E. C. No. 464

ESTIMATES COMMITTEE (1965-66)

HUNDRED AND THIRD REPORT

(THIRD LOK SABHA)

MINISTRY OF EDUCATION

COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

National Physical Laboratory, New Delhi

LOK SABHA SECRETARIAT
NEW DELHI
April, 1966/Chaitra, 1888 (S)
Price : Rs. 2·30

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CORRIGENDA
to
103rd Report of the Estimates Committee on the Ministry of Education - C.S.I.R. - National Physical Laboratory, New Delhi.

Page ii, Item V(iii), for 't' read 'at'.
Page 19, line 3 from bottom, before 'intellectual' insert 'and'.
Page 24, line 8 from bottom, for 'terms' read 'term'.
Page 37, line 4 recommendation, for 'ponit' read 'point'.
Page 39, para 37, line 3, for 'of' read 'on'.
Page 47, line 10 from bottom, for 'Developmtnt' read 'Development'.
Page 50, line 7 from bottom, for 'ferritest' read 'ferrites'.
Page 52, footnote, line 8, for 'given' read 'giving'.
Page 73, line 13, for 'stated he' read 'stated: "I'.
Page 75, line 6, for 'continously' read 'continuously'.
Page 76, line 15, for 'process' read 'possess'.
Page 81, line 18 from bottom, for 'is' read 'are'.
Page 87, lines 7-9 from bottom, delete the words 'The Committee feel.... system'.
Page 90, line 9 from bottom, for 'temparatures' read 'temperatures'.
Page 97, line 4, for 'This' read 'Trials'.
Page 101, line 15, for 'emphasise' read 'emphasis'.
Page 109, line 3 from bottom, for 'alloys' read 'alloys'.
Page 115, line 4, for 'balancing' read 'balancing'.

(P.T.O.)

Page 129, line 14, for 'decision' read 'decisions'.
Page 138, Heading, for 'Conclusions' read 'Conclusion'
Page 169, columns 1 and 2, for ' 1 13' read '2 13'.
Page 178, column 3, lines 11-12, for 'handling' read 'handing'.
Page 179, columns 1 and 2, for '8 51' read ''18 51'

CONTENTS

66 (aii) LS—1.

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(1965-66)

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INTRODUCTION

I, the Chairman, Estimates Committee, having been authorised by the Committee to submit the Report on their behalf, present this Hundred and Third Report on the Ministry of Education—Council of Scientific and Industrial Research—National Physical Laboratory, New Delhi.

2. The Committee took evidence of the representatives of the Council of Scientific and Industrial Research and National Physical Laboratory on the 17th, 18th, 19th, 20th, 21st and 25th January, 1966. The representatives of the Ministries of Education, Industry, Supply and Technical Development, Defence (Department of Defence Supplies), Communications and Planning Commission also appeared before the Committee during the course of the above sittings. The Committee wish to express their thanks to the Director General, Scientific and Industrial Research, Secretaries of the Ministries of Education, Industry, Supply and Technical Development, Defence (Department of Defence Supplies) and Communications and other officers of the above Ministries and Planning Commission and the Scientists of the Council of Scientific and Industrial Research and the National Physical Laboratory for placing before them the material and information they wanted in connection with the examination of the Estimates.

3. The Committee wish to extend their thanks to Shri J. C. Kapur, President and Chief Executive Officer, Air Conditioning Corporation Ltd., Calcutta and Dr. B. D. Nagchaudhuri of Saha Institute of Nuclear Physics, Calcutta for giving evidence and making valuable suggestions to the Committee.

4. The Report was considered and adopted by the Committee on the 4th April, 1966.

5. A statement showing the analysis of recommendations contained in the Report is also appended to the Report (Appendix XIII).

NEW DELHI-1;
April 18, 1966.
Chaitra 28, 1888 (*Saka*).

ARUN CHANDRA GUHA,
Chairman,
Estimates Committee.

CHAPTER I

INTRODUCTORY

A. Role of Science in the Planned Economy of the Country

The dominating feature of the contemporary World is the intense cultivation of science on a large scale, and its application to meet a country's requirements. It is this, which for the first time in man's history, has given to the common man in countries advanced in science, a standard of living and social and cultural amenities, which were once confined to a very small privileged minority of the population. Science has also led to the growth and diffusion of culture to an extent never possible before. It has not only radically altered man's material environment, but has provided new tools of thought and has extended man's mental horizon. Knowledge of science is vitally important; but if it is to transform society from a state of relative stagnation to one of dynamism and progress, there must be a general willingness and determination to make use of it in the service of the community.

In the planned economy of a country, science has to play an important role. Science and technology can make up for deficiencies in raw materials by providing substitutes. In industrialising a country, a heavy price has to be paid in importing science and technology in the form of plant and machinery, highly paid personnel and technical consultants. An early and large scale development of science and technology in the country could greatly reduce the drain on capital during the early and critical stages of industrialisation. Improvements in techniques evolved as a result of scientific research bring about an increase in production in different sectors of the economy. Therefore, a balanced programme of research covering every sector of the economy is essential for the development of a country.

Research activities during Second World War

2. Prior to World War II, very little attention was given to the problem of scientific and industrial research in India. A number of universities and institutions carried out research work but they were mostly on fundamental aspects of science. A few industries also had their own research organisations but by and large they depended on foreign techniques and did not develop research programmes of their own. During the Second World War a large number of products

which were earlier imported into the country, had to be manufactured in India itself to meet both civil and military needs. Indian substitutes had to be found for imported materials and processes. In these circumstances, the Council of Scientific & Industrial Research came into being in 1942.

Research Activities after Independence

3. Since independence, there has been a greater emphasis on the provision of additional facilities for the promotion of scientific and industrial research. While in the First Five Year Plan attention had been given to the building of the National Laboratories and other research institutions, the primary object of the Second and Third Plans has been to develop the existing facilities and to bring the work of scientists in National Laboratories and research workers in universities and other organisations as close as possible to important problems in different fields of national development.

Scientific Policy Resolution

4. In March, 1958 the Scientific Policy Resolution embodying the considered scientific policy of Government was brought before Parliament. The Resolution envisaged the following aims for the scientific policy:

(i) to foster, promote and sustain, by all appropriate means, the cultivation of science, and scientific research in its aspects—pure, applied and educational;

(ii) to ensure an adequate supply, within the country, of research scientists of the highest quality, and to recognise their work as an important component of the strength of the nation;

(iii) to encourage and initiate, with all possible speed, programmes for the training of scientific and technical personnel, on a scale adequate to fulfil the country's needs in science and education, agriculture and industry and defence;

(iv) to ensure that the creative talent of men and women is encouraged and finds full scope in scientific activity;

(v) to encourage individual initiative for the acquisition and dissemination of knowledge, and for the discovery of new knowledge, in an atmosphere of academic freedom;

It will thus be observed that the Scientific Policy Resolution is both a declaration of faith in science and technology as an instrument of national progress as well as a directive enjoining specific steps to be taken in this regard for the benefit of the country.

Implementation of Scientific Policy Resolution

5. The Ministry of Education which is responsible for implementing the Scientific Policy Resolution has so far convened two conferences of scientists and educationists to review the implementation of the Resolution and suggest measures for carrying further the objects ennunciated in it. The first conference was held on the 18th-19th July, 1958 *e.g.* soon after the adoption of the Resolution and the other on the 4th-5th August, 1963. These conferences were attended by a fairly large number of representatives of the Ministry of Education, Council of Scientific and Industrial Research, Universities and by a representative each of the Ministry of Defence, Planning Commission and Scientific Research Association.

6. A gist of recommendations made at the above conferences together with the statement of action taken thereon by the Ministry of Education is given in Appendix I. It will be noted that there are deficiencies even in the implementation of the recommendations made at the Conferences of scientists and educationists. Many of the recommendations made at the Second Conference of Scientists and Educationists have been brought to the notice of the concerned Ministries by the Ministry of Education but have not been followed up.*

7. During the course of evidence, the representative of the Ministry of Education has stated that "the Scientific Advisory Committee of the Cabinet have been considering the various aspects of the Scientific Policy Resolution. They have been making recommendations from time to time. Those recommendations might have been implemented or may be in the process of implementation by the various organisations concerned." The Director General for Scientific and Industrial Research has, however, stated that "at the suggestion of the Scientific Advisory Committee of the Cabinet,† the Ministry (of

*At the time of factual verification of the Report, the Ministry of Education has stated as follows:

"We had requested the various Ministries etc. concerned to let us know the action taken by them on the implementation of the various recommendations made by the Second Conference of Scientists and Educationists held in August, 1963. Replies are being received."

† Without any directive from the Scientific Advisory Committee to the Cabinet, we have requested the various Ministries etc. concerned to let us know steps taken by them to achieve the aims of the Scientific Policy Resolution. No Ministries have yet replied saying that they have not taken any action.

Education) circulated to the various Ministries to find out what action has been taken by them to implement the Resolution. I think a number of Ministries have replied that they have not taken any action."

The Committee consider that there is need for critically reviewing the progress made so far in implementation of the Scientific Policy Resolution and to take follow-up action to ensure that the progress is sustained in all the desired spheres. The Committee suggest that Government should arrange for a representative conference of scientists and educationists to review once every two years the progress made and to locate any deficiency and to suggest further measures to intensify the effort.

The Committee suggest that the conference should include not only representatives of Ministries of Education, Defence, C.S.I.R., Universities, Planning Commission, as hitherto but also include representatives of University Grants Commission, Indian Institute of Technology, Department of Atomic Energy, Indian Council of Agricultural Research, State Research Institutes, leading industrial research institutes and industry, and would make for comprehensive review of the Scientific Policy Resolution. The Conference may divide itself into suitable working groups in order to devote greater attention to specific aspects of Scientific Policy Resolution. The Committee further suggest that working papers on different aspects of the Scientific Policy Resolution should be prepared and circulated well in advance to facilitate purposive discussion and to draw up recommendations.

The Committee suggest that in order to keep Parliament informed of the progress made in the implementation of the Scientific Policy Resolution, periodical review should be drawn up in the form of a Report which may be suitably presented to Parliament. Parliament should also be informed in precise terms of the follow-up action by presenting further Reports laying statements in pursuance of the review.

B. Planning of Research on National Level

Different Agencies for Scientific Research

8. Research in various disciplines of science and technology is conducted by several agencies of Government, a few of which are listed below:

(1) The Council of Scientific and Industrial Research.

(2) The Ministry of Education. (Survey of India, National Atlas Organisation, Botanical and Zoological Surveys, Central Board of Geophysics).

(3) Defence Research and Development Organisation.
(4) Department of Atomic Energy.
(5) Indian Council of Agricultural Research.
(6) Indian Council of Medical Research.
(7) Universities and Institutes of Technology.
(8) Other Government Departments concerned with the following programmes of research:
(i) Irrigation and Power.
(ii) Transport and Construction.
(iii) Minerals.
(iv) Communication.

Expenditure on Scientific Research

9. Although *per capita* expenditure on Scientific Research in India has increased from 0·12 in 1952-53 to 0·32 in 1961-62, it is a long way from being anywhere near that being incurred by the more advanced countries as would be seen from Table I below:

TABLE I

Per Capita *Research Expenditure and* Per Capita *National Income in various countries.*

Country	Year	Expenditure on scientific research (million)	Population (millions)	*Per capita* research expenditure	*Per capita* national income	Research expenditure as per cent of national income
		Rs.	Rs.	Rs.	Rs.	Rs.
USA . .	1961-62	72,580	174	410	14,190	2·9
UK . .	1961-62	8,467	52	162	6,010	2·7
Sweden . .	1961-62	1,088	7·4	146	8,649	1·7
China . .	1960	2,000	669	3·00	..	..
Australia . .	1958-59	400	9·9	40	5,780	0·70
Norway . .	1958	124	3·5	35	4,540	0·70
Yugoslavia . .	1958	76	18	4·20	1,810	0·22
USSR. . .	1958-59	20,700	209	99	3,303	3·00
India . .	1961-62	469	440	1·07	334	0·32

Table II below shows the total expenditure on scientific research by the Centre and the State Governments during the period 1961-62 to 1963-64. Table III shows the percentage distribution of expenditure on scientific research during 1961-62 to 1963-64;

TABLE II%

Expenditure on scientific research, number of scientists and cost per scientist : 1961-62 to 1963-64.

Agency	Expenditure in Rs. lakhs									No. of scientists			Cost per scientist Rs. (000)		
	Total			Capital			Current								
	1961-62	1962-63	1963-64	1961-62	1962-63	1963-64	1961-62	1962-63	1963-64	1961-62	1962-63	1963-64	1961-62	1962-63	1963-64
(1)	(2)	(3)*	(4)	(5)	(6)	(7)	(8)	(9)*	(10)	(11)	(12)*	(13)	(14)	(15)*	(16)
Central Ministries & Departments															
1. Atomic Energy Department	740	893	934	249	344	318	491	549	636	1042	1296	1528	71	61	60
2. Atomic aided institutes	124	149	164	28	34	31	96	115	133	393	482	569	34	31	29
3. Sub-total (1) + (2)	864	1042	1118	277	377	349	587	664	769	1435	1778	2097	61	59	53
4. C.S.I.R.	754	719	1030	296	361	430	458	358	600	1711	2149	2283	44	33	45
5. C.S.I.R. Cooperative research	61	61	68	..	..	..	61	61	68	89	100	110	68	61	61
6. Sub-total (4) + (5)	815	780	1098	296	361	430	519	419	668	1800	2249	2393	45	34	46
7. Education	51	58	74	5	8	15	46	50	59	158	228	294	32	25	25
8. Education aided institutes	28	32	35	6	6	6	22	26	29	274	278	292	10	12	12
9. Universities etc.	..	370*	..	..	..	..	..	370*	..	..	3715*	..	..	10*	..
10. Health (medical research)	123	141	158	8	5	7	115	136	146	577	666	624	18	21	24
11. Food & Agriculture	413	449	496	55	57	67	358	392	429	1054	1212	1305	39	37	38
12. Irrigation & Power	37	43	..	..	..	..	37	43	..	..	116	..	..	37	..
13. Railways	20	27	35	..	..	..	20	27	35	26	35	40	77	77	88

14. Communications	11	14	19	2	2	5	9	12	14	37	44	54	29	32	36	
15. Civil Aviation	1·1	1·7	2·4	0·4	1·2	1·9	0·7	0·5	0·5	12	13	9	9	13	27	
16. Meteorological Department	24	27	..	4	5	..	20	22	..	146	171	190	17	16	..	
17. Mines	19	21	..	7	..	..	12	21	..	42	46	46	46	45	..	
18. Commerce & Industry	14	15	17	4	3	3	10	12	14	33	33	40	42	46	44	
19. Sub-Total (12) to (18)	126	149	73	17	11	10	109	138	63	296	458	379	43	33	19	
State Governments :																
20. Medical	26	32	36	..	..	..	26	32	249	237	253	10	10	13	14	
21. Agriculture	72	79	100	14	14	30	58	65	70	378	493	527	19	16	19	
22. Irrigation & Power	40	42	..	..	..	..	40	42	..	..	86	..	..	48	..	
23. Industry	35	40	47	10	11	9	25	30	38	119	128	132	30	31	35	
24. Private Industry	53	93	117	11	44	34	42	49	83	289	314	390	18	30	30	
25. Total	2646	3307*	3347	699	896	955	1947	2411*	2392	6729	11842*	8686	39	28*	38	

*The statement was furnished by the Planning Commission.

*Estimates for Universities for total expenditure and number of scientists are available only for one year 1962-63.

TABLE III%

Percentage distribution of Expenditure on scientific research and number of scientists : 1961-62 to 1963-64.

Agency	Expenditure									foreign currency			No. of scientists		
	Total			Capital			Current								
	1961-62	1962-63	1963-64	1961-62	1962-63	1963-64	1961-62	1962-63	1963-64	1961-62	1962-63	1963-64	1961-62	1962-63	1963-64
(1)	(2)	(3)*	(4)	(5)	(6)*	(7)	(8)	(9)*	(10)	(11)	(12)	(13)	(14)	(15)*	(16)
Central Ministries & Departments :															
1. Atomic Energy Department	28·0	27·0	28·5	35·7	38·4	33·3	25·2	22·8	26·6	..	..	..	15·5	10·9	17·6
2. Atomic aided institutes	4·7	4·5	4·9	4·0	3·7	3·2	4·9	4·8	5·6	..	..	..	5·8	4·0	6·6
3. Sub-total	32·7	31·5	33·4	39·7	42·1	36·5	30·1	27·6	32·2	67·0	71·1	78·7	31·3	14·9	24·2
4. C.S.I.R.	28·5	21·7	30·8	42·4	40·3	45·0	23·5	14·9	25·8	..	..	..	25·4	18·2	26·3
5. C.S.I.R. Cooperative research	2·3	1·8	2·0	..	..	..	3·1	2·5	2·8	..	..	..	1·3	0·8	1·3
6. Sub-total (4)+(5)	30·8	23·5	32·8	42·4	40·3	45·0	26·6	17·4	72·9	20·3	16·9	14·9	26·7	19·0	27·6
7. Education	1·9	1·8	2·2	0·6	0·9	1·6	2·4	2·1	2·5	1·8	1·8	2·0	2·4	1·9	3·4
8. Education aided institutes	1·1	1·0	1·1	0·8	0·7	0·6	1·1	1·1	1·2	..	..	..	4·0	2·4	3·4
9. Universities etc.	..	11·2*	..	..	..	..	..	15·3*	..	..	..	..	..	31·4*	..
10. Health (medical research)	4·7	4·3	4·6	1·2	0·5	0·7	5·9	5·6	6·1	0·3	0·1	0·1	10·0	5·6	7·2
11. Food & Agriculture	15·6	13·6	14·8	7·9	6·4	7·0	18·4	16·3	17·9	5·8	5·8	1·3	15·7	10·2	15·0
12. Irrigation & Power	1·4	1·3	..	..	..	..	1·9	1·8	..	..	..	..	..	1·0	..
13. Railways	0·8	0·1	1·1	..	..	..	1·0	1·1	1·5	..	..	..	0·4	0·3	0·5

14. Communications	0·4	0·4	0·5	0·3	0·3	0·5	0·5	0·5	0·6	..	..	..	0·6	0·4	0·6
15. Civil Aviation	..	0·1	0·1	0·1	0·1	0·2	0·1	0·0	..	..	..	..	0·2	0·1	0·1
16. Meteorological department	0·9	0·8	..	0·6	0·5	..	1·0	0·9	..	..	..	..	2·2	1·4	2·1
17. Mines	0·7	0·6	..	1·0	..	..	0·6	0·9	..	..	..	..	0·6	0·4	0·5
18. Commerce & Industry	0·5	0·4	0·5	0·5	0·4	0·3	0·5	0·5	0·6	4·8	4·3	3·0	0·5	0·5	0·5
19. Sub-total 12 to 18	4·7	4·4	2·2	2·5	1·3	1·0	5·6	5·7	2·7	4·8	4·3	3·0	4·5	3·9	4·3
State Government :															
20. Medical	1·0	1·0	1·1	..	..	..	1·3	1·3	1·5	..	..	..	3·7	2·0	2·9
21. Agriculture	2·7	2·4	3·0	1·9	1·6	3·0	3·0	2·7	2·9				5·6	4·2	5·0
22. Irrigation and Power	1·5	1·3	..	..	..	..	2·0	1·7	..	..	..	..	..	0·7	..
23. Industry	1·3	1·2	1·4	1·4	1·3	3·9	1·3	1·2	1·6	..	..	..	1·8	1·1	1·5
24. Private Industry	2·0	2·8	3·5	1·6	4·9	3·6	2·2	2·0	3·5	..	..	..	4·3	2·7	4·5
25. TOTAL	100·0	100·0	100·0	100·0	100·0	100·	0100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0
	——total expenditure in Rs. lakhs——												——total number——		
	2646	3307*	3347	699	896	955	1947	4211*	2392	236	291	455	6729	11842	8686

%The Statement was furnished by the Planning Commission.

*Estimates for universities for total expenditure and number of scientists are available for only one year 1962-63.

Planning of Scientific Research at the National Level.

10. The Second Plan states that "In every field of development there are pressing problems which call for scientific study and investigation and the application of the results of research. It is, therefore, specially important to co-ordinate programmes of research in national laboratories and in universities and other institutions with the requirements of national planning. To assist the Planning Commission in this task a Panel of Scientists has been recently constituted."

Attention is drawn to the following observations made by the late Prime Minister Jawaharlal Nehru at the Second Conference of Scientists and Educationists held in August, 1963:

> "There is one criticism that is often made about the financial resources that are put by for scientific work. Although we are spending more on scientific work than previously, it is, I suppose, correct and true to say that even so we are rather slow-moving in that direction. And some of our scientific work may have suffered because of lack of money. Recently, some months back, a Committee was appointed, I think, with Dr. Homi Bhabha as Chairman to look into this matter and to recommend both, what more might be done—scientific research work—and generally where it is possible to economise. The object of that Committee—although economy is important and is stressed—was really to encourage useful and profitable expenditure for scientific research. We did not want merely to say that so many crores of rupees should go into scientific research but rather to have it examined and to say definitely how it should be done. That Committee, so far as I know, has not produced any report or recommendations. I do not know whether they have met even. That is not a very hopeful sign. But I wish to assure you that in spite of our very considerable difficulties at the present moment because of the emergency and for other reasons Government will not hesitate to supply more funds for scientific research provided some kind of a reasoned approach is made. It is not quite enough merely to say 'Give more funds generally' but it is to be explained where more are required."

Proposal for Working Group

11. It is understood that in the middle of 1963 a proposal was made by C.S.I.R. that the Planning Commission should constitute a committee or a working group on scientific research. The proposal

was turned down and it was decided that each Ministry would form its own Working Group. A number of working groups have been set up to work on planning of research in (i) C.S.I.R., (ii) Department of Agriculture and (iii) Department of Atomic Energy etc.

Study Group for Scientific Research of the National Planning Council

12. It has been stated that in April 1965, the National Planning Council of the Planning Commission set up a Study Group for Scientific Research with the following members:

(1) Prof. P. C. Mahalanobis—Chairman.

(2) Dr. D. S. Kothari—Member.

(3) Dr. A. C. Joshi—Member.

(4) Dr. Vikram A. Sarabhai—Member.

According to the procedure laid down, the Study Group has the right to co-opt members, wherever necessary and will meet on the last Friday and Saturday of each month.

This Study Group has so far met on (1) 26th June, 1965, (2) 6th November, 1965 and (3) 6th and 7th December, 1965. The Study Group at its meeting held on 26th June, 1965 "agreed that for the formulation of policy, planning of research as a whole was essential. The Fourth Plan outlay for scientific research should be considered as a whole inclusive of the outlays to be provided for research in other fields, *e.g.* agriculture, medicine, irrigation and power, etc."

C. Scientific Research Statistics

Proper Statistics not Available

13. At the meeting of the Study Group for Scientific Research of the National Planning Council held on the 26th June, 1965, Prof. P. C. Mahalanobis stated that for planning of scientific research in the country it was essential to have basic information regarding not only expenditure on scientific research (*viz.* capital, recurring and committed, foreign exchange etc.) but also on the number of persons engaged on research distributed by agencies and institutions and that he had been trying to get this information since 1957 or 1958. Until recently it was not possible to collect even dimensional figures about the number of research scientists. It has been stated that at the present moment statistics are collected department-wise and institution-wise and not according to field of research cross-classified by basic, operational and developmental.

The Committee regret to note that India has no central body to co-ordinate, promote or plan her research and its utilisation, with

the result that the research potential has not been exploited fully to achieve the major national goals of the country during the first three Five Year Plans. The absence of such a central body has resulted in diffusion of energy and resources as also in duplication and has adversely affected the optimum utilisation of funds made available for scientific research and effective co-ordination between different agencies.

The Committee note that a Study Group for Scientific Research has at last been constituted in the Planning Commission towards the middle of 1965. The Committee consider that as the resources for research in India are extremely limited and the expenditure on research as percentage of national income is as low as 0·32 compared to other advanced countries (U.S.S.R.—3·00; U.S.A.—2·9; U.K.—2·7) there is need for carefully husbanding the resources. They would like the Working Group to ensure that research allocations in the Fourth Plan are spread out keeping in view the relative importance of research so as to render maximum assistance in the developmental plans of the country.

The Committee suggest that the Study Group should also lay down guide lines for collection of basic data regarding research being undertaken by different agencies in Government and private sector so as to have reliable overall information to decide the strategy of research in the interest of planned development of the country. The Committee suggest that the Study Group should carefully assess from time to time the progress made in tackling research problems particularly those which are of strategic importance to the development of the country and take suitable measures to make up deficiency or intensify research, as required.

Now that the Study Group has been constituted, the Committee recommend that it should immediately apply itself to the major task of planning of research so that it is in tune and on par with planning in other sectors of national development in the country.

CHAPTER II

ORGANISATION AND FUNCTIONS OF NATIONAL PHYSICAL LABORATORY

Historical Background

14. In September, 1941, the late Dr. S. S. Bhatnagar, the then Director, Scientific and Industrial Research, put forward proposals to the Government of India for the establishment of a Central Research Laboratory, which could be bifurcated later into a National Physical and a National Chemical Laboratory.

In 1943, a Planning Committee was appointed to draw up detailed plans for a National Physical Laboratory. It completed its work in 1945, and published its Report "Plan for a National Physical Laboratory, India" in 1946. It was circulated to important scientists and organisations. The then Director, Scientific and Industrial Research while attending the Commonwealth Scientific Conference held in 1946 at London took advantage of the opportunity to discuss the plan with eminent scientists.

The foundation stone of the National Physical Laboratory was laid by the late Prime Minister, Shri Jawaharlal Nehru on the 4th January, 1947. The actual construction was taken in hand in February, 1948. The main building was completed and formally opened by the late Deputy Prime Minister, Sardar Vallabhbhai Patel on the 21st January, 1950.

Objectives

15. The main objectives of the National Physical Laboratory as laid down at the time of its inception were as follows:

(a) To undertake applied research on all physical aspects with a view to helping industries.

(b) To undertake basic research in fields which have a bearing on problems of a physical nature associated with applied research as stated above.

(c) To undertake developmental testing to help industry.

(d) To maintain basic standards of mass, length, time and temperature as well as derived standards for electricity, electronics, acoustics and optics.

Organisation of National Physical Laboratory.

16. There are twenty-two Divisions/Sections in the National Physical Laboratory as per details given below:

1. Acoustics.
2. Analytical Chemistry.
3. Applied Mechanics.
4. Electricity.
5. Heat and Power
6. Heat Standards
7. Industrial Physics
8. Infrared Spectroscopy
9. Electronics
10. Time and Frequency
11. Low Temperature Physics
12. Optics
13. Solid State Physics
14. Theoretical Physics
15. Weights and Measures
16. X-ray Crystallography.
17. Radio Propagation Unit
18. Rain and Cloud Physics Unit
19. Development-*cum*-production unit of Electronic Components
20. Glass Technology Unit
21. Instrumentation Section.
22. Central Workshop.

In addition there are an administrative wing and a library.

It has been stated that in the beginning, there were only eight Divisions in National Physical Laboratory *viz.*:

1. **Weights and Measures**

2. Applied Mechanics and Materials
3. Heat and Power
4. Optics.
5. Electricity
6. Electronics and Sound
7. Building and Housing Research
8. Analytical Chemistry.

During its sixteen years of working, the Laboratory has expanded to twenty-two Divisions/Sections including the Central Workshop. Quite a few of the new Divisions, initially formed a part of one of the major Divisions, *e.g.* the Divisions of Electronics, Radio Components and Radio Propagation Unit formed one Division namely Electronics.

Prof. Blackett's Suggestions

17. It has been stated that a study of organisation and functions of the National Physical Laboratory were made in January/February, 1963 by Prof. P. M. S. Blackett, Professor of Physics, Imperial College of Science and Technology, London who was invited by the late Prime Minister Shri Jawaharlal Nehru, to give his views on the programme of research carried out in the Laboratory. The important recommendations made by Prof. Blackett are given below:

(1) The major role of the National Physical Laboratory over the next decade should be in the field of standards and testing of commercially manufactured instruments, equipment and apparatus.

(2) At present the maintenance of standards and testing in the National Physical Laboratory is spread over the following Divisions: Weights and Measures, Acoustics, Heat and Power, Electricity, Electronics, Applied Mechanics and Optics. It would seem advantageous to group together in one powerful division all the work both on the maintenance of standards and on the routine testing of instruments.

(3) All basic scientific work should be put together into one area of the building. CSIR should invite the University of Delhi to take over the scientific management of the basic science work for a period of say ten years. The Laboratory might be called "Centre for Advanced Physics of Delhi University and the CSIR".

(4) The remnants of the dismantled Divisions be grouped into a single Projects Division to concentrate its work on a limited number of concrete projects of development to meet the requirements of outside organisations *e.g.* Defence, Communication, etc.

(5) Radio Components Section and Ceramic Pilot Plant should be taken out of the National Physical Laboratory and combined to make a commercially run government owned manufacturing plant, preferably on its own, or alternatively as a subsidiary of a bigger firm such as Bharat Electronics Ltd.

(6) Glass Technology Division and the associated glass technology plant should be taken out of the National Physical Laboratory Organisation and made into an independent and eventually commercial glass blowing unit.

Menon Committee Suggestions

18. The Executive Council of National Physical Laboratory at its meeting held on the 26th February, 1963 appointed a sub-committee consisting of the following members to make a close study of the report submitted by Prof. Blackett and to advise the Executive Council as to what extent and how the recommendations of Prof. Blackett's report could be implemented:

1. Prof. M. G. K. Menon
2. Prof. B. D. Nagchaudhury
3. Prof. A. K. Saha
4. Shri J. C. Kapur
5. Dr. R. C. Majumdar
6. Dr. Lal C. Verman
7. Dr. W. M. Vaidya

The sub-committee met on the 14th and 15th March, 1963 at the National Physical Laboratory and examined the scope and functions of the Laboratory, the staff strength and the programme of work etc. The sub-committee found itself in general agreement with the spirit of the blackett Report.

The summary of the sub-committee's recommendations regarding the reorganisation of National Physical Laboratory on the lines suggested in Prof. Blackett's report is given below:

(1) *Centre for Advanced Physics*—It should consist of Division of Low Temperature, Division of Solid State Physics

plus Crystal Growing Section transferred from Applied Mechanics Division.

(2) The activities of the Divisions of (i) Weights and Measures; (ii) Applied Mechanics minus Crystal growing Section; (iii) Heat and Power; (iv) Electricity; (v) Electronics, Transistor Circuits, Time and Frequency; (vi) Acoustics; (vii) Optics; (viii) Radio Propagation Unit; (ix) Central Services—Library, Workshop and Glass Blowing, Analytical Chemistry, should be combined to form National Physical Laboratory (Reorganised) whose function should be standards, testing and certification and industrial research projects.

(3) Radio Components Section & Ceramic Pilot Plant and Glass Technology Section should be constituted into manufacturing units.

(4) Rain and Cloud Physics Unit should be transferred to India Meteorological Department.

The sub-committee's recommendations were considered by the Executive Council of the National Physical Laboratory at its meeting held on the 29th April, 1963. The Council felt that the suggestions made by Prof. Blackett which dealt with various internal matters of reorganisation in the National Physical Laboratory were generally acceptable and could be implemented.

The main recommendation concerning the separation of certain sections in the Laboratory doing fundamental research and constituting them into a Centre for Advanced Physics was a basic point which required careful consideration. Subsequently the Executive Council also recommended that the suggestion for separating the fundamental research at National Physical Laboratory unrelated to the other activities of the Laboratory and establishing a Centre for Advanced Physics could be accepted in principle. The Executive Council further recommended that the National Physical Laboratory Centre for Advanced Studies and the National Physical Laboratory for Applied Research be both provided with heads of independent status.

The following action was decided by the Executive Council to be taken on the recommendations of Prof. Blackett:

(1) A new Division of Standards was set up by abolishing the existing Divisions of Weights and Measures, Electricity, Applied Mechanics, Heat and Power.

(2) A new Project Division may be set up by abolishing the existing Industrial Physics Division and by transferring the residual work (other than those transferred to the new Standards Division) of the Divisions of Applied Mechanics and Heat and Power.

(3) A Development-*cum*-Production Unit may be established for electronics components under an officer-in-charge.

(4) A Glass Technology Unit may be established.

(5) The work of the Transistor Section and the Time and Frequency Section may be amalgamated with the Electronics Division.

(6) The existing Divisions of Solid State Physics and Low Temperature Physics will constitute into the National Physical Laboratory Centre for Advanced Physics.

Before these decisions could be fully implemented, the whole question appears to have been reopened by the last Director of National Physical Laboratory who was appointed in October, 1963. At the meeting of the Executive Council of the National Physical Laboratory held on the 7th April, 1964, a note prepared by the Director, National Physical Laboratory on the basis of his experience in the Laboratory for the past four months was considered. The Executive Council directed that:

"(i) No separate Director be appointed for the Centre for Advanced Physics and that both the wings will be under the Director of National Physical Laboratory; and

(ii) the other points raised in the Director's note be considered by the Scientific Sub-Committee and the recommendations placed before the Executive Council at its next meeting."

The Scientific Sub-committee of the Executive Council of the National Physical Laboratory at its meeting held on June 1-3, 1964, considered the note of the Director, National Physical Laboratory and made *inter alia* the following recommendations:

(i) An Information Centre dealing with Documentation Industrial Liaison, etc. should be set up.

(ii) Regarding the Centre for Advanced Physics, the Sub-committee recommended that the existing Divisions of Solid State Physics, Low Temperature Physics (including Applied Mathematics) should function as other Divisions

of the Laboratory and that the name National Physical Laboratory Centre for Advanced Physics should be dropped and that the entire Laboratory should function as a single unit.

(iii) There is urgent need for having a Materials Division in the National Physical Laboratory.

(iv) There should be four separate Divisions as they existed before namely Weights and Measures, Electricity, Applied Mechanics and Heat & Power.

The Executive Council at its meeting held on the 1st October, 1964, generally accepted the above recommendations made by the Scientific Sub-committee.

Suggestions of Third Reviewing Committee of CSIR (1964)

19. The Third Reviewing Committee of the Council of Scientific & Industrial Research which was appointed "to review the work and progress of the Council of Scientific and Industrial Research and to recommend the lines on which the activities should be directed in the national perspective", has observed *inter alia* in its Report (1964) as follows:

> "We agree with the policy advocated by Prof. Blackett and accepted by the Executive Council in that greater emphasis should be given to the applied work of the Laboratory. In this we include its essential and central concern with standards of testing. Apart from standards and testing, we would recommend support and encouragement be given to the vigorous Radio Components and Ceramic Pilot Plant Unit and the Radio Propagation Unit. The Sections on Electronics, Acoustics, Optics, Industrial Physics should be developed as also the Time Unit. We would recommend a revival of the Applied Mechanics Division with its work re-oriented to give support to the activities mentioned above."

The Reviewing Committee has further set out the following two general principles:

> "(i) Research Laboratories should not be formally divided into separate wings, 'Pure' and 'Applied'. This tends to isolation intellectual snobbery. Matters are made worse if the two wings become administratively separate with separate directors.

(ii) If 'Centre of Advanced Studies' are to be set up in any scientific discipline such as Physics, these should be set up in universities and not as part of CSIR establishments. CSIR can be of the greatest assistance to the formation of these units both financially and in other ways, but the universities are the natural and appropriate homes for 'Advanced Studies' "

Functioning of Divisions

20. About the functioning of the various Divisions/Sections, it is pertinent to note the observations made by the Sub-Committee of the Executive Council of the National Physical Laboratory in March, 1963:

"The Committee noticed that, upto now, there has been too great a compartmentalisation of the various activities and very little inter-communication amongst the various divisions and sections. This state of affairs should be radically altered. There should be enough flexibility so that when an individual project is taken up which requires that scientists from different disciplines be brought together, then it should be possible to do this without difficulty. This aspect has been sorely neglected hitherto."

During the course of evidence, the Director General, Scientific and Industrial Research agreed with the view that one of the main reasons for excessive compartmentalisation is the existence of a large number of Divisions. He has stated as follows:

"When I visited the NPL at the end of December, 1962, or in the beginning of January, 1963, there were equipments and apparatus lying in one room belonging to one division and not being lent to another division requiring those equipments. This kind of thing has now mostly disappeared and it will completely disappear.

I moved the governing body to abolish the divisions. The governing body approved it and one time the divisions were abolished. They have been instituted again, but not in the same manner as earlier. I am happy to report that the divisions are only group of scientists of one discipline put together for more or less administrative reasons. As long as the programmes are based on project divisions and not on the earlier kind of divisions, there will be no harm."

