula utilis*, and other yeasts, in relation to mitosis, polyploidy, tetraploidy, stabilizing and regulating mechanism, etc.; (6) studies on marine yeasts; (7) the role of iron in the nutrition of

some spore-forming strains of *Clostridium lacto-acetophilum*; (8) Normal flora of the alimentary canal of the silkworm, *Bombax-mori* L; (9) formate as a substrate for the enrichment of *Pseudomonas fluorescens*; (10) aldolase in *C. Lacto-acetophilum*, and (11) *C. Lacto-acetophilum* and fermentation of glycerol.

164 It is the intention of the section to continue research in the next five years mainly in three fields: (a) Microflora of soils; (b) enrichment culture methodology as applied to the subject of microbiology; and (c) nutrition of the silkworm.

165. The section has been operating mainly as a section of General microbiology. The Assistant Professor, who is now in charge of the Section, is an enthusiast who will do better work if left free to devote himself to those subjects in which he is most interested. We feel that the programme of work which he has proposed should be accepted, even though it is not in accord with the original objective for which the section was started. We suggest that there should be effective co-operation, between the cytogenetic unit in the Biochemistry department and this section, for the production of strains of micro-organisms whose performance has been upgraded by selection, hybridisation, and treatment with polyploido-genic and mutagenic chemicals and radiations.

166. The section has need of no additional building, as the rooms originally allotted to it, and now occupied by the Biochemistry Department, will be released when the new animal house is built; see (§159). The accommodation so released will satisfy the present needs of both the sections of Pharmacology and of Fermentation Technology.

A non-recurring grant of Rs. 20,000 should be sanctioned for equipment, and additional posts of one Senior Research Assistant, and one Laboratory Assistant should be established. The working expenses of the section should be increased to Rs. 8,000 per year, an amount which will allow provision for the proposed course in Applied Microbiology. It should be possible for the section to train 4 Research students, of whom at least 3 should be given scholarships.

#### Section of Pharmacology

168. The Pharmacology Laboratory was first established, as a section in the Department of Pure and Applied Chemistry, in 1941. In 1951, an adequate building was provided and the section together with the equipment necessary for an experimental pharmacological and bacteriological unit was transferred to the Department of Biochemistry. Since October 1953, the section has been in the charge of Dr. M. Sirsi, Assistant Professor.

169. The main activity of the section has been the evaluation of various synthetic drugs prepared by the Department of Organic Chemistry, and the pharmacological study of natural products provided by the department of Biochemistry.

Students and research workers sent from factories making pharmaceutical products have been trained in the section in experimental pharmacology, bacteriology, chemotherapy and biological standardisation of drugs.

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 Date: 24-01-2021

During the period under review, 4 students associated with the section were awarded the Ph.D. degree, and 2 gained the Associateship of the Institute.

170. The research carried out during the period under review may be broadly classified under three main headings: (1) In association with the Organic Chemistry Department, the chemo-therapeutic evaluation and pharmacological study of synthetic compounds, anti-bacterials, and anti-tubercular compounds, anti-malarials and essential oil hypnotics; (2) in association with the Biochemistry department, Pharmacodynamic studies of a few plant antibiotics; and (3) research on: (a) Malaria and tuberculosis, (b) Indian medicinal plants, and (c) studies on blood and tissue regeneration.

171. The programme of research work proposed by the section for the next five years envisages the following investigations—

1. *Studies on Tuberculosis*—Metabolic requirements of tubercle bacilli and the nature of drug-resistant strains; the host-parasite relationship; influence of nutritional factors in increasing or diminishing the resistance of the host; environmental factors governing the virulence of tubercle bacilli, and allied problems in tuberculosis. Chemotherapy of tuberculosis by synthetic and natural drugs, in association with the Organic Chemistry Department.
2. *Malaria*—A similar type of fundamental study, pertaining to the host-parasite relationship, and derangement in the protein metabolism in avian malaria, is in progress; it is being financed by the Indian Council of Medical Research. These studies will be extended to cover carbohydrate, vitamin and mineral metabolism.
3. Pharmacodynamic and toxicity studies of anti-coagulants prepared in the biochemistry department.

172. We recommend that studies in tuberculosis and malaria should continue. We suggest that the possibility of the unit being expanded as a centre of drug research in South India, in close association with the Central Drug Research Institute at Lucknow, and with adequate financial assistance from the C.S.I.R., should be seriously considered. An effective liaison with the Central Drug Research Institute could be established by the appointment of its Director as an Honorary Visiting Professor to this section. If this proposal is accepted, Pharmacodynamic studies of the antibiotics occurring in plant materials of South Indian origin may be taken up as long-range problems.

173. We have recommended an animal house under the Department of Biochemistry, which should be used in common with this section and that of Fermentation Technology. There is no need for additional building. The annual working expenses should be increased to Rs. 9,000 and the section should aim to accommodate 8 Research students of whom 6 should be given scholarships.

#### *Department of Chemical Engineering*

174. The Department of Chemical Engineering was originally started, as a section of the Department of Pure and Applied Chemistry, in 1943. As a result of the recommendations of the Egerton Committee, the Chemical Engineering Section was converted into a separate department in 1951. From October

From July 1952 to July 1954, Dr. S. S. Ghosh, Assistant Professor, was in charge of the department. Since July 1954, the department has been under the charge of Dr. E. Wüngaertner. In September 1954, Prof. C. T. Austin joined the department, as a Visiting Professor under the T.C.M. Scheme for two years.

175. The department at present offers a two-year diploma course in Chemical Engineering, in addition to post-graduate research work. The number of students admitted to this course, during the period under review, varied from 1 to 7. Research facilities exist in the department for about 15 students. During the period under review, 10 students were awarded the associateship, 48 students the combined diploma and associateship, 13 students the diploma, and 1 student the certificate of proficiency under the old regulations.

The department published 37 papers during the period. The research work has been carried out with a view to giving immediate or future assistance to industry. From time to time, members of staff have rendered assistance to industry with advice and guidance.

176. The plans submitted for the development of the department are estimated to involve a non-recurring expenditure of Rs. 4,50,000, with corresponding increases in the recurring expenditure. The plans envisage research in the following subjects—

1. Total gasification of many varieties of Indian low-grade coal,
2. Production of synthetic hydro-carbons,
3. Investigations for the development of a new process for reduction of iron ores,
4. Assembly of different types of special distillation columns, for separation of hydro-carbons,
5. Research work on polymerisation,
6. Investigations of de-mineralisation of Indian graphites and coals with high ash-content,
7. Investigations in heavy-water enrichment,
8. Enrichment of uranium 235 and
9. Development of atomic-power reactors.

177. We recommend that the department should continue investigations in the industrial production and separation of synthetic hydro-carbons, with special emphasis on the utilisation of South Arcot Lignites as the basic raw material. We note that much of the work in this department is being undertaken in response to suggestions received from the Atomic Energy Establishment. We recommend that it should be the policy of the Institute to continue such operations.

178. We endorse the decision already taken to discontinue the existing two-year diploma course in Chemical Engineering. The Institute was a pioneer in starting such a course in this country, but several other institutions have since organised instruction of this type. We think it unnecessary for the department now to devote its resources in men and material to undergraduate education, when satisfactory courses are available elsewhere.

179. No additional building is necessary for the department at present. We recommend an amount of Rs. 50,000 for additional equipment during the next five years.

The Department requested a grant for pilot-plant construction; in view, the construction of a pilot plant should be supported by the organisation for which the department made the investigations which now appear to show promise. In special cases, however, support may be received from the discretionary grant in the hands of the Director; see (§64).

Budgetary provision for the annual working expenses of the department should be increased to Rs. 30,000. The Department should accommodate 20 research students, 15 of whom should be given scholarships.

#### *Department of Metallurgy*

180. Dr. Adcock was in charge of the Department until August 1949; he was followed, during the period from August 1949 to December 1950, by Dr. E. G. Ramachandran, an Assistant Professor. Dr. Brahmprakash was appointed Professor in January 1951. The staff consists of a Professor, an Assistant Professor, four lecturers and other junior staff.