It will be seen from the above that the recommendations regarding the working and reorganisation of the National Physical Laboratory made by Prof. Blackett in 1963 were generally agreed to by the Scientific Sub-committee of the Executive Council of the National Physical Laboratory and the Executive Council itself in 1963. In fact these recommendations were also generally endorsed by the Third Reviewing Committee of the C.S.I.R. The Committee note the lack of the sense of urgency shown by the authorities in examining the Blackett Report which remained under consideration of the Executive Council and its Sub-committee for two years. The Committee consider that the authorities concerned should have taken firm and expeditious decision on the Blackett Report. The Committee regret to note that even before these recommendations were implemented and given a fair trial, the whole matter was reopened soon after the appointment of the preceding Director of the National Physical Laboratory. The result has been that the major recommendations regarding the reorganisation of the divisions and the setting up of commercial units were reversed and the status quo ante more or less restored. It is surprising that the Executive Council which had earlier accepted the recommendation of Prof. Blarkett to reorganise the National Physical Laboratory, later reversed its own decisions on the note of the Director without giving a fair trial to the new set up. The Committee consider that the existence of a large number of divisions in the Laboratory tends to create compartmentalisation and comes in the way of coordinated efforts as has been admitted by the Director General of Scientific and Industrial Research also.

The Committee consider that the work in the Laboratory should be organised increasingly according to projects and that Divisions and Sections should be reduced to the minimum. They have no doubt that the work of the existing 22 divisions would be critically and carefully reviewed with a view to effect co-ordination and economy.

As regards the setting up of the Advanced Centres of Study, the Committee are generally in agreement with the views expressed by the Third Reviewing Committee that the right place for setting up centres of Advanced Studies is in the Universities and not as part of Council of Scientific and Industrial Research establishments; the Committee would, however, stress the need for closer coordination between the C.S.I.R. and the Universities so that the use of specialized equipment available in C.S.I.R. laboratories is not denied to Universities for carrying out advanced research in the subjects concerned.

CHAPTER III

PLANNING OF RESEARCH PROGRAMMES IN NATIONAL PHYSICAL LABORATORY

A. Classification of Research

21. Research work at the National Physical Laboratory is classified into (i) Applied Research and (ii) Basic Research. While the object of applied research is to attain a practical goal, that of basic research is solely to increase scientific knowledge.

In this connection the Committee note that the Zuckerman Committee on "The Management and Control of Research and Development" in U.K. (1961) has classified research and development into five categories of activity as follows:

(i) Pure Basic Research;

(ii) Objective Basic Research;

(iii) Applied (Project) Research;

(iv) Applied (Operational) Research; and

(v) Development.

The definitions of these terms are given in that Report are reproduced in Appendix II.

The Committee consider that this classification is more detailed than that which has at present been adopted in the National Laboratories. They, therefore, suggest that the feasibility of adopting this detailed classification for the research and development work conducted in the various laboratories of CSIR may be examined, which was agreed to by the Director General, Scientific and Industrial Research during evidence.

22. Asked to indicate what proportion of effort and expenditure of the National Physical Laboratory is devoted to (i) pure basic research, (ii) applied research and (iii) maintenance of standards and testing of commercial manufactured instruments, it has been stated in a written reply that "no separate account is maintained for expenditure on the above. Except for the Theoretical Physics Division which may be taken to be doing work of fundamental

nature, in the case of other Divisions it would not be possible to break up the work into various categories as mentioned above."

During evidence the Director General stated that "The National Physical Laboratory has got several very theoretical basic pure work." He further added that "We have got division. 80 per cent would be applied; 20 per cent would be theoretical. We believe that without certain amount of basic work, standards of work in the applied side comes down. It is an intellectual tonic. As long as it is a good quality, it should be continued."

The Third Reviewing Committee of the Council of Scientific and Industrial Research (1964) have stated that the "bulk of the basic work of a Council of Scientific and Industrial Research laboratory should be related to and form the background of its applied work. This is particularly true of National Physical Laboratory and there are wide and exciting possibilities in this direction. However at present largely for historical reasons there are groups in NPL which are concerned with 'pure basic work' with little or no connection with applied work. We feel that the emphasis should be changed over a period of time towards applied work as suggested above."

The Committee further note that Prof. Blackett had also suggested that the basic scientific work of National Physical Laboratory be separated from its applied work and housed in the ground floor of the East Wing of the National Physical Laboratory building. He had recommended that the "C.S.I.R. should invite the University of Delhi to take over the scientific management of the basic science work for a period of, say, ten years. If and when an adequate new university physics building is built, the arrangement could be reconsidered. The laboratory might well be called "Centre for Advanced Physics of Delhi University and the C.S.I.R."

The Committee on the Management and Control of Research and Development (U.K.) (1961), also called Zuckerman Committee, has observed that "In our view, pure basic research is best carried out in the environment of a university rather than in that of a Government research establishment".

It has further been stated by that Committee that ".....We do not agree that Government research establishments should undertake basic research just because it might help recruitment and provide an intellectual stimulus for the staff. Indeed if the promise of such work ever became an overt inducement to recruitment, we suspect that it would lead only too often to so called fundmental work being pursued in a back water remote from the main stream

of scientific activity and with little concern with practical applications and that in the long run it would neither help recruitment nor provide an effective intellectual stimulus....."

The Committee are in agreement with the views expressed by the Zuckerman Committee (U.K.) that pure basic research should be carried out in a university rather than in a research laboratory. The Committee regret to observe that inspite of the recommendations made by the Third Reviewing Committee and the opinion expressed by Prof. Blackett, no conscious effort appears to have been made by the National Physical Laboratory to shed its pure basic research work. The Committee realise the difficulties of stopping altogether the basic research done in the National Physical Laboratory as it has grown there over a number of years for "historical reasons". The Committee however recommend that determined efforts should be made by the Council of Scientific and Industrial Research and the National Physical Laboratory to reduce the quantum of basic research to the minimum necessary for supporting the applied research. In this connection it would be useful if detailed information is kept about the proportion of the basic and applied research work done in the National Physical Laboratory so that a watch could be kept on the progress made in this regard from year to year. The Committee would also like Government to ensure that simultaneous efforts are made in right earnest to promote and strengthen basic research in Universities in appropriate measure.

B. Identification of Research Problems

23. The Third Reviewing Committee of C.S.I.R. (1964) observed as follows in regard to the selection of research programmes in the laboratories of C.S.I.R.:

> "At present research programmes of the institutes are inevitably based on ideas arising mostly internally with the director and the research staff. A lacuna arises in a lack of impact of ideas from people outside. The position can be improved by contact with departments of planning and industrial development, familiarity with short terms and long term programmes and problems of industry and association of scientists from industry in the framing of research programmes. This would also enable forward thinking and anticipation of the research requirements in their relation to the plans of industrial development.....
>
> We would recommend that CSIR in collaboration with the Planning Commission and the Directorate General of

Technical Development introduce what further steps may be necessary to achieve this end. It will be necessary for many of the Government Departments concerned to make available the information in sufficient detail for programming research."

During evidence the Director General, Scientific and Industrial Research has stated that "the CSIR over the last several years has been requesting both the Technical Development Wing and the Planning Commission to indicate to it from time to time problems which they would like us to tackle. Till about 1962-63 the reply invariably from Technical Development was that we were catching the wrong end of the stick, that all that they were interested in was that at suitable occasions, specially in the licencing committee where we were represented, we should tell them that these were the matters where we could supply with the technical know-how and they need not give it to any outside party." He has further stated that "there is no systematic machinery yet to get information from Government and to pass it on saying that these are the deficiencies and that we should work on them. The selection of research programme has been so far made purely on an *ad hoc* basis."

When asked whether it should have been more useful if the C.S.I.R. and each laboratory had been assigned some definite projects which are of urgent importance for the national economy, to be developed within a specified period and whether it is not possible to make such an assessment of projects, the Director General replied that "it should have been done and it is also possible."

To a question whether C.S.I.R. was consulted or contacted at the time of the formulation of the Third Plan, the Director General replied in the negative. He, however, added that at the instance of C.S.I.R., the Planning Commission had constituted a Working Group for formulating the Fourth Plan of the C.S.I.R. under the Chairmanship of Director General, Council of Scientific and Industrial Research.

The representative of the Ministry of Industry stated during evidence that "it is not easy to sit here in the office and produce projects for the laboratories to take up for research and that this should really come about by a cooperative working between the industry and the C.S.I.R. In the recent past there has been a very close association."

It is well known that research is a slow process and takes time to produce results capable of being utilised. It is, therefore, very

necessary that research programmes of the laboratories should be anticipated and spelt out in clear terms well in advance to enable the laboratories to produce results. The Committee consider that it would be advantageous if in the light of the industrial development envisaged over the next two Plan periods, an overall planning of research programme for the national laboratories and other research institutions, is done as a part of the national policy well in advance so that the requisite know-how may be available to the industry at the appropriate time. The Committee feel that the lack of clear cut assignments, oriented to the requirement of the industry has been mainly responsible for tardy contribution made by the laboratories to the development of indigenous technology and know-how in the past.

They suggest that a committee consisting of Director General, C.S.I.R., the representatives of the Planning Commission, Ministry of Industry and Directorate of Technical Development may be set up to identify the research problems to be undertaken by the research institutions on a long term basis, in the light of perspective plan for two Plan periods and review the same at suitable intervals.

C. Selection of Research Problems

24. The procedure followed by the National Physical Laboratory for the selection of research problems is as follows:

Every research problem to be undertaken is suggested by the Head of the Division/Sections in consultation with the Director. The same is scrutinised by the Scientific Sub-committee and recommended for final approval by the Executive Council. It has been stated that while preparing the programme of work, emphasis in the selection of projects has been mainly on its immediate application to industry, such as (a) study of raw materials and semi-finished products for established industries; (b) development of new industries in the country, and (c) developmental testing of a variety of products manufactured in the country—an activity which helps new industries to make a better quality product. It has been stated that the priority of projects thus undertaken is being considered in the context of country's requirements in the following order:

(i) Defence;

(ii) Import substitution;

(iii) Export promotion;

(iv) Promotion of indigenous know-how.

It has been stated in a written note submitted to the Committee by the National Physical Laboratory that "there is need to have better contacts with the Government Departments and industry for selecting problems for solution at the laboratory."

During the course of evidence, the Director General for Scientific & Industrial Research stated as follows:

> "I had a big conference with the scientists of the laboratory and I indicated that that was not the correct way to formulate the problems. It was better to put it not division-wise not just listing the headings like in the text book, the aspects or subjects and the problems should be more correctly identified and adopted. In June, 1964, the programme was recast on the project basis, with time targets. This is the first time it has been done in National Physical Laboratory. We must give them some time. They are now working on those lines. I, personally, am quite satisfied that a basic change has been made. They have formed advisory panels of industrialists and scientists to scrutinise each one of these projects. The programme was formulated in June, 1964 and reviewed in September, 1965 and modified to some extent and is now moving forward."

In this connection, the Committee would like to draw attention to the recommendations made by the Zuckerman Committee regarding the "obligations falling on Research Organisation" while selecting research problems, which are reproduced below:

> "We consider that all Government organisations controlling establishments engaged in applied research and development should review their arrangements both at the Headquarters and at each of their research establishments, to see how far they provide satisfactory answers to the following questions:
>
> (a) Are they adequately informed of relevant research being done or planned in other Government research establishments, universities, colleges of technology, industrial research associations and individual firms; and do they encourage organisations outside the Government, either voluntarily or by extra-mural contracts, to fill in gaps in the overall research effort relevant to their respective fields?

(b) Are contacts with the administrative and executive branches of Government departments as users or potential users, adequate in practice as well as on paper?

(c) Is their knowledge of industry sufficient to enable them to understand the user's business and to help him to formulate his needs for applied research?

In regard to the selection of individual projects, the Zuckerman Committee has stated as under:

"When it comes to the choice of individual projects for applied research and development, we recommend that those responsible for the selection (or approval of the selection) should ask themselves the following questions:

(a) Has there been close collaboration between the user and those responsible for research and development in agreeing requirements and priorities and defining them as specifically as possible?

(b) Could the requirements be made by using or adapting techniques, processes or equipment already in existence or under development either in this country or abroad?

(c) Is the project technically feasible within an acceptable period of time, having regard to the current state of scientific knowledge?

(d) Has the best possible estimate been made of the cost of completing the project by a given date in terms of money and scientific manpower? Would it be advantageous to investigate the project more closely, *e.g.* by way of a project study, before a final commitment is made?

(e) Is this the first project of its kind? And if so, has allowance been made for the inexperience of those carrying out the feasibility and project studies?

(f) Would the work be best done in a Government establishment or elsewhere? Are there, within Government, resources available (in particular, staff of the necessary competence) to carry out the project? If not, is the project important enough to justify recruiting extra staff and paying for extra equipment? Should the project be carried out under an extra-mural contract placed

with industry or with a university or college of technology?

(g) Has the potential market—home or overseas—for the new equipment, technique or process been adequately considered?

(h) Where appropriate, has the estimated cost of producing the equipment or applying the technique or process, when developed, been taken into account? To what extent will industry have to learn to build up new manufacturing techniques?"

The Committee appreciate that selection of projects is a difficult task—first of all it is necessary to locate the areas in which research is needed and may yield good results, and secondly to determine how many of these could be fruitfully undertaken at a given time with the resources of a laboratory. It is also essential to ensure that there will be full and effective coordination and no unnecessary duplication of research work, and that research planned in a laboratory is not already being done at other laboratories or institutions without proper consultation and coordination. The task is even more complicated for the National Physical Laboratory where for historical reasons, the headings of the projects are given 'from text books like Solid State Physics Projects' as admitted by Director General, Scientific and Industrial Research during evidence—a practice which the Committee feel should have been abandoned long ago. The Committee recommend that National Physical Laboratory should evolve an effective machinery for locating the needs of industry and user departments within the scope of its objectives and select projects which will yield quick returns. The Committee further suggest that the principles enunciated by the Zuckerman Committee (U.K.) for selecting projects for applied research which provide valuable guidelines in this regard, should be considered for adoption by the national laboratories in the country.

D. Project Reports

25. It is usual for every research laboratory to draw up in detail its annual research programmes, indicating the number of items to be taken up during a year, their objectives, scientific personnel and equipments required, time target, etc. Such programmes are presented in the form of project reports for consideration and approval of the Scientific Sub-committee of the Executive Council of the Laboratory in the first instance and then of the Executive Council itself. The Laboratory embarks upon its programme of work only after seeking approval of the Executive Council.

26. The Executive Council of the National Physical Laboratory, while reviewing the programme of research work for 1964-65 observed in April, 1964 that the "programme of work as drawn up at present was not quite clear and that it should be recast on the basis of detailed information such as the objective of the project, personnel, apparatus and equipment required, present stage of work and future lines of research, and the probable period required for completion of the work; the programme so recast be submitted to the Scientific Sub-committee." The Executive Council had also decided that the progress report of the work done during 1963-64 should also be recast project-wise before the same is submitted to the Sub-committee.

27. The Scientific Sub-committee of the Executive Council which considered the progress of research work of the National Physical Laboratory for 1963-64 and programme of work for 1964-65 suggested in June, 1964 that the following information should be given in the project reports:

(1) The code number should indicate the type of the project, *viz.* whether it was fundamental, applied, developmental or purely routine.

(2) The royalties and test fees earned Division-wise should be given.

(3) The contribution of each project to the national economy, either as regards finance, additional knowledge or technical know-how should also be indicated, wherever possible.

(4) The basis on which conclusions were carried out, *e.g.* saving in foreign exchange should be given.

28. The Scientific Sub-committee was also of the view that the aim of undertaking any particular project should not merely be the publication of papers, but it ought to have some industrial application as well, as defined in (3) above.

In September, 1965, the Scientific Sub-committee had to observe again as follows:

"It was also felt that many of the projects so far reported are not really projects but may be termed as problems or investigations. A project should have a definite aim and be of limited nature, so that a completed report could be brought out in a reasonable time and should ordinarily involve an expenditure of not less than Rs. 25,000.00. The others may be considered as short-term problems or investigations.

Projects on which no work has been done should be tabulated and shown at one place without giving any additional information.

When completed, a project report should be brought out and circulated to the Members of the Sub-committee and the Executive Council and also to interested parties."

29. The Committee also note that the 14th Directors' Conference which was held in December, 1964 had also laid down that "once the projects have been chosen tentative plans of action would be drawn up for each of them, along with a time target for completion."

30. The representative of the National Physical Laboratory has stated during evidence in January, 1966 that the project report for 1965-66 has also not been drawn up in accordance with the various suggestions made by the Executive Council and its Scientific Sub-committee. In February, 1966 it has been stated in the written reply furnished by the National Physical Laboratory that "Action is being taken to separate the projects and problems. Most of the projects of 1965-66 will be carried over to the next year—1966-67. The projects for 1966-67 are being formulated."

During the course of evidence, the Director General stated that "they (i.e. NPL) put their headings from text books like Solid State Physics Project. It is not a project. You have to enunciate exactly what you want to do in Solid State Physics, why you want to do it, how long will it take you to do it, what stage you will reach after one year, two years and so on. That is the methodology of putting your problems in the form of projects and then the scientist knows exactly what he is doing and arriving at; it does not stunt your initiative or individuality; it gives more direction to his thought and thinking."

The Committee regret to note that in spite of the clear directive of the Executive Council of the National Physical Laboratory in April, 1964 for recasting of the project reports for 1964-65, National Physical Laboratory has not been able to carry out the directive till date. Even the project report for 1965-66 has not been prepared in accordance with the suggestions of the Executive Council and the decisions taken at the 14th Directors' Conference. On the other hand the Committee note that at Central Electronics Engineering Research Institute, a sister laboratory, a project proforma is drawn up which more or less conforms to the suggestion of the Executive Council and which inter alia gives a survey of the potential users, the technical

approach to be followed, the main requirements, the major steps and the estimated time for completion of each of the major steps as well as the entire project. The Committee cannot help observing that there appears to be persistent resistance at the National Physical Laboratory to adopt new ideas and progressive procedures in such matters.

It is really surprising that neither the C.S.I.R. nor the Executive Council of the National Physical Laboratory could so far ensure that the National Physical Laboratory formulates its programme of research and the project report in accordance with the procedures laid down by them. The Committee suggest that the C.S.I.R. should lay down standard proformas for the preparation of project reports by the national laboratories and ensure their implementation in actual practice.

E. Association of Scientists with too many Projects

31. The Executive Council of National Physical Laboratory had observed in October, 1964 that in many cases, large number of projects were being undertaken by the same scientist who also in several cases acted as project leader. It had decided that it was neither necessary nor desirable that the Head of the Division should always be the project leader but that once a project had been drawn up, it was for the Director to decide as to who should be the project leader. The Executive Council had further decided that any one of the scientists should not be associated with more than three or four projects.

From the Report of National Physical Laboratory for 1964-65, it is noted that individual scientists of some of the Divisions have been associated with a number of projects, *e.g.*:

(1) Acoustics Division . . .	One scientist has been associated with 7 projects.
(2) Analytical Chemistry Division .	One scientist has been associated with 10 projects.
(3) Development-cum-Production Unit of Electronic Components	One scientist has been associated with 6 projects.
(4) Electricity Division . . .	One scientist has been associated with 9 projects.
(5) Heat Division	One scientist has been associated with all the 20 projects.
(6) Heat and Power Division . .	One scientist has been associated with all the four projects.
(7) Radio Propagation Unit . .	One scientist has been associated with 9 projects and another with 8 projects.
(8) Solid State Physics Division . .	One scientist has been associated with 10 projects.

32. It is further noted that many of the projects of 1964-65 have been continued in 1965-66 presumably with the same staff. The National Physical Laboratory has not furnished the Project Report for 1966-67 to the Committee but the Laboratory has stated that "most of the projects of 1965-66 will be carried over to the year 1966-67."

The Director General for Scientific and Industrial Research has stated during evidence that action is being taken to implement the directions of the Executive Council.

The Committee are in agreement with the decision of the Executive Council of the National Physical Laboratory that no scientist should be associated with more than three or four projects as otherwise the senior scientists tend to associate themselves with all projects of their division irrespective of the fact whether they could devote their time effectively to those projects and whether they have the technical aptitude for all the projects. Further the association of one scientist with many projects, apart from causing delays in the progress of projects, does not allow the junior scientist to share the pride of participation in the project which is necessary to enthuse him.

The Committee regret to note that action to implement the above decision of the Executive Council of October, 1964 is being taken only now. They hope that at least now this decision will be implemented in right earnest. The Committee further suggest that the Council of Scientific and Industrial Research should ensure that this principle is observed in other laboratories also.

F. Costing of Research Projects

33. The Committee desired to know the expediture incurred by the National Physical Laboratory on individual research projects. It has been stated by the National Physical Laboratory in the written replies furnished to the Committee as well as during the course of evidence, that the Laboratory has not been maintaining separate accounts for different research projects and as such no indication could be given of the amount spent on them.

The Committee note that the 14th Directors' Conference (1964) had recommended that the "methods of accounting should be streamlined so that without increase in the accounts staff at least a broad data may be available about the overall costs of the individual projects."

The representative of the C.S.I.R. has admitted during evidence that "the method of accounting in the research laboratories is com-

pletely wrong. The present method of accounting leaves a person without any knowledge as to what has been spent on a project or division, whether the expenditure has been infructuous or has resulted in any return. We are now reorienting the accounting side of the project. There will be then two types of Budget. We have not yet done this. Now there is no separate account."

The Committee are surprised that even though the need of costing of research projects was felt by the Council of Scientific and Industrial Research, the same has not been implemented in the National Physical Laboratory. The Committee would like to draw attention to the recommendation made in this connection by the Zuckerman Committee (U.K.) that "in the control of applied research or development, an assessment of results achieved and of likely future progress should always be carried out concurrently with a review of expenditure to date and estimated future costs. Such dual assessments should be undertaken at intervals of not more than three to six months, and the results should be made available not only to higher management but also, as a way of encouraging cost consciousness, to those who are directly responsible for individual projects i.e. down to Principal Scientific Officer level, or possibly lower."

The Committee strongly urge that methods of accounting in the national laboratories should be reoriented in such a way as to ensure that estimated and actual costs of individual research projects are available. They would also emphasise that the progress made in each research project should be reviewed by the Director of the Laboratory with the Project Leader once a quarter with specific reference to the actual and anticipated expenditure so as to achieve maximum economy consistent with results.

G. Expenditure during the three Plan Periods

34. A brief review of the allocation made to and the actual expenditure incurred by the National Physical Laboratory during the First, Second and Third Plan is given below:—

(i) First Plan

Grant

	Recurring	Capital	Pilot Plant
1951-52	Rs. 16,75,500	Rs. 18,75,000	..
1952-53	Rs. 26,58,400	Rs. 17,00,000	..
1953-54	Rs. 25,14,600	Rs. 2,50,000	..
1954-55	Rs. 24,93,400	Rs. 46,000	..
1955-56	Rs. 27,11,200	Ks. 95,000	Rs. 5,000

Actual Expenditure

	Recurring	Capital	Pilot Plant
1951-52	Rs. 16,32,091	Rs. 22,58,812	..
1952-53	Rs. 23,45,568	Rs. 8,05,607	..
1953-54	Rs. 23,90,033	Rs. 3,89,780	..
1954-55	Rs. 23,93,000	Rs. 1,87,100	..
1955-56	Rs. 25,62,000	Rs. 92,000	Rs. 5,000

(ii) SECOND PLAN

Grant

	Recurring	Capital	Pilot Plant	Total
		(In lakhs of rupees).		
1956-57 . . .	27·390	1·560	2·390	31·340
1957-58 . . .	26·240	2·750	2·380	31·370
1958-59 . . .	29·596	3·850	3·497	36·943
1959-60 . . .	33·198	4·153	4·850	42·201
1960-61 . . .	34·200	3·660	5·333	43·393
				185·247

Actual Expenditure

	Recurring	Capital	Pilot Plant	Total
		(In lakhs of rupees)		
1956-57 . . .	25·760	1·101	1·089	27·950
1957-58 . . .	26·167	2·735	2·326	31·228
1958-59 . . .	29·154	3·678	3·248	36·080
1959-60 . . .	33·121	3·931	4·851	41·903
1960-61 . . .	31·733	3·624	4·875	48·232
				177·393

(iii) THIRD PLAN

Garnt

	Recurring	Capital	Pilot Plant	Total
		(In lakhs of rupees)		
1961-62 . . .	37·952	6·000	6·000	49·952
1962-63 . . .	36·295	2·142	5·460	43·847
1963-64 . . .	33·460	2·897	7·650	44·007
1964-65 . . .	36·488	5·578	10·922	52·988
1965-66 . . . (Revised Estimate)	43·247	7·300	15·672	66·219
				257·013

Actual Expenditure

	Recurring	Capital	Pilot Plant	Total
		(In lakhs of rupees)		
1961-62 . . .	37·850	5·057	4·954	47·861
1962-63 . . .	36·236	2·120	5·433	43·789
1963-64 . . .	33·699	2·898	7·713	44·310
1964-65 . . .	37·204	5·495	10·921	53·624
			(Till 1964-65)	189·584

The National Physical Laboratory has proposed the following financial requirements during the Fourth Plan period :

	(Rs. in lakhs)
1. Recurring	349·75
2. Capital (Equipment, building and furniture) . . .	80·25
3. Pilot Plants.	60·00
4. Staff Quarters	69·00
TOTAL	559·00

35. From the Fourth Plan proposals of the Laboratory, it is noted that apart from undertaking developmental testing, the labpratory would continue the major research projects in which it is currently engaged. In addition a new Materials Division will be set up at the National Physical Laboratory to develop new techniques and locate sources of raw materials for the manufacture of articles at present imported. The Committee note that the projects mentioned under various Divisions of the National Physical Laboratory do not focus attention on the benefits of the projects.

During evidence, the Director General has stated that the Fourth Plan of the C.S.I.R. including that of the National Physical Laboratory was framed in July, 1965 by a Working Group of the Planning Commission of which the Director General was the Chairman. There was a representative of the Directorate General of Technical Development on the Working Group. The Director General further stated that "it would be very difficult for me to say what specific proposals were made by the representative of the D.G.T.D. but he is a party to the Plan for the N.P.L. for the Fourth Plan."

When asked to indicate what specific projects for the development of indigenous know-how have been given to the National Physical Laboratory during the Fourth Plan Period the Director General has replied "there is none, as such given officially but through consultation and discussions problems are selected by us."

To another question, the Director General has replied that "when the Fourth Plan of the N.P.L. was drafted, it was not oriented to the needs of (i) Defence (ii) Import substitution (iii) Export promotion (iv) Agriculture Production and Promotion of indigenous know-how. However, steps were being taken to categorise the list of items in the above manner."

The Committee note with concern that the Fourth Plan proposals of the National Physical Laboratory indicate only the broad financial outlay and do not specify the projects in accordance with their relative significance from the ponit of view of defence, import substitution, promotion of indigenous know-how, etc., for which the financial outlays are earmarked. The Committee feel that the Study Group of the Planning Commission should be provided with such vital statistics as number of projects under various Divisions and their significance in national economy, the progress made in respect of each of the projects, the probable date of completion and approximate expenditure etc. These statistics are important even for the National Physical Laboratory itself to achieve physical targets in respect of its various schemes. The Committee are afraid that the procedure

followed by other Laboratories of C.S.I.R. for preparation of Plan proposals is also the same as followed by National Physical Laboratory and strongly recommend for its revision so as to incorporate all the necessary data required to enable the planners to examine the programme of each laboratory in the context of national economy.

The Committee would therefore strongly urge that the National Physical Laboratory should take immediate steps to reorient its research programme in the context of defence requirements, import substitution and building up of indigenous know-how.

The Committee are distressed to note that neither the Planning Commission, nor the Ministry of Industry/Directorate General, Technical Development nor any other user departments have indicated specific areas where the potentialities of the National Physical Laboratory could be fruitfully exploited during the Fourth Plan. The Committee deplore this lack of contact between the National Physical Laboratory and the potential users even among the Government departments. They, however, hope that various Technical Committees set up as a result of the recommendations of the Conference of Research and Industry held in December, 1965 would be able to indicate specific problems to National Physical Laboratory for solution during the Fourth Plan period.

H. Perspective Plan

36. The Committee have been informed that National Physical Laboratory has tentatively prepared a perspective plan indicating broad fields of research where it would be active during the next 10-15 years. It has been stated that the plan does not indicate the areas to be developed by indigenous efforts and those in which foreign collaboration may be necessary. The Plan has also not been circulated to scientists/user departments/related institutions for suggestions.

The Committee are glad to note that the National Physical Laboratory has prepared a perspective plan for the next 10-15 years. The Committee recommend that the perspective plan of the National Physical Laboratory should be fitted into the national plan for the development of research within the country and should be based on the perspective plan of industrial and scientific development of the country for the next three Plan periods. They further suggest that this should be widely circulated amongst the industry, user departments, research institutions and scientists for inviting their suggestions so that the plan could be improved upon and duplication of research efforts among institutions could be avoided.

CHAPTER IV

SPONSORED RESEARCH IN NATIONAL PHYSICAL LABORATORY

37. It has been stated that the N.P.L. has taken several steps to develop contacts with user departments. Instead of waiting for the problems to come from the Defence, the Laboratory of its own volunteers information as to what they are in a position to do. Similarly, the scientists at N.P.L. have attended the meetings of Railway Research Board and have undertaken some work for the Railways. The scientists of the N.P.L. are represented on 120 ISI Committees and 26 miscellaneous committees of other Ministries so as to maintain liaison with Government departments and industry. The Laboratory attends to enquiries of small scale industries for whom developmental testing is being carried out.

38. A list of the research problems which were referred to N.P.L. by the industry and other departments for solution during the years 1962 to 1965 is given in the Appendix III. A brief summary is given below:

Agencies who have referred problems to NPL during 1962-1965	*Number of problems.*
(1) Industry	16
(2) Ministry of Defence	11
(3) Railways	5
(3) C.S.I.O.	1
(5) Indian Standards Institution	4
(6) Universities/Institutes	14
(7) Other Ministries/User Deptts.	3
	54

While the Committee note that the N.P.L. has been solving research problems referred to it by the Industry and user departments, they consider that the number of such problems—54 in four years—has been very small in the past, considering the facilities available at the N.P.L. and the number of problems requiring solution. The Committee are aware that in India both public and private industries

are less research minded than those in the advanced countries and do not have proper machinery for formulating their requirements for research to be undertaken at the laboratories. The Committee consider that National Physical Laboratory should try to create an atmosphere whereby industry is encouraged to approach it with its technological problems. The Committee have no doubt that N.P.L. can gain the confidence of the industry if successful solutions of their problems are found expeditiously and communicated to them urgently.

The Committee are sure that National Physical Laboratory can be of great help to small scale industries which have largely to depend upon indigenous know-how for their future development. The Central Small Industries Organisation can do a great deal in formulating the requirements of the small scale industries which require research to be carried out at the National Physical Laboratory.

Conference of Research and Industry

39. A two-day conference of research and industry was organised by C.S.I.R. in Delhi in December, 1965 with a view to promoting self-reliance on industrial know-how. The main findings of the 15 working groups which had been set up by the Conference is that in the near future a major break-through in import substitution of know-how could be expected in the fields of electronics, food production and preservation, design engineering, fabrication of industrial and chemical plants and control and recording instruments. It has been stated that the Conference would be followed up by the compact body of experts for each major industry whose job would be to produce a plan for complete self-reliance in as short time as possible.

The Committee welcome the steps, though belated, taken by C.S.I.R. for organising the Conference of representatives of research and industry to build a bridge which may eventually open a new era of industrialisation in the country. The Committee recommend that such conference should be held periodically so that there is utmost co-ordination between research and industry and research can render the expected help to industry.

PL-480 Schemes

40. The National Physical Laboratory is working at present on the following PL-480 schemes in co-operation with the National Bureau of Standards of U.S.A.:

(i) Study of F-layer Effects with Doppler Fading Technique.

(ii) Determination of physical properties of, and iradication effects on ironic crystals and semi-conductors with a view to develop more useful solid state devices.

The main objectives of the two projects are stated to be as under:—

(i) The Doppler Fading Technique has been developed at the National Bureau of Standards and has proved to be a very powerful method of studying the effects of solar flares on the F-layer of the atmosphere.

(ii) The main objective of the second scheme is to produce semi-conductors of desired properties. The ultimate aim is to use these semi-conductors for solid state devices such as thermally sensitive resistors, photo cells, thermo couples, refrigerators etc.

The first scheme was sanctioned in June, 1963 for a period of three years and Rs. 1,14,500 were granted for the research scheme by the National Bureau of Standards authorities. The second scheme was sanctioned in December, 1963 for a period of two years. Rs. 1,53,000 were also granted for it by the National Bureau of Standards.

As on 30th September, 1965 the expenditure on the 1st and 2nd schemes has been Rs. 29.024 and Rs. 15,518 respectively.

The Committee regret the slow progress made by the N.P.L. on the two PL-480 research schemes. The Committee would urge that once such schemes have been undertaken in co-operation with foreign institutes, they should be completed expeditiously within the stipulated time schedules. The Committee further suggest that while selecting projects under foreign assistance in future, the Laboratory should always bear in mind that the selected projects fit in with the objectives of the laboratories, so that the energies of the scientists are not dissipated on projects of extraneous nature.

CHAPTER V

COMMERCIAL EXPLOITATION OF PROCESSES

41. The National Physical Laboratory has so far evolved 22 processes successfully. Their particulars are given at Appendix IV. It has been stated that quite a few of these products, developed by the Laboratory, were not previously manufactured in the country. The N.P.L. has thus created new industries which have also provided additional employment potential.

42. Out of the 22 processes, 7 processes have been licensed through National Research Development Corporation for commercial production. Their detailed particulars are given below:

Sl. No.	Title of the process	Year of successful completion at the Laboratory	Date on which the process was handed over to NRDC for commercial exploitation	Date on which the process was actually given by NRDC for commercial exploitation	Annual value of Production	Royalties earned
1	2	3	4	5	6	7
					Rs.	Rs.
1	Silver Mica Capacitors	May, 1956	May, 1956	1957-1959	9,60,210*	44,613
2	Ceramic Capacitors	Sept., 1956	Sept., 1956	Nov.1960	5,40,000*	25,484
3	Carbon Slabs and Rods	Jan. Feb. 1953	June-Aug. 1953 (CSIR was approached)	11-1-1954	2,13,670†	10,600
4	Duplicating, Printing and Allied Inks.	1945	July, 1957	Oct., 1958	7,02,600†	69,899
5	Indelible Ink	1951	1958	1-4-1961	1,43,000†	3,553
6	Anti-rust Solution	1951	1958	1-10-1961	6,851†	182
7	Cheap hearing Aid.	1962				

†1964-65
*1963-64

In regard to these processes the National Physical Laboratory has further stated that:—

(1) Practically the entire requirements of silver mica capacitors are produced in the country.

(2) The number of ceramic capacitors produced by the Licensee Bharat Electronics Ltd. which are given exclusive licence is about 2.5 million. The Bharat Electronics Ltd. propose to produce 6 millions in 2 years and later 20 millions.

(3) The production of carbon slabs for making brushes is increasing year by year. Some of the requirement is met from imports. The value of imports varies from Rs. 1 to Rs. 1½ lakhs per year.

43. The Committee have been informed that seven processes developed by the N.P.L. are intended to be given free to the industries. The particulars of these processes are as under:—

Sl. No.	Name of the Process.	Year of successful completion at the Laboratory	Year of commercial exploitation	Value of Production
1	Magnetic fluid for crack detection.	1958	1960	..
2	Improvements in or relating to Shaft and bearing mechanism. . .	1957	1960-61	..
3	Electrolytic engraving or etching on metals or alloys thereof. .	1960	1960-61	..
4	Transistorised community receivers	1959	1960-61	..
5	An Improved System . . .	1956	1960-61	..
6	Improvements in or relating to oxidising salt.	March 1959	1960-61	..
7	Manufacture of magnetic oxide of iron.	1957	1961-62	..

44. The particulars of the remaining processes which are at present being exploited through departmental production at the N.P.L., are given below:—

Sl. No.	Title of the process	Successful completion at the Lab.	Year of Departmental production		Value of production (Rs.)
1	Ceramic Capacitors	1959	1960-61		5,40,000 (during 1963-64)
2	Ferrites				
	(i) Soft Ferrites	1962	1964		50,796 (during 1964-65)
	(ii) Hard Ferrites	1965	1965		
3	Porcelain rods	1963	1962	1962-63	6,156
				1963-64	4,074
4	I. F. Cores	1963	1963	1963	10,179
5	Railways Signal Magnet	1964	1964-65		3,000
		(3000 pcs. were produced experimentally and supplied to one user)			
6	A tunable magnetron	1956			
		(One piece was produced but the work was discontinued as Dr. Amarjit Singh had joined C.E.E.R.I., Pilani)			
7	Metal detector. Battery operated	1954	1954	1954-55	8,975
	Transistorised	1960	1962	1962-64	71,500
8	Traffic signals.	1962	1962	1962-64	28,800
				1964-65	4,800
				1965-66	5,100

As to the need for departmental production the representative of the N.P.L. has stated during evidence that "as soon as a process is satisfactorily developed, it is brought to the notice of C.S.I.R. and the N.R.D.C. Departmental production is undertaken with a view to supplying the produce to the consumers with an idea of getting its commercial acceptability".

Asked about the reasons for delay in commercial exploitation of processess developed in the Laboratory, the Committee have been informed in a written note that: "a scientist could only take the responsibility for the scientific solution of the problem, but cannot be

held responsible for the commercial exploitation of the same as there are many extraneous factors such as legal in contractual work, economics and the licensing policy of the Development Wing".

It will be seen that only 22 processes have been successfully evolved so far by the N.P.L. for commercial exploitation. Out of these about half a dozen only are being produced on a commercial scale. In many cases the annual value of production is not very large. Considering the heavy expenditure that has been incurred on the working of the N.P.L. during the last 15 years, the Committee cannot help feeling that its performance in the field of industrial research during this period has been rather disappointing. It would appear that in the past, due care was not given to the selection of research programmes which should have been oriented towards industry and capable of yielding quick results.

It is regrettable that in three cases, there has been a delay ranging from 7 to 9 years in handing over the processes to the National Research Development Corporation after their successful completion by the N.P.L. Thereafter there have been further delays ranging from 1 to 3 years in giving the processes for commercial exploitation by the N.R.D.C. The result has been that in some cases, it has taken 10 years to exploit a process for commercial production after it is stated to have been completed successfully by the N.P.L.

The Committee note with regret that six out of seven processes developed by the National Physical Laboratory and intended to be given free to industry remain yet to be commercially exploited and that a few of the processes such as Carbon Slabs, Ceramic Capacitors, etc. though established as long back as 1959-60 have not been fully exploited to meet the requirements of the country, thus necessitating imports of the commodities. The Committee are also not happy that as many as eight processes should still be exploited by departmental production. The Committee feel that the responsibility for ensuring expeditious commercial exploitation of the processes, as soon as they are successfully developed at the Laboratory, devolves both on the Laboratory itself and the National Research Development Corporation whose main aim is "to develop and exploit in the public interest, for profit or otherwise, inventions, whether patentable or otherwise including technical and engineering 'know-how' of processes developed by the C.S.I.R. laboratories." Research and development are continuous processes; and therefore the Laboratory should not remain in seclusion after successful completion of processes but should also maintain closest links with National Research Development Corporation and the Directorate General, Technical Development to see that

successful processes are being fully exploited for the benefit of the country. The Committee suggest that the successful processes should be widely publicised to stimulate interest of industrialists and users.

The Committee also note that recently the C.S.I.R. has sanctioned an Industrial Engineering Section for the National Physical Laboratory. The Committee hope that this Section will render necessary assistance resolving technical problems faced in translating the processes developed in the Laboratory to large scale manufacture.

45. Some of the important processes developed by the N.P.L. are discussed in the following paragraphs:

Ferrites

46. Ferrites are a class of magnetic materials used extensively by the radio and telecommunication industry including television. They are fabricated in various forms to suit particular applications. Ferrites used in the radio and television industry are designated as 'Soft' or 'Entertainment' while those used in the telecommunication industry as 'Professional'. It is stated that "They differ only in respect of closer tolerance limits and more stringent specifications, the know-how for manufacture being the same. The requirements of equipment processing, raw materials etc. are also common".

Process for the manufacture of Soft Ferrites

47. The N.P.L. started research work on the manufacture of soft ferrites in 1961-62 and the process was successfully completed in the pilot plant stage in 1962. The project report and the programme to manufacture soft ferrites on pilot plant were approved by a Sub-Committee of the Executive Council in August 1963 and later by the Vice-President of the Council of Scientific and Industrial Research in November, 1963.

Production at Pilot Plant

48. The production of soft ferrites was started at the pilot plant of the N.P.L. in 1964. The average production up to December, 1965 was 9,000 rods per month as against the production programme of 10,000 rods per month. The production has thereafter risen to 20,000 rods per month which are sold through the National Small Industries Corporation both to large and small scale sectors. It has been stated that the quality and cost of soft ferrites produced by the pilot plant of N.P.L. compares favourably with the imported ferrites.

Commercial Exploitation

49. The process for the manufacture of soft ferrites has been patented by N.P.L. Two firms of Poona were licensed in August, 1963 and July, 1964, for an estimated annual production of 40 tonnes and 25 tonnes of soft ferrites respectively. One firm has just gone into production and the other would be in production shortly. In addition, one firm of Delhi and another of Calcutta have been licensed in October and November, 1965 and their estimated capacity of production will be 25 tonnes and 50 tonnes respectively of soft ferrites annually. The royalty will accrue to N.R.D.C. at the rate of 2½ per cent of the sales effected.

It has been stated during evidence that applications for the manufacture of soft ferrites on the basis of N.P.L. know-how have been received from firms of Bombay, Calcutta and Coimbatore. which are under consideration of C.S.I.R.

Demand of Soft Ferrites

50. The Committee have been informed during evidence that the current demand for soft ferrites is about 70 tons and that the demand would go up to 700 tons, in another 10 years. At present all ferrites products are imported except what N.P.L. is producing. During evidence, the representative of the N.P.L. has stated that "when the four factories go into production, their total production capacity will be 100 tons and that should meet the immediate requirements. They can expand also."

The Committee note with regret that though two firms were licensed in August, 1963 and July, 1964 to manufacture soft ferrites with the process developed by National Physical Laboratory, they have yet to go into full production, thus necessitating import of soft ferrites in addition to their production departmentally by the National Physical Laboratory. The Committee recommend that National Research Developmtnt Corporation should ensure that the parties, who are granted licences for commercial exploitation of the C.S.I.R. processes, actually adhere to the stipulated schedules for commercial production, and that the production targets are adhered to by them in actual practice.

The Committee should think that since soft ferrites can be manufactured with the know-how developed by National Physical Laboratory there should be no occasion for allowing foreign collaboration for manufacture of this variety of soft ferrites. Effective measures should also be taken to ensure that production of soft ferrites is

commenced immediately by the firms concerned, with the National Physical Laboratory process, in order to meet all internal requirements so that the import of soft ferrites and departmental production by National Physical Laboratory could be stopped, as early as possible.

Licence for the manufacture of electronic components for radio Industry.

51. In reply to a specific question by the Committee regarding the issue of licence to M/s. Philips India Ltd. for the mnaufacture of electronic component. required by the radio industry, it has been stated by the Ministry of Industry that:—

"M/s. Philips India Ltd. have been granted a licence on the 4th November, 1960 for the manufacture of Radio receivers and another licence for the manufacture of components for the Radio receivers. The items licenced and the capacity are given below:—

Sl. No.	Item	Annual Capacity.
1	Polyestar capacitors. . . .	3·84 million nos.
2	Valve holders.	960·000 nos.
3	Electrolytic Capacitors (high voltage and miniature) . . .	1·92 million nos.
4	Carbon resistors . . .	13·2 million nos.
5	I. F. coils.	1·08 million nos.
6	Wave range switches . . .	540,000 nos.
7	Potentiometers . . .	1·7 million nos.
8	Loudspeakers	540,000 nos.
9	Ceramic capacitors (tubularnormal and miniature)	9·6 million nos.
10	Variable condensers . . .	936,000 nos.
11	Trimming capacitors (wire/ceramic/ air)	7·14 million nos.

It has been stated that:

"The firm was initially given a period of 12 months for effecting the expansion, which was later extended up to 30th November, 1963. Within that period they took up on hand

the manufacture of 8 items but production was not started in respect of Electrolytic capacitors, Carbon resistors and I.F. coils. The firm was therefore given another extension up to 30th November, 1964. Even by this date the firm could not establish capacity for the three items mentioned above though effective steps were taken. The firm therefore requested for extension of time up to 30th November, 1966, and was given time till 30th November, 1965. The firm reported in October, 1965 that capacity for all items has been established or would be established shortly excepting Carbon resistors. Some imported raw materials were required for Carbon resistors and that the application for such import was under consideration of the Government and pending receipt of the raw materials the production of this item will be delayed. Therefore, the firm requested for time till 30th November, 1966. Extension has, however, been given up to 30th June, 1966 only."

At the time of the factual verification of the Report, the Ministry of Industry have stated as follows:—

"The first extension was necessitated by the Government's not being able to find the required foreign exchange for import of capital goods. The firm was asked to find the foreign exchange itself and the loan negotiated by M/s. Philips for this purpose was approved only in February 1962 and the import licence itself was issued only in June, 1962. Hence the firm asked for time till November, 1963 which had to be agreed to. As regards further extension it is to be noted that when out of 11 items production has been established in respect of 8 items the licence has to be treated as implemented. Partial revocation of the licence is not permissible under the Industries (Development & Regulation) Act, 1951 and if M/s. Philips were to be restrained from the manufacture of the other three items the only way would have been by amending the licence to effect deletion of these items. This, however, could be got done only with M/s. Philips' consent as effective steps for the manufacture of these three items also had been taken and under the Act once effective steps had been taken the licence cannot be amended without the consent of the licensee.

Apart from these technical difficulties the reasons for delay were genuine. Even now the firm is not able to commence manufacture of carbon resistors not because of any

unwillingness or failure on their part but because they are not able to obtain imported raw materials necessary for the carbon resistors. As such in the circumstances it was thought proper to extend the validity period of the licence.

As regards capacity there is ample scope available for the manufacture of radio components and we are encouraging scheme for the same. Development of indigenous know-how, therefore, cannot be stated to have suffered any set back due to the issue of this licence to the firm with foreign collaboration."

The Committee deprecate the tendency to give such a large number of licences to a firm with foreign collaboration. They also feel unhappy at the repeated extensions, given to the firm to establish manufacture of these items.

The Committee note that the delay in the manufacture of the electronic components was mainly due to the non-abailability of foreign exchange. They feel that in cases where foreign collaborations are agreed to, the provision of foreign exchange requirements for the unit should be generally made the responsibility of the foreign collaborators.

The Committee would like to point out that granting of such blanket licence for the manufacture of large number of items is apt to dampen the research effort within the country and act as a disincentive to the manufacture of products with indigenous know-how. The Committee recommend that before negotiations for foreign collaboration are started or the capacity of the existing licences is increased, the concerned Ministries/Directorate General, Technical Development should contact the national laboratories and other research units to find out whether and when they can establish the necessary know-how.

Process for the Manufacture of Professional Ferrites

52. The major portion of the ferrites required is "entertainment" ferrites. These are required for radio manufacturing industry, while there is a fair demand for "professional" ferritest which are required by the telecommunication industry. Both "entertainment" and "professional" ferrites are of the soft variety but differ in performance and other particulars. The professional ferrites are of a high electrical standard and are made to very close electrical and mechanical tolerance limits, while the entertainment types need not have these features.

In August, 1963, Indian Telephone Industries started negotiations with M/s. Philips, Holland for technical collaboration for the manufacture of ferrites. Philips were invited to offer know-how for the "professional ferrites" being the specific requirements of the Indian Telephone Industries and also the "entertainment" ferrites for the radio manufacturing industry. The Council of Scientific and Industrial Research intimated to the Ministry of Industry on the 9th August, 1963 that "National Physical Laboratory is in a position to supply know-how for specialised quality of ferrites required by the Indian Telephone Industries". National Physical Laboratory also informed the Managing Director of the Indian Telephone Industries in August, 1963 that "National Physical Laboratory is in a position to supply know-how for specialised quality of ferrites required by the Indian Telephone Industries. We also wrote in August, 1963 to the Managing Director of the Indian Telephone Industries offering co-operation and saying that National Physical Laboratory will undertake to produce ferrites of the requisite quality required by them in its pilot plant and requesting them to send some samples. Indian Telephone Industries however was reluctant to accept National Physical Laboratory process because they said:

(a) Their experience in using the National Physical Laboratory process for Silver Mica Capacitors has not been happy;

(b) There is a gulf of difference between the ferrites they will need and those used by radio industry for which National Physical Laboratory was manufacturing."

During evidence in January, 1966 the Secretary of the Ministry of Communications has informed the Committee as follows:

"We have just been told that some information was conveyed to us, in the second half of 1963. We were told about this that the soft ferrites, that is, entertainment type of ferrites, were being developed and we gave our minimum specifications at that time to the N.P.L. and the exact requirements of ferrites. There are thousands of varieties of ferrites. We gave our requirements. After that for a long time we did not hear anything further. N.P.L. had promised to send us some samples of the ferrites they had produced. Those samples were not sent as far as I know till 1964 and we did not receive the details whether the ferrites would be in accordance with the specifications required. In any case we are not interested in the enter-

tainment type of ferrites. We are mainly interested in the professional type, that is, the hard ferrites."*

53. The Committee note that in January, 1965, the Director General, Scientific and Industrial Research addressed the Secretary, Ministry of Industry, giving the gist of discussions the scientists of the N.P.L. had with the Managing Director of Indian Telephone Industries emphasising that:—

"(a) Indian Telephone Industries is interested in National Physical Laboratory undertaking a development programme for professional ferrites.

(b) Indian Telephone Industries also has a group working on the development of Ferrites.

(c) National Physical Laboratory has offered all assistance to the Indian Telephone Industries group on Ferrite development.

(d) In the alternative National Physical Laboratory is prepared to undertake development work immediately in Ferrites required by Indian Telephone Industries.

The National Physical Laboratory has been asked to give high priority to development of professional ferrites.

The possibilities of setting up a production unit under the Council of Scientific and Industrial Research for making professional ferrites is being examined. National Physical Laboratory scientists are confident of developing them

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*At the time of the factual verification of the Report, the Ministry of transport and Communications have amplified the previous statement as follows:—

"The development of professional ferrites has been under discussion from 1961 between the ITI and NPL. There was a protracted correspondence and, in view of this, in 1963, a letter was issued by the P. & T. Department to Shri T. V. Ramamurthi of NPL given complete details of the types of ferrites required and the mechanical and electrical characteristics and sizes. The letter also referred to earlier unsuccessful efforts by ITI to get samples. This letter also pointed out that samples promised on 5th September, 1963, had not then been delivered. There was no further response to this letter with regard to professional type ferrites required by the ITI. In March, 1965, in a meeting held in the room of Secretary (Industry), NPL, for the first time, stated that they did not at that time have professional ferrites, while earlier they held the view that they were ready to send samples and even promised to do so in a few days. The interest of ITI has been for professional ferrites only and not for entertainment ferrites".

to the specification of Indian Telephone Industries based on their success in controlling and stabilising production of the entertainment ferrites.

It is no longer necessary to pursue negotiations with Philips or any other foreign manufacturer for setting up the manufacture of ferrites in collaboration with them."

Subsequently a meeting was held on the 5th April, 1965 between the Secretary, Ministry of Industry and Director General, C.S.I.R. where representatives of N.P.L. and the Ministry of Communications were also present. Referring to this meeting the Secretary, Ministry of Industry stated during evidence before the Committee in January, 1966 that:

"All these questions of delay are now only historical because all this happened before the April, 1965 meeting at which, having considered all these things, Dr. Zahir and I agreed that we should go ahead with the Philips things. About the middle of December they have written to us, which I have passed on to Shri Jain, saying that their professional ferrites are now almost ready and they can give it to you. Today they have mentioned that they have given it for test to the LRDE, the Defence Laboratory. Therefore, now the more important question of urgency is how soon they expect the report from that end and how soon they can give it to ITI for testing than the previous charges and countercharges about delay and samples having been given which are pre-April 1965 things."

During evidence, the Secretary of the Ministry of Communications has informed the Committee that:

"the main know-how developed by N.P.L. is in respect of entertainment type. Till April, 1965 they had clearly said that they are not yet ready with the professional type. So far as the development taking place within the last one or two months is concerned, we do not know the specifications of the professional ferrites that have been developed. We have not been given the details of the specifications and we have not been given any samples. Therefore, it is not possible to design an electronic equipment round an unknown factor, when we get samples and specifications, we can have another look at it."

The Director General, Scientific and Industrial Research has stated in his evidence before the Committee as follows:

> "Right in the beginning of 1964 we had prolonged discussions with Dr. Ramamurti, Mr. Ranganathan and Mr. Vasudevan over this problem. At that stage we were ready with the entertainment type of ferrites and not with the professional type. The negotiations were also going on with Philips. They insisted that they should have both or none. That was the kind of pistol played on us. Then at a later discussion with Mr. Ramamurti, Mr. Vasudevan and Mr. Ranganathan we agreed that, in view of the fact that we had made enough progress in the direction of processing professional ferrites, it would be better to drop the negotiations with Philips, I had also written a letter to Mr. Ranganathan in January, 1965. However, in April, 1965 we had another meeting with Mr. Vasudevan, Mr. Ranganathan and Mr. Ramamurti. At that time it was pointed out to us that we would be losing so much of foreign exchange in importing the professional type of ferrites and because we were not ready they had to induce the Philips to start making them, and we might also agree to their making entertainment type of ferrites giving them the licence. But in effect we will see that we will not allow them to make the entertainment type. That was the position then to which Mr. Ranganathan has referred. Later on, my colleagues in N.P.L. told me that they were actually ready with the professional type also, and therefore I should request them that no agreement with the Philips should be entered into. I took some time to assure myself of this fact. In the meanwhile we had testing done by L.R.D.E. and then in the middle of December I wrote a letter* to Mr. Ranganathan again saying that we had now reached a stage where no further negotiations with Philips should be carried on."

54. Relevant extracts from the letter* dated the 14th December, 1965 from the Director General C.S.I.R. to the Secretary, Ministry of Industry are given below:

> "The N.P.L. has since then been pursuing developmental work on this item and the laboratory is now fully prepared to supply professional ferrites to the specification of I.T.I. 1

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*This letter has been written after the visit of the Study Group of the Estimates Committee to NPL on the 9th December, 1965 when this matter was discussed with the Director, NPL.

understand that negotiations between I.T.I. and M/s. Philips Ltd. are still in the discussion stage and are yet to be finalised.

In view of the foreign exchange difficulties and also developmental work in N.P.L., we feel that further negotiations with M/s. Philips Ltd. need not be pursued. N.P.L. is also in a position to set up a production unit for the supply of professional ferrites to the specification of I.T.I. The laboratory is prepared to supply bulk samples for large scale testing by I.T.I.".

Asked whether the samples have been furnished to the Indian Telephone Inaustries, the representative of the National Physical Laboratory has stated during evidence:

"The samples have not yet been sent. We have just got the die made. They (I.T.I.) will not be able to use torride samples directly in their equipment for tests. They have given the sizes and specifications."

It is noted that the view of the National Physical Laboratory that the know-how for soft and professional ferrites is the same, has subsequently been corroborated by the Philips "who have stated, in defence of their argument on royalty payments that the know-how for professional type of ferrites automatically involves the know-how for entertainment type ferrites also and, therefore, they should be paid for both, irrespective of the fact that Indian Telephone Industries use theirs or the National Physical Laboratory know-how."*

55. The Secretary of the Ministry of Industry has explained during evidence as follows:

"The National Physical Laboratory says that their thing is very good. When the Indian Telephone Industries received it they have to do some testing and they say that it is not according to their specification. It is very diffi-

*At the time of factual verification of the Report, the Ministry of Transport and Communications have stated as follows:

"Professional ferrites are more advanced in type and have tighter electrical and mechanical characteristics, the know-how for the professional ferrites would necessarily include the know-how for entertainment ferrites but not vice versa. This is also obvious from the fact that, in March, (1965) NPL itself stated that they had the know-how for entertainment ferrites and not for professional ferrites".

cult to reconcile two violently opposing technical views as Chairman of the Licensing Committee. Every year we are losing Rs. 25 lakhs in foreign exchange for the import of hard ferrites. Even if we delay for a few months in the hope that we will give some encouragement to the indigenous know-how, it does not matter. But if we wait for two years, we will be losing about Rs. 50 lakhs as against Rs. 7 lakhs which you will be paying to Philips for the next seven years. Unless the National Physical Laboratory is ready to exploit it commercially the balance will still be for going ahead with Philips."

56. The Committee have been informed by the Ministry of Industry in a written reply dated the 26th March, 1966 as follows:—

"The agreement between Indian Telephone Industries and M/s. Philips has not yet been approved. Under the agreement Philips should advise I.T.I. on factory lay out, specification of raw materials and machinery, train I.T.I. experts and offer complete technical advice for the manufacture of ferrites. Technical know-how fees proposed in DFL 258315 *i.e.*, approximately Rs. 343559. The royalty proposed is 5 per cent of the net price on production up to 100 tonnes, 4 per cent on production beyond 100 tonnes but within 200 tonnes and 3 per cent on production beyond 200 tonnes. The total royalty is expected to be about 4 to 5 lakhs for the entire period. Since I.T.I. have not been permitted to manufacture soft ferrites the question of payment of royalty on this item does not arise.

Further in respect of possible new invention for which Philips may take out new patents in the territory during the period of this agreement Philips hereby grant to the company for the duration of this agreement for the territory a non-exclusive licence for the manufacture and sale of the productions under any such new patents. For the sake of removal of doubts M/s. Philips have suggested in the agreement that the use of such new patents by the company after the termination of this agreement will be on such reasonable terms as may then be mutually agreed upon separately."

At the time of factual verificatio nof the Report in April, 1966, the Ministry of Transport & Communications have stated as follows:

> "The negotiations with Philips have been deferred and a meeting was held on the 9th March, 1966 with the D.G., C.S.I.R., and with NPL representatives. A copy of the minutes of this meeting is herewith enclosed (Appendix V). In the meeting, NPL promised to send by the end of April samples to one internationally standard size and tolerance for which they said they had the mould ready. On further correspondence, it is now found that the size offered by them is not of any standard international size and they also say that the ferrites which they manufacture will have wider tolerance above what is admissible in professional ferrites. We are also in correspondence with them on this matter and up to now we have not received any samples. They have also not confirmed as to whether they are supplying samples of ferrites as promised by them in this meeting, held last month, conforming to grade 3-B-7 and of an international standard size and within the electrical and mechanical tolerance permissible."

The Committee cannot resist the conclusion that there has not been close co-operation between the National Physical Laboratory and the Indian Telephone Industries in the matter of developing professional ferrites. The Committee consider that both the organisations should have shown greater sense of urgency in developing suitable professional ferrites with indigenous know-how and thereby help to reduce, if not eliminate, the import of professional ferrites, which is entailing an outgo of about rupees 25 lakhs every year in foreign exchange.

The Committee would urge the National Physical Laboratory to supply samples of professional ferrites without delay, which may be got tested, if necessary, from an independent laboratory so as to reach definitive conclusion about their suitability. The Committee are firmly of the view that the indigenous know-how developed in the national laboratories should be given a fair chance or even a preferential treatment vis-a-vis foreign collaboration schemes so as to achieve self-reliance at the earliest. The Committee have given in greater detail their views on the development of indigenous know-how vis-a-vis foreign collaboration agreements in the later part of the Chapter.

Process for the manufacture of Arc Carbons

57. High intensity illumination is necessary for projecting motion pictures in theatres and arc lamps are used for this purpose. These

arcs are struck between Carbon Electrodes and are generally known as Projector Arc Carbons. The electrode contains a central core of light giving chemical salts. Essentially it is a pencil containing light giving salts in the thin core surrounded by thick shell of carbon. A thin over-coating of copper is given to carry high currents. The ingredients used in them as well as the technique of their manufacture is a closely guarded secret.

The requirement of high intensity cinema projector carbons in India is estimated at 6 million pairs per year. The import figures of the cinema carbons for the last five years are as under:

Year	Quantity* (Nos.)	Value Rs.
1960-61	1,09,34,045	37,75,390
1961-62	1,17,31,461	38,11,645
1962-63	60,03,306	19,91,133
1963-64	99,16,963	36,98,340
1964-65	1,25,64,137	42,45,718

*The corresponding figures in pairs:

1960-61	54,67,022
1961-62	58,65,730
1962-63	30,01,653
1963-64	49,58,431
1964-65	62,82,068

With a view to establish this industry in the country research work was undertaken at the National Physical Laboratory in 1959 and a process was developed successfully by the Laboratory in 1961-62 at the Pilot Plant Scale. The process is based on indigenously available raw materials and the specialised equipment necessary for this work has also been designed and fabricated in the Laboratory for pilot plant production which is being continued in National Physical Laboratory. A Project Report for the manufacture of 6000 pairs a day was prepared by the National Physical Laboratory in September, 1963 based on the pilot plant work done in the Laboratory. The project envisages an investment of Rs. 17 lakhs. The cost of production of two types of carbon rods is estimated at about Rs. 80 and Rs. 70 per hundred pairs compared to the corresponding price of Rs. 98 and Rs. 87 respectively for the imported carbons.

The rods manufactured are being tested regularly in the Laboratory and tried commercially by various theatres in Delhi and in other towns. The rods are stated to have been found as good as the imported ones. About 6000 pairs are stated to have been sold for large scale commercial trials at a nominal price through the Association of Film Distributors, Delhi.

Commercial Exploitation of the know-how for the manufacture of Arc Carbons.

58. It has been stated that even when the National Physical Laboratory was on the developmental work for the manufacture of arc carbons, M/s. R. J. Wood and Company wished to enter into contract with Council of Scientific and Industrial Research and National Research Development Corporation for the development of the item on their behalf. A contract was signed on the 21st November, 1959.

The original contract entered into with the firm which was initially for a period of four years subject to renewal by mutual consent of the parties, was to develop this process in 4 different stages which are given below:

"I. Copper plating on imported Projector Carbon Rods,

II. Filling of imported rods with imported core compound;

III. Working out formulations for the core compound; and

IV. Working out details for the manufacture of core rods."

The Board of the National Research Development Corporation which met in June, 1961 to consider the progress of the project passed the following resolutions:

"(i) The difference of opinion between NPL and M/s R. J. Wood regarding the payment to be made by M/s R. J. Wood to NPL under clause 2 of the Agreement dated the 21st November 1959 be referred to Prof. M. S. Thacker, DGSIR for arbitration and his decision be binding on all the parties.

(ii) Shri Joglekar having stated that laboratory work on the project had almost been completed NPL would immediately prepare and send a list of equipment required for large scale trials to NRDC, who after consulting Dr. G. P. Kane will arrange for its procurement so that the project is expeditiously implemented and commercial production established within six months time. Finances required for the pilot plant would be provided by NRDC and the equipment could be transferred to M/s R. J. Wood & Co. at a later stage on terms to be mutually arranged. M/s R. J. Wood would also send copies of all quotations they had received to NRDC for information. NPL would also send to NRDC the detailed report on the investigations conducted by the results obtained together with proposals for their projection on a commercial scale."

Thereafter a period of two years was taken up to prepare the project report which was submitted in September, 1963. According to the firm M/s. R. J. Wood & Co. the contract was not fulfilled as required under the NRDC resolution. They, therefore, referred the case to Arbitration. The arbitrator also found that contractual terms as modified by the NRDC resolutions were not fulfilled. The arbitration award was available in January, 1965 which ended the contract entered into with M/s R. J. Wood & Co.

To sum up the position in this regard is that the National Physical Laboratory successfully developed the process for the manufacture of arc carbons on laboratory scale in 1961-62 and prepared project report for its large scale manufacture in September, 1963 but due to arbitration proceedings, the process could be made available to private industry only after January, 1965.

59. Meanwhile, Government issued an industrial licence to Messrs. Union Carbide for manufacturing 3 million pairs in 1961. In March, 1963 the capacity of the Union Carbide was enhanced to 6 million pairs on the assumption that the total requirements of the country were 12 million pairs, which in fact does not exceed 7 million pairs even at present.

The expansion agreement was opposed by the Council of Scientific and Industrial Research in the Licensing Committee.

In December, 1965 the Director General, Scientific and Industrial Research wrote to the Secretary of the Ministry of Industry which *inter alia* contained the following points:

"The grant of licence to manufacture 6 million pairs gives a position of monopoly to M/s Union Carbide and as such they may be directed that initial capacity of 3 million pairs may be used for the Indian market while the expanded capacity granted to them, which has not uptil now come into operation should be for export only. M/s Union Carbide import uncoppered carbons. All the raw materials for the manufacture of uncoppered carbons are available in the country and M/s. Union Carbide should be asked to manufacture from indigenous materials instead of importing uncoppered carbons in a finished form."

60. Asked to indicate the total capacity licensed for the manu-

facture of cinema carbons within the country, the Ministry of Industry have furnished the following information:--

"Name and address of the party	Cinema Arc Carbons
1. M/s. Union Carbide India Ltd., Calcutta	6 million pairs.
2. M/s. India Carbon Company, Ganesh Bagh, Nehru Road, Bombay-80.	3 million pairs.
3. M/s. Shanti Lal J. Shah, 5, Sriranagar, Madras	3 million pairs.
4. M/s. B. S. Gupta & Sons., 135, Canning Street, Calcutta	3 million pairs.
5. M/s. R. J. Wood & Co. (P) Ltd., State Bank Building, Chandni Chowk, Delhi	3 million pairs.
6 M/s. Shri S.R.P. Punnuswamy, Paraswamy Road, Coimbatore.	3 million pairs.

A show cause notice has been issued to M/s. R. J. Wood Company and Shri S. R. P. Punnuswamy asking why the licence cannot be revoked since they have not taken any effective steps. M/s. B. S. Gupta & Sons. have been told that no foreign collaboration will be permitted and their reply is awaited. The foreign exchanged outlay in respect of the others is as under:

(i) *M/s. Union Carbide Limited*

The firm has been given C.G. licence for import of machinery for Rs. 27·20 lakhs. This licence was intended to cover the equipment for the manufacture of 3 million pairs only. Subsequently by resorting to new process, the firm stated that they will be able to manufacture up to 6 million pairs without any increase in value. This change over, however, involved a payment of $30,000 towards engineering and design charges, which will however be met out of the foreign exchange requirements of Rs. 27·20 lakhs already approved. Besides, after commencement of manufacture from indigenous raw materials they have to pay an *ad hoc* royalty of $20,000 p.a. (taxable) and 5 per cent on exports to the collaborators.

(ii) *M/s. India Carbon Limited*

M/s. India Carbon Limited will utilise the know-how developed by NPL and the foreign exchange outlay will be Rs. 12,47,430 for the import of machinery.

(iii) *M/s. Shanti Lal Shah*

The value of the imported plant and machinery in this case is roughly estimated to be Rs. 6,28,015 CIF and the technical know-how charges payable to foreign collaborators is Rs. 2,38,091 (approximately DM 2,00,000)."

It will be seen that at present only two million pairs of arc carbons are manufactured by the Union Carbide; and 0.75 million pairs per annum by M/s. India Carbons annually and about five million pairs are imported.

When asked to comment on the prospect of utilisation of National Physical Laboratory know-how, the Secretary of the Ministry of Industry has stated: "The capacity of 7 million pairs which is being estimated is only the demand as we foresee it for the next three/four years. There is going to be considerable increase in the demand. All this indigenous know-how will be available for any other party who wants it."

When asked to indicate the possibility of compelling M/s. Union Carbide to produce arc carbons in the country for export, the Secretary of the Ministry of Industry replied that "the country still depends on the imports of arc carbons and only when all the requirements are met indigenously M/s. Union Carbide could be pressed to export. But this would require the consent of Union Carbide."

61. It has been represented to the Committee that "the price of imported cinema carbons manufactured by M/s. Union Carbide in U.S.A. was Rs. 120 while the same now made in India is being sold at Rs. 157·50 as against our price of Rs. 119·20 fixed by the Joint Chief Controller of Imports and Exports, Bombay for the carbons made from imported raw materials, same as of M/s. Union Carbide, and processed in a local factory since 1964."

Asked to explain the different prices fixed for arc carbons produced by different agencies, the Secretary, Ministry of Industry has stated during evidence: "I think if this price is artificially kept

low the Indian producers will go out of production. I am not sure how the Joint Chief Controller of Imports and Exports is in a position to fix such a price. I will have to look into this."

62. Even in the matter of import of raw material for production of arc carbons by the process other than National Physical Laboratory process, there is discrimination made between M/s. Union Carbide and the local manufacturers. Whereas M/s. Union Carbide is allowed to import their raw materials direct, other local manufacturers are required to get their supply through the State Trading Corporation. The Secretary of the Ministry of Industry was inclined to agree during evidence, that to remove the discrepancy it was proper to put M/s. Union Carbide also under the supply control from the State Trading Corporation.

The Committee find it difficult to appreciate how Government could have licensed the manufacture of 21 million pairs of arc carbons even though the total demand in the country is admittedly not more than 7 million pairs even at present. The Committee are surprised that the capacity of a company to manufacture arc carbons was doubled in March, 1963 from 3 million pairs to 6 million pairs, though the Ministry of Industry was informed that the National Physical Laboratory had developed the know-how for arc carbons by using indigenous materials and inspite of the fact that the company had not even achieved the production target of 3 million pairs of arc carbons.*

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*At the time of factual verification of the Report, the Ministry of Industry have stated as follows:—

"As regards demand even though the demand at present is of the order of only about 7 million nos. of pairs it is expected that the demand would increase to 13 million pairs in about three to four years' time. It is also to be noted that at the time of the issue of the expansion licence to M/s Union Carbide it was anticipated that the demand in 1965-66 would be 12 million pairs as assessed by a United Nations Expert and in order to cater to this demand it was considered necessary that capacity for 18 million pairs should be set up. With this end in view licences were issued to M/s. Union Carbide and others in 1963. They were also told at that time that they should approach CSIR for know-how. As was made clear in the written reply to the questionnaire only after obtaining clearance from CSIR foreign collaboration was permitted in case of M/s. Shantilal Shah. The others have all been told that they should approach only CSIR for know-how. It would, therefore, be seen that this Ministry is not trying to encourage foreign know-how when Indian know-how is available.

It may also be mentioned in this connection that M/s. Union Carbide have since been told that they should make all efforts to export their production beyond three million pairs".

The Committee are also unable to appreciate why there should be discrimination between this company and other manufacturers in the matter of import of raw materials and fixation of prices of arc carbons produced by them. They recommend that Government should fully investigate the matter and remove the anomalies, if any

The Committee would also like Government to persuade the company to export arc carbons as soon as sufficient production capacity of other units is developed within the country with National Physical Laboratory know-how to meet the internal requirements. It should not be too difficult for this company, which has international connections to export arc carbons in excess of 3 million pairs produced by them. This would leave scope for marketing of arc carbons with National Physical Laboratory know-how and would induce the Indian manufacturers to take it up in right earnest.

The Committee would further urge Government to ensure that the other parties which have been given licences for the manufacture of arc carbons and have not yet finalised their arrangements of technical know-how for its production should be encouraged to take up the know-how developed by the National Physical Laboratory for the indigenous manufacture of arc carbons. The Committee hope that Government will not encourage any foreign collaboration in this particular field in future and would insist that National Physical Laboratory know-how should be utilised for the manufacture of arc carbons.

The Committee also regret the haste with which the National Research Development Corporation/Council of Scientific and Industrial Research/National Physical Laboratory had entered into an agreement with M/s. R. J. Wood & Co. for the development of arc carbons in 1959 when research work was still in progress. This resulted in arbitration proceedings with the firm which led to abnormal delay in the commercial exploitation of the process.

Know-how for Dry Cell Carbon Rods.

63. The Committee have been informed during evidence that the manufacturing process for the dry cell carbon rods is the same as for arc carbons. The National Physical Laboratory has got the basic know-how of dry cell carbon rods and are now engaged in developing it for commercial exploitation.

The Committee would like National Physical Laboratory to intensify its research on dry cell carbon rods so that the know-how can be farmed out to Indian manufacturers at an early date.

Ceramic Capacitors

64. In 1956, the National Physical Laboratory started research work on 'Ceramic Capacitors' which are used by electronic industry and developed them successfully in 1961.

The National Physical Laboratory licensed its process to Bharat Electronics on an exclusive basis to produce Ceramic Capacitors in 1961 after (B.E.L.) had run a pilot plant under their supervision at the National Physical Laboratory for one year. The B.E.L. obtained the necessary equipment and machinery from abroad and started production in their own premises at Bangalore in 1961. Three members of the staff of the National Physical Laboratory trained in this work were absorbed by Bharat Electronics.

Bharat Electronic have desired to increase the production to 20 million of ceramic capacitors and have stated that the know-how they have got from the National Physical Laboratory through National Research Development Corporation, does not include the details required for large-scale production and automation of the process. The B.E.L. have now concluded an agreement with the Compagnic generale de telegraphic Sans Fil (C.S.F.) on payment of royalty to obtain their technical assistance and to acquire automatic machinery from them for increasing the production to 20 million. It is the contention of Bharat Electronics that with a view to substantially reduce the cost they should automatise the processes; otherwise they will not be able to attain international price.

The National Physical Laboratory has stated that "it has no facilities for designing or fabricating automatic machinery; neither is it the intention of the Laboratory to provide such facilities in the future. If it has to do it in efficient manner a Design and Engineering Organisation will have to be set up at the National Physical Laboratory. Even the machinery that they can design will have to be put to trials over a long period before they can be offered to a licensee. Such a procedure will mean a significant departure from the policy that has been followed so far by the National Physical Laboratory."