181. The Department offers a Diploma Course in Metallurgy, of two years duration, to which graduates in science are admitted. Until 1952, the Diploma Course was of three years duration, the final year being devoted to research, but after 1952, the period was reduced to two years. In all, 58 students have been trained in courses of both types.

182. We recommend the retention of the diploma course. The expansion of the Metallurgical Industry in India will require a large number of metallurgists, and there is no other institution in the Southern Region which provides a course at the first degree level in Metallurgy.

We are of the opinion, however, that the duration of the course should be 3 years. A comprehensive 3-year curriculum, open only to graduates in Science, and having a greater content of engineering studies, would, in our view, best serve the growing industry. We also recommend that the number of students admitted annually to this course should be increased to 30.

183. The Department has been engaged in many useful fields of research, such as mineral dressing, extraction and electro-metallurgy, and physical and mechanical metallurgy. Researches on floatation mechanisms and the upgrading of Indian ores are being pursued. The Department has also undertaken several investigations sponsored by the Atomic Energy Commission, and the Council of Scientific and Industrial Research. 27 papers have been published during the period under review.

184. The proposals submitted by the Department for the future activities relate to fundamental and applied research on mineral dressing, chemical metallurgy and physical and mechanical metallurgy.

185. As extensive work on ferrous metallurgy will be carried out in research laboratories attached to the existing and projected steel plants, well as in the National Metallurgical Laboratory, we recommend that the Department should devote itself to researches in non-ferrous metallurgy, particularly in the field of light alloys.

200. The fundamental research work carried out during the period under review is concerned mainly with the question of heat transfer. The development work undertaken by the Department was mainly concerned with the utilization of indigenous fuels, and has led to several new engine conceptions, such as the U-type two-stroke Diesel engine, the aero-otto engine, and the hot-ir engine.

An interesting problem undertaken is the complete gasification of low grade coal using a cyclone chamber developed and built in the department. Studies in the suitability of power alcohol as an additional fuel for diesel engines are being made. Solution to the problem of spray characteristics, to avoid the costly injection pump, is also being studied. 32 papers have been published. A number of patents have been secured in India and foreign countries.

The department has also assisted a number of industries and government organisations by conducting routine tests of engines and of components. Initial work has been done in the department, and installation completed, for testing compressors and turbines for the development of the gas turbine. Work in heat transfer materials, and mechanical phenomena connected with atomic-energy power production, is being carried out under a project sponsored by the Department of Atomic Energy

201. The sanctioned staff consists of one professor, one assistant professor, three lecturers and other junior staff. In addition, for the Automobile Engineering Course, which the Department has been asked by the Government of India, to conduct the following additional staff has been sanctioned.

One assistant professor, and one lecturer in group I, and 6 members under Group II.

202. The department has at present total accommodation of 25,680 sq. ft. comprising of 18,400 sq. ft. for laboratory, 2,640 sq. ft. for class rooms, 2,230 sq. ft. for office accommodation and staff rooms, 1,220 sq. ft. for workshop, and 1,090 sq. ft. for stores.

During the period under review the following non-recurring expenditure was made under various headings.

1	Sanctioned grant	Expenditure on		Total
		Buildings	Equipment	
2	3	4	5	
<b>Internal Combustion Engg.</b>				
Deptt.				
(a) Grant from Government				
of India .. .. .	4,40,000	3,12,900	1,35,340	4,48,260
(b) Grants by the Tata Trust				
	1,15,000	..	64,870	64,870
<b>Gas Turbine Scheme</b> .. .. .	<b>2,00,000</b>	..	<b>2,04,290</b>	<b>2,04,290</b>
<b>Automobile Engineering</b> .. .. .	<b>75,000</b>	..	<b>1,900</b>	<b>1,000</b>
<b>Fuels &amp; Lubricants Laboratory</b> .. .. .	<b>1,13,250</b>	..	<b>11,130</b>	<b>11,130</b>

The budgetted working expenses for the year 1955-56 is Rs. 44,900, and the department offers three studentships of an annual value of Rs. 4,500.

203. The future activities proposed by the Department are sub-divided into the following groups—

- (i) Administration.
- (ii) Standards and patents.
- (iii) Educational activities.
- (iv) Fundamental & research work in ultimately two sections.
- (v) Development work and experimental investigation in three sections.
- (vi) Automobile Engineering—Automotive Power Plants.
- (vii) Gas Turbine and Power Production.
- (viii) Atomic Energy Power Production.
- (ix) Automobile Engineering in all aspects.
- (x) Propulsive devices.

204. The production of I.C. Engines in India, is at present, on a small scale only, but the potential demand for such engines, for pumping and for agricultural use generally, as well as for road vehicles, is very large; their manufacture is likely to become a major industry in the foreseeable future.

We have, therefore, considered the work of the department in the light of the contribution it can make to a young but rapidly growing industry.

205. We believe that it can serve the country best by (1) training young mechanical engineers well versed in the principles, construction, and handling of I.C. engines; concentrating more particularly, at present, on the mechanical and practical problems which are the more urgent and insistent; (2) carrying out very thorough analytical tests on the various types of engines now being produced in India, and advising on how they can be improved; (3) carrying out researches into those problems which such tests may bring to light; (4) carrying out a certain amount of fundamental research into such general problems as heat transfer, dust removal etc., which are common to all forms of I.C. engines, and to many other applications as well.

206. We do not, at this stage, recommend the dispersion of the energies and resources of the Department on the development of unconventional types of engines. This we suggest might come later, after the more immediate problems relating to conventional engines made in India have been solved, and after a much closer liaison with industry has been established.

We consider that, at a somewhat later stage, if necessary, the Department should be in a position to issue certificates to engine manufacturers certifying that their productions are capable of giving a certain performance and may safely be rated at a certain specified power output, for intermittent or continuous running, and so on.

207. With regard to (1), from general observations, and from discussions with industrialists in India, it would seem that the urgent need at the present time is for what may be termed the practical engineer, rather than the theoretical; that is to say, for the man who understands thoroughly the capacity and the limitations of the ironmongery at his disposal. This is a matter of experience, and such experience can best be attained, at first hand, by testing engines to the limits of their capacity. To this end, we would recommend the purchase and testing of a few of the best examples of European and American engines. Not only should this prove of great educational value to the students, but intelligent analysis of the results obtained will provide the data from which, ultimately, a highly efficient all-Indian design can be evolved.

208. With regard to (2) and (3), for these to be effective, it is quite essential to gain the confidence and co-operation of industry.

Industry, in general, is apt to be suspicious of research establishments of this nature on several grounds—

- (a) It suspects, and often with justice, that the research worker is not fully aware of the practical problems that the industrialist has to face, that he is both too "high-power", and too inexperienced. It is essential, therefore, that the staff of the Department should have actual first hand experience of the testing, handling and behaviour of conventional I.C. engines of the widest possible range of types.
- (b) It suspects that such establishments do not appreciate the vital importance of time, which to industry is usually the most important factor of all. It is essential, we consider, that the organisation of the department be such as to enable it to take prompt action to meet the requests of industry.
- (c) The technical members of the staff of any industrial firm are liable to fear that their functions may be usurped by the intrusion of outsiders into their domain. In order to allay any such fears, it is most important to secure their confidence and goodwill, preferably by informal social contacts. Without the co-operation and the goodwill of a firm's technical staff, little or nothing can be achieved.

209. The essential factors in establishing good relations with, and gaining the confidence of, industry are (1) to be able to demonstrate that the Institution really has something worth while to offer in the way of first hand knowledge and experience of their problems; (2) that their troubles (which probably have already become acute before they have appealed to the Institute) will be dealt with promptly; and (3) that an approximate answer arrived at quickly is usually of much more value to industry than a more precise one reached at the cost of delay and expense.

210. If it be accepted, and we believe it to be essential, that the function of the I.C. Engineering Department is to co-operate with, and assist, industry, then we consider that the first essential is that it shall make itself thoroughly conversant with industry's products and problems by carrying out very thorough analytical tests, not only on engines produced in India, but also on the latest and best examples of European or American practice,



211. It would seem that, for some years to come, the major demand in India will be for small industrial engines of the order of 3 to 10 H.P. per cylinder, either single or twin-cylinder. Later will come, no doubt, a demand for multi-cylinder vehicle engines, but probably of much the same individual cylinder size.

212. For the testing of such engines, it would seem that the Department has already very nearly all the test equipment it requires, and that such of the additional equipment as may be needed later had better be designed and made by the Department itself to suit its particular needs. Not only is home-made equipment less expensive but, for more important, its capacity, its limitations, and its idiosyncrasies are well understood. To this end, we feel that the Department itself should have a rather better equipped machine shop, and a small store of material of its own, sufficient to enable minor modifications to engines or test-equipment to be carried out without delay.

#### *Student-Training*

213. The primary function of the department, is, we believe, the training of practical engineers who later will play an important role in the design, development, and production of I.C. engines, in India. To this end, we consider that emphasis should be placed on the practical rather than on the theoretical aspects of the problem, in so far as this can be reconciled with the diploma or other courses.

214. The existing conditions at the Institute are not very favourable to long-range development projects by this department because—

- (1) All such projects take many years to carry through to a successful conclusion, with a transient population of students, no one student can be fully conversant with the project, nor enjoy the satisfaction of seeing it through all its stages.
- (2) All such projects call for frequent redesign and reconstruction which, under present conditions, entail very long delays, and so cause frustration and discouragement.
- (3) Without the active support and encouragement of one or more industrial firms, there is very little chance of the project becoming a commercial success.

215. At the present moment, however, a large number of long-range development projects relating to unconventional types of engine are in hand. In most cases, these projects have long since been examined, tried out and abandoned; e.g. the U-type two-cycle engine, the open cycle hot air engine, etc. There would seem to be no valid reason why failures in Europe should become successes in India, and projects fore-doomed to failure or abandonment must lead to discouragement. In any event, the projected number and diversity of long range developments is far too great to permit adequate concentration on any one of them. If such projects are to be continued, we would recommend that the number be reduced to one, or at the very most two.

216. The above remarks do not apply to what may be described as fundamental research, as opposed to development, such as research into the problems of heat transfer, dust removal, etc., problems which are common to all types of I. C. engines, and to many other applications as well. We recommend that such work should be continued.

217. We are not in favour of the department undertaking post-graduate courses in Automobile Engineering. We do not, however, have any objection to the Department providing advanced training in Automobile Engines to a section of the students attached to the post-graduate course in I. C. Engine; and we feel that the department should be allowed to have the additional staff recently sanctioned.

218. We would, however, like to see a concentration of efforts and recourses, (a) to train such engineers as would be immediately useful to the developing I. C. Engines industry; and (b) to carry out fundamental researches, and limited development work, on more or less conventional types of engines. We also suggest that in the post-graduate course in I.C. engines, more emphasis may be laid to training in design and drawing, on analytical testing, and on production possibilities.

219. We recommend that 12 students be admitted to the post-graduate course each year, and that they be paid scholarships of the value of Rs. 200 p.m. The department should be able to take care of 8 research students, and we recommend the establishment of 6 research scholarships, each of the value of Rs. 200 p.m.

220. It will then be necessary to provide some additional working space of say, 5,000 sq. ft. A sum of Rs. 1 lac may be sufficient for this purpose. We also recommend a capital grant of Rs. 1.5 lacs for necessary instrumentation and for the purchase of a few modern British and American engines; and a small gas turbine for training purposes. (A special note on Industrial Gas Turbine from Sir Harry Richardo is given in Appendix III).

The working expenses of the department may be increased to Rs. 50,000 per annum.

#### *Department of Power Engineering*

221. The plan to establish a Power Engineering Department was formulated by a Committee of experts under the Chairmanship of the late Prof. M. N. Saha, F. R. S., in 1947, and it was implemented mainly during the period under review. The department was formed by merging the Heavy Engineering Section of the old Electrical Technology Department, which had functioned since 1911, with the High Voltage Engineering Section started in 1946.

222. The objective in establishing the department were set out by the Expert Committee in the following terms—

“The object of the course is to provide instruction for Engineering graduates from Indian Universities in Power Engineering (Hydro, Thermal and Electrical) for a period of two years, so that the products of the course may be able, after this training, to take up immediately, and discharge with confidence, superior responsibilities.”

“There is at present a dearth of power technologists in this country and in view of the post-war power development schemes, of very great magnitude, India will require the services of a large number of power engineers. It is considered that 60 to 100 qualified engineers are likely to be demanded, and absorbed by this Industry, every year during the next ten years.”

“The graduates in engineering in India, when they emerge from their college courses, do not possess sufficient practical knowledge and experience of power engineering for any responsibility being immediately entrusted to them. It is common knowledge that adequate facilities do not exist in this country. Proposals therefore, have emanated for the establishment of a post-graduate power engineering department, for imparting specialised training in Power Engineering to selected civil, electrical, and mechanical engineering graduates, for producing adequately qualified engineers for power development and operation, mainly for the electric supply industry, and also for large industrial undertakings having their own generating plants”.

“It is proposed to admit 60 students every year, as indicated below to this course, which will extend over a period of two years:

- (1) 15 civil engineers, specialising in civil works hydro-electric installations.
- (2) 15 Mechanical or thermal engineers, specialising in thermal power and hydro-electric installations.
- (3) 30 Electrical engineers, specialising in electric power generation, transmission and utilisation.”

“The course is divided into three sections, Civil Electrical and Mechanical.”

“Admittedly, students will be given theoretical training, but this will be of an advanced nature, and so arranged as not to overlap, or be of the same standard, as the theoretical training which they have had in their Engineering Colleges”.

223. We are of the opinion that these objectives should still provide the guiding principles in considering work and development of the department.

224. The department was started with Prof. M. S. Thacker as its Head, and he continued in this position, after his appointment as the Director, until he left the Institute in 1955. Since then, the post of the Head of the Department has remained vacant.

225. The department now consists of four sections, each under the charge of a Professor as shown below—

- (a) Electrical Engineering Section—Prof. C. S. Ghosh, now on deputation. Acting Professor Mr. H. N. Ramachandra Rao.
- (b) High Voltage Engineering Section—Prof. D. J. Badkas.

(c) Mechanical Engineering Section—Post of Professor—Vacant. Visiting Professor, Mr. G. H. Kent in Charge of Section.

(d) Civil and Hydraulic Engineering Section, Prof. N. S. Govinda Rao.

226. The department provides a post-graduate course in power engineering, and conducts a diploma course in electrical technology at the first degree level. The number of students, trained during the period under review, is given below—

Electrical Technology Diploma courses	..	123
Power Engineering (Electrical)	..	15
Power Engineering (Mechanical)	..	7
Power Engineering (Civil & Hydraulic)	..	8

227. On the recommendation of the All India Council for Technical Education, the Government of India has sanctioned funds for the institution of post-graduate courses in High Voltage Engineering, Industrial Engineering (part-time), and foundry engineering, at the Institute. The Institute has also been selected by the Government of India as a research training centre in electrical measurements and measuring instruments; and in transmission, distribution and net work practice. We understand that the institution of a few other post graduates courses is under consideration by the All India Council for Technical Education.

228. In addition to these activities, the various sections have engaged in research and routine testing for industry. 125 papers have been published.

229. The staff of the department consists of a Head of the Department (vacant), 4 Professors, 7 Assistant Professors, 11 Lecturers, and members of the Junior Staff.

230. According to a recent assessment by an expert committee of the Planning Commission, a large number of Electrical Engineers of the degree level, are urgently required. Further, the Institute has already established a reputation in the field, and now has excellent laboratory and teaching facilities. In view of these facts, and although the Egerton Committee was not in favour of continuing courses at the first degree level, we are of the opinion that the Institute should continue to offer the present diploma course in Electrical Technology.

We also recommend that the annual admission to this course should be increased from 25 to 30.