The National Physical Laboratory has further stated that "at present 2·5 million of Ceramic Capacitors are being produced and

the rest i.e., about 2·5 million are imported. Expansion plans of the licensee (Bharat Electronics Limited) propose to produce 6 million in 2 years and later 20 million. However, there is scope for more licensees. Bharat Electronics Limited prices are very high and it is advisable to licence other parties".

The Committee note that the Council of Scientific and Industrial Research has established in New Delhi a Central Design and Engineering Unit in 1963 with the object of assisting research and industry in designing and engineering the plants for exploitation of research processes evolved by the Council of Scientific and Industrial Research. The Committee recommend that National Physical Laboratory should take full advantage of this Unit to solve the Engineering problems such as automation of the processes developed by the National Physical Laboratory.

The Committee are not sure whether it was correct for Bharat Electronics Ltd. to have gone in for foreign collaboration for the production of ceramic capacitors on the plea of large scale production and automation of the process when the NPL process was already available to them. The Committee would have thought that instead of entering into agreement with foreign collaboration, the Bharat Electronics should have asked NPL to modernize and automatise their process so as to facilitate large scale production at economic cost. This should not have been insuperable as CSIR has not only the Central Design and Engineering Organisation but also a number of other research institutes, including Mechanical Engineering Research Institute, which could have helped in tackling the problem. Now that the B.E.L. has already concluded an agreement with the French firm (C.S.F.) and may not be interested in commercially exploiting the process developed by NPL, the Committee would like Government to examine whether the know-how developed by NPL for the manufacture of ceramic capacitors should be farmed out to any other Indian manufacturer.

Indigenous know-how-vis-a-vis *Foreign Collaboration*

65. The policy of Government as regards the development of indigenous know-how on the one hand and the import of foreign know-how and entering into foreign collaboration on the other, has been a subject of keen debate these days. During the course of evidence, the representative of the Ministry of Industry has stated as follows:—

> "It is not that there is any difference of opinion about the desirability of encouraging Indian know-how. In the private

sector if you want to compel any sizable investment and ask the private party to utilise what we may consider a reasonable know-how which is available indigenously, there is no means by which we can compel the party to go ahead. To secure the objectives of import substitution and promotion of indigenous know-how, we use "Judicious Compulsion". If it succeeds, well and good. If it does not, then we hope to face the situation. The situation has not developed to that acuteness because the laboratories themselves have not yet in a large number of cases proved a process which is commercially workable".

When asked whether at the time of giving import licence of sanction for the import of foreign know-how, Government makes any assessment as to whether any particular know-how can be developed in India, the representative of the Ministry of Industry has replied that "I won't say that we consider whether it can be developed in India. We certainly consider, whether it is at the time available in India. In most of the cases where we have licensed foreign know-how, at the time they were licensed, no suitable or proved Indian know-how was available. There may be occassionally one or two lapses which may have slipped through, but by and large that is the general position."

The Director General for Scientific and Industrial Research has stated during evidence "In the recent past we have not been overruled completely. Whenever the C.S.I.R. has claimed that they can supply something, the matter has been closely examined and our advice has been normally accepted."

Appointment of Committees

66. It is noted that Government of India have constituted in February 1966 two important committees to go into the question of development of technical consultancy services and commercial utilisation of indigenous technical know-how.

The detailed terms of reference of the Committee regarding the development of technical consultancy services are as follows:

"(1) To assess the extent and types of technical consultancy services required to meet the country's needs during the Fourth Plan period and subsequent years;

(2) To assess the existing facilities available in the country, in both the public and private sectors, and locate the gaps to be filled up;

(3) To advise on the measures to be taken to fill up the gaps;

(4) To suggest the general type of organisational patterns, for the technical consultancy establishments, which will be suitable for our conditions;

(5) To advise on the pattern of technical collaboration or association, which may be necessary for drawing on foreign technical know-how, to the required extent; and

(6) To recommend suitable measures to expedite the establishment of the technical consultancy services to the required extent in this country."

The terms of the reference of the Committee regarding the commercial utilisation of indigenous technical know-how are as follows:—

"(1) To examine the extent to which at the present stage of our economic development import of technical know-how from abroad can be dispensed with;

(2) To examine the general conditions subject to which indigenous know-how can be deemed to be capable of commercial exploitation; and

(3) To suggest general guide-lines regarding the type of cases in which foreign collaboration may be allowed."

Both the Committee have been requested to submit their reports within six month.

The Committee welcome the appointment of committees to go into the questions of development of technical consultancy services and commercial utilisation of indigenous technical know-how. They hope that both the committees will provide useful guidelines for the development and encouragement of indigenous know-how.

The Committee consider that the planning, development and utilisation of indigenous know-how should be a part of the policy to progressively reduce the country's dependence on foreign know-how. The Committee recommend that while according sanction for import of foreign know-how Government should not only satisfy

themselves that the particular indigenous know-how is available or not, at the moment but should also assess whether the particular know-how could be developed indigenously within a reasonable time as foreign collaboration agreements also take on an average 2-3 years to materialise, and as it involves a long term commitment of payments in foreign exchange.

Government should also suitably consult other research organisations such as Defence Research and Development Organisation, Railway Research Standards and Design Organisation, Department of Atomic Energy etc., before according sanction to foreign collaboration arrangements, so as to make sure that there is no indigenous know-how available or in the offing for the process. The committee note that C.S.I.R. is represented on the Directorate General of Technical Development. The Committee would like Government to examine the suggestions of CSIR that they should also be represented on the Capital Goods Committee to ensure that foreign equipment and machinery are not imported where it is or may be made available within the country, within a short period.

Out right purchase of foreign know-how

67. The representative of the Ministry of Industry and Supply has informed the Committee during evidence that whether the purchase of foreign know-how is made out-right, or in the shape of recurring royalties, it costs roughly about the same in terms of money. He however, agreed that in the case of latter, there were complaints that even after three or four years of collaboration, the Indian scientists have not been allowed to know the basic facts. The point in favour of going into foreign collaboration on royalty basis is that in a large number of cases, foreign exchange payment is normally done by the collaborator.

The Committee recommend that while negotiating foreign collaboration agreements, Government should keep in view the advantages of going in for outright purchase of foreign know-how in preference to 'on royalty basis.'

Transfer of N.R.D.C. from the Ministry of Education

68. In regard to the reasons for the delay in the Commercial ex-,

ploitation of the process of Silvered Mica Capacitors which was successfully completed by the National Physical Laboratory in 1956 and was farmed out for commercial exploitation by the N.R.D.C. in 1959, the Committee was informed by the Director General, C.S.I.R. that "the time lag of three years is due to certain difference of opinion between the Indian Telephone Industries and the N.R.D.C. in regard to the terms of agreement." He further remarked that "the organisation of N.R.D.C. is not, in my opinion technically as oriented as it ought to be."

The Committee note that the setting up of the National Research Development Corporation was recommended by the first Reviewing Committee of the C.S.I.R. for the proper utilisation and exploitation of the result of research. As a result the NRDC was set up on the 31st December, 1953 as a Company under the provisions of the Indian Companies Act, 1913 (now Companies Act, 1956) and acts the sole agency through which the Council of Scientific & Industrial Research can approach the industry for getting its results applied. The NRDC has the following aims and objects:—

1. To develop and exploit in the public interest, for profit or otherwise, inventions, whether patentable or otherwise including technical and engineering 'know-how' of processes developed by the CSIR Laboratories and other Government and Semi-Government research institutes or industries.

2. To enter into reciprocal arrangements with similar organisations in other countries, to exploit Indian inventions in these countries and their inventions in India.

3. To issue exclusive and or non-exclusives licenses on such terms and conditions regarding payment of premia, royalties share of profits and/or any other basis as are considered advisable to commercially developed inventions and ensure commercial production of the products of invention.

4. To instal and work pilot, prototype or semi-commercial units or full commercial plants to develop a particular invention or inventions and ensure production from such inventions, to sell or otherwise dispose of the products of such terms and conditions as may be deemed fit.

The Third Reviewing Committee of Council of Scientific and Industrial Research (1964) observed:—

> "It appears to be the general opinion that this organisation has not been able to match the country's need and should be reorganised and substantially strengthened. Although it may remain a separate entity, it is recommended that for operational purposes, it should function under the control and direction of the Director-General of Council of Scientific and Industrial Research."

During the course of evidence, the Director General for Scientific and Industrial Research has stated that National Research Development Corporation should be under the control of Council of Scientific and Industrial Research whereas the Secretary of the Ministry of Industry has stated that "It might solve many problems, if it is given to the Ministry of Industry." When asked to indicate whether it was proper to retain National Research Development Corporation under the Ministry of Education, as it was almost an industrial venture, the Secretary of the Ministry of Education, replied that he has recommended that it should be transferred to the Ministry of Industry for closer co-operation with the industries and the Directorate-General of Technical Development. The matter is under discussion between the Ministries of Education and Industry.

The Committee hope that Government will take an early decision in regard to the transfer of the National Research Development Corporation from the administrative control of the Ministry of Education to a more suitable Ministry so that it wonld fulfil the purpose for which it was originally set up.

Joint Standing Committee for Scientific Research and Industry

69. The committee have noted that many of the processes developed by the laboratories of C.S.I.R. have not been exploited on account of lack of proper coordination between the C.S.I.R., Directorate General of Technical Development and the Industry. The need for such close cooperation was felt by Government as long back as 1956, when a Joint Standing Committee for scientific Research and Industry was constituted by the Governing Body of the CSIR "with a view to maintaining close and effective coordination and liaison with the Development Wing (now the Directorate

General of Technical Development) and the C.S.I.R.". It consisted of the following:—

1.	Shri Manubhai Shah, Minister for Industries.	Chairman
2.	D.G.,S.I.R.	Member
3.	Dr. A. Nagaraja Rao, Chairman, Heavy Industries Corporation.	Member
4.	Lala Shri Ram, New Delhi.	Member
5.	Shri S. Anantharamakrishnan, Amalgamations Ltd., Madras.	Member
6.	Development Commissioner, Small Scale Industries Ministry of Commerce & Industry.	Member

The Committee held some meetings to evaluate the projects emanating from national Laboratories before they were passed on to the N.R.D.C. or any other agency for exploitation. The committee was also expected to discuss "such matters as merit the attention of Ministries concerned from the point of view of better utilisation of the national resources."

Considering the importance of the Joint Standing Committee for Scientific Research and Industry, the Estimates Committee made the following recommendations in their 76th Report (1959-60):

(1) The Committee suggest that the strength of the Joint Standing Committee should be suitably augmented.

(2) The Committee regret to note that there has been slow progress and not much of active follow-up action in regard to the recommendations made by the Joint Standing Committee. They further suggest that the Joint Standing Committee should periodically review its previous recommendations and ensure that they are expeditiously implemented.

The recommendations were accepted by Government/C.S.I.R. in January, 1961. The Joint Standing Committee was reconstituted in 1961 under the chairmanship of the then Minister for Industries. No meeting of the Joint Standing Committee was held thereafter till 31st July, 1965.

At the meeting held on the 31st July, 1965 and Joint Standing Committee has approved the following terms of reference for the Committee:

"(i) Determination of the overall requirements of research in relation to industrial development plans of the country.

(ii) Indication of major areas for investigation or research projects on which research effort may be concentrated at a national level.

(iii) Relations between the organisations of industrial research and department responsible for industrial development and planning.

(iv) Relations between research organisations and industry.

(v) Resources required for industrial research.

(vi) Policies on utilisation of the results of research."

The composition of the Joint Standing Committee, as constituted on the 31st July, 1965 is given in Appendix VI.

During evidence, the Director General for Scientific and Industrial Research stated he was not aware of its existence. The Committee was formed by the Vice-President of C.S.I.R., *i.e.*, the Education Minister. We have a number of such committees now with the Health Ministry and so on. The situation would have been much better if we did not have these committees."

The Committee are surprised that the Joint Standing Committee for Research and Industry which was sponsored by the C.S.I.R. itself in 1956 with laudable objectives for forging coordination with D.G.T.D. should have been put into cold storage even though the recommendation of the Estimates Committee for its effective functioning which was made in 1960 had been accepted by Government. The Committee note that while C.S.I.R. is trying for representation on committees of D.G.T.D. so as to farm out fruitful researches for commercial exploitation, it could not make any use of the machinery set up by itself for the same purpose. The Committee recommend that the Joint Standing Committee should be activised and should deliberate at least twice a year and should also periodically review its previous recommendations so as to ensure that they are expeditiously implemented.

CHAPTER VI

STANDARDISATION AND TESTING WORK

70. The objectives laid down for the National Physical Laboratory at the time of its constitution include *inter alia the* following:—

(i) To undertake developmental testing to help industry.

(ii) To maintain basic standards of mass, length, time and temperature as well as derived standards for electricity, electronics, acoustics and optics.

The work of standardisation and maintenance of basic standards have been the statutory obligation of the National Physical Laboratory under the Standards of Weights and Measures Act, No. 89 of 1956. The representative of the National Physical Laboratory has stated during evidence that the maintenance of standards of different items is inter-linked and can be properly done by one laboratory only. He further stated that this procedure is followed in other countries also *e.g.*, National Physical Laboratory (Teddington) in London and National Bureau of Standards in U.S.A. and they are the custodians of basic standards in these countries.

71. The work done by the National Physical Laboratory in developmental testing is spread over its different Divisions. A brief review of work being done by these Divisions is given below.

(1) *Acoustics*

The Division maintains and regularly calibrates primary standard microphones used for measurement of sound intensity. Other instruments employed in testing and standardisation work are examined periodically to determine their performance characteristics and accuracy of calibration. The Division also carries out performance tests on acoustic and electro-acoustic devices on request from Government departments, industries and other institutions.

(2) *Analytical Chemistry*

The Division has developed facilities for the testing of a very wide range of material; these include alloy and plain steels, cast iron, brasses, bronzes, aluminium, zinc and lead based alloys, precious

metals, water, clays, buildings materials, ores, plastic surface, finishes and coatings, electroplatings, mineral, wood, dyes, textile fabric and miscellaneous chemicals.

(3) *Applied Mechanics*

The testing facilities available cover a wide field such as tensil, bending and shear strengths, hardness etc. The testing facilities are being continously extended and the Laboratory undertakes the design of jigs and fixtures necessary for specialised jobs. The Division also undertakes the calibrations of providing rings, load cells and universal testing machines.

(4) *Electricity*

The Division holds and maintains, under carefully controlled conditions, the internationally recognised units of Absolute Ohm and Absolute Volt.

The Division is well equipped with necessary measuring equipment to carry out high precision measurements of electrical quantities of resistance, EMF, current, power, capacitance, inductance, etc., and regularly undertakes the work of standardisation and calibration of electrical measuring instruments, and associated apparatus from other research and standardising organisations, both in the public and the private sector.

The Division is also equipped with facilities for a large number of developmental investigations in electrical fields.

(5) *Electronics*

Standards of time and frequency are maintained conforming to internationally accepted accuracy. Developmental testing of domestic and community radio receivers, electronic instruments like signal generators, frequency metres and oscilloscopes are undertaken as well as high frequency and microwave cables.

(6) *Heat and Power*

The Division has undertaken the development of various types of thermometer comparators. The Division has the facilities (i) to calibrate and test clinical thermometers, (ii) to conduct standard tests on physical and chemical properties of gaseous and liquid fuels, fresh and used Lubricating oils, transformer oils etc., (iii) to test diesel used in tractors, (iv) to calibrate and standardise different types of visco metres.

(7) *Industrial Physics*

The Division is engaged in the following:

(i) Developing methods of assessing the performance characteristics of carbon, graphite and carbongraphite brushes.

(ii) Developing the methods and instruments for determining the writing qualities of lead pencils.

(iii) Drawing up specifications for cinema arc carbons

(iv) Testing of powders for particle size distribution.

(8) *Infra-red Spectroscopy*

The Infra-red Section has undertaken the following analysis of the materials for industry:

(i) Analysis of ethylene gas for other peroxides, acetylene, ethane and methane.

(ii) Analysis of a brightening agent.

(iii) Analysis of the methane gas from Jawalamukhi.

(iv) Analysis of some cross-linked celluloses which are supposed to process greater strength.

(v) Analysis of some bamboo pulps used for preparing paper. In addition. nearly a thousand records of infra-red spectra have been supplied to various universities and research institutes.

(9) *Low Temperature*

The Section has a project of maintaining low temperature thermometer standards. For the maintenance of such standards three platinum resistance thermometers with gold leads have been constructed. Apparatus for producing the various fixed points (sulphur point, steam and ice points) have been constructed.

The testing facilities are being set up for the testing of permanent magnet steels as well as other magnetic materials.

(10) *Optics*

The main standards maintained in this Division are standards of light.

The testing work of the Division covers a wide range of optical instruments, lamps, lighting equipment coloured and other glasses.

In addition, the Division undertakes the following types of work, where, in many cases, the apparatus has to be specially set up according to the need: colour measurement of food products; testing of precious stones, gems etc. Further, advice is being given by the Division to various Government and industrial organisations in such work as design of lighting installations for indoor and outdoor, development of glasses for signalling purposes, designing of testing apparatus for optical instruments, miscellaneous optical designs and photo-metric equipment.

(11) *Radio Components*

An active part has been taken in the drawing up of standards for various electronic components with a view to finding their suitability for reliable operation under tropical conditions.

Tests are also conducted regularly on the components that are developed and produced in the Unit with a view to determining their properties and suitability for use both in radio receivers and communication type of equipment.

(12) *Time and Frequency*

The time signals are correct to a millisecond per day and the frequency is constant to 2 parts in 100 million over a nominal value, conforming to the recommendations of the International Radio Consultative Committee (C.C.I.R.). This high precision is maintained by the continuous comparison of the standards among themselves and by the check-up of the time signals against those received from similar stations established in other countries such as Japan and U.S.A.

(13) *Weights and Measures*

The Division has the responsibility of maintaining the primary standards of mass and length and makes and calibrates number of sub-standards for supply to all those who need them. As a very large portion of the work of this Division is concerned with standards, to facilitate the work, different sections for mass, length and horology have been formed together with a precision workshop.

The Division has been supplying standards of mass, capacity measures and length measures to manufacturers of scientific and industrial equipment, scientific institutions and to the Weights and

Measures Enforcement Department in all the States and Union territories. About 200 adjusted sets of reference and secondary weights, more than 100 sets of working standard weights and 40 sets of standard capacity measures have been calibrated.

More than 300 officials deputed by the various States at the instance of the Commerce and Industry Ministry have undergone training in the methods of enforcement of the Weights and Measures Act. It has also undertaken training of representatives of industrial firms and many from scientific, educational and engineering institutions.

A. Developmental Testing and Routine Testing

72. In a written reply furnished to the Committee, the National Physical Laboratory has stated:—

> "The objective of the Laboratory is to undertake the testing in connection with standardisation and development and this has been followed since its inception. However, as expressed by the Executive Council and also the Ghosh Committee, testing of routine nature is not undertaken where such facilities exist elsewhere in the country. This type of test is undertaken till such time these facilities are developed elsewhere, for example testing of Community Radio Receivers was done for some time at National Physical Laboratory before the National Test House took over this type of testing. The testing method for routine check up of Clinical Thermometers manufactured in the country is being developed in the Laboratory and when fully developed will be passed on to Indian Standards Institution as it is proposed that all thermometers manufactured in the country will be certified. In the field of standards and calibration, this Laboratory is testing and calibrating all standards instruments apparatus etc."

It has been represented to the Committee that "the promptness of service (certification and testing) is poor and unbusiness-like. Some kind of incentive scheme or closer control on the requests for such services would be helpful".

The National Physical Laboratory has also stated in written reply that "staff at present available for issue of test reports and certificates is inadequate resulting sometimes in backlog to testing work."

However, the above view of the National Physical Laboratory was not corroborated by the Director, General, Scientific and Industrial Research, during evidence before the Committee. He had observed, "I personally feel that the delays have been due to some confusion and lack of methods. The routine or the testing side should be separated from the developmental and the research side. Special type of staff is required, for both. We should not try to mix them up. When people know definitely what type of work they are supposed to do, they train themselves for it and work for it. There was too much mixing up in people who do testing and who do developmental work".

The Committee note that the Second Reviewing Committee of the Council of Scientific and Industrial Research had observed as follows in 1954:

> "The National Physical Laboratory is not intended to provide facilities for routine testing but for specialised testing involving studies of methods leading to decisions about specification of standards, etc. This, in our opinion, is right. A National Physical Laboratory should 'set standards of accuracy for the Nation' but it should not become an establishment for routine testing for all and sundry".

The Committee realise that the maintenance of basic standards of mass, length, time and temperature and the work of developmental testing done by the N.P.L. are very important for the industrial development of the country and should be pursued vigorously. The Committee, however, note that these functions are at present spread over a number of divisions. They consider that it would make for economy and efficiency if the work relating to the maintenance of the standards and developmental testing is grouped together as far as feasible.

The Committee also consider that National Physical Laboratory should concentrate only on developmental testing and that routine testing should not be undertaken--save in exceptional cases—such as absence of specialised equipment for testing in other establishments in the country or where it is absolutely essential in the interest of developmental testing. The Committee need hardly point out

that it is the function of the Indian Standards Institution to arrange for necessary testing facilities. Besides, Government have already established two Test Houses* for undertaking this work.

The Committee would like, however, to emphasise that close co-ordination should continue to exist between the National Physical Laboratory, the Indian Standards Institution and the Testing Houses in the field of developmental testing and in undertaking research to design suitable instruments for testing work. The National Physical Laboratory should, in particular, assist in adopting techniques and in designing instruments which would make for cheaper and quicker testing.

B. Schedule for Testing Charges

73. The following table shows the amounts received on account of testing and certification carried out by the various divisions of the National Physical Laboratory during the years 1961-62, 1962-63, 1963-64 and 1964-65:—

Sl. No.	Name of the Division	Amount received (in Rs.)			
		1961-62	1962-63	1963-64	1964-65
1.	Acoustics	3486·00	1500·00	2123·00	2482·00
2.	Analytical Chemistry	2831·84	2051·00	4192·00	6304·00
3.	Applied Mechanics	6026·36	3680·22	8148·35	13211·00
4.	Electricity	4849·35	6602·19	5738·00	6260·00
5.	Electronics	973·00	1400·00	29400·00	335·00
6.	Heat & Power	1170·00	1471·00	2109·00	1910·00
7.	Industrial Physics	645·00	342·50	1936·50	942·00
8.	Optics	1417·17	2940·50	3160·00	4888·00
9.	Weights & Measures	10727·80	5005·00	14227·22	18562·00
10.	D.P.E.C.	899·00	627·00	92·00	555·00
11.	X-ray Crystalography	..	..	..	600·00
12.	Transistorised community receivers	479·00	..	..	..
		33025·52	28098·41	71126·00	56050·00

*It is understood that there are proposals to set up more Test Houses in the country.

Asked to indicate the expenditure incurred on staff, equipment etc. for testing work, division-wise, it has been stated by the National Physical Laboratory in a written reply that "no separate account is maintained regarding the expenditure of Divisions". However, taking into consideration the number of workers, above the level of Junior Scientific Assistant in each division, the National Physical Laboratory has furnished the figures of average annual expenditure in respect of the following four divisions only:—

	Income during 1964-65	Annual Expenditure
	Rs.	Rs.
1. Divisions of Weights & Measures	18,563	2,95,776
2. Division of Electricity	6,260	2,21,832
3. Heat & Power	1,910	1,23,240
4. Applied Mechanics	13,211	1,97,184

It will be seen that the income derived from testing and certification by above Divisions is less than even 10 per cent of the annual expenditure incurred on them. The position in respect of other Divisions, for which information has not been supplied to the Committee, is presumably no better. The Committee are unable to appreciate why accounts of expenditure incurred on testing work under the two broad heads of routine testing and developmental testing is not being maintained. They would like such cost accounting to be introduced with immediate effect. They have subsequently recommended revision of charges for routine testing. As far as developmental testing is concerned, the Committee would like to stress that the expenditure incurred on each developmental test should be carefully reviewed by the Director in consultation with the Head of the Division concerned at intervals of three months so as to ensure that no infructuous expenditure is incurred.

Asked about the basis for fixing testing charges at the National Physical Laboratory, the representative of the National Physical Laboratory has stated that "in fixing the testing fees in the beginning, the fees charged by the National Physical Laboratory, Teddington (U.K.) were taken into consideration and the fees were fixed in a manner so that they would not adversely affect the development of the industry in the country. So far, the various schedules of testing fees have not been revised. Recently a departmental committee was set up to go into the question of fixing of the testing fees".

It has been represented to the Committee by an industrialist that "charges for testing could even stand some increase if the quality of service could be improved".

Prof. Blackett has also recommended in his report on the National Physical Laboratory that "charges to industry should be high enough to make industrialist believe in the value of National Physical Laboratory certificate and that the cost of the certificate will be recoverable in a higher selling price. The personnel of the Standard and Testing Division should be made cost conscious, encouraged to develop quicker and cheaper method of testing . . ."

It is surprising that the schedule for testing charges for different divisions which was laid down by the National Physical Laboratory several years ago has not been revised so far. The Committee hope that the testing charges would be suitably reviewed at an early date by the departmental committee which has been appointed recently by N.P.L. The Committee consider that testing charges should be fixed in such a manner as would make them commensurate with the expenditure incurred in this regard consistently of course with what the industry can bear, and the charges should be reviewed periodically.

C. Testing of Clinical Thermometers

74. The Committee understand that though clinical thermometers are now being produced by different small scale industries all over the country, to the tune of (about 2 million thermometers every year) yet the indigenous products have not inspired confidence in the customers regarding their accuracy.

Asked about the arrangements made for large scale testing of clinical thermometers the Committee have been informed that while the National Physical Laboratory would be required to carry out developmental tests for such thermometers the Indian Standards Institution was prepared to set up its own laboratory for carrying out routine tests of such thermometers.

The National Physical Laboratory has now fabricated the necessary equipment and has already tested about 5,000 thermometers as trial tests. During evidence, the representative of the National Physical Laboratory has stated as follows:—

> "The National Physical Laboratory will carry out the routine testing of clinical thermometers on behalf of the Indian Standards Institution till we are satisfied that it could be

handed over to the Indian Standards Institution for further testing. The technical staff of Indian Standards Institution will be trained to carry out this testing work. National Physical Laboratory has played a very significant role in drafting the specifications of the clinical thermometers and also developed methods for carrying out these tests. Indian Standards Institution will do the testing of thermometers after a period of a year or so".

The representative of the National Physical Laboratory has further stated that "Government is going to pass an Act that no clinical thermometer should be in the market unless it has been certified."

While the Committee appreciate the developmental work done in the National Physical Laboratory for testing of clinical thermometers, they feel that with the development of the testing instruments and the stabilization of the technique for testing, it should be possible to transfer the work of routine testing to Indian Standards Institution within one year.

CHAPTER VII

WORKING OF DIVISIONS/UNITS

A. Development-cum-Production Unit for Electronic Components

75. The Development-*cum*-Production Unit for Electronic Components (D.P.E.C.) was set up at National Physical Laboratory on the 1st June, 1963 for the production of the following items on commercial lines:

Item	Target programme of Production
(1) Antenna rods	1 lakh rods.
(2) I.F. Cores	1 million cores.
(3) Porcelain rods	3·5 million rods.

The staff strength of this Unit is given in Appendix VII.

76. It has been stated that due to lack of extrusion machine, furnaces and sufficient orders for I.F. cores, the D.P.E.C. concentrated on the manufacture of antenna rods only, as firm orders had been booked for them through National Small Industries Corporation.

Production of Antenna Rods

77. The shortfall in production of antenna rods in the initial stages is stated to be due to the following reasons:

"(1) It usually takes time to reach targetted production from start.

(2) In the case of NPL, the period has been longer due to lack of sufficient number of furnaces for which an essential component, the heating element had to be imported.

(3) The heating rods were received only on the 28th July, 1965.

(4) Administrative delays in ensuring smooth and adequate supply of raw materials."

In recent months there has been a rising trend in the production of antenna rods, as is seen from the following table:

	Target per month	Production per month
October, 1965	10,000	8,732
November, 1965	10,000	15,071
December, 1965	10,000	20,909

It has been stated by the National Physical Laboratory that the production of 15,000 rods per month would be kept up.

Profit and Loss Account.

78. The proforma accounts of D.P.E.C. are being maintained from July, 1964. It is noted from the Profit and Loss Account statement for 1964-65 (reproduced in Appendix VIII) that the D.P.E.C. unit suffered a loss of Rs. 15,219 in the production of antenna rods during that year. This has been explained as mainly due to shortfall in the targetted production. However, there has been a change for the better after April, 1965. For the first quarter from 1st April to 30th June, 1965, the D.P.E.C. unit has been able to earn a gross profit of Rs. 16,128·04 and net profit of Rs. 8,802·66.

Rejected Rods.

79. It is further seen from the Profit and Loss Accounts statement for 1964-65 that rejected rods in the process of manufacture were worth Rs. 37,500. During evidence the representative of the National Physical Laboratory has stated that:

> "Since we carry on development work also in conjunction with production work, a certain amount of rejections due to process variation experiments is inevitable. Our average reject percentage over the year is 17 per cent overall which is not considered high in a process which is also under development as well as production."

It has been further stated that "experiments are being conducted to try and see whether by slight process modifications, we may not be able to recover the material from rejected rods in the form of good finished rods. If our experiments prove successful the rods will fetch Rs. 37,500 otherwise the whole amount will have to be

written off." When asked to indicate the results of these experiments, the representative of the National Physical Laboratory has stated during evidence that "results have been encouraging. We hope to evolve a suitable method of utilising these rods which are sub-standard."

Cost of Production

80. It is noted from the proceedings of the third meeting of the D.P.E.C. Sub-committee held on the 18th September, 1964 that they had observed that "even if we reached the targetted production based on our present performance for the past four months, we would not be able to reach the standard cost which was fixed at the second meeting."

Antenna rods for medium wave is given below:

	Length m.m.	Diameter m.m.	Price (each)
			Rs.
(1)	102	9·6	1·20
(2)	152	9·6	1·40
(3)	203	9·6	1·70
(4)	254	0·6	2·00

The Committee note that the Development-cum-Production Unit for Electronic Components has been able to make some profit in 1965-66.

They feel that there is scope for effecting economy by improving the percentage of rejections of antenna rods. They would also stress that research efforts should be intensified to put to profitable use the antenna rods worth Rs. 37,500 which were rejected in 1964-65.

The Committee would like to emphasise that production of I.F. cores and Porcelain Rods may be taken up only after firm orders therefor have been received. They have, no doubt, that the commercial experience gained in the production of antenna rods would be put to good use while taking up the manufacture of I.F. Cores and Porcelain Rods.

B. Electronics Division

81. The staff strength of the Division is as follows:

	Sanctioned	Actual
Scientific	21	13
Technical	23	23
Ministerial	1	1
Class IV (Technical)	6	6

This Division is responsible for the maintenance and broadcasting of standard signals of time and frequency. It has also the statutory obligation to carry out testing and calibration of electronic equipments. In addition, other divisions of the laboratory require the assistance of Electronics Division in building up suitable apparatus for their experiments.

Project on "Simultaneous Inter-Communication System"

82. The work on the Project on 'Simultaneous Inter-communication' which was started in 1951 has been completed in 1963. It has been stated that "the work was not carried out continuously due to shortage of qualified staff and also constant change of even the existing ones." It has been further stated that "steps are now being taken to put it on a commercial basis."

The Committee regret to note that no action has so far been taken by the National Physical Laboratory for the commercial exploitation of the process on 'Simultaneous Inter-communication System', which was completed successfully in 1963.

The Committee feel that National Physical Laboratory should have taken patent rights soon after the successful development of the 'Simultaneous Inter-communication System'. The Committee feel that National Physical Laboratory should have taken patent rights soon after the successful development of the 'Simultaneous Inter-communication System' and approached the National Research Development Corporation for farming out the process for commercial exploitation. The Committee recommend that steps should now be taken in this direction immediately.

C. Solid State Physics Division

83. The staff strength of this Division is as follows:

	Sanctioned	Actual
Scientific	14	111
Technical	6	6
Ministerial	1	
Class IV (Technical)	4	4

Asked about the need for having the Solid State Physics Division in the National Physical Laboratory, which is engaged mainly in basic research work, the National Physical Laboratory have informed the Committee in December, 1965 as follows:

> "In the last meeting of the Executive Council of National Physical Laboratory when the detailed programme consisting of 13 projects of the Solid State Physics Division was considered, the Executive Council approved all the projects with reservation and made a further remark that some of the projects were highly objective and had a bearing on applied work and should be encouraged. Research in Solid State Physics, Solid State devices and the connected technology are the nucleus of scientific development in most advanced countries. The proposed intense scientific programme of the National Physical Laboratory for the coming ten years as envisaged now (most of which has been approved by the Executive Council of the National Physical Laboratory), would revolve around Solid State Physics and as such it is considered that the Solid State Physics Division continue to be an integral part of the National Physical Laboratory."

Collaboration with Solid State Physics Laboratory

84. Asked about coordination and collaboration between the Solid State Physics Division of the National Physical Laboratory and the Solid State Physics Laboratory, Delhi, of the Ministry of Defence, the National Physical Laboratory have stated that:

> "There is no official collaboration between the Solid State Physics Division of the National Physical Laboratory and the Solid State Physics Laboratory of the Ministry of Defence. However, the scientist in charge of the Division in the

National Physical Laboratory keeps personal contacts with the scientists doing related work on Solid State Physics in the Laboratory of the Ministry of Defence."

During evidence, the Director General, Scientific and Industrial Research has stated as follows:

"As far as we are concerned, we put our programme to them (Ministry of Defence). We expect them to tell us whether there is any duplication. There are Defence Panels who are members of the Scientific Advisory Committee and the Executive Council. So far they have not told us anything. So we presume there is no duplication. But we cannot say the same about their work."

The Committee are not happy about the existing arrangements for collaboration merely on personal level between the Solid State Physics Division of the National Physical Laboratory and the Solid State Physics Laboratory of the Ministry of Defence.

The Committee recommend that to avoid infructuous duplication of research efforts between these two institutions, there should be closer collaboration on institutional level.

D. Electricity Division

85. The staff strength of this Division is as follows:

	Sanctioned	Actual
Scientific	9	8
Technical	8	8
Ministerial	1	1
Class IV (Technical)	4	4

Scientist-in-Charge

86. The Committee learn that this Division has been without a Scientist-in-charge to guide its research activities for the last twelve years. It has been stated during evidence that "a year ago, an Indian scientist who is abroad, has been appointed to this post but he has not yet joined." The Director General, Scientific and Industrial Research has further stated that "This is basically a fundamental research division. Here qualified people are not easily available for this type of work. This was the reason why this post was vacant."

Prof. Blackett in his Report on National Physical Laboratory has observed as follows about the Division of Electricity:

> "This Division has had no Assistant Director for eight years and the morale is admittedly poor. I doubt if anything worthwhile will remain after the transfer of the standards and testing work. It is felt in this Division that standard work has not led in the past to advancement."

The Committee are surprised that C.S.I.R. could not find a suitable scientist to hold the charge of the Electricity Division for the last twelve years. The Committee strongly recommend that the C.S.I.R. should urgently decide whether the work of the Electricity Division pertaining to only standards and testing justifies the strength of 16 scientific and technical and 4 class IV technical personnel. As the Director General himself has admitted that 'Electricity Division is basically a fundamental research division', the Committee would further recommend that C.S.I.R. should examine whether this work could not be carried on with greater advantage in the Power Research Institute, Bangalore or the Indian Institute of Science, Bangalore, or in some universities.

Survey and Investigation of Dielectric and Insulation Materials

87. It has been stated that the Electricity Division is currently carrying out a survey and investigation of dielectric insulation materials available in the country to assist the industry in choosing the right material for use.

The Committee note that in the Project Report for 1964-65, the Electricity Division has laid down the following objectives for the above survey undertaken by them:

> "It is necessary to make a systematic study of the properties of various kinds of dielectric and insulating materials, natural and synthetic, with special reference to their suitability in a hot and humid climate as existing in our country. Existing data at different temparatures, frequencies, electric stress, doses of irradiation may be studied and used to classify the materials so that a suitable choice can be made for any electrical purpose."

It has been stated by the representative of the National Physical Laboratory during evidence that the work relating to the survey and investigation of dielectric and insulation materials "is still in progress and it may take another year or so before we are in a position to cover all the insulation materials."

When asked whether this work was not being done at the Power Research Institute, Bangalore one of whose responsibilities is to carry on research on "Insulating Materials", the representative of the C.S.I.R. replied "We did not know that they were doing it. But we will certainly be in touch with what they have done and what they are doing and if there is any duplication, we will take steps to avoid it."

The Committee regret that research on 'Insulating Materials' which is one of the main functions of the Power Research Institute, Bangalore, has been undertaken in the National Physical Laboratory without ascertaining the research work done at the former Institute. In view of the limited resources available in the country for research, the Committee cannot too strongly stress the need for avoiding such infructuous duplication of work. They feel that before long term research on any project is undertaken, the national laboratory/CSIR should make sure that identical research work is not being done by other institutions. Where it is absolutely essential in national interest to undertake research in more than one institution, there should be full coordination and exchange of information to help speed up research and avoid infructuous duplication.

E. Radio Propagation Unit

88. The Radio Research Committee had often expressed the view that an organisation should exist to coordinate the ionospheric data recorded in India at the various ionospheric stations and to initiate arrangements for regular forecasting of radio wave propagation conditions. Such an organisation was initiated in the Secretariat of the Committee by Dr. A. P. Mitra in January, 1955 immediately after his joining the Committee as Secretary.

On April 1, 1956, at the suggestion of the then Director, Dr. K. S. Krishnan, the scientific staff of the Radio Research Committee Secretariat (excepting Dr. A. P. Mitra) were detached and formed into a separate unit named Radio Propagation Unit and attached to the National Physical Laboratory.

89. The following are the objectives of the Radio Propagation Unit:

(i) To study the characteristics of propagation of radio waves over different regions of the radio spectrum, of the media through which these are transmitted (*e.g.*, ionosphere and space) and the interaction of these waves with the media.

(ii) The programme is intimately connected with the requirements of all major radio traffic services in India.

90. The Unit, now functioning as a Division of the National Physical Laboratory, has currently the following activities:

(i) Radio Propagation Service.

(ii) Space Radio Research.

(iii) Ionospheric Physics.

(iv) Aeronomy.

(v) Radio Astronomy.

(vi) Interdisciplinary Activities (Currently International Quiet Sun Year Activities).

(vii) Operation of an Associate Regional Warning Centre (as part of the International World Day and URSIGRAM Service).

Strength of Staff

91. The staff strength of the Radio Propagation Unit is as follows:

Scientist F	1
Scientist C	4
Scientist A	
Senior Scientific Assistants	3
Senior Research Fellows	2

Achievements of the Unit

92. It has been stated that:

(1) The Unit is responsible for the establishment of the first world-wide radio forecasting service in India. While more limited traffic predictions are undertaken by a number of organisations in India, these are generally limited to departmental uses; the unit's prediction is the only comprehensive one undertaken in the country and is on the same lines as the prediction of U.K., U.S.A. etc.

(2) The Unit has developed a technique for the prediction of solar activitiy, the raw materials for radio forecasts, which appear to be superior to most other forecasts of similar nature.

(3) Initiation of the first systematic IF/VIF propagation work in India, which has special advantages in long distance propagation and specially in standard frequency transmission.

(4) Successful piloting of the Indian programme for the International Geophysical Year.

(5) The Unit has contributed significantly to Indian space activities and is the earliest to start space research in India.

(6) Dr. Mitra, Scientific in-charge of the Unit who made the first successful use of the radio noise from the galaxy for the study of the terrestrial ionosphere (later named the Biometer technique) as a Colombo Plan Fellow in Australia initiated this technique in India now known as Ionospheric Radio Astronomy.

(7) The Unit detected 26 out of 30 known atmospheric nuclear detonations in 1962, using three low frequency equipments.

(8) The Unit operates one of the world's most extensive flare patrol systems, and feeds the International Geoalert System.

93. The Scientific Sub-committee of the Executive Council (Menon Committee) had observed in March, 1963 that "Programmes of the Radio Propagation Unit are closely related to the Space Research Programme of the Indian Government in the fields of Ionospheric and Upper Atmosphere Studies. Once the overall Indian Space Research Programme get going with established facilities the future of this Unit and the Orientation of its activities can be discussed more realistically."

94. Again in June, 1964 the Scientific Sub-committee of the Executive Council made the following recommendation:

"In view of the importance of the work carried out in the Unit, and the difficulty of its expansion in the National Physical Laboratory itself, the Committee recommend that it should be given sufficient scope for expansion by amalgamation with the Indian Space Research Programme. The Committee accordingly suggest that the Director may discuss the matter with the Chairman, Indian Space Research Programme and report the results to the Executive Council at its next meeting."

95. At the meeting of the Executive Council held in October, 1964 the Director General remarked that "the Unit was doing very good work and that it would not be advisable at this stage to hand over the Unit to another organisation. He suggested that in case it was decided to proceed further, the views of Dr. Mitra may be ascertained and that he should be closely associated with the discussions between the Director, National Physical Laboratory and Dr. Sarabhai of Physical Research Institute." The Council accepted the suggestion. "It was also decided that the word 'association' would express the idea of the Executive Council better than the word 'amalgmation' as appearing in the proceedings of the Scientific Subcommittee."

96. When asked to indicate whether it would be more appropriate to have the Radio Propagation Unit in the National Physical Laboratory or the Physical Research Laboratory, Ahmedabad, the representative of the C.S.I.R. stated during evidence:

> "Actually it is part of a nation-wide programme of sounding the ionosphere from points of view of predicting ionospheric condition for radio purposes. There are about six or seven stations in India. One is in the Physical Research Laboratory, another is in Haringhata, Calcutta, one more is in Kodaikanal which is near the magnetic equator. In addition to these, the All India Radio is running three more stations. So this gives a country-wide network. All the data is correlated by the radio propagation unit in Delhi and they publish what they call "Ionosphere Prediction'

97. Asked about the reasons for retaining this Unit under the administrative control of the National Physical Laboratory, it has been stated in a written note furnished to the Committee that:

> "The Unit has grown up in the National Physical Laboratory under the administrative control of Director, National Physical Laboratory and has continued to remain in it for (a) ease of operation, (b) availability of technical services (*e.g.* workshop facilities, electronic testing equipment etc.) and (c) because, in addition to above, there were several areas of scientific interaction with other projects in the National Physical Laboratory (*e.g.* Time and Frequency Section. Microwave Communication Project etc.).

Similar organisations in U.K. (Radio Research Station, Slough) and U.S.A. (Central Radio Propagation Laboratory) also began as Divisions of their respective National Standards Laboratories (N.P.L., U.K.; N.B.S., U.S.A.). These, however, eventually separated out as independent organisations as the programme expanded, with the rapid growth in radio science, and the opening up new radio communication systems."

While the Committee are happy to note that the achievements of the Radio Propagation Unit have been praised by Prof. Blackett in 1963, the Third Reviewing Committee of C.S.I.R. (1964) and other scientists, they are unable to appreciate why this Unit is being continued as a part of the National Physical Laboratory.

It has been admitted that the work of this Unit has no direct relation to the objectives of the National Physical Laboratory but pertains more to the fields of Ionospheric and upper atmosphere studies which are dealt with by specialist organisations, like the Physical Research Institute, Ahmedabad and the Indian Space Research Committee. The Committee recommend that in the interest of proper development of the work on this important subject the question of transferring/associating the unit with Physical Research Institute, Ahmedabad and/or the Indian Space Research Committee may be examined early.

F. Heat and Power Division

98. The work of the Heat and Power Division may be broadly classified into (1) Standardisation and Testing, and (2) Solar Energy Programme. The erstwhile Division of Heat and Power now consists of two sections (1) Heat Standards, and (2) Heat and Power. The following is the strength of these two sections:

(1) *Heat Standards Section* :

Scientist B	1
SSA	3
JSA	2
JMA	1
Lab. Asstt.	1
Mechanics	
Mistries	
Steno-typist	

(2) *Heat and Power Section* :

SSO (I)	1
S.L.A.	1
Fine Mechanic	1
Lab. Attendant	2
Bearer	1

Standardisation and Testing activities of the Division have been dealt with earlier.

The work done by the Division of Heat and Power in the field of Solar Energy Programme is briefly indicated below:

Solar Cooker

99. The project on 'Solar Energy" was taken up in November, 1951. Solar Cooker was developed in 1952 and was patented. It was given for commercial exploitation to a firm each in Bombay and Calcutta. Due to poor off-take, the Bombay firm has stopped its manufacture while the Calcutta firm still markets the solar cooker. Its capital cost and the inconvenience caused by outdoor cooking are some of its shortcomings. During evidence, the representative of the C.S.I.R. has informed the Committee that "the solar cooker that we have at present is not suitable either for commercial exploitation, nor is it a practical proposition." Japan, Burma, U.S.A. and other countries have also developed solar cookers of different shapes using different materials but the fundamental concept of concentrating solar radiation to a small area with the help of parabolic reflectors is common to them all.

For cooking outdoor picnic meals, a light weight umbrella-type solar cooker is marketed in U.S.A., Japan, Lebanon. etc. Solar ovens have also been developed in U.S.A. with aid from the Ford Foundation.

It is stated that these would be useful in countries where food is 'baked'. However, cooking and frying of food, as practised in this country, cannot be successfully carried out in these ovens .

It has been stated that the possibility of adopting the solar cooking devices developed in U.S.A., Japan, etc. for manufacture in India has been examined from time to time, but it was felt that they suffer from the same shortcomings as encountered with the Indian Solar Cooker.

Solar Water Heaters

100. This device operates with an overall efficiency of 70 per cent on a clear day. A single unit delivers 30 gallons of hot water at 55°C during the winter months (ambient temperature 20°C. This conducted at sub-zero temperatures have also been successful. Its characteristic features are simplicity of construction, low cost manufacture and thermosiphon action in water circulation. The National Physical Laboratory has stated that "solar water heater is now ready for commercial exploitation."

Solar Still

101. The use of solar still for rendering brakish well or sea water fit for drinking purposes has been experimentally studied in detail. One of the models tried yields nearly 0·06 gallons of fresh water per day per square feet, in summer months. As larger sums of money are involved in its testing on a pilot plant scale, conducting of the trials in collaboration with the Central Arid Zone Research Institute, Jodhpur could not materialise. However, the present status of the entire field of demineralization of saline water was discussed in a paper presented last year in the International Symposium held in Jodhpur, including the possibilities of combining the multi-stage flash distillation with nuclear power generation.

During evidence, the representative of the C.S.I.R. has stated:

> "The use of solar still is important in areas like Rajasthan and parts of Gujarat. Bhavnagar laboratory has put up solar still. We are trying to use alternative methods. In the next year we propose to instal solar still at some other place, Gujarat, Saurashtra and Rajasthan. It is extremely important in those areas."

It is noted that the work on solar still was started in 1958 which is still going on at the National Physical Laboratory as well as at the Central Salt and Marine Chemicals Research Institute, Bhavnagar.

102. Experiments on hot air engine, operated with solar energy, for use in lift-irrigation and for small power generation, were conducted for sometime in the laboratory. For its successful working, the correct design of the heat exchanger is very essential. The National Physical Laboratory has stated that the Phillips Company of Eindhoven, Holland, also gave up this project for want of proper type of heat exchanger and suitable materials.

103. The Committee understand that the National Physical Laboratory of Israel has developed a turbine which can convert any source of heat—sunshine, petrol, gas, oil, wood, radio-active isotopes or geo-thermal energy into power. The turbine has only one moving part, needs to be serviced only once a year and would prove a boon to the out-of-the-way places—stations in the desert or the polar regions. The turbine is now being manufactured by the Ormat Turbine Company of Youne, Israel.

104. A scientist has represented to the Committee that "there are many problems in the field of solar energy research other than the solar cooker, which could make material contribution in many fields of endeavour, particularly in the field of water supply in arid zones, desalinisation of sea water for drinking purposes, saving of gas and fuel for domestic water heating, solar water heating and cooking in homes, solar power generation. In some of these fields, outstanding work has been done in various parts of the World but due to the lack of proper leadership, the paucity of finances and inadequate appreciation of the needs has brought about a condition of stalemate in the work in this field."

The Committee are disappointed at the work of the Heat and Power Division particularly in the Solar Energy Research Programme. India is very fortunately placed in the matter of solar energy and they feel that it should not be beyond scientific ingenuity to harness this energy profitably for industrial, commercial and domestic purposes as has been done by scientists in many other countries like U.S.A., Japan, Israel etc. The Committee would in particular stress the need for intensifying research in solar still, water heater and turbine which could prove boons in the arid zones of the country *e.g.*, Rajasthan, Gujarat etc. The Committee would urge in this connection closer collaboration between the National Physical Laboratory and the Central Salt and Marine Chemical Research Institute (C.S.I.R.), the Central Arid Zone Research Institute (Indian Council of Agricultural Research) and the Power Research Institute, Bangalore (Ministry of Irrigation and Power).

G. Applied Machines Division

105. In 1963, Prof. Blackett had suggested that "some of the more routine testing work of Applied Mechanics Division might go to the new Standards and Testing Division, and the rest might either remain as it is, or be expanded or be transferred to the new Central Mechanical Engineering Research Institute."

During the course of evidence, the Director General has informed the Committee as follows:

> "More or less we will try to do the work on the line of Blackett's report. The Head of the Weights and Measures Division has made frequent visits to Durgapur and we are trying to establish contacts there. There is a suggestion which is under discussion between myself and the two Directors whether the work may be transferred to the Mechanical Engineering Research Institute along with the scientist."

The Committee suggest that C.S.I.R. should take an early decision regarding the transfer of work of the Applied Mechanics Division to the Central Mechanical Engineering Research Institute, as suggested by Prof. Blackett as far back as 1963.

H. Theoretical Physics Division

106. The Theoretical Physics Division was created at the National Physical Laboratory in 1963. The work of the Division has been classified as:

(i) Service to other Divisions of National Physical Laboratory; and

(ii) Fundamental Research in Theoretical Physics.

The following table gives the sanctioned and actual strength of the Theoretical Physics Division for the last three years:

Year	Scientific		Ministerial		Class IV Technical	
	Sanctioned	Actual	Sanctioned	Actual	Sanctioned	Actual
1963 . . .	2	2	..	..	..	..
1964 . . .	11	10	1	1	..	..
1965 . . .	11	9	1	1	1	1

It has been stated by the National Physical Laboratory in written note furnished to the Committee that:

> "The National Physical Laboratory cannot work without the help of a Theoretical Physics Division because the other Divisions get a better understanding of basic principles of physics through this Division. To achieve this, the Division of Theoretical Physics has already started giving

lectures in the Laboratory for the benefit of the workers on problems connected with the fundamental principles of physics, which goes a long way in carrying out the problems."

When asked whether National Physical Laboratory could not seek the assistance of the Physics Department of the University of Delhi in solving their mathematical computations or seeking theoretical understanding of the problems that may arise in the course of the working of the National Physical Laboratory, the Director General, Scientific and Industrial Research has stated during evidence that "we can do it ourselves better. We are maintaining this Division because it is doing good work. This Division is getting about 6 to 8 scholars registered in the Universities for Ph.D. work." When his attention was drawn to the observations of Zuckerman Committee that "pure basic research is best carried out in the environment of a University rather than in that of a Government research establishment, the Director General observed "National Physical Laboratory is one place where perhaps the research scholars are too many. We are trying to curtail the number."

The Theoretical Physics Division has also taken up the study of high energy physics, elementary particles and plasma physics. When asked whether similar work was not being undertaken at the Tata Institute of Fundamental Research, Saha Institute of Nuclear Physics and the Indian Institute of Science, etc., the Director General has stated that "this work is done in various places. But the quality of the work done at National Physical Laboratory is definitely comparable if not better than anything else. We know what each other is doing."

The Committee are not convinced that a full-fledged Theoretical Physics Division is necessary for the National Physical Laboratory. They note that the main work of the Theoretical Physics Division is to train the new entrants, prepare research scholars for Ph.D. work and solve the mathematical problems arising out of the day-to-day working of the National Physical Laboratory.

The Committee have been informed that National Physical Laboratory has recently entered into an agreement with the University of Delhi under which scientists of the National Physical Laboratory give regular lectures at the University of Delhi. The Committee would like the National Physical Laboratory to take the assistance of University of Delhi as necessary, for its training programme as well as for solving mathematical problems connected with research

work. The Committee think that such collaboration between National Physical Laboratory and University of Delhi would be in consonance with the recommendations made by the Third Reviewing Committee of C.S.I.R. (1964) that "the general policy of the C.S.I.R. should be to develop mutual confidence and reliance between the C.S.I.R. and its institutions and the universities." As regards the fundamental work of the Division on high energy physics, plasma physics etc., which is also being done at other institutions, the Committee would draw attention of the National Physical Laboratory to the observations of the Third Reviewing Committee that "the bulk of the basic work of a C.S.I.R. laboratory should be related to and form the background of its applied work.....However at present largely for historical reasons, there are groups in National Physical Laboratory, which are concerned with 'pure basic work' with little or no connection with applied work. We feel that emphasise should be changed over a period of time towards applied work."

The Committee consider that the number of research scholars being admitted in the Laboratory for preparing Ph.D. thesis, which has no direct bearing on applied research work, should be severely curtailed.

The Committee suggest that the functions and the staff strength of the Division of Theoretical Physics should be carefully reviewed by the C.S.I.R. in the light of the above considerations.

I. Division of Analytical Chemistry

107. The Division of the Analytical Chemistry was organised at the National Physical Laboratory mainly as a service division to render assistance to the physicists in the laboratory with their chemical problems.

The following is the sanctioned and actual strength of staff of the Division for the last four years:—

Year	Scientific		Technical	
	Sanctioned	Actual	Sanctioned	Actual
1962	10	9	5	5
1963	9	8	5	5
1964	10	8	3	3
1965	10	8	5	5

Basic Research Products:

108. It has been stated that as far back as in March, 1963, the Sub-Committee of the Executive Council had made definite recommendation that basic research work should not be taken up at the Division of Analytical Chemistry. The Sub-Committee had observed that: "Apart from the pioneering work connected with the development of new techniques and methods of analysis, which is now being carried out, it would be difficult to justify an activity such as basic chemical research in an organisation such as the National Physical Laboratory". The Executive Council of National Physical Laboratory at its meeting held in October, 1964 had recommended that the Division of Analytical Chemistry should function only as a "Service Division" and that it should not concern itself with researches or analytical techniques. The Executive Council recommended that several of the projects may be dropped and that the Division should recast and reorientate its work so as to co-ordinate its activities with that of 'Materials' and 'Solid State Physics' Divisions. When asked whether the work of the Divisions has been reoriented, the representative of the National Physical Laboratory has replied during evidence that "efforts are being made continuously to reorient the work of the division as the service unit of the laboratory. When the new Division of Materials, which we are thinking of having in the National Physical Laboratory comes, it will be of great importance and value to this Division." When asked whether dropping of several projects and reorientation of work has resulted in economy, the representative of the National Physical Laboratory replied in the negative.

Project on "to investigate the utilisation of fish body oil

109. It has been stated by the National Physical Laboratory that on a specific request, the Division of Analytical Chemistry undertook to investigate the utilisation of fish body oil which constitutes a waste product. When asked why the above project was taken up at the Analytical Chemistry Division, the Director General has replied during evidence "It was a mistake and we are trying to correct it now." The representative of the C.S.I.R., has further observed: "We find that this project had absolutely no relationship with any objectives of the National Physical Laboratory. It was taken as an isolated project. This is a dry oil project in connection with making of paints and at Hyderabad project, there are already 20—30 people working on it".

Asked about the reasons for taking up an isolated project, it has been stated during evidence that " . . . . They had a chemistry division which apparently was accepting all types of odd jobs and

frankly speaking we found that there was absolutely no justification for its being there. We decided that it would be in the best interest to take it to the laboratory where specialisation exists rather than being done in the analytical division. It was transferred about 1½ or two years ago."

The Committee are concerned to find that a subject like "Utilisation of Fish Body Oil" which has no relation whatever to the objectives of N.P.L. was taken up as a research project in the Laboratory. This is indicative of the lack of proper selection of research projects in the Laboratory. The Committee would like the Council of Scientific and Industrial Research to ensure that such unconnected and isolated subjects of research which have no bearing on the objectives of National Physical Laboratory are dropped forthwith.

The Committee also find it difficult to believe that even after dropping several projects and reorientation of the work of the Analytical Chemistry Division, as recommended by the Executive Council in October, 1964, the National Physical Laboratory have not been able to effect economy in the working of the Division; on the other hand the strength of the Division has been increased. As the Materials Division for which the Analytical Chemistry Division is expected to render considerable assistance, is yet to be set up in the National Physical Laboratory, the Committee recommend that staff position of the Analytical Chemistry Division should be reviewed immediately so as to effect economy.

J. Low Temperature Division

110. The Low Temperature Division has been concentrating on study of the nature of properties which characterise the metallic state of matter and which would lead to a better understanding of the theory of the metallic state. The Low Temperature Division requires use of costly equipments for research purposes.

X-Ray Crystallography Unit

Norleco & Philips X-ray equipment:

111. The first Director of N.P.L., who took special interest in the work of this Division had acquired imported equipments like Norleco and Philips X-ray Units costing Rs. 50,000 each, for conducting experiments.

After his death in 1961, no experiments were conducted on these equipments. Later in 1962, National Physical Laboratory found that

these units were unworkable. These units were set right in the middle of 1964 i.e. after a lapse of two years.

When asked to explain the delay in setting right these units, the National Physical Laboratory has informed the Committee as follows:—

> "So long as the late Dr. Krishnan was alive, the work on the Norleco and Philips X-ray equipment was being done by him with the help of one Research Fellow. The Research Fellow left sometime during 1961, and it was only during 1962, after Dr. Krishnan's death, that it was found that the Units were unworkable. In 1962, Dr. Jain, Head of Division of Solid State Physics, undertook to repair both the Units. Fortunately most of the parts required for the repair of the Philip's Units were traced from the National Physical Laboratory itself, and so it was repaired in a few months' time. However, the Norleco Unit was in a very bad shape. An order was placed for the assistance of a Philip's Engineer for the repair of the Unit. After extensive search in the Laboratory itself, some of the more important components could be located. An order was also placed for a water pressure pump, but unfortunately the firm supplied a pump which was found to be unsuitable and it took a very long time for the firm to replace it. By early 1964 all the necessary arrangements for the repair of the Unit were completed. An imported X-ray tube used in the Unit was also traced within the Laboratory itself, and the Philip's Engineers could set the Unit in working order, in the middle of 1964".

The Committee regret that an X-ray generator was allowed to go into disuse after the death of the first Director of the N.P.L. and that it took more than two years to locate the various parts and put it back into working condition. The Committee would like the Laboratory to ensure that proper arrangements are made for the up-keep of the expensive equipment.

K. Glass Technology Unit

112. The Glass Technology Unit in the N.P.L. has been organised basically as a service division making complicated scientific glass apparatus as well as to train glass technicians in the art of fabricat-

ing glass, silica and quartz apparatus. The Unit undertakes fabrication for research institutions, universities and industrial research laboratories.

The following are the main achievements of the Unit:—

It has reconditioned high power rectifiers tubes and designed and built the necessary equipment for carrying out this work.

In recent years, it has undertaken reconditioning of large industrial mercury arc rectifiers, single phase, 3 phase and 6 phase, used by the Delhi Electric Supply Undertaking, the Delhi Cloth Mills and similar institutions. This has resulted in considerable saving of foreign exchange.

This Unit is also fabricating equipments such as high vacuum systems and high voltage degassing and flashing apparatus with a view to reconditioning X-ray tubes and high voltage rectifiers.

Training: The most important phase of the programme of the Unit is the high level training imparted to apprentices and technicians sent by many scientific institutions. They are very much in demand and form the nucleus of skilled glass technicians in their parent institutions. Many industrial firms, making varied types of glassware such as mirror and safety glasses, glass syringes, mercury switches, thermometers, vacuum flasks and car bulbs have been benefited from this scheme.

In 1963, Professor Blackett had observed about this Division as follows:—

"The Glass Technology Division under Mr. Kiss has a personnel of 17 and the associated glass technology pilot plant 19, giving a total of 36. Effectively all the work is glass blowing and the technical level is high. Only a fraction of the work is for the National Physical Laboratory. Much difficult repair work, *e.g.* of mercury rectifiers etc. is done for outside bodies. I would strongly recommend that the concerned unit be taken out of the National Physical Laboratory organisation and made into an independent and eventually commercial glass blowing unit. It could well be located in a small factory type building near the National Physical Laboratory. Even with its present personnel of 36, such a manufacturing unit, if properly organised

to produce standard lines of high grade laboratory glassware, standard ground glass joints etc. as well as special research apparatus, should have a substantial output."

"In March, 1963 the Scientific Sub-Committee of the Executive Council endorsed the recommendation of Professor Blackett that Glass Technology Section should be constituted into an independent manufacturing unit managed on commercial lines.

In October, 1964, the Executive Council of the National Physical Laboratory decided that Glass Technology Section should function within the National Physical Laboratory itself but located in a separate building within the National Physical Laboratory campus."

In a written reply furnished to the Committee, the National Physical Laboratory have stated that:

"There is a proposal to expand the Glass Technology Unit and run it as a commercial organisation, when they will be in a position to render service to many more."

The Committee are in agreement with the recommendations made by Prof. Blackett and the Sub-Committee of the National Physical Laboratory that Glass Technology Section should be constituted into an independent manufacturing unit managed on commercial lines. They would like the Council of Scientific and Industrial Research to take early action in the matter.

Research on Vacuum Tubes and High and Ultra-high Vacuum Practice.

113. In June, 1964, the Scientific Sub-Committee of the Executive Council had recommended that in its development programme of basic components and basic processes, the N.P.L. should start the following projects:—

(i) Vacuum tubes (X-ray tubes, oscillographs, transmitter tubes)

(2) High and ultra-high vacuum practice.

In October, 1964 the Executive Council accepted the above projects for execution in the N.P.L.

When asked to indicate the progress made in respect of the above projects, the representative of the N.P.L. has informed the Committee during evidence that "We have not taken up the work as yet. We intend to take it up.'

In reply to a question it was further stated that "no assessment of financial implications and the utility of the above projects has yet been made by the N.P.L."

The Committee are surprised that even after 15 months of the decision of the Executive Council, no action has been taken by the N.P.L. in assessing the financial implication, time and personnel required for the execution of the projects on 'Vacuum Tubes' and 'High and Ultra-high Vacuum Practice' and the utility of the projects.

The Committee need hardly stress that after a proposal is approved by the Executive Council in principle, full details thereof should be worked out, at an early date, to give effect to the decision. They would like National Physical Laboratory to take early action in the matter.

L. Rain and Cloud Physics Research Unit

114. Following the symposium on Artificial Rain held in Delhi on the 9th February, 1953, the Atomospheric Research Committee of the Council of Scientific and Industrial Research which met on February 11, 1953 recommended that:—

(i) India should set up a Rain Research Unit at Delhi for trying out various methods of cloud seeding and accumulate necessary technical knowledge and experience in the subject of rain-making; and

(ii) Cloud Physics Research Unit at Poona should undertake a comprehensive programme of fundamental studies on Cloud Physics.

It has been stated that the Rain & Cloud Physics Research Unit at the National Physical Laboratory was set up in 1955 in accordance with these recommendations.

Strength of the Unit

115. The Rain & Cloud Physics Research Unit has the following strength of staff:

1. Scientific.	..	10
2. Technical.	..	7
3. House keeping.	..	2
4. Class IV.	..	7

Part-time staff

1. Temporary labourer for period of 4 months.	4
2. Raingauge observers.	25

Expenditure of the Unit

116. The expenditure incurred by N.P.L. on the Rain & Cloud Physics Research Unit for the years 1962-63 to 1964-65 is given below:

	1962-63	1963-64	1964-65
Recurring	Rs. 151869.43	Rs. 158996.07	Rs. 173463.98
Capital	..	Rs. 15222.24	Rs. 19543.77
Total	Rs. 151869.43	Rs. 174218.31	Rs. 193007.75

Achievements of the Unit

117. The Committee have been informed that following are the achievements of the Unit:

(i) The dominant mechanism responsible for development of natural rain in clouds over the Delhi region in different seasons was established.

(ii) One of the suggested methods for increasing the season's total rainfall which is by warm cloud seeding technique has been closely examined. Investigations conducted so far have pointed out that it is possible to bring about a 10-20 per cent increase in the natural rainfall over Delhi and such other similarly placed areas by properly designed artificial/experimentation.

(iii) About 33 research papers have been published by the Unit.

Transfer of the Unit from NPL

118. The Sub-Committee of the Executive Council of N.P.L. had observed in March, 1963 that "Committee sees no justification for the continuation of the work of the Rain and Cloud Physics Research Unit in the NPL."

In a note dated the 7th April, 1964 for the consideration of the Executive Council the then Director of the N.P.L. had stated that

"the research programme of the Rain & Cloud Physics Research Unit cannot be fitted into the programme of the N.P.L. It appears most appropriate that the work be carried out in the India Meteorological Department."

At its meeting held in October, 1964, the Executive Council of N.P.L. noted that "the question of transferring the work of the Rain & Cloud Physics Research Unit to Meteorological Department was under the active consideration of the C.S.I.R., and that probably that transfer might be effected from the 1st March, 1965."

The Director General, Scientific and Industrial Research has informed the Committee during evidence that "C.S.I.R. has moved the Meteorological Department about two years ago for taking over this Unit. The Civil Aviation Department have still not given their approval. Since it takes a very long time to get any approval of any Ministry, the matter is still under consideration. The possible saving for C.S.I.R. would be Rs. 2½ lakhs per year."

The Committee are surprised to find that though the decision to transfer the Rain and Cloud Physics Research Unit to the Meteorological Department was taken by the Executive Council about two years ago, it has not yet been implemented. As the work of this Unit is not directly connected with National Physical Laboratory they would urge Government to arrange for the transfer of this Unit to the Meteorological Department without further delay.

M. Division of Materials

119. In view of the importance of the development of materials and the study of their behaviour, it was suggested in April, 1964 by the then director of National Physical Laboratory that a new division of Materials be organised at N.P.L. It has been stated in the Director's note that "the recent progress in Physical processes and techniques is intimately tied up with the development of new materials which can satisfy the stringent and exacting demands of science, industry and technology. He suggested that some of the projects which can be started, pending the organisation of such a Materials Division, besides the studies of the properties of materials under high temperatures and pressures, are:

(a) Refractory metals—their production and working;

(b) Binary and ternary alleys.

(c) Fused silica—in collaboration with Central Glass & Ceramic Research Institute.

(d) Vacuum tubes.

(e) Optical surfacing and technical optics.

(f) Synthetic Optical crystals, lasers, etc.

(g) Photo-conducting materials.

The Executive Council of the National Physical Laboratory considered the above proposals of the Director in October, 1964 and recommended that work on the following items may be started:—

(i) Refractory Metals.

(ii) Fused Silica.

(iii) Crystal Growth.

No action was taken by the Laboratory on the above directive of the Executive Council till June, 1965.

120. The Director-General of the C.S.I.R. has recently set up a Committee to examine the question of formation of the Materials Division at the N.P.L. The proceedings of that Committee which met on the 23rd December, 1965, are given at Appendix IX.

It has been stated that financial implication of the setting up of the Materials Division which would be formally associated with the analysis testing of properties, manufacture and application of materials in different industries, has not yet been worked out.

The Committee are concerned at the leisurely manner in which the details for setting up the Materials Division are being worked out, particularly when Materials Division is, stated to be, one of the major projects included in the Fourth Plan proposals of the National Physical Laboratory. In the working out of the detailed proposals, the Committee would stress the need for ensuring close collaboration with other Laboratories e.g., National Metallurgical Laboratory, National Chemical Laboratory, Central Glass and Ceramic Research Institute which are working in the field and to set time targets for development of materials with particular reference to those which are being imported at present.

N. Division for Computer Technology

121. The Committee have been informed during evidence that about five laboratories or units in the country have carried out development of very simple type of computers for their own use. The Atomic Energy Department was the first to develop a computer

in this country, but Central Building Research Institute, Central Mining Research Station and Central Mechanical Engineering Research Institute have also built a Computer each for their use. It is expected that in about 5 years, about 300 to 500 computers would be reqiured by different centres in the country. It has been stated by the Director General of the Council of Scientific and Industrial Research that it is their intention to develop computer technology which is necessary to build highly Sophisticated and instricate computers. He has further stated that National Physical Laboratory appeared to be the most suitable place to set up a Division of computers technology but final decision has not yet been taken in this regard.

The Electronics Committee have indicated in their Report a possible scheme for the development of computer technology and the establishment of a computer industry in India during the next decade. The Committee would like Government to take an early decision in the matter. The Committee feel that at present the work is being done by several units without much coordination. They suggest that Government should assign specific roles for computer research to the research institutions under C.S.I.R., Atomic Energy Establishment, Universities etc.

The Committee have no doubt that full advantage would be taken of the work being done at Jadavpur University which has developed a computer indigenously.

CHAPTER VIII

CENTRAL WORKSHOP AND STORES

122. The Central Workshop of the National Physical Laboratory employs 111 people and occupies 35,000 sq. ft., about 30% of all space of the National Physical Laboratory. In 1963, Prof. Blackett recommended that "a close study should be made by an outside expert of the organisation, programme and efficiency of the Central Workshop and Drawing Office". He was of the view that some major tasks such as small scale production of wave guides for the communication project, could be given to the Workshop.

The Sub-committee of the Executive Council which made a further study of the working of the Central Workshop in March, 1963 made the following observations:

> "The deprecated value of machines in the workshop is less than Rs. 1·5 lakhs; most of the machines are old and in relatively poor condition and cannot be considered suitable for serious work over any length of time. The overheads of the workshop are of the order of Rs. 1 lakh per year and the wages of the labour employed come to about Rs. 1·5 lakh per year. At this stage it will not be possible to assess whether the workshop is a self-supporting unit in an industrial sense since the extent of material consumed or the work completed is not available. It is felt that the useful part of the workshop is only of the size necessary as a service facility for the National Physical Laboratory and for the Centre for Advanced Physics. Steps will have to be taken to balance the machine lay out by scrapping some of the old machines, and replacing some others, so that maximum results could be obtained at minimum cost."

Till September, 1965 no steps were taken to implement the suggestion of the Sub-committee, especially to balance the machine lay out so that maximum results could be obtained at minimum cost. At the meeting of the Executive Council held in September, 1965, a member stated that "the workshop should devote attention to the fabrication of specialised equipment not easily obtainable or which cannot be fabricated within the country, and suggested that a committee should

be constituted from among the scientists of the Laboratory associating some experts from outside, to make suitable recommendations for improving the work of the Workshop."

Workshop Reviewing Committee

123. The Committee note that a Workshop Reviewing Committee consisting of the following has been constituted in February, 1966:

(1) Dr. A. R. Verma—*Director, NPL.*

(2) Prof. N. M. Athavale—*Bajaj Electricals Ltd.*

(3) Shri E. Isacc—*Hindustan Machine Tools Ltd., Bangalore.*

(4) Shri T. N. Bose—*Prototype Production Unit, Delhi.*

(5) Shri G. D. Joglekar—*Scientist, NPL.*

124. The Workshop Reviewing Committee held the first meeting on the 15th and 16th February, 1966 and has made the following recommendations:

(1) It was found that a substantial effort on the part of the Workshop is spent in maintenance of equipment and minor jobs required by the scientists in the different divisions. With a view to saving time of the scientist and to reducing this type of workload on the Central Workshop it is suggested that divisions or group of divisions should have their own workshop. With this view, a part of the present equipment may be allotted to the sectional workshops so formed. The Central Workshop should then concentrate on building special instruments or equipments required for research. The Workshop should then concentrate on building special instruments or equipments required for research. The Workshop during the course of several years has manufactured equipment, such as for cyrstal growth, thermometer testing, pyrometer calibration, specialised gear equipment, 3-tonne dead weight testing machine, extrusion press for carbon work, etc., which are specialised and not available as made in India. There would be more emphasis on the applied work in the near future, and the Central Workshop would therefore be called upon to do such type of work. This really would be the function of the Central Workshop.

(2) The Central Workshop should undertake to supply the equipment developed by it to other research institutions or industry on the basis of reasonable profits. The Central

Workshop should plan projects of manufacturing specialised and precision instruments and equipment and particularly for testing work in industry and research institutes. It was found that the Central Workshop has to undertake work from other Government departments, like Defence and P. & T., but this should be done on a strictly commercial basis, meaning thereby the cost of design should also be included in the price charged.

(3) When some of the present equipment is transferred to the Divisional Workshops and in view of the work to be undertaken as above, it will be necessary to add the following machines to the Central Workshop:

1. Tool room lathes with accessories.
2. Milling machines—Universial type available on rupee payment from Czechoslovakia or from G.D.R.
3. Two more milling machines manufactured *e.g.* by Fritz Warner, Bangalore.
4. A number of drilling machines of varying capacities.
5. A small radial drilling machine from prototype factory, when available.
6. Small tools—dial gauges, micrometers, workshop microscope as made by Zeiss of West Germany or by G.D.R.
7. Heat treatment furnace of medium capacity with controlled atmosphere and pyrometers.