231. Since the course is of only 3 years duration, we suggest that the total working hours should be increased so that time may be found to impart adequate instruction in such practical subjects as shop-practice, drawing and design

232. Hitherto, only a few students have been trained in Power Engineering. It is true that, for much of the time during the period under review, all the sections have been occupied in securing, installing and commissioning equipment; the High Voltage Laboratory, and the Electrical Machine Laboratory were completed in 1950-51, and the Hydraulics Laboratory only recently; but since great financial expenditure has been made on this department with a specific

objective, and since the output of students has been relatively small, we have thought it necessary carefully to examine the various other causes, which may have contributed to the present stage of affairs. This is particularly important since the activity in the electric supply industry in the country is increasing rapidly.

233. The installed capacity, at the beginning of the first Five-Year Plan (1951), was 2·3 million kw. At the end of the First Five-Year Plan, the installed capacity is expected to be 3·41 million kw. With the greater emphasis that is being laid on the industrial development of the country, the programme of power development for the second Five-Year Plan contemplates a doubling of the generating capacity in the country; it is estimated that the total installed capacity at the end of the second Five-Year Plan period will be about 6·8 million kw.

234. The available evidence suggests that there will be great activity also in the field of electricity supply industry, during the periods of the third and later Plans. Concurrently with the installation of additional generating capacity, a large integrated network of transmission lines will have to be constructed to make the generated power available throughout the country. This involves great expenditure for establishing large-sized generating stations, regional high tension grids, and large-scale distribution systems. This programme will require large numbers of Power Engineers of all types, for the provision of which the department has an important responsibility.

235. In the situation outlined above, we found with regret that graduates in engineering have been rather hesitant to join the course. They tend to believe that, after two years of specialised training, they will be unlikely to secure places of correspondingly higher status and emoluments. Further, the employment position for engineering graduates has been very good during the last few years, and after an expensive education at a College, lasting four years, they tend to dislike remaining dependent upon their parents for another two years.

236. It is not uncommon that when new courses are started their full value is not immediately recognised; employers commonly have little regard for any advantages which the students may have gained, and make no financial recognition of an increased period of training. Since the number of students who have completed their training in Power Engineering is still very small, representatives of industry have had little experience of their quality. It is, however, satisfactory to record that the few graduates who have taken this course have been found useful and reliable men. We hope that as numbers increase, the value of the training in the Power Engineering Department will become duly recognised, and that the employers—who in future will, for the most part, be the State Governments—will offer its graduates terms of employment which take account of the extra years they have spent in training, and the increased command of their subject which this should bring. In formulating these remarks, we have had the benefit of the views of Sri N. N. Iengar of the Tata Power Ltd.

237. It is our opinion that it is in the national interest that steps should be taken to attract young graduates to the courses in Power Engineering. To solve the problem of the proper employment of those trained in the different branches of Power Engineering, we suggest that the Ministry of Irrigation and Power in the Government of India, which co-ordinates the activities of the Power Supply Industry in the Country, should be requested to take active steps to ensure that the specially trained graduates are given employment at appropriate levels in the various Power Supply Systems.

238. We also suggest that the number of students admitted annually to these courses should be 60 (30 Electrical, 15 Civil and Hydraulic, and 15 Mechanical), as originally planned. To ensure that the facilities of the Institute are fully utilised, admissions should be regulated as follows—

- (a) There should be an equitable distribution of places to the four regions demarcated by the All-India Council for Technical Education.
- (b) The Institute, in consultation with the All-India Council for Technical Education and the Ministry of Irrigation and Power, should prepare a list of Engineering Colleges of appropriate standard in each region, and allocate a number of places to each.
- (c) Each college shall furnish a panel of names of candidates corresponding to twice the number of places allocated to it. The Senate of the Institute shall make the final choice of candidates from those whose names appear on the panels.
- (d) All the students admitted to the courses shall be given scholarships of the value of Rs. 200 p.m.

239. We noted with regret a tendency for the professors in charge of sections to work independently of one another. This tendency towards isolation was reflected in the fact that it was suggested that the present Power Engineering Department should be dissolved, and replaced by three departments of Electrical, Civil and Mechanical Engineering separate one from another.

240. We are convinced, however that the original structure of the organisation of the Power Engineering Department must be retained, if the original objectives are to be fulfilled. We strongly recommend that the post of the Head of the Department should be filled as soon as possible.

241. In order to bring the benefit of practical experience into the teaching of Power Engineering, we recommend that expert power engineers in the different fields be invited to give lectures on their subjects of special competence. Necessary budgetary provision should be made to meet the expenses involved.

242. Attempts should be made by the Institute to attract men in the profession for short refresher courses. The facilities available in the Institute are sufficiently attractive to ensure a good response, if such courses are properly advertised.

243. In our opinion, the first responsibility of the department is to train Power Engineers in the three branches of the subject, and to conduct the course in Electrical Technology; this alone will involve an increased effort. During the next few years, we believe the department should consolidate the work in these fields, and should conduct the post-graduate courses and training in research in the Electrical Engineering subjects already sanctioned.

244. The Central Workshop, and the post-graduate courses in foundry engineering and industrial engineering, now under the direction of the Mechanical Engineering Section, should be transferred to a new Department of Industrial and Production Engineering, the creation of which we recommend; see (§105).

245. The Institute has been established as a centre of post-graduate instruction and training in research. The proposals for future activities submitted by the various sections include the routine testing and certifying of electrical equipment, as well as solution of day-to-day problems arising in Industry. The Institute in the past rendered this service in a small way.

246. The need for this type of service has recently increased considerably and is likely to assume still greater proportions; but the Institute can hardly be expected to render a much greater service without detriment to its normal activities. It is our view that, as a general principle the Institute should not make routine tests for Industry.

We understand, however, that the Ministry of Irrigation and Power are contemplating the establishment of a separate organisation for meeting the requirements of Industry such as those involved in routine testing. Until that organisation has been established, the Institute should continue to assist in such work, but it should not expand its scope. There would be some advantages in locating the proposed new organisation so as to allow close co-ordination between it and the Institute.

247. Useful work has been done with the network analyser installed in the Electrical Engineering, Section, especially after the ability of the staff to make satisfactory applications of the equipment to the solution of power system problems came to be widely known. As a large network of integrated transmission systems are established in the country, the Institute will no doubt be asked to render further help and assistance to the industry with the network analyser. We are of the view that this should be done since no similar equipment is available in the country.

248. Very large sums of money have been spent in the establishment of the High Voltage Laboratory. We understand that the Government of Mysore originally promised a recurring grant of Rs. 24,000 for this laboratory in return for the testing of H. V. insulators to be made in the Government Porcelain Factory, Mysore. It may be seen from the budget that the grant has not been made. The authorities of the Institute should pursue this matter with the Government of Mysore.

249. The High Voltage Laboratory and the network analyser are being sparingly used; since no other institution has similar equipment, it is desirable that the Institute should provide facilities for staff and students of other institutions to become familiar with it. This could be done by fortnightly courses of study in Bangalore under the guidance of their own Professors, and assisted by the Professors of the Institute.

250. We have examined the proposals for development put forward by the various sections, and their financial implications. We have already stated our view that the future policy of the department should be the fulfilment of the objectives laid down in the Saha Committee Report. Our recommendations for additional equipment are therefore designed only to fill gaps in their existing facilities. There is no justification for additional buildings, except for an extension in the high voltage section.

251. We recommend that the Group I teaching staff of the Electrical Engineering Section, and of the High Voltage Section, should be treated as a single unit for teaching subjects in Electrical Engineering. We have examined the teaching load on the staff, and are satisfied that it should be able to deal with the work without hardship.