(4) The above equipment may not meet the demands made on the Central Workshop for manufacture of specialised parts like precision ground rods and gears. A survey should therefore be made for surplus capacity available round-about Delhi—such as Prototype Centre at Okhla and whenever possible such parts may be made there or at any other available workshop.

(5) The present costing procedure requires modification and the following procedure is suggested:

Cost on direct labour plus material used and an equal amount of overhead charges to cover rent, electricity, water taxes, management, etc.

Add 50 per cent to the above cost as reasonable margin on profit for charging the different sections. This should form the income side of the Workshop for each job to get an idea of the functioning of the Workshop.

(6) As a Workshop of this nature, which is meant primarily for helping research, would not be self-supporting and should not be judged on this basis. It is likely that some of the equipment like job balamcing machine etc. and even various types of grinding machines may lie idle for some days, but it should be remembered that Central Workshop would not be able to manufacture precision equipment without these machines. It was also found that at present major part of the capacity of equipment like lathes, is being con'inuously utilized and would con-' tinue to be used in future. In order to ascertain if there is any lacuna in the utilization of such machines, pilot survey of machine loading should be carried out occasionally.

(7) The machines which have been listed at 'poor' would not be useful for the type of work to be taken up by the Central Workshop and as such they can be handed over to the divisional workshops after reconditioning.

(8) With a view to utilizing the spare machine capacity, due publicity should be given to the type of work which can be undertaken in the Central Workshop. Similar publicity for any equipment or any instrument designed in the Workshop be given.

(9) The Committee inspected the EXCEL-0 lying in the garrage and recommended that step should be taken to bring it into working condition. If this machine is in proper working condition, then only it would be capable of making precision gears and screws. After it has been tried out, it should be tested and then only a decision should be taken regarding the future disposal of this machine.

(10) The mechanics working in the Welding, Spray Painting Sections etc. should be trained in another trade so that their services are fully utilised.

(11) The workmen-card system should be started. This system should also be applied to the Design office.

The Committee regret the inordinate delay of three years in setting up a committee to review the working of the Central Workshop of the National Physical Laboratory, which was suggested by Prof. Blackett, as early as February, 1963.

The Committee consider that the role of a Workshop in the National Physical Laboratory is primarily one of service to the Divisions of the Laboratory and it should not be enlarged to include

service to other Government Departments and Institutions except in case of some sophisticated instruments whose repairs and manufacture is not available elsewhere in the country. They suggest that the Workshop may be re-organised keeping this central role in view. If it is necessary to undertake manufacture of specialised equipment and instruments for other organisations *e.g.*, Universities, other research Institutions as a regular measure, the Committee would suggest that Government should decide in consultation with C.S.I.R., the most appropriate organisation *e.g.*, Central Scientific Instruments Organisation, where it could be undertaken. The machinery and the staff of the Workshop which are found surplus to the requirements of the National Physical Laboratory may also be considered for transfer to that organisation.

The Committee are surprised that in a Workshop with this limited role, the wage bill of labour should be Rs. 1·50 lakhs per year and the overheads should account for another Rs. 1 lakh. The Committee would stress the need for effecting economy and in particular, the introduction of proper costing procedure so as to distinguish clearly between the cost of maintenance and manufacture.

The Committee need hardly stress that machines which are obsolete or surplus to requirements should be disposed off at an early date so as to reduce unnecessary recurring expenditure which is being incurred on staff engaged for their operation and maintenance.

War Disposals Stores

125. The National Physical Laboratory had received a number of free war disposal machinery and equipment after the Second World War. The Committee learn that some of this machinery is still lying unopened at the National Physical Laboratory. It has been stated that recently a machine worth Rs. 2½ lakhs was found from the disposal stores at the National Physical Laboratory which according to the Director General, Scientific and Industrial Research "was absolutely in good condition and was urgently required at many places".

When his attention was drawn to the allegations that crates of Disposal stores were lying unopened at the National Physical Laboratory, the Director General replied during evidence that "with regard to the disposals equipment, I think these allegations are reasonably correct. We have made considerable progress in that direction and the situation now is not the same as it was eight years ago. But still the quantities were so enormous that the position is not satisfactory".

A note furnished to the Committee by the Ministry of Industry on war-disposal stores is reproduced in Appendix X.

The Committee are concerned to note that some 'war disposal' Machinery and equipments are lying unopened even after more than ten years of their receipt in the National Physical Laboratory. They are unable to appreciate why the National Physical Laboratory with such a large number of administrative and technical staff could not find it possible to open these crates, identify the machines and decide whether they were to be retained in the National Physical Laboratory or to be given to some other organisation by Government who could put them to use.

The Committee would like C.S.I.R. to have a thorough inventory made of all the surplus machinery and equipment lying unused in the National Physical Laboratory and other laboratories and to arrange for their proper disposal in consultation with the Ministries of Industry, Railways and Defence. The Committee would also like to draw attention to recommendation made in para 123 of their 91st Report on the South Eastern Railway wherein they have recommended that war surplus machinery lying unutilised in the Railway Workshops should be brought into use at an early date.

CHAPTER IX

REVIEW OF PROJECTS

126. On a specific enquiry from the Committee the National Physical Laboratory has stated in a written reply that only one research project *viz.*, "National characteristics of colour matching and luminous efficiency function" has so far been abandoned by it since its inception. This project on which Rs. 500 only were spent was started in April, 1964, and abandoned in November, 1964. They have further stated that "considerable expenditure of foreign exchange would have been necessary to carry out the project. As the result of this investigation would not have any immediate utility, it was thought advisable not to carry on the project."

During the course of evidence, it transpired that a number of jobs had been abandoned by the National Physical Laboratory at various stages of fabrication on account of which a sum of Rs. 16,504 was written off. The details of the jobs abandoned as furnished to the Committee is given below:

Job No. and particulars of job.	Year of Registration	Expenditure incurred			Reasons for abandonment
		Cost of Material	Cost of labour including overhead	Total	
		Rs.	Rs.	Rs.	
Job No. 125 Fabrication of two micro-wave antennae.	1957	2012·04	9360·94	11,372·98	A UNESCO expert and an Indian scientist who were doing work on the Project left the Laboratory.
Job No. 1561 Fabrication of three solar water heaters.	1959	840·55	426·50	1,267·05	Design had to be changed.
Job No. 1309 Making a Crystal grinder.	1960	18·33	235·55	253·88	Design did not meet the specialised requirement.
Job No. 590 Making two rocket models.	1961	261·75	3348·97	3,610·72	Job was meant for the Museum of the NPL which was subsequently transferred to Bangalore.

During the course of evidence, the Director remarked that "the whole project (job No. 125) was misconceived. It should not have been taken up. Probably there was no need to take it up."

The Committee have been informed that the Executive Council of the National Physical Laboratory has given a directive that henceforth fabrication of any item, estimated to cost more than Rs. 5,000 should be taken up after ensuring that one or two other scientists are associated in the project so that even if one of them leaves, the work could be continued uninterrupted and completed.

The Committee feel that there is general tendency for keeping unrewarding research projects on the books either for reasons of prestige or because of hopes that some efforts and money might produce some eventual rewards and justify the money spent on a project. This appears to be particularly so in the case of National Physical Laboratory as the Committee find that even after recommendations had been made by Prof. Blackett, the Executive Council of the National Physical Laboratory and the Third Reviewing Committee of the C.S.I.R. for dropping and recasting of the projects, no serious attempt appears to have been made in this direction. The Committee consider that if resources on research projects are to be utilised effectively and to the best advantage, it is essential to review their progress from time to time systematically and vigorously. Apart from the occasions that such reviews provide for discussion and guidance, they also offer good opportunities for exercising control and ensuring that the resources are not being expended on research where progress is unlikely because of lack of new ideas or the necessary techniques. The Committee recommend that reviews of all research projects should be conducted at least quarterly by the Director of the laboratory in conjunction with the Head of the Division/scientist concerned with reference to the progress made, expenditure incurred, the anticipated expenditure and time required to achieve results so as to take necessary steps for early fruition or failing that to abandon the unrewarding projects at the earliest possible time. The Committee would further suggest that the results of such reviews should also be communicated to the C.S.I.R. half-yearly to keep it informed of the overall progress made in the research projects.

Independent Review

127. The Third Reviewing Committee of C.S.I.R. (1964) observed "we feel that in addition to the overall review of the CSIR, individual institutions should be reviewed by a panel of scientists once in

every quinquenium. Such a review could usefully precede the review by the Reviewing Committee which would then take into cognizance the recommendations made in respect of individual research institutions."

During evidence, the Director General has informed the Committee that "Governing Body has approved the recommendation and we will take action."

The Committee consider that it would be useful to have a periodical evaluation of the research work of the National Physical Laboratory every five years by an independent committee consisting of eminent physicists and representatives of user departments who are not members of the Executive Council of the Laboratory. In the opinion of the Committee such an evaluation would provide an objective and independent assessment of the work of the laboratory and would act as a stimulant to its functioning. They further recommend that this system of evaluation by an independent committee should be applied to all the research laboratories and institutes under the C.S.I.R.

CHAPTER X

COORDINATION OF RESEARCH ACTIVITIES

A. Coordination between Divisions of N.P.L.

128. Several instances have come to the notice of the Committee which indicate that there is not proper coordination between the various divisions of the National Physical Laboratory. A few examples are given below:—

(1) The Indian Standards Institution referred to the Weights and Measures Division two projects *viz.*, "Reduction of Noise in Bearings" and "Progressive Load Testing of Antifriction Bearings." Even though these projects should have been passed on to the Accoustics Division and Applied Mechanics Division respectively the Weights and Measures Division showed these projects as its own items of work in November, 1964 the Sub-committee of the Executive Council had to correct it.

(2) There were certain projects such as the point, tripple point and thin films etc. which were tackled from different angles by various Divisions. But the experience gained by these Divisions was not being pooled together. The Sub-Committee of the Executive Council had to recommend in September, 1965 that "the work on them should be co-ordinated".

(3) The equipments of one Division is not easily being made available to other Divisions.

The Director General has attributed historical reasons for the lack of coordination between the various Divisions. He has informed the Committee that such a state of affairs also existed in a few other laboratories of C.S.I.R. He has further stated that "one of the means of getting over that is to have the programmes divided on project basis. Quite a number of these projects are inter Divisional. Once the project idea is accepted, this compartmentalisation will disappear".

The Committee cannot too strongly emphasise the need for closer collaboration among the scientists of the National Physical Laboratory in sharing their experience on projects of common interest and

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sharing their equipments, which will evidently lead to better output. The Committee have already observed in para 20 that excessive compartmentalisation of work in the National Physical Laboratory is due to the existence of a large number of Divisions and each division being unduly conscious of and eager for self-sufficiency. The Committee recommend that the C.S.I.R. should take effective steps to streamline the overall working of the National Physical Laboratory and bring about the much needed coordination amongst its various Divisions.

B. Coordination with other Laboratories

129. The National Physical Laboratory is one of the first laboratories to be set up by the C.S.I.R. As such, diverse problems used to be referred to it. To day C.S.I.R. is having more than 30 laboratories in different disciplines. Even so, the National Physical Laboratory has still got divisions, in certain disciplines in which full-fledged research institutions have been set up. The details of such Divisions of National Physical Laboratories are given below:

NPL Divisions	Other Institutions of CSIR/ other Ministries
1. Electronics Division . . .	(i) Central Electronics Engineering Research Institute. (ii) Electronics and Radar Development Establishment, (Def. Res. & Dev. Org.), Bangalore. (iii) Defence Electronics Research Laboratory, Hyderabad (Def. Res. & Dev. Org.) (iv) Atomic Energy Department.
2. Development and Production Unit for Electronic Components.	
3. Solid State Physics Division . .	Solid State Physics Laboratory of the Def. Res. & Dev. Org.
4. Applied Mechanics Division . .	Central Mechanics Engineering Research Institute (CSIR).
5 Acoustics Division	Central Building Research Institute (CSIR).
6. Glass Technology Division . .	Central Glass and Ceramic Research Institute (CSIR).
7. Electricity Division	Power Research Institute, Bangalore (Ministry of I & P).

The Committee note that 30 laboratories have now been set up by C.S.I.R. in different disciplines. In view of the fact that there is inter relation and similarity in the work of some of the Divisions of National Physical Laboratory and other Institutions of the C.S.I.R. as well as of other research institutes and departments which have come into being after the N.P.L. the Committee would urge closer cooperation and coordination between them especially while selecting problems for research. The Committee welcome the steps taken by C.S.I.R. in organising inter-laboratory conference. They would further suggest that steps should be taken by C.S.I.R. to appoint conveners for each major item of research work which is being done in more than one laboratory so as to bring about close coordination. The Committee would also suggest that the N.P.L. may drop some of the subjects for which separate laboratories and institutions have been set up.

C. Coordination with Universities

130. Asked to indicate the nature of collaboration existing between the National Physical Laboratory and Universities, the Committee have been informed as follows:—

> "Coordination between the National Physical Laboratory and other Universities and technical institutions already exists and the facilities available in the Laboratory are made available to research workers from other institutions. This is particularly true of the Delhi University and the facilities in the Workshop and Glass Blowing Section of the Laboratory are made available to them. Some of the senior members of the National Physical Laboratory give lectures at the Delhi University, Indian Institute of Technology, Delhi, and other Universities on subjects of their specialisation."

Guest Workers

131. It is noted that the National Physical Laboratory has been recognised by the following Universities for post-graduates study and research:—

(i) Agra University
(ii) Andhra University
(iii) Banaras Hindu University
(iv) Bombay University
(v) Delhi University
(vi) Kerala University

(vii) M.S. University of Baroda.

(viii) Punjab University

The number of students of the various Universities, who worked at the National Physical Laboratory as guest workers during the years 1962 to 1965 and took advantage of the facilities available at the Laboratory is given in the Appendix XI. It has been stated during evidence that no request from University workers to avail of the facilities at National Physical Laboratory has been turned down.

Special Courses

132. National Physical Laboratory organises occasionally special courses on specialised subjects where technicians and members from the universities also attend. National Physical Laboratory has so far organised a course on electronic microscopy, high vacuum technology, semi-conductors and microwaves in collaboration with the UNESCO.

National Physical Laboratory has also given a course of instructions to about 250 Assistant Controllers of Weights and Measures of all the States in the implementation of the Weights and Measures Act.

Steps taken by CSIR

133. As regards the efforts made by CSIR in forging collaboration between the laboratories and the universities, the CSIR has informed the Committee as follows:—

"Steps have been taken to assess the extent of collaboration with the universities. The first was to collect data on the already existing collaboration between the laboratories/ Research Institutes and the universities under 16 heads. This will form the basis for stepping up the extent of collaboration. Secondly, information has been procured from leading professors and scientists of various universities and institutes of higher learning with a view to consolidating data on the research projects. These include information on:—

1. Titles of research projects under them,
2. Short descriptions of these, and
3. Whether these schemes are financed by the University, U.G.C., C.S.I.R., or by any other agencies.

The data will be of great help from the point of view of utilisation of national research potential."

The Committee appreciate that a number of guest workers from various universities took advantage of the facilities at N.P.L. They suggest that guest workers from other universities, particularly those having Advanced Centres in Physics, should also be encouraged to avail of the facilities at N.P.L.

CHAPTER XI

GENERAL MATTERS

Executive Council of the NPL

134. Rule 71 of the Rules and Regulations of the Council of Scientific and Industrial Research states that "for each National Laboratory, at the time considered appropriate by the Governing Body, there shall be appointed an Executive Council responsible for the control and general direction of the laboratory within the framework of rules and regulations and directives issued from time to time by the Governing Body".

The functions of the Executive Council are as follows:—

(i) To consider the scientific programme as recommended by the Scientific Advisory Committee and to appropriate funds within the block grant (which may be allotted to the National Laboratory by the Governing Body).

(ii) To frame the annual budget of the National Laboratory on the basis of the views of the Scientific Advisory Committee with the block grant and to regulate the expenditure.

(iii) To consider proposals for projects recommended by the Scientific Advisory Committee and/or the Board of Scientific and Industrial Research which require additional expenditure beyond the block grant to make recommendations to the Governing Body regarding the same.

(iv) To determine the strength of staff; and take decisions on creation, suspension and abolition of posts provided that in the case of Junior Scientific Officers and above this should be subject to the approval of the Governing Body.

(v) To appoint scientific and such other staff as provided by regulations framed by the Governing body of the Council of Scientific & Industrial Research, other than those of Junior Scientific Officers and above who shall be appointed by the Governing Body of the Society;

(vi) To consider extension of service of staff (except the staff appointed by the Governing Body) as referred to in (v) including extension beyond the age of superannuation in accordance with rules; and

(vii) To impose penalties on members of the staff in accordance with the rules, provided that no officer of the rank of Junior Scientific Officer and above is dismissed or discharged except with the previous approval of the President.

Meeting of Executive Council

135. Bye Law 39 of the Rules and Regulations of the Council of Scientific and Industrial Research states that

> "Meeting of the Executive Council shall be convened not less than twice a year in the National Laboratory or such other place as the Chairman may decide."

A special meeting can be convened under Bye-law 40 if not less than half the number of members of the Executive Council make a request to that effect.

Present Composition of Executive Council

136. The Executive Council of the National Physical Laboratory consists of the following members at present:—

Chairman

1. Dr. A. Ramaswami Mudaliar, Indian Steamship House, Calcutta.

Members

2. Dr. S. Chandrashekhar, Professor of Physics, University of Mysore, Mysore.
3. Dr. A. K. Saha, Saha Institute of Nuclear Physics, Calcutta.
4. Dr. Lal C. Verman, Director, Indian Standards Institution, New Delhi.
5. Shri J. C. Kapoor, President & Chief Executive Officer, Air-Conditioning Corporation Ltd., Calcutta.
6. Shri B. V. Baliga, Managing Director, Bharat Electronics Ltd., Bangalore.
7. Dr. J. N. Nanda, Director, Defence Research Laboratory (Materials), Kanpur.

8. Shri G. R. S. Rao, Chairman, Radio Manufacturers' Association of India, Calcutta.

9. Dr. D. S. Kothari, Chairman, University Grants Commission, New Delhi.

10. Prof. R. C. Mazumdar, Head of the Dept. of Physics, University of Delhi, Delhi.

11. Dr. Vikram A. Sarabhai, Physical Research Laboratory, Ahmedabad.

12. Director-General, Scientific and Industrial Research, New Delhi.

13. Financial Adviser to CSIR, New Delhi.

14. Director, National Physical Laboratory, New Delhi.

The Committee learn that since its inception in 1950 the Executive Council of the National Physical Laboratory has held only 14 meetings. The particulars of the meetings held by the Executive Council since 1961 are given below:—

Meetings—

(1) 7th August, 1961.

(2) 15th September, 1962.

(3) 26th February, 1963.

(4) 29th April, 1963.

(5) 7th April, 1964.

(6) Ist October, 1964.

(7) 9th September, 1965.

It will be seen that while rules provide for at least half yearly meetings of the Executive Council of the National Physical Laboratory, in actual practice it has held 14 meetings only during the 16 years of the existance of the Laboratory. The Committee note that except in years 1963 and 1964, the Executive Council has not held the minimum two meetings in any year so far.

137. A scientist has observed as follows regarding the working of the Executive Council of the National Physical Laboratory:—

> "The Executive Council meets once or twice a year where the various scientists and the people working in different divisions of the National Physical Laboratory make available

the information concerning the projects they are working on. These projects have no relationship with the pattern of our national development. The Director recommends such projects to the Executive Council which examines it in terms of the comment of the Director of the Laboratory. Once this is done, the Executive Council does not see what is going on in the Laboratory. After some time a report comes to the Executive Council that this Project has been worked out for a little while. This is the net result. Whether it has been successful or not, it has not come to the notice of the Executive Council".

During the course of the examination of the estimates of the National Physical Laboratory, the Committee have also noticed that in several cases the decision of the Executive Council have not been carried out by the National Physical Laboratory.

The Committee regret to note that the meetings of the Executive Council, which is the main body responsible to direct the research programmes of the National Physical Laboratory, have not been held at least twice a year as provided for in the Rules, and on an average, the Executive Council has not met even once a year. Fourteen meetings in a period of 16 years can hardly provide the necessary guidance and supervision over the working of the Laboratory which is expected from such a body. Moreover the duration of the meetings of the Executive Council which is usually a day at a time, can hardly allow sufficient time to the Members to probe into the matters placed before them. The Committee consider that the past performance of the National Physical Laboratory may in part be attributable to the inadequate number of times the Executive Council has met. The Committee consider that the Executive Council should function energetically and effectively so as to give a clear lead in the formulation of the research programmes of the National Physical Laboratory and to watch zealously the progress made in research projects in implementation of its decisions. The Committee urge that the Executive Council should meet not less than twice a year, but it would be preferable if it meets once a quarter, so as to deliberate promptly and critically over problems and give guidance.

Scientific Advisory Committee of National Physical Laboratory.

138. Rules 75 and 76 of the 'Rules and Regulations of C.S.I.R.' state that:—

"The Executive Council of a National Laboratory shall be assisted by a Scientific Advisory Committee, appointed by a Governing Body.

The Scientific Advisory Committee of a National Laboratory shall consist of scientists actually engaged in the particular subject, leading industrialists interested in the subject and representatives of the concerned Ministry or Ministries of the Government of India. The Director of the Laboratory shall be *ex-officio* chairman of the Scientific Advisory Committee."

The function of the Scientific Advisory Committee as laid down in the rule 77, are as follows:—

(i) To consider the budget of the National Laboratory and give its views;

(ii) To consider and recommend the programme of research for the Laboratory;

(iii) To review the progress of research;

(iv) To consider the annual report;

(v) To make recommendations relevant to the implementation of research projects; financial and otherwise;

(vi) To advise on matters of policy relating to patents and publication, excepting scientific communications to learned periodicals, urgent publications may be undertaken at the discretion of the Director in consultation with the Director-General;

(vii) To advise on pilot plant investigation;

(viii) To maintain liaison with universities, Government Departments and industry; and

(ix) To advise on processes considered fit for release to industry and to the National Research Development Corporation.

The Director General, Scientific and Industrial Research has stated during evidence that "the Scientific Advisory Committee did not exist at the National Physical Laboratory till March, 1963. Since then the Executive Council has nominated a Scientific sub-Committee of the Executive Council to perform the functions of the Scientific Advisory Committee".

The Committee note that while under the Rules, the Scientific Advisory Committee has to be appointed by the Governing Body of the C.S.I.R., whereas the Scientific Sub-Committee is appointed by the Executive Council of the National Physical Laboratory. Further

the Rules provide that the Scientific Advisory Committee should consist of scientists, leading Industrialists and representatives of Government departments, but the Scientific Sub-Committee of the National Physical Laboratory consists of the members of the Executive Council only.

Asked whether the absence of Scientific Advisory Committee has adversely affected the work of the National Physical Laboratory, the Director General has stated as follows:—

> "It is very difficult for me to express an opinion. I have been a Director of one laboratory and, I think, they are doing a very good job with a very powerful and critical Scientific Advisory Committee. I got on very well there, so learning from that, I will reply to you that National Physical Laboratory would have worked better with a scientific Advisory Committee."

The Committee are concerned to note that the Scientific Advisory Committee for the National Physical Laboratory has not been appointed so far although it has been specifically provided for in the Rules. It is surprising that neither any amendment to the Rules has been made by the C.S.I.R. nor has any exemption been sought from the provisions thereof. Apart from the question of compliance with the rules, which is a statutory obligation, the Committee do not agree that the Scientific Sub-Committee which has been appointed by the Executive Council since 1963, can be a proper substitute for the Scientific Advisory Committee which is to be composed of scientists actually engaged in the particular subject, leading industrialists and representatives of the concerned Ministries of the Government of India. The Committee regret to observe that the C.S.I.R. has not been able to ensure that the provisions made in the Rules and Regulations are being observed by the Laboratory in actual practice. The Committee recommend that immediate action be taken to appoint Scientific Advisory Committee for the National Physical Laboratory as provided for in the Rules and also for other Laboratories where it has not been formed so far.

Post of Director

139. Prof. K. S. Krishnan, F.R.S. an eminent scientist, was the first Director of the National Physical Laboratory for the period from 21st January, 1950 till his death on 14th June, 1961.

After a lapse of 2 years Dr. P. K. Kichlu was appointed as the second Director of the National Physical Laboratory on October 29, 1963. He resigned from the Directorship on 12th September, 1964

and relinquished the charge on the 3rd October, 1964. Dr. A. R. Verma has been appointed as the third Director of the National Physical Laboratory with effect from the 26th May, 1965 and is continuing in that office.

Asked to explain the delay in the appointment of a Director after Dr. Krishnan's death, the Director General has stated as follows:—

> "In the beginning of 1962, a Deputy Director was selected but the Scientist did not accept the post. The second meeting of the selection committee was held in April, 1963 when our scientists could not agree upon recommending any scientist for selection. Another meeting was held in October, 1963, when a Director was selected by the scientists as a matter of compromise. In about one year, he resigned. It took us about four months again to select a new director who took over in May, 1965."

It is pertinent to note the recommendation of the Third Reviewing Committee of C.S.I.R. (1964) to the effect that "posts of directors should be filled as expeditiously as possible to ensure the proper functioning of the research organisations and temporary appointments should be avoided as far as possible. Where, however, the Selection Committee feels unable to make a permanent appointment of a Director with complete confidence, it could make the appointment on contract or for a probationary period. It is recommended that in either case this period should not exceed one or at the most two years before confirmation or termination."

It is well known that the success of an organisation depends to a large extent on the direction and guidance provided by its Head, who should be a man of standing and proven administrative ability and possessing expert knowledge and experience of the subject matter dealt with by the organization. This is all the more important in the case of research laboratories where senior scientists work. The Director of such a laboratory should have the ability to inspire team work and set a high example by his own dedication to research work. The Committee consider it extremely unfortunate that the N.P.L. remained without an effective Director for a period of about 4 years i.e. from 1961 to 1965. This led to uncertainties about its future programmes and policies which affected the general morale of the scientists working in the N.P.L. The Committee hope that Government/C.S.I.R. would benefit from the sad experience of National Physical Laboratory which has affected its reputation to a considerable extent. The Committee fully endorse the recommendation of the Reviewing Committee that the Directors of national labo-

ratories be appointed as expeditiously as possible to ensure the proper functioning of the research organisations and interim and *ad hoc* arrangements extending over long periods should be avoided.

Administrative Class IV Staff

140. The existing strength of staff of National Physical Laboratory category-wise is given below:—

	Permanent	Temporary	Total
Scientific	129	73	202
Technical	249	114	363
Non-technical	130	10	104
Class IV Technical	99	63	112
Class IV Non-technical	91	41	132
TOTAL	698	251	949

It will be observed from the above table that for every 100 scientists in the National Physical Laboratory, there are 237 technical staff and 136 administrative and class IV staff.

The corresponding ratio among these categories of staff in foreign countries is given below:

Year	Country	Type of Research	Proportion of staff per 100 scientist			
			Scientists	Engineers	Technical staff	Administrative staff
1960	USA	Basic and Applied Research.	100	35	40	75
		Developmental work	100	287	266	..
		Production work	100	276	367	..
1963	France	Research and Development work	100	..	120 (workmen) 190 (trainees)	50
1961	Japan	Research and Development work	100	..	150 Auxiliary staff (technical and administrative)	..
		Universities	100	..	78	..
		Industry	100	..	210	..

It is noted from "A Study of Expenditure in National Physical Laboratory", published by the C.S.I.R. in 1964, that "among the developed laboratories, National Physical Laboratory has highest percentage (60·0 per cent) of auxiliary technical staff and lowest percentage (15·8 per cent) of scientific and technical staff directly engaged in research."

At the meeting of the Executive Council of the National Physical Laboratory held in September, 1965, the Director General observed that "so far as the existing strength of the laboratory was concerned, there was a very great imbalance between the scientific staff and non-scientific staff and that efforts should be made to remove this problem."

During evidence, the Director General informed the Committee that "no additional posts in these grades (administrative and Class IV) have been sanctioned and as far as possible vacancies are not filled, except in the production unit where we have transferred people from other places. We are conscious of the imbalance and we are trying to correct it."

The Committee stress that National Physical Laboratory should make concerted efforts to remove the imbalance between the scientific staff and non-scientific staff existing in the laboratory and effect economy by reducing the administrative and Class IV staff to the barest minimum. The Committee would like C.S.I.R. and the Executive Council of National Physical Laboratory to take urgent action in the matter. The Committee would like C.S.I.R. to lay down norms about the proportion of scientists, technical and non-technical staff for each laboratory so that the strength of staff is regulated accordingly.

Drift of Scientists

141. It is noted that during the period from 1961 to 1965, 11 scientists resigned from their posts in the National Physical Laboratory and 17 scientists left the National Physical Laboratory to join other institutions. Among the 28 scientists who left the Laboratory as many as 19 had been sent abroad earlier for training on deputation from the National Physical Laboratory. It has been stated by the National Physical Laboratory in a written reply that "their leaving has upset the work of the laboratory to a considerable extent."

The Committee further note that in one Division of Applied Mechanics alone, the following projects were kept in abeyance because a senior scientist for whom these projects were intended has left the laboratory a year and a half ago:

AM/5 Magnetic and Penetrant methods of non-destructive testing of materials.

AM/6 (i) Hardness of very hard materials, precision stones diamonds, carbides and other hard alloys.

(ii) Elastic constants by Hardness measurements.

(iii) Nomo-grams of Hardness values *e.g.* vikers-Rookwel-land Brinell.

AM/7 Maintenance of standard of Force calibration and verification of Elastic devices, providing rings, load eells and material testing machines.

Asked whether these projects would be continued, the Director General has stated that "We are trying to recruit staff and revive them, they are important projects."

When asked if the projects were intended for a particular scientist, was it not proper to go in for contract appointment, the Director General remarked, "I quite agree. My experience has been that if a proper scientific atmosphere is created in the laboratories, that will prevent him from going away."

The Committee regret that a large number of scientists, have left the National Physical Laboratory during the last four years, thereby adversely affecting the progress of research work in the laboratory. The Committee feel that this may partly be due to lack of proper scientific atmosphere in the laboratory. The Committee would urge that National Physical Laboratory should immediately take remedial measures to retain the scientists engaged in specific projects so that the important research projects which were being carried out by these scientists, may continue without interruption.

Research Fellows

142. The idea behind the scheme of allotting research fellowships is to attract bright young men with good academic or research background who are fit for a research career and give them opportunity for research before they drift into some other less suitable vocation.

The following statement gives the number of research fellowships allocated each year by the National Physical Laboratory during the years 1960—1965:

	Senior Research Fellows	Junior Research Fellows
As on 1-3-60	6	3
Allotted	1	9
	7	12
Left	3	8
As on 1-3-61	4	4
Allotted	10	13
	14	17
Left	6	..
As on 1-3-62	8	17
Allotted	6	8
	14	25
Left	..	10
As on 1-3-63	14	15
Allotted	14	12
	28	27
Left	15	19
As on 1-3-64	13	8
Allotted	5	12
	18	20
Left	6	3
As on 1-3-65	12	17

The National Physical Laboratory have informed the Committee that 39 Research fellows left the laboratory without completion of research work allotted to them during the last four years.

The Committee are unhappy to note that a large number of research fellows left the National Physical Laboratory without completing their assigned work. The Committee would like the C.S.I.R.

to investigate the causes for this phenomenon in this and other laboratories and take suitable remedial measures.

It appears that all was not well in the N.P.L. with the result that quite a large number of scientists and research fellows have left the Laboratory. They hope that the C.S.I.R. will make a proper study into the causes of so many desertions.

Publicity

143. The National Physical Laboratory has not been publishing any annual report of its own in spite of a directive by the C.S.I.R. Its research activities are very briefly described in the Annual Reports of C.S.I.R. The National Physical Laboratory has also not brought out any publicity material about its activities except two brochures—one in 1954 and another in 1965. The Committee have been informed that since January, 1966 National Physical Laboratory has made a beginning in publicising its important activities by publishing a quarterly technical bulletin.

The Committee note that in 1963, Prof. Blackett had recommended that the facilities available and the activities of the National Physical Laboratory should be vigorously publicised. In 1964, the Third Reviewing Committee of C.S.I.R. had observed "We feel that publicity is badly lacking about the useful activities of National Physical Laboratory and its achievements and services by way of testing and standardisation facilities. Steps to remedy this should be taken."

The Committee note that while many C.S.I.R. laboratories are bringing out annual reports and technical bulletins to inform the scientists, industrialists and the public of their activities and the facilities they can extend, National Physical Laboratory has not done this till very recently in spite of the directive of the C.S.I.R. The Committee, however, note that the National Physical Laboratory has begun to publish a quarterly Technical Bulletin since January, 1966. The Committee strongly recommend that National Physical Laboratory should regularly and in time, bring out its Annual Report and circulate it amongst industry and other laboratory institutions and universities who are interested in the subject.

They commend the new practice of observing an 'Open Day', as done in January, 1965 to acquaint the public and industry with the work done at National Physical Laboratory.

CHAPTER XII

CONCLUSIONS

144. In the realm of Physics, India's contribution has been in some ways of the highest standard. The discoveries like Sir J. C. Bose's work on 'Hertzian Waves' and 'Coherers'; Raman Effect; Ramanujam-Hardy Formula; Saha Ionization Theory; the concept of Bosons, Bose Einestein Statistics etc. could be the envy of many countries.

To pure scientists, physics may be an expression of the human spirit in which man's imagination often leading to mataphysics, the logic of his thinking and his skill with the materials at his command is constantly challenged in seeking new knowledge of his physical surroundings. To society and the country, physics can make possible ever higher standards of living. It is the general belief that physics is the seed from which new industries grow or, when wedded to technological skill and inventiveness becomes a source ef wealth and power.

145. The idea of establishing the National Physical Laboratory in 1950 as the first in the chain of C.S.I.R. laboratories was mainly to promote the application of research for national development. The Second Reviewing Committee of C.S.I.R. observed: "There are few, if any, institutions of this character in the World which are so designed that the work is housed as conveniently. Most similar institutions consist of widely scattered buildings, which are consequently less easily directed."

146. The performance of the National Physical Laboratory during its existence of 16 years cannot be considered very encouraging, notwithstanding its commendable work on the manufacture of cinema arc carbons, various electronic components such as Ferrites and Piezo-Electric ceramics and, recently, defence items, etc. using indigenous materials. The main factors responsible for not achieving the results expected of the NPL were the greater emphasis on basic research in the earlier part of its existence that is, till 1961, and thereafter administrative uncertainties in policies on account of the post of Director remaining vacant for over two years and then appointing a Director who continued in the post for about one year only and then resigned.

147. The National Physical Laboratory has now a new Director and a shift has been effected to applied research programme oriented towards industry, defence, import substitution etc. The Laboratory now enters into the Fourth Plan period along with the rest of the country. The Committee expect that the National Physical Laboratory would be able to fulfil satisfactorily the research programme envisaged for it during the Fourth Plan period. The Committee hope that the NPL will be able to turn a new leaf in the near future, achieve concrete and quick results for the benefit of the industrial and economic development of the country and above all build up an *espirit de corps* and win for itself laurels of achievement in applied research.

NEW DELHI—1;
April 18, 1966.
Chaitra 28, 1888 (*Saka*).

ARUN CHANDRA GUHA,
Chairman,
Estimates Committee.

APPENDIX I

(*Vide* Para 6)

A. ***Statement showing gist of recommendations made by the first Conference of Scientists and Educationists held on the 18-19th July, 1958 to consider the implementation of the Scientific Policy Resolution.***

Gist of Recommendation	Action taken
1	2
1. *Recruitment and Retention of Teachers of Science & Research Workers at Various levels.*	
(i) Salaries and conditions of service of teachers in various scientific professions as well as in humanities and social sciences and research workers should be rationalised and improved in relation to the Administrative services to attract the best men in various scientific professions and teaching.	The recommendation has been implemented in the universities, technical institutes, scientific departments and private scientific organisations. To give incentive to scientific workers, a scheme of "Merit Promotions and Advance Increments" has been introduced in a number of scientific departments and outstanding workers in these departments have been given merit promotion/ advance increments. The extension of this scheme to other scientific departments is under consideration.
(ii) A number of National Professors in different faculties should be instituted on all-India basis whose salaries should be comparable with the highest administrative posts to ensure that the ablest men continue in the teaching profession.	National Professorships have been instituted and there are at present 8 National Research Professors namely, 1. Professor C.V. Raman— Physics 2. Professor S.N. Bose—Physics. 3. Dr. R.B. Pal—Jurisprudence 4. Dr. P.B. Kane— Indology. 5. Dr. D.N. Wadia —Geology. 6. Dr. V.R. Khanolkar—Medicine. 7. S.K. Chatterjie—Humanities. 8. Dr. S.R. Ranganathan— Library Science. National Professors are paid Rs. 2,500/- p.m.

1	2
2. *Talent Search.*	
Search for scientific talent should start at the Higher Secondary School level. The scholars selected should be placed in appropriate institutions, 15 to 20% of the students should be given scholarships to cover their legitimate expenses.	The National Council of Educational Research and Training, in collaboration with the State/ territory Directorates of Education, has implemented a programme of Science Talents Search for students reading in the final year of the Higher Secondary/Multipurpose, P.U.C., first year of Intermediate and Indian School Certificate schools/colleges of the country.
3. *Expansion of Opportunities*	
Adequate facilities should be given to research workers by way of financial assistance, supply of apparatus and equipment and library and clerical facilities. They should be given freedom to choose their subjects and to publish the results of the research.	Considerable headway has been made both in the universities through the University Grants Commission and in the laboratories under the Council of Scientific and Industrial Research in providing laboratory and library facilities to research workers. Research workers have also been given the freedom to publish results of the research in scientific journals of repute both in India and abroad.
	University Grants Commission have considerably increased the amounts of grants-in-aid to the Universities and Schools of research with a view to provide them with all possible equipment, laboratory, library and building facilities for research work. Similarly amounts of grants-in-aid paid by the Ministry of Education direct to the various Scientific Societies and Institutes have been considerably increased for the same purpose.
	Regarding financial procedure, the main stumbling block is the scarcity of foreign exchange for the pur-

1	2
	chase of equipment, etc., from abroad.
4. *Research Versus Immediate Employment.*	
(i) To encourage talented young men to remain in research, a greater number of research fellowships of adequate value at the Master's and Doctor's levels should be instituted.	(i) A large number of scholarships and fellowships have been instituted.
(ii) A machinery should be set up to ensure that these trained men are subsequently absorbed in suitable employment.	(ii) This has been dealt with under recommendation No. 5.
5. *Proper Coordination and full utilization of available talents and resources.*	
(*a*) There should be a closer collaboration and exchange of scientific and technical personnel for limited periods between teaching and research institutions and Government and Quasi-Government organisations engaged in similar work.	There are practical difficulties of exchange for limited periods. The difficulties arise mainly on account of shortage of scientific and technical staff and also on account of the fact that the technical personnel do not necessarily have aan ptitude for teaching and research work. The University Grant Commission are however, exploring the possibilities of closer collaboration and exchange of scientific and technical personnel between Universities and non-universities institutions.
(*b*) Industries and Government departments should be encouraged to draw upon the technical and scientific talents available with the teaching and research organizations, for employment as consultants, without taking them away from their parent organisations.	Some departments are utilizing the scientific and technical talents available with the teaching and research Institutions and it is a normal practice of the Government to associate such personnel from the research and teaching organisations in the advisory committees dealing with scientific departments and Scientific matters.

1	2
	As regards utilization of the technical and scientific talents by the Industries, the recommendation was brought to the notice of the Industry through the Federation of the Indian Chambers of Commerce and Industry and the All India Manufacturers' Organisation.
(*c*) A pool of scientists and technologists should be created by recruiting outstanding young men available in the country and by recalling young Indian Scientists and Technologists working abroad. Until such time as they are found suitable employment, they should be given fellowships, and employed on research in Universities, National Laboratories and Institutions of Higher Learning and Industry.	Such a Pool has been created in the Council of Scientific and Industrial Research. Every attempt is made to provide the persons taken into the Pool with suitable assignments. To facilitate absorption of the Scientists in the Pool as well as of the scientists working and studying abroad, approved scientific institutions have been authorised to create supernumerary posts to which temporary appointments can be made quickly.
(*d*) Suitable machinery should be evolved to enable young research workers to be transferred from one place to another in order to ensure that the available talent is utilised to the best advantage of the country.	Transfer of available scientific personnel from one place to another is done as far as possible in the scientific departments of the Government of India. But specialization being the essence of research there is a limit to which such transfers can be made.
6. *Encouraging the study of science.*	
Measures should be taken to encourage the study of science by arranging popular lectures, setting up of museums and libraries, organising science clubs and exhibitions and publishing popular science books in Indian languages.	In the rural areas, 50 Vijnan Mandirs have been set up to popularise science amongst the rural people and these Vijnan Mandirs are provided with projectors, slides and other simple scientific apparatus and equipment to demonstrate to the village people the benefits of scientific methods in their day to day life. Vijnan Mandirs are also provided with libraries and museums.

1	2
	Science Clubs are also arranged through these Vijnan Mandirs and prizes are awarded to the best exhibitors and writers of scientific essays. The Vijnan Mandirs are functioning under the administrative control of State Governments. In the urban area, lectures, exhibitions and seminars are arranged periodically by different scientific societies for the scientific education of the people.
7. *Text Books.* The conference noted with regret that Text Books used in certain institutions were not satisfactory and contained incorrect information. The importance of correct Text Books cannot be over-emphasised ; and the conference recommended that the greatest care should be taken to prescribe Text Books containing correct information, and that as far as possible, the selected Text Books should use international terminology to avoid duplication of effort.	The Ministry of Education wrote to the State Governments and Union Administrations to bring this recommendation to the notice of their Text Book Committees for guidance and implementation.
8. *Instrument* The conference noted that Government had already appointed a Committee to go into the question of the manufacture of scientific instruments and equipment. The conference recommended that the attention of this Committee be drawn to the need to manufacture in India the scientific apparatus required by the schools and colleges.	A Central Scientific Instruments Organization has been set up under the C.S.I.R. to advise the Industry in the manufacture of Scientific instruments and apparatus for use in schools, colleges as well as in Laboratories and other scientific institutions.
9. *Documentation Centre* A Central Institute for Scientific and Technical Information should be set up to serve as a Clearing House for information from all sources, national and international.	The Indian National Scientific Documentation Centre functions as a Clearing House for all scientific information.

B. *Statement showing gist of recommendations made by the Conference of Scientists and Educationists held on the 4—5th August 1963 to review the implementation of the Scientific Policy Resolution and action taken thereon.*

Gist of recommendation 1	Action taken 2
The Conference welcomed the measures which had been taken so far (attention is invited in this connection to the statement at Appendix I-A) for implementing the Scientific Policy Resolution had expressed its appreciation of Government's interest in the promotion of Scientific Research.	Noted.
The Conference was however of the view that additional measures were necessary if the objectives laid by the Resolution were to be realised in the near future and therefore recommended as follows :—	
(1) Total allocation of resources for scientific research must be increased both in terms of manpower and finances. In terms of manpower there are at present approximately 15000 persons engaged in scientific research. The aim should be to double this number within the next 5 years. This will require provision of additional funds and the conference is of the view that roughly 1% of the total national income should be ear-marked for scientific research.	The recommendation was forwarded to the Planning Commission to be brought to the notice of the Working Groups for Scientific Research in order to give due consideration to it and keep the principle in view in formulating proposals for the fourth plan and for prospective planning for the subsequent ten years. The recommendation was also brought to the notice of the Ministries etc. concerned with scientific research.
(2) While increase in allocation of resources is imperative measures must be taken to ensure that these are utilised in the most economic manner. There should be appraisal of the work already done and future programmes should also be on the basis of definite projects undertaken within the frame work of national programme.	The recommendation was brought to the notice of the Ministries etc. concerned with scientific research and the Planning Commission.

1	2
(3) In order to ensure the most effective use of available material and human resources, it is necessary to set up an Advisory body consisting of representatives of the major Government agencies, the universities and non-official scientific organisations and independent scientists of eminence to survey the entire field, determine priorities and programmes and advise Government on allocation of funds and projects to different bodies.	An advisory committee was set up with composition and functions shown in the enclosed Resolution No. 42(9)/63-S.R. III dated the 22nd October 1963 but later in March 1964 it was dissolved as it was considered that there was no need to have the committee.
(4) This Conference is of the view that greater attention should be paid to the needs and requirements of universities and non-official agencies in order to achieve a proper and balanced development in the present and ensure an adequate supply of scientists in the future.	The recommendation was brought to the notice of the Ministries etc. concerned with scientific research and the Planning Commission.
(5) The Conference recommends to Government to allocate to Ministry of S.R. & C.A. an annual amount of Rupees five crores in foreign Exchange to be utilised for import of scientific equipment and material needed for purposes of research. The Ministry may keep about 10% out of this amount as a reserve to be distributed at its discretion and allot out of the remainder testified quotas to each university, national laboratory and other recognised centre so that Heads of such Institutions can secure the necessary equipment or material without undue delay.	The recommendation was brought to the notice of the Ministry of Finance (Department of Economic Affairs). It was stated by that Department that the foreign exchange reserves of the country are very low and while attempts are made by them to meet essential requirements of various Ministries to the extent possible, it is not feasible for these to be fully met within the limited foreign exchange resources. The recommendation was however noted by the Ministry of Finance (Department of Economic Affairs).
(6) The Conference requests Government to simplify the structure of scientific services and ensure greater mobility and internal democracy in order to achieve optimum conditions for creative work. Conditions of recruitment should be liberalised so as to give adequate recognition to actual achievement as established through published papers or completion of pro-	The recommendation was brought to the notice of the Ministries etc. concerned with scientific research.

1	2
jects in addition to the academic qualifications which at present form only basis of recruitment.	
(7) The Conference welcomes attempts at greater collaboration between science and industry and recommends that there should be greater exchange of personnel between laboratories and industrial concerns.	The recommendation was brought to the notice of the Ministries etc. concerned with scientific research.
(8) The Conference recognises the need of foreign collaboration in certain areas but is of the view that wherever Indian processes are available this should be given the first preference. For this purpose greater effort should be made for designing and fabricating our own equipment and machinery and develop consultative industrial advisory services with proper emphasis of operational research and productivity. Where lack of necessary development within the country compels foreign collaboration and use of imported processes such collaboration should be utilised for developing an indigenous know how.	The recommendation was brought to the notice of the Ministries etc. concerned with scientific research.

APPENDIX II

(*Vide* Para 21)

Classification of Research as Suggested by the Zuckerman Committee (U.K., 1961).

We have found it helpful to differentiate between five categories of activity normally included under the portmanteau term, research and development. These are pure basic research, objective basic research, applied (project) research, applied (operational) research, and development. Our definitions of these terms are set out in the following paragraphs.

(i) *Pure Basic Research.*

Pure basic research is research carried out solely in order to increase scientific knowledge: that is, knowledge of the nature of the material world.

(ii) *Objective Basic Research.*

Between "pure" and "applied" research there lies an intermediate category of scientific work to which we have given the name "objective basic". This denotes basic research in fields of recognised potential technological importance.

(iii) & (iv). *Applied (Project or Operational) Research.*

Applied research has as its object the attaining of a practical goal, which can be fairly precisely defined, such as a new process or piece of equipment. We believe that this type of work is best described as project research to distinguish it from applied research directed to improving the use of an existing process or piece of equipment. The latter may be called operational research.

(v) *Development.*

Development bridges the gap between research and production. It may be defined as the work necessary to take, for example, a new process or piece of equipment to the production stage. It will often include the erection and operation of pilot plants or the construction of prototypes.

APPENDIX III

(*Vide* para 38)

List of Research Problems referred to NPL by Industry and Government Departments during 1962—1965.

Item referred to	Party	Year	Time taken for completion
1	2	3	4
Development of methods of testing and standardization of air crew visors flying goggles for quality control during their manufacture in India.	Defence Ministry DTD & P (Air)	1962	3 months. Now being carried out as routine work.
Advice on the design and development of test methods for "lens Burning".	Defence Ministry DTD & P	1962	3 months, the work lead to the manufacture of this lens in India.
Development of method of measuring the angle of razor blade edges for quality control during manufacture.	Sharpedges Ltd. Delhi	1962	3 months the method developed being used by the firm.
Advice on tests and the design of box camera lens.	Ensign India P. Ltd. Calcutta Indian Optical Industries, Bombay.	1962	One month/completed.
Advice on equipment for gem testing.	All India Handicrafts Board.	1962	Two months completed.
Total energy radiation of flourescent lamp.	Univ. of Delhi.	1962	Two months completed.
Determination of Efficacy factors of torchlight lamps.	ISI	1962	About 3 months completed.
Designing the interior and outdoor lighting systems of Rabindra Rangmanch.	Min. of SRCA New Delhi.	1962	About one month/ Design submitted.
Development and fabrication of perspex polish tester.	Defence Ministry of DTD & P (Air)	1963	4 months some initial tests were carried out by party did not make any further use of the instruments developed due to other preoccupations.
Development of test method for particle size determination in aircraft turbine fuel.	Defence Ministry	1963	Two months. Now being carried out as a routine test.
Field test for railway signal glasses.	Railways	1963	One year completed
Aberration of microscope objectives for quality control.	Himachal scientific and optical works.	1963	2 months completed.

1	2	3	4
Standardization of precision prisms.	C.S.I.O.	1963	3 months/completed.
Setting up of suitable apparatus to test large lamps, flouescent lamps.	Several lighting industries in the country and ISI.	1963	At least 6 months required to set up. Lack of funds, space and additional staff hampering progress.
Advice on testing of right-angle and tetragonal prisons and development of test methods.	Defence Ministry 1964 ordnance Factory Dehradun.	1964	4 months. A new method developed.
Development of tests for whiteness of wool samples in connection with the problem of yellowing of the wool from Rajasthan sheep.	Shri Ram Institute.	1964	3 months. A large number of samples were tested also in 1965.
Development of semi-reflecting prisms for optical instruments.	Prince optical works.	1964	One month/completed.
Abberration in microscope objectives.	Andhra Sci. Co.	1964	2 months/completed.
Determination of quality of Photo-flash lamps.	Photo Optical Co., Calcutta.	1964	2 months/completed.
The work regarding Development of test method for optical distortion in air crew visors.	Defence Ministry DTD & P (Air)	1965	Six months the work is still in progress.
Repair and commissioning of a vacuum evaporation UVIJ and training of personnel in its use.	Shri Gopal Gold and Silver (P) Ltd., Ludhiana.	1965	One week/completed.
Development of test method for taxiway light fitting for aerodromes.	Amma (P) and Paisa Fund Glass Works.	1965	3 months/completed.
Development of test method for reflex reflectors for vehicles.	Nanavati Plastic Cop. Bombay.	1965	3 months/completed.
Determination of efficacy factors of rough service lamps for use in signalling.	ISI	1965	About 3 months/completed.
Development of test method for measurement of density for welding glasses.	Atul Industries Delhi.	1965	About 3 months/on Guhand.
Development of Indian designed headlights for motor-cycles.	Rajdoot motor cycles, Escorts.	1965	Actual work about 3 months/work to be continued as new designed fittings to be supplied.
Development of test method for hot strips for railway signal.	Railway Ministry	1965	About 3 months, the work is in progress.
Standardization of red flouresecent lamp for total energy.	Delhi Univ.	1965	Six months, the work is still in progress.
Noise Survey in Calcutta.	(ii) Public nuisance Committee of the Citizens Club, Calcutta.		About one month.

1	2	3	4
N.P.L. was asked to transform the existing instruments of theirs, originally working on batteries for working on mains.	Ministry of Food.		This was done.
Two problems have been taken by N.P.L. The work on them could be faster if we had more senior staff, but at any rate the work on them would be started at the earliest permissible opportunity.	Railways.		
Helmet testing. For testing helmets for Air Force and starting their indigenous manufacture. NPL was asked to set up facilities for testing them for shock absorption.	Defence.		Facilities were setup and necessary testing done.
About six problems on microwaves have been referred, some relating to making indigenous components and some to designing instrumentation for Radar and some to testing of components and instruments.	Defence. Universities—Delhi. Roorkee Solid State Physics Laboratory.		6 months.
Fabrication of temperature control unit and temperature measuring unit for Bhakra Dam.	Kota Dam and CWPC	1961 1962	Started completed Period One year.
Fabrication of V—notch charpy test piece apparatus.	Defence, Development and Production Unit West Bengal.	Mar., 1963	Started Dec.' 63 Completed Period—9 months.
Fabrication of low temperature unit for Steering Wheel test for Auto Steering Private Ltd., New Delhi.	Auto Steering Pvt. Ltd., New Delhi.	January 1965 December 1965	Started. Completed Period One Year.
Helmet testing and supply of equipment to Kanpur Unit.	Defence	1962 & 1965	Helmet testing with the existing equipment. The equipment for Kanpur is being fabricated.
Details for getting correct acoustics in the auditoria and lecture rooms.	Delhi University, Panjab University, Agricultural University, Ludhiana. Rajasthan University, Agra University, Indian Instt. of Technology Madras. Christian Medical College Vellore, Maulana Azad Medical College, Delhi, Lady Hardinge Medical College, Delhi, Sainik School Kunjpura (Karnal Distt.),		

1	2	3	4
	School of Planning and Architecture, Delhi.		
	Research Design & Standards Org., Ministry of Railway Northern Rly., N. E. Railway, Neyveli Lignite Corporation, Neyveli.		
	C.P.W.D., P.W.D. U. P., P.W.D. Madras.		
Guidance on the question of noise suppression.	Army Base Workshop, Kirkee, Poona, Research Department Telephones, Delhi, Trunk Exchange, Indian Telephone Industries, Indian Express Building, Railway Board.		
Guidance on large sound distribution systems.	Chittaranjan Loco Works, Diesel Loco Works, Banaras.		
Work has been done on measuring and analysing vehicle noise.	Bombay Traffic authorities.		
Comprehensive survey of prevailing noise in Delhi and Bombay has been done for forming a basis for recommending a code of practice for sound insulation in residential and other non-industrial buildings.	I.S.I.		

APPENDIX IV

(*Vide* para 41)

Processes developed at National Physical Laboratory

1. Silver Mica Capacitors.
2. Ceramic Capacitors.
3. Soft and hard ferrites.
4. Porcelain rods.
5. I. F. Cores.
6. Carbons Slabs and rods.
7. Cinema Arc Carbons.
8. Duplicating, printing and allied inks.
9. Indelible ink.
10. Anti Rust solution.
11. Railways signal magnet.
12. Magnetic fluid for crack detection.
13. Cheap Hearing Aid.
14. Improvements in or relating to shaft & bearing mechanism.
15. Electrolytic engraving or etching on metals or alloys thereof.
16. Transistorised community receiver.
17. An improved syphen.
18. Improvements in or relating to oxidising salt.
19. Manufacture of magnetic oxide of iron.
20. A tunable magnetron.
21. Metal Detector.
22. Traffic signals.

APPENDIX V

(*Vide* para 56)

Minutes of the meeting held on the 9th March, 1966, in the room of Shri L. C. Jain, Secretary, Department of Communications, regarding manufacture of professional ferrites to meet the requirements of Indian Telephone Industries Limited.

PRESENT

Department of Communications

(1) Shri L. C. Jain, Secretary.

(2) Shri C. P. Vasudevan, Director, Telecom. Research Centre, P&T Board.

(3) Shri T. R. Mantan, Deputy Secretary.

Indian Telephone Industries Limited

(1) Shri Uma Shankar, Managing Director.

Ministry of Finance

(1) Shri S. D. Nargolwala, Joint Secretary.

(2) Shri P. K. Nair, Asstt. Financial Officer.

Ministry of Industry

(1) Shri C. Balasubramaniam, Deputy Secretary.

Council of Scientific and Industrial Research and National Physical Laboratory.

(1) Dr. S. Husain Zaheer, Director General, CSIR.

(2) Dr. A. R. Verma, Director, National Physical Laboratory.

(3) Shri T. V. Ramamurti, Offr. I/C. D.P.E.C., Unit. NPL.

(4) Shri Baldev Singh, ILEO, CSIR.

Dr. Husain Zaheer stated at the outset that the National Physical Laboratory have now developed several varieties of professional ferrites which would meet the requirements of ITI and that NPL are in a position to supply the requirements of ITI. Shri Jain asked when NPL would be in a position to supply the sample to the ITI.

The Director of NPL and Shri Ramamurti, Offr. I/C. D.P.E.C. Unit of NPL handed over a sheet containing the characteristics of several types of ferrites which had been developed and tested by them. Shri L. C. Jain enquired as to when NPL will be in a position to

supply the samples to ITI for test purposes. Shri Ramamurti stated that, while the ferrite material was ready and he had the capacity to produce it, he had at present only one size of the die for making the ferrite core and that he would supply samples of this size to the P&T and to the ITI before the end of April. It was decided that out of the samples of ferrites offered by NPL, samples of 3-B-7 should be supplied in three batches of 20 each. Of these 20, 10 will be supplied to the P&T Research Centre and 10 will be supplied to the ITI. The actual IEC size will be indicated by NPL immediately to the Research Centre who in turn will specify to NPL the effective permeability for that particular size.

Shri T. V. Ramamurti confirmed that he does not expect any difficulty in either maintaining the quality of the ferrite or in producing them to the required sizes within the tolerances required for such professional ferrites. Shri Vasudevan stated that the cost of the ferrites made in India with Philips process would, on an average, cost about Rs. 50/- per kg. for the finished pot cores and he hoped that the NPL process will not be considerably more expensive.

On an enquiry from Shri Jain, Shri Ramamurti stated that the present plant for making the entertainment ferrites would be diverted to produce the professional ferrites in large scale manufacture and that he would supply about 10 tons or so annually from the existing plant with a small additional foreign exchange. Shri Zaheer stated that this foreign exchange could be made available by him. The period given for setting up this production was estimated at about a year and it was decided that NPL will send a detailed report indicating the programme regarding manufacture and supply of 10 tons and more annually to the ITI. After the process is established, it is up to the NPL to continue with them the process or to hand over the process to other manufacturers.

Even before the manufacture was taken up, NPL will be in a position to supply larger quantities in 4 to 5 sizes as soon as they could get the required dies and the production tools. This was estimated to take a few months and NPL agreed that they would supply 4 sizes in about six months in the required permeability values satisfying the requirements of the P&T for large scale batch testing and obtaining of data for design purposes. A copy of the characteristics of the Philips 3-B-7 and other professional ferrites which were contemplated for manufacture by ITI was handed over to NPL during the meeting and it was agreed that the ferrites to be supplied by them will be of these types starting with 3-B-7 or 3-H-1 which would constitute the largest requirements.

APPENDIX VI

(*Vide* para 69)

Composition of Joint Standing Committee for Scientific Research & Industry

1. Union Minister for Industry, Government of India, New Delhi. (*Chairman*).
2. Minister for Supply and Technical Development, Government of India, New Delhi.
3. Shri T. Swaminathan, Secretary to the Govt. of India, Ministry of Industry & Supply, (Deptt. of Supply & Tech. Development), New Delhi.
4. Shri S. Ranganathan, Secretary to the Government of India, Ministry of Industry & Supply, (Department of Industry), New Delhi.
5. Dr. S. Husain Zaheer, Director General, Scientific & Industrial Research, New Delhi.
6. Shri P. C. Kapur, Director General, Technical Development, New Delhi.
7. Dr. S. T. Merani, Development Commissioner, Small Scale Industries, New Delhi.
8. Shri P. R. Ramakrishnan, M.P. 17, Canning Lane, New Delhi.
9. Dr. A. Nagaraja Rao, Adviser (Resources), Planning Commission, New Delhi.
10. Dr. T. S. Subramanian, Director of Research, Indian Jute Mills Association, Calcutta.
11. Dr. B. D. Tilak, Prof. & Head of the Department of Chemical Technology, Bombay University, Bombay.
12. Dr. D. Banerjee, Vice-President, Indian Rubber Manufacturers' Research Association, Calcutta.
13. Shri J. H. Doshi, M/s. Amar Dye-Chem Ltd., Bombay.

14. Shri G. L. Bansal, Secretary General, Federation of Indian Chambers of Commerce & Industry, New Delhi.
15. Shri M.P.N. Namboodripad, Assistant Secretary, Federation of Indian Chambers of Commerce & Industry, New Delhi. *Representing the President FICCI.*
16. Shri B. D. Kapur, Representing the President, All India Manufacturers' Organisation, Jeevan Sahakar Bldg., Sir P.M. Road, Bombay-1.
17. Dr. H. A. B. Parpia, Director, Central Food Technological Research Institute, Mysore.
18. Dr. M. G. Krishna, Director, Indian Institute of Petroleum, Dehra Dun.
19. Shri Baldev Singh, Research Co-ordination, Industrial Liaison & Extension Officer, CSIR, New Delhi.
20. Shri K. B. Rao, O.S.D. Ministry of Industry, New Delhi.
21. Shri K. K. Birla, Industrialist.

APPENDIX VII

(*Vide* para 75)

The Staff Strength of the Development-cum-Production Unit for Electronic Components.

Name of Post	No. of posts	Development	Production
1	2	3	4
1. Scientist 'E'	2	2	..
2. Scientist 'C'	2*	2	..
3. Production Manager	1	..	1
4. Scientist 'B'	2	2	..
5. Design Engineer	1*	1	..
6. Asstt. Plant Engineer	1*	..	1
7. Technical Operator	1	1	..
8. Foreman	1	1	..
9. Sr. Sc. Assistant	5	4	1
10. Jr. Sc. Assistant	2	2	..
11. Jr. Tech. Assistant	4	2	2
12. Asstt. Tech. Operator	4	3	1
13. Sr. Lab. Assistant	7	7	..
14. Jr. Lab. Assistant	3	3	..
15. Senior Electrician	2	2	..
16. Supervisor Mechanic	4	4	..
17. Fine Mechanics	5	4	1
18. Shift Operator	3	3	..
19. Mechanics	10	9	1
20. Mistry	2	2	..
21. Mistry/Fitter	2	2	..
22. Senior Operator	10	5	5
23. Junior Operator	10	6	4
24. Operator Trainee	45	28	17
25. Store-keeper	1	..	1
26. Junior Draftsman	1	1	..
27. Tracer	1*	1	..
28. Jr. Stenographer	2*	2	..

1	2	3	4
29. Upper Division Clerk . . .	2*	1	1
30. Lower Division Clerk . . .	4	1	3
31. Steno-typist	1	..	1
32. Cost Accountant . . .	1	..	1
33. Laboratory Attendant . . .	1	1	..
34. Daily Wage Helpers . . .	6	6	..
35. Daily Wage Labours' . . . in lieu of 15 vacant post of Operator trainee	15	4	11
	164	112	52

*The posts marked with asterisk are vacant.

APPENDIX VIII

(*Vide* para 78)

Estimated Manufacturing & Profit & Loss Account for 1,00,000 *Antenna Rods for* 1964-65.

Raw-materials	60,000	By sale proceeds of 1,00,000 rods (a) average price of Rs. 1·56 per rod	1,56,000
Direct salary	50,000		
Rent	2,000		
Electricity	3,333		
Water	400		
Depreciation of machinery & tools.	13,836		
Administrative salaries	10,612		
Printing & Stationery	600		
Estimated profit & loss	15,219		
	1,56,000		1,56,000

APPENDIX IX

(*Vide* para 120)

Proceedings of the meeting of the Committee formed to consider the proposal regarding setting up of a Material Research Laboratory in the Fourth Five Year Plan, held on 23rd December, 1965 at 10.30 A.M. *in the National Physical Laboratory, New Delhi.*

The following were present:

1. Dr. Amarjit Singh
2. Dr. S. R. Valluri
3. Dr. S. Ramaseshan
4. Dr. A. R. Verma
5. Shri A. Rahman.

As a first step towards the creation of a Materials Laboratory. it was felt that a strong active group of workers of different disciplines may at present be created at N.P.L. and the analytical facilities at the NPL may be oriented to meet the specific requirements of the analytical work in this connection. This group will carry out the analytical work at the NPL and will also do the farming out of the specific work to other Laboratories where better facilities exist.

In view of the very stringent requirements of aeronautical industry, it was felt that in due course corresponding facilities may be created at N.A.L.

For development of materials, which are required in large quantity, the existing materials oriented laboratories may be approached. This list would include NML, NCL, CGCRI etc.

There would be however, a second category of materials which are not required in very large quantities but which are vital for specialized areas of technology such as aeronautic, electronics etc. In such cases it is necessary to develop working groups at the Laboratories concerned.

This project on materials development and import substitution should have an identity of its own and it must not be submerged

under the normal routine of the laboratories. The projects should be time-targetted on a country-wide basis.

To implement the above outlined recommendations and continuously review the scope of this organisation, it is recommended that this Committee may continue to function.

It was considered necessary that the Committee should survey the existing work on materials in different laboratories and facilities and plan the projects in the light of the requirements.

With regard to the requirements this Committee would keep in touch with the newly formed research and industry Committee, and would draw upon the projects and financial requirements.

APPENDIX X

(*Vide para* 125)

Reply of the Ministry of Industry as regards War Disposals Stores

It is understood that in 1956-57 proposals were received from Railways and N.S.I.C. for the import of U.S. war surplus machine tools under the Aid Programme. The proposal was approved by the then Development Wing and a licence for the import of 250 Nos. of machine tools by the N.S.I.C. and roughly 2,000 Nos. by the Railways, was issued. It was later found that some of the equipment received by the N.S.I.C. could not be utilised by them and was disposed of by auction.

The two thousand machine tools imported by the Railways were distributed to various Railway Workshops and were utilised. During 1962-63 emergency, it was proposed to utilise some of these machine tools for the manufacture of some ordnance items. The Directorate General of Technical Development were asked to assist in the inspections of a particular machine tool, known as Fay Automatics, for the manufacture of Shells. Officers of the D.G.T.D. assisted representatives of American firms to inspect these machine tools. A proposal was prepared for re-conditioning of these machine tools, which involved expenditure of foreign exchange for import of certain components. The scheme thereafter was handled by the Railway Board. It was understood that the Railways did not find it possible to proceed with the scheme to manufacture Shells and the proposal was dropped. Further details will be available from the Railway Board.

The Directorate General of Supplies & Oisposals were not involved in these transactions.

APPENDIX XI

(*Vide* para 131)

List of Guest Workers who worked at the N.P.L.

Sl. No.	Name	Division Section
1962 :		
1	Shri Gopala Menon Shreekantath Prof. of Physics, University College, Trivandrum . . .	Optics and Acoustics.
2	Prof. L. H. Khubchandani, Deccan College, Poona University . .	Acoustics.
3	Shri Sher Bahadur, Lecturer Geology and Geophysics, Roorkee University.	Time & Frequency and Low Temperature.
4	Miss Tolani, All India Institute of Medical Sciences.	Electron Microscope.
5	Shri M. P. Paul, Lecturer, Gauhati University.	R.P.U.
6	Shri R. S. Singh, Banaras University.	Ionosphere and Space Physics.
7	Dr. Gurbaksh Singh, Khalsa College, Delhi.	Acoustics.
1963 :		
1	Shri B. A. Patil, Lecturer, Shivaji College, Satara.	Electronics.
2	Shri S. L. Juneja, Lecturer in Physics, Jat College, Rohtak.	Electronics.
3	Shri S. N. Mathur, Lecturer in Physics, Jodhpur University.	Electronics.
4	Shri S. P. Puri, Reader (Physics Deptt.) Roorkee University.	Electronics.

Sl. No.	Name	Division/Section
5	Shri S. K. Mathur, Lecturer in Physics, Jodhpur University.	Low Temperature.
6	Shri Dinker Sirdeshmukh , Lecturer in Physics, Osmania University, Hyderabad.	Low Temperature.
7	Shri S. P. Goel, Lecturer in Physics, Kurukshetra University.	Solid State Physics.
8	Shri O. P. Agarwal from Delhi University.	Analytical Chemistry.
1964 :		
1	Shri S. N. Verma, Lecturer in Telecommunication Engg. Govt. College, Jabalpur.	R.P.U.
2	Shri Mahabir Sinha, Asstt. Prof. B.I.T. Sindri.	Electronics.
3	Shri J. B. Lal, Lecturer in Physics, Kurukshetra University.	Electronics.
4	Shri Roshan Lal, Lecturer, S. D. College, Palwal.	Electronics.
5	Shri P. L. Bhatia, Associate Prof. of Electrical Engg. Thapar College, Patiala.	Electronics.
6	Shri Surinder Pal Singh Khalsa, Senior Teacher in a Delhi School.	Electronics.
7	Mrs. Kunda Lokre, Lecturer in Nagpur University.	Optics.
8	Shri Anand Prakash, Lecturer in Physics, M.M.H. College, Ghaziabad.	Infrared Spectroscopy.
9	Shri K. K. Vij, Lecturer Electronics Faculty, Madras Instt. of Technology, Madras.	R.P.U.
10	Shri P. S. Verma, Deptt. of Education, Delhi.	Analytical Chemistry.

Sl. No.	Name	Division/Section
11	Shri A. N. Kumar, Research Fellow, Deptt. of Chemistry, University of Allahabad.	Analytical Chemistry.
12	Shri K. C. Grover, Lecturer in Chemistry, Jodhpur University.	Analytical Chemistry.
13	Shri M. L. Sharma, Lecturer in Physics, M.M.H. College, Ghaziabad.	Solid State Physics.
14	Shri B. N. Saksena Lecturer in Gorakhpur University.	Infra-red Spectroscopy.
15	Dr. Singhal from the Allahabad University.	Infra-red Spectroscopy.
16	Shri R. N. P. Jaiswal, Research Worker from Gorakhpur University.	Infra-red Spectroscopy.
17	Shri Ajay Prakash, Research Fellow from Aligarh University.	Infra-red Spectroscopy.
1965 :		
1	Shri H. D. Pathak, Lecturer in Chemistry, D.S.P. Government College, Nainital.	Electro Microscopy.
2	Shri D. R. Thakur, Assistant Horticulturist Regional Fruit Research Station, Mashobra (Simla-7).	Analytical Chemistry.
3	Shri B. K. Gupta, Research Scholar, Agra College, Agra.	Electro Miscroscope.
4	Shri J. W. Martin, Research Assistant, Lady Hardinge Medical College & Hospital.	Electronics.
5	Shri Satish Kumar Sharma, Lecturer in Hindu College, Sonepat.	Solid State Physics.
6	Shri V. B. Anand, Head of the Applied Physics Department, Thapar Institute of Engineering & Technology, Patiala.	Solid State Physics.

Sl. No.	Name	Division/Section
7	Shri P. L. Bhatia, Associate Professor of Electrical Engineering, Thapar Institute of Engineering & Technology, Patiala.	Electronics.
8	Shri V. Hari Babu, Research Scholar, Department of Physics Osmania University, Hyderabad.	Solid State Physics.
9	Shri R.S. Srivastva, Lecturer in Physics, Holkar Science College, Indore.	Solid State Physics.
10	Shri Atar Singh, Research Scholar Botany Department, Agra College, Agra.	Electron Microscope.

N. B. Apart from the aforesaid list of guest workers, students from various Technological & Engineering Colleges are also afforded facilities for completing their practical training the various Divisions of the Laboratory.

APPENDIX XII

Summary of Conclusions/Recommendations

Sl. No.	Reference to Para No. of Report	Summary of Conclusion/ Recommendation
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1	7	(i) The Committee consider that there is need for critically reviewing the progress made so far in implementation of the Scientific Policy Resolution and to take follow up action to ensure that the progress is sustained in all the desired spheres. The Committee suggest that Government should arrange for a representative conference of scientists and educationists to review once every two years the progress made and to locate any deficiency and to suggest further measures to intensify the effort. (ii) The Committee suggest that the conference should include not only representatives of Ministries of Education, Defence, C.S.I.R., Universities, Planning Commission, as hitherto but also include representatives of University Grants Commission, Indian Institute of Technology, Department of Atomic Energy, Indian Council of Agricultural Research, State Research Institutes, leading industrial research institutes and industry, and would make for comprehensive review of the Scientific Policy Resolution. The Conference may divide itself into suitable working groups in order to devote greater attention to specific aspects of Scientific Policy Resolution. The Committee further suggest that working papers on different aspects of the Scientific Policy Resolution should be prepared and circulated well in advance to facilitate purposive discussion and to draw up recommendations. (iii) The Committee suggest that in order to keep Parliament informed of the progress made in the implementation of the Scientific Policy Resolution, periodical review should be drawn

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		up in the form of a Report which may be suitably presented to Parliament. Parliament should also be informed in precise terms of the follow up action by presenting further Reports/laying statements in pursuance of the review.
1	13	(i) The Committee regret to note that India has no central body to coordinate, promote or plan her research and its utilisation, with the result that the research potential has not been exploited fully to achieve the major national goals of the country during the first three Five Year Plans. The absence of such a central body has resulted in diffusion of energy and resources as also in duplication and has adversely affected the optimum utilisation of funds made available for scientific research and effective coordination between different agencies. The Committee note that a Study Group for Scientific Research has at last been constituted in the Planning Commission towards the middle of 1965. The Committee consider that as the resources for research in India are extremely limited and the expenditure on research as percentage of national income is as low as 0·32 compared to other advanced countries (USSR—3·00; USA—2·9· UK—2.7) there is need for carefully husbanding the resources. They would like the Study Group to ensure that research allocations in the Fourth Plan are spread out keeping in view the relative importance of research so as to render maximum assistance in the developmental plans of the country. (ii) The Committee suggest that the Study Group should also lay down guide lines for collection of basic data regarding research being undertaken by different agencies in Government and private sector so as to have reliable overall information to decide the strategy of research in the interest of planned development of the country. The Committee suggest that the Study Group should carefully assess from time to time the progress made in tackling research problems particularly those which are of strategic importance to the development of the country and take suitable measures to make up deficiency or intensify research, as required.