252. We recommend the following financial provision for the needs of the different sections—

<i>Non-Recurring—</i>	Rs.
Building (for H.V. Lab. extension) .. .. .	45,000
<i>Equipment—</i>	
H. V. Laboratory .. .. .	4,00,000
Power Engineering (Electrical) .. .. .	50,000
Electrical Workshop .. .. .	12,000
Mechanical Engineering Section .. .. .	50,000
Civil & Hydraulic Engg. Section .. .. .	50,000
<b>TOTAL</b> .. .. .	<b>6,07,000</b>

*Recurring—*

<i>Additional working expenses—</i>	
Electrical Engineering Section .. .. .	10,000
Mechanical Do. .. .. .	10,000
Civil & Hydraulic Do. .. .. .	5,000
<b>TOTAL</b> .. .. .	<b>25,000</b>

*Additional staff for H.V. Section—*

1 Mechanic, 4 Assistant Mechanics, 2 Helpers for the care of H.T. Sub-station and transmission line—Temporary labour for shifting conductors of transmission line .. .. .	8,000
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*Department of Aeronautical Engineering*

253. During most of the period under review, until February 1955, Prof. O. G. Tietjens was the Head of the Department. He was succeeded by Dr. S. Dhawan, who was appointed Professor in May 1955.



254. The Institute is the only place in India where facilities exist for training and research in Aeronautical Engineering. The staff of the department consists of a Professor, two Assistant Professors, eight Lecturers and other Junior staff.

255. The department offers a post-graduate diploma course in Aeronautical Engineering, of two years duration, open to graduates in mechanical engineering. During the period under review, 82 graduates were awarded the Diploma. Owing to the unsatisfactory prospects of employment, the number of students applying for admission to the course has fallen rapidly. We suggest that, in consultation with the Hindustan Aircraft Ltd., and the Director General of Civil Aviation and the Defence Science Organisation, steps be taken to utilise fully the existing training facilities. The Department can easily accept an annual admission of 20 students.

256. During the period under review, the teaching and research facilities of the department have been extended at a cost of Rs. 11.4 lacs by installing, mainly from the designs prepared by the staff of the Department, sub-sonic and supersonic wind-tunnels, a spinning tunnel with a diameter of 15 ft. for a maximum speed of 60 m.p.h., and an open-circuit wind-tunnel, 9 ft. by 14 ft. for a maximum speed of 250 miles an hour. The work on the last two tunnels is far advanced, and it is anticipated that they will be completed within 6 months. Some additional funds are necessary to provide the tunnels with instruments and measuring devices, at a cost of about Rs. 1 lac. We recommend that this amount should be provided.

257. The staff of the department have been engaged in theoretical and experimental research, and 27 papers have been published. In addition, the department has rendered assistance to the Hindustan Aircraft Ltd., the Indian Air Force, and the Indian Ordnance Factories. The department has been receiving technical help from Hindustan Aircraft Ltd., and there is a cordial relation between the technical staffs. We suggest that part-time services of the technical staff of the Design and Production Divisions of Hindustan Aircraft Ltd., be secured to assist in teaching these subjects. Financial provision for such lectures should be included in the working costs of the department.

258. The Professor is of the opinion that important original contributions can best be made by concentrating on one or two selected subjects of research, rather than by spreading the effort over a wide field, and he has planned his work accordingly. We commend his approach. In our view, the department should not be called upon to undertake scientific work beyond its capacity. If the Government of India desires to set up an aeronautical research laboratory, we believe it should establish an entirely separate organisation, located near the Institute or the Aircraft Factory. There should be very close co-operation between such an organisation and the department, but the latter should concern itself with long-term fundamental problems only.

259. We believe it is necessary to strengthen the airframe and structures section of the department, and we recommend the appointment of a Professor of Aircraft Design. This new post should be filled by a person having extensive experience in design. An additional post of an Assistant Professor in aero and

hydro-dynamics should also be established. We recommend that it should be filled by a person skilled in mathematics, and with laboratory experience. As the two large wind-tunnels come into operation, the following additional personnel will also be needed—4 Technical Assistants, 1 Mechanic and 2 cleaners.

260. We suggest that serious consideration should be given to changes in the curriculum of the existing two-year diploma course, in order to produce specialists in aerodynamics and in aeroplane structures. For the latter, we suggest that the admission of suitable graduates in Civil Engineering should be considered.

261. If all the facilities recommended above are provided, the department should be able to accept 12 research students, all of whom should be given scholarships of Rs. 200 p.m. All students admitted to the post-graduate course should also receive scholarships of this value. The annual grant for working expenses of the department should be increased to Rs. 50,000.

#### *Section of Economics and Social Sciences*

262. This section was established by a Council Resolution in 1947, and was placed under the Director. Until 1949, its activities were confined to giving students a background of economics and industrial psychology. In that year, the Senate approved the proposal that the section should also engage in research, and this decision was later confirmed by the Council. The section is now under the charge of Dr. Munshi, Assistant Professor of Industrial Economics. The section has been publishing a monthly economic bulletin since January 1950, and has made researches in the fields of Industrial Economics and Physiology.

263. The section has put forward plans for expanding its activities, and for its establishment as a Department of Scientific Instruction and Research. It was also suggested that the section should organise a post-graduate course in industrial engineering and administration.

264. Elsewhere in the report we have recommended that a new Department of Production and Industrial Engineering should be established; this in our view will make it unnecessary for the section to expand its activities and be established as a full department. We recommend, however that two research scholarships of Rs. 150 p.m. should be established in this section. We also recommend that when the Department of Production and Industrial Engineering begins its work, this section should teach economics and social science to students taking post-graduate courses in the Department.

#### *Department of Applied Mathematics*

265. On the recommendation of the previous Reviewing Committee, the Department of Applied Mathematics was instituted with provision for one professor and one lecturer. These two posts are vacant but we understand that the Professor was recently appointed and that he should be soon joining the Institute,

266. We endorse the views of the Egerton Committee that this department should give service to the other departments both by teaching their students and by giving them assistance in their researches. In their memorandum to us the Senate stated that more staff should be given for this department. We feel that there is no case for any more staff at present, since the department has not even started functioning. The progress of the department, and the actual amount of contribution it can make, to the work of the Institute should be watched, for any concrete recommendation, for its expansion.

### *Library*

267. During the period under review, the Library was under the direction of Dr. V. T. Kale, until Dr. Raghavendra Rao, the present Librarian, took charge in April 1951.

268. In addition to the Central Library, Departmental Libraries have recently been established, some of which contain a considerable number of books. Thus, the total number of books in the library is at present approximately 20,000. During the period under review, about 11,700 books have been acquired by the Institute, of which 3,600 have been added to the main library, the others being held in the various departments. The library also holds about 35,500 bound volumes of periodicals, and about 1,300 sets of periodicals. During the period under review, 310 new periodicals have been added, and 32 discontinued.

269. The library is at the service of 373 students, 133 members of the teaching staff, and 38 members of the technical staff. On an average, about 100 people use the library every day between 8 a.m. to 10 p.m., except on Sundays, when the library is open between 8 a.m. to 5 p.m.

It was suggested to us that the library should be re-housed in a new functional building, and that it should be given the full status of a department. In our view, the existing accommodation for the library is quite adequate, and there is no present need for the construction of a new building. The present arrangement for the management of the library as a section under the Director, with the librarian a member of the Senate is quite satisfactory.

270. The budget grant for the purchase of periodicals is Rs. 23,500 per year, and this sum was stated to be quite inadequate. We recommend that the grant should be increased to Rs. 25,000. We suggest that a number of periodicals, which are very rarely consulted, may after consultation with the departments be discontinued and more important journals purchased. The present annual allocation for books is only Rs. 12,500. This appears to us to be very inadequate, in view of the number of departments and we suggest that it should be increased to at least Rs. 25,000. We believe that the present tendency for departmental libraries to become established at the expense of the main library should be checked. The two main objections are that the books held by departments are not easily accessible to students outside the ordinary working hours, whereas the main library is normally open from 8 a.m. to 10 p.m. Further, the growth of departmental libraries is likely to result in an unnecessary duplication of books, and to an increase in library staff.

271. We, therefore, suggest that books should normally be held in the Central Library. Each department should, however, be allowed to borrow, say, 600 reference books and bound periodicals to form a sub-library, the contents of which should be reviewed annually. We also suggest that copies of specialised periodicals, in which only one department may be interested, should on receipt be passed to the department concerned for retention until the arrival of the next issue; the previous issue should then be returned to the library.

272. A number of valuable pamphlets, bulletins, reprints and reports are being received, most of them free of cost. The work of classifying them is complicated, as they are irregular publications, and little attention has been given to it hitherto. We suggest that this work should be brought up to date. Since 1947, this library has assisted many institutions by producing photostat copies of extracts from journals, the work being done by a private photographer on piece-rate. Since the establishment of the INSD OC in 1951, the volume of this work has diminished; but since the Institute has one of the best collections of periodicals in the country, we favour the continuation of this service, and we suggest that it should be supported by the addition of a Micro-film unit to the library. For this purpose, we recommend a non-recurring grant of Rs. 4,000 and the sanction of the post of a Technical Assistant.

273. We feel that the salary scale Rs. 400—600 p.m. attached to the post of a Librarian is rather low, and recommend that it should be increased to that of a Lecturer, namely Rs. 350—850 p.m. Further, if the Central Library is to take over the care of most of the books of the Institute, as we recommend, an additional post of Assistant Librarian should be sanctioned. We do not recommend any further increase in staff since we understand there has been no call to render technical service, such as abstracting documentation, etc.

274. Since 1951, the library has been made responsible for the publication of the Institute Journal. This seems to us appropriate, since the present librarian is a Doctor of Science and has only to supervise the work of the library. It should be possible for him to discharge this additional responsibility with the small increase in staff which we have recommended. We see no reason for the revival of the Bureau of Industrial and Statistical Information, for the service it gave is now adequately rendered by the organisation in Delhi, and duplication is unnecessary.

### *The Journal of the Institute*

275. We generally agree with the views expressed by the Egerton Committee regarding publications from the Institute; namely—

“279. It has become widely recognised that the amount of scientific literature at present published is inordinately large, and we hesitate to make any recommendations which would increase the volume. In any case, we would strongly deprecate any publication of original work unless it is made on a high scientific level; and we consider that such publication is properly the function of scientific societies rather than of bodies like the Institute.

280. On the other hand, there is a great need to make the work of the Institute known to industrialists and to general scientific readers in India. Further, it has been suggested to us, and we agree, that more publicity should be given to the work of the Institute. We recommend, therefore, that it should form part of the function of the Information Bureau to publish a regular, simply written, and readable bulletin, reviewing recent advances in science which are of particular interest to science and industry in India, and giving information on the work progressing at the Institute. Such a publication would, we believe, be a benefit both to industry and to the Institute....”

276. We understand that one of the advantages derived from the publication of the journal is that the library is able to obtain copies of other journals in exchange and free of cost. We suggest that the journal of the Institute should be continued but should confine itself to publishing short reports on the progress of investigations, together with reviews, with adequate bibliographies, of the results of researches carried out over a number of years in important fields of investigation. Accounts of new contributions to knowledge should be published in the journal of Scientific Societies

SECTION IV  
*Financial Position*

The financial position of the Institute during the period under review and the financial implications of our recommendations are given in the following statements. All figures are rounded to the nearest hundred.

*Statement I* shows the year-wise recurring receipts and expenditure for the years 1948-49 to 1954-55 and also includes the revised budget figures for 1955-56. It will be seen from these figures that the financial position for these years has been quite satisfactory and that the annual block grant from the Government proved to be adequate.

*Statement II* gives the normal annual receipts and payments based on the average figures for the last three years ending March 1955.

*Statement III* gives Non-Recurring expenditure incurred during the period under review (1947-48 to the end of December 1955) and contains:

- (a) Expenditure on Government of India Non-Recurring development schemes,
- (b) Non-Recurring expenditure from Institute funds, and
- (c) Non-Recurring expenditure from Sir Dorabji Tata Trust and Sir Ratan Tata charities grants.

*Statement IV* gives the recommendations affecting the recurring expenditure of the Institute. It contains additional staff recommended and the cost thereof including the revision of salary scales suggested in specific cases; increase in working expenses recommended and the cost of additional scholarships.

*Statement V* gives our recommendations for Non-Recurring expenditure for each department during the next five year period.

We recommended that the additional recurring expenditure should be so phased that the maximum amount of about Rs. 12 lacs is reached in the year 1960-61 and that the total additional recurring expenditure till the end of 1960-61, works out to Rs. 30 lacs.

*Statement VI* shows the budget estimates for the year 1955-56.

STATEMENT I  
*Recurring Receipts and Expenditure from 1948-49 to 1954-55*

Year	Receipts	Expenditure	Excess of Receipts over payments	Closing Balance	Cost of vacant posts
1948-49	14,55,600	14,32,000	+23,600		1,85,700
1949-50	14,87,600	17,13,700	-2,26,100		1,92,800
1950-51	17,11,200	15,09,200	+2,02,200		1,14,400
1951-52	18,00,600	18,41,300	-40,700		67,900
1952-53	23,26,900	23,28,800	-1,900		1,72,700
1953-54	28,21,500	24,85,400	+3,36,100	74,274	1,15,600
1954-55	28,11,100	25,92,800	+3,18,300	3,39,000	1,38,200
Revised Budget 1955-56	32,07,800	29,50,200	2,57,600	57,600	

(All figures rounded up to the Nearest Hundred)  
Opening balance for 1956-57 .. 2,57,600

## STATEMENT II

*Normal annual Receipts and Payments for last 3 years ending March 1956*

RECEIPTS				Rs.
Income from Bombay Properties	..	..	..	75,500
Interest on Investments	..	..	..	2,10,000
Interest on unapplied income	..	..	..	32,100
Miscellaneous Receipts	..	..	..	2,25,300
Grants—Government of India	..	..	..	19,65,700
Do. Mysore	..	..	..	80,000
Do. Hyderabad	..	..	..	17,000
Do. Madras	..	..	..	6,000
Do. Madhya Pradesh	..	..	..	10,000
Do. Bombay	..	..	..	5,000
Do. Travancore	..	..	..	5,000
Do. Uttar Pradesh	..	..	..	3,300
TOTAL				26,34,900
PAYMENTS				
Administration	..	..	..	8,42,400
<i>Departments/Sections—</i>				
Modern European Languages	..	..	..	7,100
Economics & Social Sciences	..	..	..	34,300
Pharmacology	..	..	..	34,100
Fermentation Technology	..	..	..	21,600
General Chemistry	..	..	..	1,22,500
Organic Chemistry	..	..	..	96,300
Biochemistry	..	..	..	1,28,600
Physics	..	..	..	84,800
Aeronautical Engineering	..	..	..	1,53,200
Internal Combustion Engineering	..	..	..	1,46,100
Metallurgy	..	..	..	1,03,400
Power Engineering	..	..	..	4,95,400
Electrical Communication Engineering	..	..	..	1,00,500
Chemical Tech. & Chemical Engineering	..	..	..	83,000
Applied Mathematics	..	..	..	..
TOTAL				24,53,300
Excess of Receipts on payments	..	..	..	1,81,600

## OTHER RECEIPTS AND EXPENDITURE

	Receipts	Expenditure
E. M. E. (N. C. C.)	21,000	15,600
A. I. C. T. E. Grants Revised Estimates 1955-56	79,800	79,800

## STATEMENT III

*Non-Recurring Expenditure—1947-48 to December 1955*

	Sanctioned Grants	Total Expenditure till Dec. 55
<i>(a) Expenditure on Government of India, Non-recurring Development Schemes—</i>		
1. Economic and Social Sciences Section ..	71,000	71,000
2. General Chemistry Department .. ..	2,35,000	2,37,000
3. Organic Chemistry .. ..	1,33,000	1,31,900
4. Department of Chemical Technology Chemical Engineering .. ..	2,45,000	2,41,900
5. Biochemistry including Fermentation Technology and Pharmacology .. ..	6,15,000	5,12,800
6. Physics .. ..	4,00,000	4,00,000
7. Aeronautical Engineering .. ..	14,40,000	11,74,200
8. Internal Combustion Engineering .. ..	6,40,000	6,52,500
9. Metallurgy Department .. ..	5,30,000	5,29,000
10. Power Engineering Department (Incl. High Voltage Labs.) ..	1,20,29,900	1,17,08,700
11. Electrical Communication Engineering ..	8,00,000	8,23,700
12. (a) Overhauling unserviceable articles ..	1,50,000	1,49,400
(b) Overhead distribution .. ..	3,08,000	3,40,100
(c) Rewiring Chemistry Department ..	92,000	1,03,300
<b>TOTAL ..</b>	<b>1,76,88,800</b>	<b>1,70,76,300</b>
<i>(b) Non-recurring expenditure from Institute Funds—</i>		
Sanctioned Grant .. ..	4,08,600	
Amount spent .. ..	3,70,500	
<i>(c) Non-recurring expenditure from Sir Dorabji Tata trust and Sir Ratan Tata Charities Grants—</i>		
1. Electrical Communication Engineering Department .. ..	1,15,000	95,500
2. Internal Combustion Engineering Department ..	1,15,000	64,900
3. Metallurgy Department .. ..	30,000	30,000
4. Physics Department .. ..	40,000	40,000
<b>TOTAL ..</b>	<b>3,00,000</b>	<b>2,30,000</b>
Closing Balance on 31st March 1956 ..	10,568	



## STATEMENT IV

*Recommendations affecting the Recurring expenditure of the Institute*

## A. Additional Staff

Sl. No.	Department/Section	Designation	No. recommended
1	2	3	4
GROUP I STAFF			
1	Administration (for the Central Instruments and Services Laboratory).	Senior Scientific Officer (Rs. 600-40-1000)	1
		Scientific Officers Rs. 350-850	2
		Technical Assistants	8
2	Physics	Lecturer	1
	Inorganic and Physical Chemistry	Assistant Professor	1
		Senior Research Assistant	1
3	Organic Chemistry	Lecturer	1
4	Fermentation Technology Section.	Senior Research Assistant	1
5	Metallurgy	Assistant Professor	1
		Technical Assistants	2
6	Aeronautical Engineering	Professor	1
		Assistant Professor	1
		Technical Assistants	4
7	Library	Assistant Librarian	1
		Technical Assistant	1
	Annual cost of the above Group I Staff including D. A. and P. F. contribution	.. ..	Rs. 2,04,887
	Cost of Revision of salary scale for the Librarian	..	1,476
TOTAL FOR GROUP I STAFF			2,06,363

1	2	3	4
<b>GROUP II STAFF</b>			
<b>1. Administration:</b>			
(a) Central Store	L. D. Clerk	..	1
	U. D. Clerk	..	1
(b) Central Instruments and Services Laboratory	Principal Glass Blower (Rs. 250—500)		1
	Senior Glass Blower Laboratory Assistant	..	1
(c) Central Workshop	A grade mechanics	..	3
	L. D. Clerk	..	1
2 Organic Chemistry	Laboratory Assistant	..	1
3 Biochemistry/Pharmacology	Animal House Attendants		2
	Laboratory Assistant	..	1
4 Fermentation Technology Section.	Laboratory Assistant	..	1
5 Power Engineering	Mechanic	..	1
	Assistant Mechanics	-	4
	Helpers	..	2
	Temporary Labour Rs. 8,000 per year		
6 Aeronautical Engineering	Mechanic	..	1
	Cleaners	..	2
<b>Annual cost of above Group II Staff including D.A. and P.F. contribution .. .. . Rs. 53,445</b>			
<b>TOTAL COST OF ADDITIONAL STAFF</b>			<b>.. Rs. 2,59,808</b>
Say			.. Rs. 2,59,800
<b>B. Increase in working expenses of the departments and administration.</b>			<b>Rs. 1,41,900</b>
<b>C. Annual contribution to quadrennial repairs to roads and buildings.</b>			<b>Rs. 30,000</b>
<b>D. Discretionary Grant with the Director (average)</b>			<b>.. Rs. 1,50,000</b>
<b>E. Additional cost on scholarships recommended</b>			<b>.. Rs. 6,41,300</b>
<b>TOTAL B, C, D AND E</b>			<b>.. Rs. 9,63,200</b>
<b>ULTIMATE TOTAL ANNUAL RECURRING COST</b>			<b>.. Rs. 12,23,000</b>

## STATEMENT V

*Recommendations for non-recurring expenditure*

	Building	Equipment	Total
	Rs.	Rs.	Rs.
<b>A. Administration and Central Facilities—</b>			
1. Hostel improvement and auditorium .. ..	..	..	80,000
2. Staff Common Room ..	10,000	..	10,000
3. Black topping of main roads and repairing of others ..	..	..	65,000
4. Central Instruments and Services Laboratory ..	1,50,000	2,00,000	3,50,000
5. Central Glass Blowing Shop ..	..	1,40,000	1,40,000
6. Central High Vacuum Service Unit .. ..	..	30,000	30,000
7. Central Workshop ..	..	1,00,000	1,00,000
<b>B. Departments and Sections—</b>			
1. Department of Physics ..	..	3,00,000	3,00,000
2. Department of Inorganic and Physical Chemistry ..	50,000	1,00,000	1,50,000
3. Department of Organic Chemistry .. ..	3,00,000	70,000	3,70,000
4. Department of Bio-Chemistry ..	40,000	40,000	80,000
5. Fermentation Technology Section .. ..	..	20,000	20,000
6. Department of Chemical Engineering .. ..	..	50,000	50,000
7. Department of Internal Combustion Engineering ..	1,00,000	1,50,000	2,50,000
8. Department of Power Engineering .. ..	45,000	5,62,000	6,07,000
9. Department of Electrical Communication Engineering ..	40,000	50,000	90,000
10. Department of Metallurgy ..	1,00,000	2,00,000	3,00,000
11. Department of Aeronautical Engineering .. ..	..	1,00,000	1,00,000
Library .. ..	..	4,000	4,000
			TOTAL .. 30,96,000
			Say .. 31,00,000

## STATEMENT VII

*Summary of Receipts and Payments*

Receipts	Budget Estimate 1955-56	Payments	
Part I Recurring	Rs.	Pat I Recurring	Rs.
1. Endowments .. .. .	2,90,300	1. Direction	
2. Grants from Governments .. ..	22,22,000	A. Council and Establishment .. ..	6,42,810
3. Interest on other investments .. ..	28,800	B. Works and Maintenance .. ..	2,39,370
4. Miscellaneous Receipts .. .. .	2,59,000	C. (i) Hostel .. .. .	55,420
5. E.M.E. Section—National Cadet Corps ..	28,200	(ii) Gymkhana .. .. .	9,420
		(iii) Tata Memorial Sports Club .. ..	2,280
		D. Library .. .. .	86,500
		E. Modern European Languages .. ..	7,850
		F. Economics and Social Sciences Section .. ..	34,570
		G. Pharmacology Laboratory .. .. .	38,600
		H. Fermentation Technology Laboratory .. ..	26,300
		I. Power and Maintenance .. .. .	88,700
		J. Pump House .. .. .	44,860
		K. Gas House .. .. .	20,540
		L. Central Stores .. .. .	17,680
		2. Department of General Chemistry .. ..	1,33,620
		3. Department of Organic Chemistry .. ..	1,05,430
		4. Department of Biochemistry .. .. .	1,33,510
		5. Department of Physics .. .. .	99,760
		6. Department of Aeronautical Engineering .. ..	1,74,400
Total Receipts Part I .. .. .	28,28,300		

## STATEMENT VI—contd.

Receipts	Budget Estimate 1955-56	Payments	Rs.
Opening Balance .. .. .	2,97,604	7. Department of Internal Combustion Engineering	1,46,250
	—————	8. Department of Metallurgy .. .. .	1,17,960
Part I—Receipts plus Opening Balance ..	31,25,904	9. Department of Power Engineering—	
		(a) Head of the Department .. .. .	26,440
		(b) Electrical Engineering Section .. .. .	1,52,360
		(c) Mechanical Engineering Section .. .. .	2,06,230
		(d) Civil and Hydraulic Engineering Section .. .. .	83,600
		(e) High Voltage Engineering Section .. .. .	66,970
		10. Department of Electrical Communication Engineering .. .. .	1,17,040
		11. Department of Chemical Technology and Chemical Engg. .. .. .	1,05,260
		12. Department of Applied Mathematics .. .. .	18,440
		13. Provident Fund Contribution .. .. .	..
		14. Lump sum provision for conversion of Research Assistants from Junior to Senior .. .. .	..
		15. E.M.E. Section—National Cadet Corps .. .. .	28,200
		Total Payments Part I .. .. .	30,30,370
		Institute Capital Expenditure .. .. .	30,30,370
		Closing Balance .. .. .	95,534
		Part I—Payments plus Closing Balance .. .. .	31,25,904

## APPENDIX I

AA. *List of members of the Court and Council whose views were obtained through correspondence—*

Dr. R. A. Kraus  
 Dr. B. N. Ghosh  
 Dr. N. R. Dhar  
 Mr. A. N. Khosla  
 Dr. G. S. Mahajani  
 Dr. H. J. Bhaba

IB. *List of persons other than the members of Court, Council and staff whose views were obtained through correspondence—*

Dr. P. Nilakantan  
 Prof. Srinivasan  
 Dr. N. Anjaneyluw  
 Dr. D. P. Antia  
 Mr. P. Kutar  
 Mr. Kanwar Sain  
 Brig. B. D. Kapur  
 Dr. B. C. Guha  
 Mr. R. Natarayjan  
 Dr. Mata Prasad  
 Mr. Tirumala Iyengar  
 Prof. T. R. Seshadi  
 Dr. H. L. Roy  
 Dr. Daya Swarup  
 Dr. V. Subramanyan  
 Dr. B. Mukerji  
 Mr. Jagedeesh Prasad  
 Mr. P. Mukerji  
 Lt. Col. B. M. Chakravarti  
 Dr. Whittakar  
 Prof. B. Sen Gupta

IC. *List of persons interviewed by the Committee—*

Mr. N. N. Iengar  
 Prof. N. R. Dhar  
 Mr. N. Srinivasan  
 Dr. V. Subramanyan  
 Dr. B. N. Ghosh

## APPENDIX II

*List of schemes sponsored by outside bodies at the Institute B.S. 4*

Serial No.	Title of the scheme	Department/Laboratory
<b>I. Council of Scientific &amp; Industrial Research (C.S.I.R.)—</b>		
1.	Age Determination of Rocks .. .. .	Physics
2.	Analogue Computer of X-Ray, etc. .. .. .	Physics
3.	Cultural Experiments on Patchouli .. .. .	Organic Chemistry
4.	Vitamin 'A' in Fishes .. .. .	Biochemistry
5.	Physico-Chemical Studies in indigenous Proteins. .. .. .	Biochemistry
6.	Biosynthesis of Vitamin B Complex .. .. .	Biochemistry
7.	Electrical Resistance Strain Gauges .. .. .	Metallurgy
8.	Electrical & Mechanical Properties of Aluminium-rich alloys .. .. .	Metallurgy
9.	Studies on the growth of precipitation S. Aluminium, etc. .. .. .	Metallurgy
10.	Hot air engines and their development .. .. .	Internal Combustion Engineering.
11.	Design of transient analogue computer. .. .. .	Power Engineering (Electrical Engineering)
12.	Experiments for design of cavitation tunnels .. .. .	Power Engineering (Civ. & Hyd. Engg.)
13.	Study of the behaviour of soils under heavy machine foundation (New Scheme) .. .. .	Do.
14.	Centrifugal pumps research, etc. (New Scheme) .. .. .	Do.
15.	Study of techniques for wind tunnel tests (New Scheme) .. .. .	Aeronautical Engineering
<b>II. Indian Council of Agricultural Research (I.C.A.R.)—</b>		
1.	Micro-flora of Soils .. .. .	Fermentation Tech.
2.	Sewage Farming .. .. .	Biochemistry.

APPENDIX II—*contd.*

Serial No.	Title of the scheme	Department/Laboratory
III. Indian Council of Medical Research (I.C.M.R.)		
1.	Malaria Scheme	Pharmacology
2.	Intracellular distribution of vitamins	Biochemistry
IV. Department of Atomic Energy (D.A. E.)		
1.	Separation of hafnium from zirconium	Metallurgy
2.	Heat transfer to run gas turbine, etc.	Internal Combustion Engg.
V. Government of Mysore—		
11	Nutrition of silk-worm	Fermentation Tech.
VI. Kirloskar Oil Engines Ltd., Poona—		
11	Kirloskar Oil Engines	Internal Combustion Engineering.
VII. Champion Reef Gold Mines—		
11	Wire-Rope Testing	Civ. & Hyd. Engineering.



## APPENDIX III

*Industrial Gas Turbines*

We understand that very large sums of money have been earmarked for research on industrial as opposed to aircraft gas turbines and that up to date about two lakhs have been spent mostly on equipment to be installed in the Department of I.C. Engineering. We find it difficult to understand—

- (1) What useful purpose the industrial gas turbine is likely to fulfil in India.
- (2) What precisely is the nature of the research contemplated? Is it a research into such vital general problems as heat transfer, heat resisting materials, combustion of indigenous fuels etc? If so this is already in hand and can be resumed at very little extra cost and with the minimum of additional equipment. Or, is it a research into the very complex mechanical problems of turbines and compressors involving constant re-design and re-construction? If so a large amount of very costly equipment will be necessary together with the services of a machine shop with tooling capable of handling the very intractable materials required for high temperature working.

On the mechanical side of the problem a vast amount of research and development work has already been carried out in Europe and America during the last 20 years, the results of which are all available to India through the National Gas Turbine Establishment in England and through many other sources as well.

We understand that the principal demand in India is for small power plants ranging from two to about 30 horse power, for use in villages where electricity is not yet available, by far the main requirement being for engines of less than ten horse-power. On purely theoretical grounds the gas-turbine presents an attractive picture but the mechanical problems involved are very formidable and become the more difficult the smaller the unit. It is difficult to conceive of the possibility of making gas turbines of such small power as these, such a turbine would probably have to run and that with very fine working clearances at a speed of the order of 50,000 to 100,000 R.P.M. (depending upon the number of stages) and the mechanical problems involved in the way of dynamic balancing, governing, design, lubrication and cooling of bearings, distortion and realignment due to unequal temperature distribution, the development of speed reduction gearing to deal with these enormous speeds etc. would seem to be almost insuperable, while at best such a costly and delicate machine would require a highly skilled operator, and unless a really efficient heat exchanger be added, it could run only on a refined liquid fuel, and that at a fuel consumption of probably more than double that of a corresponding piston engine. It has been suggested that small industrial gas turbines could operate with solid fuel through the medium of a heat exchanger that this will involve some appalling problems in the way of sensitive temperature control under varying load conditions.

The claim that the gas turbine requires no water for cooling is not a very convincing one, for the small piston engine can always be made in the air cooled version or with a closed circuit cooling system. In any case in completely waterless areas there can be little use for a power plant of any kind.

It has been suggested also that since India will shortly be making gas turbines for jet propelled or turbo-propeller aircraft, the experience gained from research on small industrial gas turbines will be very valuable, but the resemblance between a light aircraft turbine of several thousands of horse power and a small industrial turbine of 50 H.P. or less is so remote and the operating conditions so widely different that very few of the major mechanical problems are common to both—as well to argue that “research” on the mechanical features of a motor-cycle engine would be applicable to a main line diesel locomotive.

## APPENDIX IV

*Estimate of Equipment required for the Central Glass Blowing Shop*

	£
Stocks of glasses and other materials .. .. .	2,000
Ordinary benches, blowpipes and hand equipment .. .. .	500
Lathes (minimum 3): 1 large, 1 small, high quality, 1 small second quality, all complete with accessories .. .. .	3,500
Annealing Ovens: 1 large, 2 small, 1 vertical .. .. .	1,500
Diamond sawing, milling and drilling equipment .. .. .	700
Carborundum stopcock and plate grinders .. .. .	400
Mechanical pump for general purpose pumping plant .. .. .	120
Spot welders and small metal working equipment .. .. .	500
H.F. heating equipment .. .. .	1,200
Evaporation plant for aluminising mirrors etc. .. .. .	1,000
Sundries to include strain viewer, etc. .. .. .	500
About .. .. .	11,920

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