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		Now that the Study Group has been constituted, the Committee recommend that it should immediately apply itself to the major task of planning of research so that it is in tune and on par with planning in other sectors of national development in the country.
3	20	(i) The Committee note that the recommendations regarding the working and reorganisation of the National Physical Laboratory made by Prof. Blackett in 1963 were generally agreed to by the Scientific Sub-committee of the Executive Council of the National Physical Laboratory and the Executive Council itself in 1963. In fact these recommendations were also generally endorsed by the Third Reviewing Committee of the C.S.I.R. The Committee note the lack of sense of urgency shown by the authorities in examining the Blackett Report which remained under consideration of the Executive Council and its Sub-committee for two years. The Committee consider that the authorities concerned should have taken firm and expeditious decision on the Blackett Report. The Committee regret to note that even before these recommendations were implemented and given a fair trial, the whole matter was reopened soon after the appointment of the preceding Director of the National Physical Laboratory. The result has been that the major recommendations regarding the reorganisation of the divisions and the setting up of commercial units were reversed and the *status quo ante* more or less restored. It is surprising that the Executive Council which had earlier accepted the recommendation of Prof. Blackett to reorganise the National Physical Laboratory, later reversed its own decisions on the note of the Director without giving a fair trial to the new set up. The Committee consider that the existence of a large number of divisions in the Laboratory tends to create compartmentalisation and comes in the way of coordinated efforts as has been admitted by the Director General of Scientific and Industrial Research also.
		(ii) The Committee consider that the work in the Laboratory should be organised increasingly according to projects and that Divisions and

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		Sections should be reduced to the minimum. They have no doubt that the work of the existing 22 divisions would be critically and carefully reviewed with a view to effect coordination and economy.
		(iii) As regards the setting up of the Advanced Centres of Study, the Committee are generally in agreement with the views expressed by the Third Reviewing Committee that the right place for setting up centres of Advanced Studies is in the Universities and not as part of Council of Scientific and Industrial Research establishments; the Committee would, however, stress the need for closer coordination between the C.S.I.R. and the Universities so that the use of specialized equipment available in C.S.I.R. laboratories is not denied to Universities for carrying out advanced research in the subjects concerned.
4	21	The Committee consider that classification of research should be more detailed than that which has at present been adopted in the National Laboratories. They, therefore, suggest that the feasibility of adopting detailed classification for the research and development work conducted in the various laboratories of CSIR may be examined, which was agreed to by the Director General, Scientific and Industrial Research during evidence.
5	22	The Committee are in agreement with the views expressed by the Zuckerman Committee (U.K.) that pure basic research should be carried out in a university rather than in a research laboratory. The Committee regret to observe that in spite of the recommendations made by the Third Reviewing Committee and the opinion expressed by Prof. Blackett, no conscious effort appears to have been made by the National Physical Laboratory to shed its pure basic research work. The Committee realise the difficulties of stopping altogether the basic research done in the National Physical Laboratory as it has grown there over a number of years for "historical reasons". The Committee however recommend that determined efforts should be made by the Council of Scientific and Industrial Research and the National Physical Laboratory to reduce the quan-

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		tum of basic research to the minimum necessary for supporting the applied research. In this connection it would be useful if detailed information is kept about the proportion of the basic and applied research work done in the National Physical Laboratory so that a watch could be kept on the progress made in this regard from year to year. The Committee would also like Government to ensure that simultaneous efforts are made in right earnest to promote and strengthen basic research in Universities in appropriate measure.
6	23	It is well known that research is a slow process and takes time to produce results capable of being utilised. It is, therefore, very necessary that research programmes of the laboratories should be anticipated and spelt out in clear terms well in advance to enable the laboratories to produce results. The Committee consider that it would be advantageous if in the light of the industrial development envisaged over the next two Plan periods, an overall planning of research programme for the national laboratories and other research institutions is done as a part of the national policy well in advance so that the requisite know-how may be available to the industry at the appropriate time. The Committee feel that the lack of clear cut assignments, oriented to the requirement of the industry has been mainly responsible for tardy contribution made by the laboratories to the development of indigenous technology and know-how in the past. They suggest that a committee consisting of Director General, C.S.I.R., the representatives of the Planning Commission, Ministry of Industry and Directorate of Technical Development may be set up to identify the research problems to be undertaken by the research institutions on a long term basis, in the light of perspective plan for two Plan periods and review the same at suitable intervals.
7	24	The Committee appreciate that selection of projects is a difficult task—first of all it is necessary to locate the areas in which research is needed and may yield good results, and secondly to determine how many of these could be fruitfully undertaken at a given time with the re-

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		sources of a laboratory. It is also essential to ensure that there will be full and effective co-ordination and no unnecessary duplication of research work, and that research planned in a laboratory is not already being done at other laboratories or institutions without proper consultation and coordination. The task is even more complicated for the National Physical Laboratory where for historical reasons, the headings of the projects are given 'from text books like Solid State Physics Projects' as admitted by Director General, Scientific & Industrial Research during evidence—a practice which the Committee feel should have been abandoned long ago. The Committee recommend that National Physical Laboratory should evolve an effective machinery for locating the needs of industry and user departments within the scope of its objectives and select projects which will yield quick returns. The Committee further suggest that the principles enunciated by the Zuckerman Committee (U.K.) for selecting projects for applied research which provide valuable guidelines in this regard, should be considered for adoption by the national laboratories in the country.
8	29	The Committee regret to note that inspite of the clear directive of the Executive Council of the National Physical Laboratory in April, 1964 for recasting of the project reports for 1964-65, National Physical Laboratory has not been able to carry out the directive till date. Even the project report for 1965-66 has not been prepared in accordance with the suggestions of the Executive Council and the decisions taken at the 14th Directors' Conference. On the other hand the Committee note that at Central Electronics Engineering Research Institute, a sister laboratory, a project proforma is drawn up which more or less conforms to the suggestion of the Executive Council, and which *inter alia* gives a survey of the potential users, the technical approach to be followed, the main requirements, the major steps and the estimated time for completion of each of the major steps as well as the entire project. The Committee cannot help observing that there appears to be persistent resistence at the National Physical Laboratory to adopt new ideas and progressive procedures in such matters.

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		It is really surprising that neither the C S.I.R. nor the Executive Council of the National Physical Laboratory could so far ensure that the National Physical Laboratory formulates its programme of research and the project report in accordance with the procedures laid down by them. The Committee suggest that the C.S.I.R. should lay down standard proformas for the preparation of project reports by the national laboratories and ensure their implementation in actual practice.
9	32	The Committee are in agreement with the decision of the Executive Council of the National Physical Laboratory that no scientist should be associated with more than three or four projects as otherwise the senior scientists tend to associate themselves with all projects of their division irrespective of the fact whether they could devote their time effectively to those projects and whether they have the technical aptitude for all the projects. Further the association of one scientist with many projects, apart from causing delays in the progress of projects, does not allow the junior scientist to share the pride of participation in the project which is necessary to enthuse him. The Committee regret to note that action to implement the above decision of the Executive Council of October, 1964 is being taken only now. They hope that at least now this decision will be implemented in right earnest. The Committee further suggest that the Council of Scientific and Industrial Research should ensure that this principle is observed in other laboratories also.
10	33	The Committee are surprised that even though the need of costing of research projects was felt by the Council of Scientific and Industrial Research, the same has not been implemented in the National Physical Laboratory. The Committee would like to draw attention to the recommendation made in this connection by the Zuckerman Committee (U.K.) that "in the control of applied research or development, an assessment of results achieved and of likely future progress should always be carried out concurrently with a review of expenditure to date and estimated future costs. Such dual assessments

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		should be undertaken at intervals of not more than three to six months, and the results should be made available not only to higher management but also, as a way of encouraging cost consciousness, to those who are directly responsible for individual projects *i.e.* down to Principal Scientific Officer level, or possibly lower."
		The Committee strongly urge that methods of accounting in the national laboratories should be reoriented in such a way as to ensure that estimated and actual costs of individual research projects are available. They would also emphasise that the progress made in each research project should be reviewed by the Director of the Laboratory with the Project Leader once a quarter with specific reference to the actual and anticipated expenditure so as to achieve maximum economy consistent with results.
11	35	The Committee note with concern that the Fourth Plan proposals of the National Physical Laboratory indicate only the broad financial outlay and to do not specify the projects in accordance with their relative significance from the point of view of defence, import substitution, promotion of indigenous know-how, etc., for which the financial outlays are earmarked. The Committee feel that the Study Group of the Planning Commission should be provided with such vital statistics as number of projects under various Divisions and their significance in national economy, the progress made in respect of each of the projects, the probable date of completion and approximate expenditure etc. These statistics are important even for the National Physical Laboratory itself to achieve physical targets in respect of its various schemes. The Committee are afraid that the procedure followed by other laboratories of C.S.I.R. for preparation of Plan proposals is also the same as followed by National Physical Laboratory and strongly recommend for its revision so as to incorporate all the necessary data required to enable the planners to examine the programme of each laboratory in the context of national economy.
		The Committee would therefore strongly urge that the National Physical Laboratory should take immediate steps to reorient its research programme in the context of defence require-

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		ments, import substitution and building up of indigenous know-how. The Committee are distressed to note that neither the Planning Commission, nor the Ministry of Industry/Directorate General, Technical Development nor any other user departments have indicated specific areas where the potentialities of the National Physical Laboratory could be fruitfully exploited during the Fourth Plan. The Committee deplore this lack of contact between the National Physical Laboratory and the potential users even among the Government departments. They, however, hope that various Technical Committees set up as a result of the recommendations of the Conference of Research and Industry held in December, 1965 would be able to indicate specific problems to National Physical Laboratory for solution during the Fourth Plan period.
12	36	The Committee are glad to note that the National Physical Laboratory has prepared a perspective plan for the next 10—15 years. The Committee recommend that the perspective plan of the National Physical Laboratory should be fitted into the national plan for the development of research within the country and should be based on the perspective plan of industrial and scientific development of the country for the next three Plan periods. They further suggest that this should be widely circulated amongst the industry, user departments, research institutions and scientists for inviting their suggestions so that the plan could be improved upon and duplication of research efforts among institutions could be avoided.
13	38	While the Committee note that the N.P.L. has been solving research problems referred to it by the Industry and user departments, they consider that the number of such problems—54 in four years—has been very small in the past, considering the facilities available at the N.P.L. and the number of problems requiring solution. The Committee are aware that in India both public and private industries are less research minded than those in the advanced countries and do not have proper machinery for formulating their requirements for research to be undertaken

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		at the laboratories. The Committee consider that National Physical Laboratory should try to create an atmosphere whereby industry is encouraged to approach it with its technological problems. The Committee have no doubt that N.P.L. can gain the confidence of the industry if successful solutions of their problems are found expeditiously and communicated to them urgently. The Committee are sure that National Physical Laboratory can be of great help to small scale industries which have largely to depend upon indigenous know-how for their future development. The Central Small Industries Organisation can do a great deal in formulating the requirements of the small scale industries which require research to be carried out at the National Physical Laboratory.
14	39	The Committee welcome the steps, though belated, taken by C.S.I.R. for organising the Conference of representatives of research and industry to build a bridge which may eventually open a new era of industrialisation in the country. The Committee recommend that such Conference should be held periodically so that there is utmost co-ordination between research and industry and research can render the expected help to industry.
15	40	The Committee regret the slow progress made by the N.P.L. on the two PL-480 research schemes. The Committee would urge that once such schemes have been undertaken in co-operation with foreign institutes, they should be completed expeditiously within the stipulated time schedules. The Committee further suggest that while selecting projects under foreign assistance in future, the Laboratory should always bear in mind that the selected projects fit in with the objectives of the laboratories, so that the energies of the scientists are not dissipated on projects of extraneous nature.
16	44	The Committee note that only 22 processes have been successfully evolved so far by the N.P.L. for commercial exploitation. Out of these about half a dozen only are being produced on a commercial scale. In many cases the annual value of production is not very large. Consider-

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ing the heavy expenditure that has been incurred on the working of the N.P.L. during the last 15 years, the Committee cannot help feeling that its performance in the field of industrial research during this period has been rather disappointing. It would appear that in the past, due care was not given to the selection of research programmes which should have been oriented towards industry and capable of yielding quick results.

It is regrettable that in three cases, there has been a delay ranging from 7 to 9 years in handling over the processes to the National Research Development Corporation after their successful completion by the N.P.L. Thereafter there have been further delays ranging from 1 to 3 years in giving the processes for commercial exploitation by the N.R.D.C. The result has been that in some cases it has taken 10 years to exploit a process for commercial production after it is stated to have been completed successfully by the N.P.L.

The Committee note with regret that six out of seven processes developed by the National Physical Laboratory and intended to be given free to industry remain yet to be commercially exploited and that a few of the processes such as Carbon Slabs, Ceramic Capacitors, etc. though established as long back as 1959-60 have not been fully exploited to meet the requirements of the country thus necessitating imports of the commodities. The Committee are also not happy that as many as eight processes should still be exploited by departmental production. The Committee feel that the responsibility for ensuring expeditious commercial exploitation of the processes, as soon as they are successfully developed at the Laboratory, devolves both on the Laboratory itself and the National Research Development Corporation whose main aim is "to develop and exploit in the public interest, for profit or otherwise, inventions, whether patentable or otherwise including technical and engineering 'know-how' of processes developed by the C.S.I.R. laboratories." Research and development are continuous processes; and therefore the Laboratory should not remain in seclusion after successful completion of processes but should also maintain closest links with National

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		Research Development Corporation and the Director General Technical Development to see that successful processes are being fully exploited for the benefit of the country. The Committee suggest that the successful processes should be widely published to stimulate interest of industrialists and users. The Committee also note that recently the C.S.I.R. has sanctioned an Industrial Engineering Section for the National Physical Laboratory. The Committee hope that this Section will render necessary assistance resolving technical problems faced in translating the processes developed in the Laboratory to large scale manufacture.
17	50	The Committee note with regret that though two firms were licensed in August, 1963 and July, 1964 to manufacture soft ferrites with the process developed by National Physical Laboratory, they have yet to go into full production, thus necessitating import of soft ferrites in addition to their production departmentally by the National Physical Laboratory. The Committee recommend that National Research Development Corporation should ensure that the parties, who are granted licences for commercial exploitation of the C.S.I.R. processes, actually adhere to the stipulated schedules for commercial production and that the production targets are adhered to by them in actual practice. The Committee should think that since soft ferrites can be manufactured with the know-how developed by National Physical Laboratory there should be no occasion for allowing foreign collaboration for manufacture of this variety of soft ferrites. Effective measures should also be taken to ensure that production of soft ferrites is commenced immediately by the firms concerned, with the National Physical Laboratory process, in order to meet all internal requirements so that the import of soft ferrites and departmental production by National Physical Laboratory could be stopped, as early as possible.
8	51	The Committee deprecate the tendency to give such a large number of licences to a firm with foreign collaboration. They also feel unhappy at

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		the repeated extensions, given to the firm to establish manufacture of these items.
		The Committee note that the delay in the manufacture of the electronic components was mainly due to the non-availability of foreign exchange. They feel that in cases where foreign collaborations are agreed to, the provision of foreign exchange requirements for the unit should be generally made the responsibility of the foreign collaborators.
		The Committee would like to point out that granting of such blanket licence for the manufacture of large number of items is apt to dampen the research effort within the country and act is a disincentive to the manufacture of products with indigenous know-how. The Committee recommend that before negotiations for foreign collaboration are started or the capacity of the existing licences is increased, the concerned Ministries/Directorate General, Technical Development should contact the national laboratories and other research units to find out whether and when they can establish the necessary know-how.
19	56	The Committee cannot resist the conclusion that there has not been close co-operation between the National Physical Laboratory and the Indian Telephone Industries in the matter of developing professional ferrites. The Committee consider that both the organisations should have shown greater sense of urgency in developing suitable professional ferrites with indigenous know-how and thereby help to reduce, if not eliminate, the import of professional ferrites, which is entailing an outgo of about rupees 25 lakhs every year in foreign exchange.
		The Committee would urge the National Physical Laboratory to Supply samples of professional ferrites without delay, which may be got tested, if necessary, from an independent laboratory so as to reach definitive conclusion about their suitability. The Committee are firmly of the view that the indigenous know-how develop-

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		ed in the national laboratories should be given a fair chance or even a preferential treatment vis-a-vis foreign collaboration schemes so as to achieve self-reliance at the earliest.
20	61	The Committee find it difficult to appreciate how Government could have licensed the manufacture of 21 million pairs of arc carbons even though the total demand in the country is admittedly not more than 7 million pairs even at present. The Committee are surprised that the capacity of a company to manufacture arc carbons was doubled in March, 1963 from 3 million pairs to 6 million pairs, though the Ministry of Industry was informed that the National Physical Laboratory had developed the know-how for arc carbons by using indigenous materials and in spite of the fact that the company had not even achieved the production target of 3 million pairs of arc carbons. The Committee are also unable to appreciate why there should be discrimination between this company and other manufacturers in the matter of import of raw materials and fixation of prices of arc carbons produced by them. They recommend that Government should fully investigate the matter and remove the anomalies, if any. The Committee would also like Government to persuade the company to export arc carbons as soon as sufficient production capacity of other units is developed within the country with National Physical Laboratory know-how to meet the internal requirements. It should not be too difficult for this company, which has international connections to export arc carbons in excess of 3 million pairs produced by them. This would leave scope for marketing of arc carbons with National Physical Laboratory know-how and would induce the Indian manufacturers to take it up in right earnest. The Committee would further urge Government to ensure that the other parties which have been given licences for the manufacture of arc carbons and have not yet finalised their arrangements of technical know-how for its production, should be

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		encouraged to take up the know-how developed by the National Physical Laboratory for the indigenous manufacture of arc carbons. The Committee hope that Government will not encourage any foreign collaboration in this particular field in future and would insist that National Physical Laboratory know-how should be utilised for the manufacture of arc carbons. The Committee also regret the haste with which the National Research Development Corporation/Council of Scientific and Industrial Research/National Physical Laboratory had entered into an agreement with M/s R. J. Wood & Co. for the development of arc carbons in 1959 when research work was still in progress. This resulted in arbitration proceedings with the firm which led to abnormal delay in the commercial exploitation of the process.
21	63	The Committee would like National Physical Laboratory to intensify its research on dry cell carbon rods so that the know-how can be farmed out to Indian manufacturers at an early date.
22	64	The Committee note that the Council of Scientific and Industrial Research has established in New Delhi a Central Design and Engineering Unit in 1963 with the object of assisting research and industry in designing and engineering the plants for exploitation of research processes evolved by the Council of Scientific and Industrial Research. The Committee recommend that National Physical Laboratory should take full advantage of this Unit to solve the engineering problems such as automation of the processes developed by the National Physical Laboratory. The Committee are not sure whether it was correct for the Bharat Electronics Ltd. to have gone in for foreign collaboration for the production of ceramic capacitors on the plea of large scale production and automation of the process when the NPL process was already available to them. The Committee would have thought that instead of entering into agreement with foreign collaboration, the Bharat Electronics should have asked NPL to modernize and automatise their process so as to facilitate large scale production at economic cost. This should not have been insuperable as CSIR

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		has not only the Central Design and Engineering Organisation but also a number of other research institutes, including Mechanical Engineering Research Institute, which could have helped in tackling the problem. Now that the B.E.L. has already concluded an agreement with the French firm (C.S.F.) and may not be interested in commercially exploiting the process developed by NPL, the Committee would like Government to examine whether the know-how developed by NPL for the manufacture of ceramic capacitors should be farmed out to any other Indian manufacturer.
23	66	The Committee welcome the appointment of committees to go into the questions of development of technical consultancy services and commercial utilisation of indigenous technical know-how. They hope that both the committees will provide useful guidelines for the development and encouragement of indigenous know-how.
		The Committee consider that the planning, development and utilisation of indigenous know-how should be a part of the policy to progressively reduce the country's dependence on foreign know-how. The Committee recommend that while according sanction for import of foreign know-how, Government should not only satisfy themselves that the particular indigenous know-how is available or not at the moment but should also assess whether the particular know-how could be developed indigenously within a reasonable time as foreign collaboration agreements also take on an average 2-3 years to materialise, and as it involves a long term commitment of payments in foreign exchange.
		Government should also suitably consult other research organisations such as Defence Research and Development Organisation, Railway Research Standards and Design Organisation, Department of Atomic Energy etc., before according sanction to foreign collaboration arrangements, so as to make sure that there is no indigenous know-how available or in the offing for the process. The Committee note that C.S.I.R. is represented on the Directorate General of Technical Development. The Committee would like Government to examine the suggestions of CSIR

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		that they should also be represented on the Capital Goods Committee to ensure that foreign equipment and machinery are not imported where it is or may be made available within the country, within a short period.
24	67	The Committee recommend that while negotiating foreign collaboration agreements, Government should keep in view the advantages of going in for outright purchase of foreign know-how in preference to 'on royalty basis'.
25	68	The Committee hope that Government will take an early decision in regard to the transfer of the National Research Development Corporation from the administrative control of the Ministry of Education to a more suitable Ministry so that it would fulfil the purpose for which it was originally set up.
26	69	The Committee are surprised that the Joint Standing Committee for Research and Industry which was sponsored by the CSIR itself in 1956 with laudable objectives for forging coordination with D.G.T.D. should have been put into cold storage even though the recommendation of the Estimates Committee for its effective functioning which was made in 1960 had been accepted by Government. The committee note that while CSIR is trying for representation on committees of D.G.T.D. so as to farm out fruitful researches for commercial exploitation, it could not make any use of the machinery set up by itself for the same purpose. The Committee recommend that the Joint Standing Committee should be activised and should deliberate at least twice a year and should also periodically review its previous recommendations so as to ensure that they are expeditiously implemented.
27	72	The Committee realise that the maintenance of basic standards of mass, length, time and temperature and the work of developmental testing done by the N.P.L. are very important for the industrial development of the country and should be pursued vigorously. The Committee, however, note that these functions are at present spread over a number of divisions. They consider that it would make for economy

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		and efficiency if the work relating to the maintenance of the standards and developmental testing is grouped together as far as feasible. The Committee also consider that National Physical Laboratory should concentrate only on developmental testing and that routine testing should not be undertaken—save in exceptional cases—such as absence of specialised equipment for testing in other establishments in the country or where it is absolutely essential in the interest of developmental testing. The Committee need hardly point out that it is the function of the Indian Standards Institution to arrange for necessary testing facilities. Besides, Government have already established two Test Houses for undertaking this work. The Committee would like, however, to emphasise that close coordination should continue to exist between the National Physical Laboratory, the Indian Standards Institution and the Testing Houses in the field of developmental testing and in undertaking research to design suitable instruments for testing work. The National Physical Laboratory should, in particular assist in adopting techniques and in designing instruments which would make for cheaper and quicker testing.
28	73	The Committee note that the income derived from testing and certification by some Divisions is less than even 10 per cent of the annual expenditure incurred on them. The position in respect of other Divisions, for which information has not been supplied to the Committee, is presumably no better. The Committee are unable to appreciate why accounts of expenditure incurred on testing work under the two broad heads of routine testing and developmental testing is not being maintained. They would like such cost accounting to be introduced with immediate effect. As far as developmental testing is concerned, the Committee would like to stress that the expenditure incurred on each developmental test should be carefully reviewed by the Director in consultation with the Head of the Division concerned at intervals of three months so as to ensure that no infructuous expenditure is incurred.

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29	73	It is surprising that the schedule for testing charges for different divisions which was laid down by the National Physical Laboratory several years ago has not been revised so far. The Committee hope that the testing charges would be suitably reviewed at an early date by the departmental committee which has been appointed recently by N.P.L. The Committee consider that testing charges should be fixed in such a manner as would make them commensurate with the expenditure incurred in this regard consistently of course with what the industry can bear, and the charges should be reviewed periodically.
30	74	While the Committee appreciate the developmental work done in the National Physical Laboratory for testing of clinical thermometers, they feel that with the development of the testing instruments and the stabilization of the technique for testing, it should be possible to transfer the work of routine testing to Indian Standards Institution within one year.
31	80	(i) The Committee note that the Development-*cum*-Production Unit for Electronic Components has been able to make some profit in 1965-66. They feel that there is scope for effecting economy by improving the percentage of rejections of antenna rods. They would also stress that research efforts should be intensified to put to profitable use the antenna rods worth Rs. 37,500 which were rejected in 1964-65. (ii) The Committee would like to emphasise that production of I.F. Cores and Porcelain Rods may be taken up only after firm orders therefor have been received. They have, no doubt, that the commercial experience gained in the production of antenna rods would be put to good use while taking up the manufacture of I.F. Cores and Porcelain Rods.
32	82	The Committee regret to note that no action has so far been taken by the National Physical Laboratory for the commercial exploitation of the process on 'Simultaneous Inter-communication System', which was completed successfully in 1963.

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		The Committee feel that National Physical Laboratory should have taken patent rights soon after the successful development of the 'Simultaneous Inter-communication System' and approached the National Research Development Corporation for farming out the process for commercial exploitation. The Committee recommend that steps should now be taken in this direction immediately.
33	84	The Committee are not happy about the existing arrangements for collaboration merely on personal level between the Solid State Physics Division of the National Physical Laboratory and the Solid State Physics Laboratory of the Ministry of Defence. The Committee recommend that to avoid infructuous duplication of research efforts between these two institutions, there should be closer collaboration on institutional level.
34	86	The Committee are surprised that C.S.I.R. could not find a suitable scientist to hold the charge of the Electricity Division for the last twelve years. The Committee strongly recommend that the C.S.I.R. should urgently decide whether the work of the Electricity Division pertaining to only standards and testing justifies the strength of 16 scientific and technical and 4 class IV technical personnel. As the Director General himself has admitted that 'Electricity Division is basically a fundamental research division', the Committee would further recommend that C.S.I.R. should examine whether this work could not be carried on with greater advantage in the Power Research Institute, Bangalore or the Indian Institute of Science, Bangalore, or in some universities.
35	87	The Committee regret that research on 'Insulating Materials', which is one of the main functions of the Power Research Institute, Bangalore, has been undertaken in the National Physical Laboratory without ascertaining the research work done at the former Institute. In view of the limited resources available in the country for research, the Committee cannot too strongly stress the need for avoiding such infructuous duplication of work. They feel that before long term research on any project is undertaken, the

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		national laboratory/CSIR should make sure that identical research work is not being done by other institutions. Where it is absolutely essential in national interest to undertake research in more than one institution, there should be full coordination and exchange of information to help speed up research and avoid infructuous duplication.
36	97	While the Committee are happy to note that the achievements of the Radio Propagation Unit have been praised by Prof. Blackett in 1963 the Third Reviewing Committee of C.S.I.R. (1964) and other scientists, they are unable to appreciate why this Unit is being continued as a part of the National Physical Laboratory. It has been admitted that the work of this Unit has no direct relation to the objectives of the National Physical Laboratory but pertains more to the fields of Ionospheric and upper atmosphere studies which are dealt with by specialist organisations, like the Physical Research Institute, Ahmedabad and the Indian Space Research Committee. The Committee recommend that in the interest of proper development of the work on this important subject the question of transferring/associating the unit with Physical Research Institute, Ahmedabad and/or the Indian Space Research Committee may be examined early.
37	104	The Committee are disappointed at the work of the Heat and Power Division particularly in the Solar Energy Research Programme. India is very fortunately placed in the matter of solar energy and they feel that it should not be beyond scientific ingenuity to harness this energy profitably for industrial, commercial and domestic purposes as has been done by scientists in many other countries like U.S.A., Japan, Israel, etc. The Committee would in particular stress the need for intensifying research in solar still, water heater and turbine which could prove such boons in the arid zones of the country e.g., Rajasthan, Gujarat etc. The Committee would urge in this connection closer collaboration between the National Physical Laboratory and the Central Salt and Marine Chemical Research

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		Institute (C.S.I.R.), the Central Arid Zone Research Institute (Indian Council of Agricultural Research) and the Power Research Institute, Bangalore (Ministry of Irrigation and Power).
38	105	The Committee suggest that C.S.I.R. should take an early decision regarding the transfer of work of the Applied Mechanics Division to the Central Mechanical Engineering Research Institute, as suggested by Prof. Blackett as far back as 1963.
39	106	The Committee are not convinced that a full-fledged Theoretical Physics Division is necessary for the National Physical Laboratory. They note that the main work of the Theoretical Physics Division is to train the new entrants, prepare research scholars for Ph.D. work and solve the mathematical problems arising out of the day-to-day working of the National Physical Laboratory. The Committee have been informed that National Physical Laboratory has recently entered into an agreement with the University of Delhi under which scientists of the National Physical Laboratory give regular lectures at the University of Delhi. The Committee would like the National Physical Laboratory to take the assistance of University of Delhi as necessary, for its training programme as well as for solving mathematical problems connected with research work. The Committee think that such collaboration between National Physical Laboratory and University of Delhi would be in consonance with the recommendations made by the Third Reviewing Committee of C.S.I.R. (1964) that "the general policy of the C.S.I.R. should be to develop mutual confidence and reliance between the C.S.I.R. and its institutions and the universities." As regards the fundamental work of the Division on high energy physics, plasma physics, etc. which is also being done at other institutions, the Committee would draw attention of the National Physical Laboratory to the observations of the Third Reviewing Committee that "the bulk of the basic work of a C.S.I.R. laboratory should be related to and form the background of its applied work. ....However at present largely for historical reasons, there are groups in National Physical

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		Laboratory, which are concerned with 'pure basic work' with little or no connection with applied work. We feel that emphasis should be changed over a period of time towards applied work". The Committee consider that the number of research scholars being admitted in the Laboratory for preparing Ph.D. thesis, which has no direct bearing on applied research work, should be severely curtailed. The Committee suggest that the functions and the staff strength of the Division of Theoretical Physics should be carefully reviewed by the C.S.I.R. in the light of the above considerations.
40	109	The Committee are concerned to find that a subject like "Utilisation of Fish Body Oil" which has no relation whatever to the objectives of N.P.L. was taken up as a research project in the Laboratory. This is indicative of the lack of proper selection of research projects in the Laboratory. The Committee would like the Council of Scientific and Industrial Research to ensure that such unconnected and isolated subjects of research which have no bearing on the objectives of National Physical Laboratory are dropped forthwith. The Committee also find it difficult to believe that even after dropping several projects and reorientation of the work of the Analytical Chemistry Division, as recommended by the Executive Council in October, 1964, the National Physical Laboratory have not been able to effect economy in the working of the Division; on the other hand the strength of the Division has been increased. As the Materials Division for which the Analytical Chemistry Division is expected to render considerable assistance, is yet to be set up in the National Physical Laboratory, the Committee recommend that the staff position of the Analytical Chemistry Division should be reviewed immediately so as to effect economy.
41	111	The Committee regret that an x-ray generator was allowed to go into disuse after the death of the first Director of the N.P.L. and

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		that it took more than two years to locate the various parts and put it back into working condition. The Committee would like the Laboratory to ensure that proper arrangements are made for the up-keep of the expensive equipment.
42	112	The Committee are in agreement with the recommendations made by Prof. Blackett and the Sub-Committee of the National Physical Laboratory that Glass Technology Section should be constituted into an independent manufacturing unit managed on commercial lines. They would like the Council of Scientific and Industrial Research to take early action in the matter.
43	113	The Committee are surprised that even after 15 months of the decision of the Executive Council, no action has been taken by the N.P.L. in assessing the financial implication, time and personnel required for the execution of the projects on 'Vacuum Tubes' and 'High and Ultra-high Vacuum Practice' and the utility of the projects. The Committee need hardly stress that after a proposal is approved by the Executive Council in principle, full details thereof should be worked out, at an early date, to give effect to the decision. They would like National Physical Laboratory to take early action in the matter.
44	118	The Committee are surprised to find that though the decision to transfer the Rain and Cloud Physics Research Unit to the Meteorological Department was taken by the Executive Council about two years ago, it has not yet been implemented. As the work of this Unit is not directly connected with National Physical Laboratory they would urge Government to arrange for the transfer of this Unit to the Meteorological Department without further delay.
45	120	The Committee are concerned at the leisurely manner in which the details for setting up the Materials Division are being worked out, particularly when Materials Division is, stated to be, one of the major projects included in the Fourth Plan proposals of the National Physical Labora-

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		tory. In the working out of the detailed proposals, the Committee would stress the need for ensuring close collaboration with other Laboratories *e.g.*, National Metallurgical Laboratory, National Chemical Laboratory, Central Glass and Ceramic Research Institute which are working in the field and to set time targets for development of materials with particular reference to those which are being imported at present.
46	121	The Electronics Committee have indicated in their Report a possible scheme for the development of computer technology and the establishment of a computer industry in India during the next decade. The Committee would like Government to take an early decision in the matter. The Committee feel that at present the work is being done by several units without much coordination. They suggest that Government should assign specific roles for computer research to the research institutions under C.S.I.R., Atomic Energy Establishment, Universities etc. The Committee have no doubt that full advantage would be taken of the work being done at Jadavpur University which has developed a computor indigenously.
47	124	The Committee regret the inordinate delay of three years in setting up a committee to review the working of the Central Workshop of the National Physical Laboratory, which was suggested by Prof. Blackett, as early as February, 1963. The Committee consider that the role of a Workshop in the National Physical Laboratory is primarily one of service to the Divisions of the Laboratory and it should not be enlarged to include service to other Government Departments and Institutions except in case of some sophisticated instruments whose repairs and manufacture is not available elsewhere in the country. They suggest that the Workshop may be reorganised keeping this central role in view. If it is necessary to undertake manufacture of specialised equipment and instruments for other organisations *e.g.* Universities, other research Institutions as a regular measure, the Committee would suggest that Government should

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		decide in consultation with C.S.I.R., the most appropriate organisation *e.g.*, Central Scientific Instruments Organisation, where it could be undertaken. The machinery and the staff of the Workshop which are found surplus to the requirements of the National Physical Laboratory may also be considered for transfer to that organisation. The Committee are surprised that in a Workshop with this limited role, the wage bill of labour should be Rs. 1.50 lakhs per year and the overheads should account for another Rs. 1 lakh. The Committee would stress the need for effecting economy and in particular, the introduction of proper costing procedure so as to distinguish clearly between the cost of maintenance and manufacture. The Committee need hardly stress that machines which are obsolete or surplus to requirements should be disposed of at an early date so as to reduce unnecessary recurring expenditure which is being incurred on staff engaged for their operation and maintenance.
48	125	The Committee are concerned to note that some 'war disposal' machinery and equipments are lying unopened even after more than ten years of their receipt in the National Physical Laboratory. They are unable to appreciate why the National Physical Laboratory with such a large number of administrative and technical staff could not find it possible to open these crates, identify the machines and decide whether they were to be retained in the National Physical Laboratory or to be given to some other organisation by Government who could put them to use. The Committee would like C.S.I.R. to have a thorough inventory made of all the surplus machinery and equipment lying unused in the National Physical Laboratory and other laboratories and to arrange for their proper disposal in consultation with the Ministries of Industry, Railways and Defence. The Committee would also like to draw attention to recommendation made in para 123 of their 91st Report on the South Eastern Railway wherein they have recommended that war surplus machinery lying unutilised in

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		the Railway Workshops should be brought into use at an early date.
49	126	The Committee feel that there is a general tendency for keeping unrewarding research projects on the books either for reasons of prestige or because of hopes that some efforts and money might produce some eventual rewards and justify the money spent on a project. This appears to be particularly so in the case of National Physical Laboratory as the Committee find that even after recommendations had been made by Prof. Blackett, the Executive Council of the National Physical Laboratory and the Third Reviewing Committee of the C.S.I.R. for dropping and recasting of the projects, no serious attempt appears to have been made in this direction. The Committee consider that if resources on research projects are to be utilised effectively and to the best advantage, it is essential to review their progress from time to time systematically and vigorously. Apart from the occasions that such reviews provide for discussion and guidance, they also offer good opportunities for exercising control and ensuring that the resources are not being expended on research where progress is unlikely because of lack of new ideas or the necessary techniques. The Committee recommend that reviews of all research projects should be conducted at least quarterly by the Director of the laboratory in conjunction with the Head of the Division/scientist concerned with reference to the progress made, expenditure incurred, the anticipated expenditure and time required to achieve results so as to take necessary steps for early fruition, or failing that abandon the unrewarding projects at the earliest possible time. The Committee would further suggest that the results of such reviews should also be communicated to the C.S.I.R. half-yearly to keep it informed of the overall progress made in the research projects.
50	127	The Committee consider that it would be useful to have a periodical evaluation of the research work of the National Physical Laboratory every five years by an independent committee consisting of eminent physicists and representatives of user departments who are not members of the

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		Executive Council of the Laboratory. In the opinion of the Committee such an evaluation would provide an objective and independent assessment of the work of the laboratory and would act as a stimulant to its functioning. They further recommend that this system of evaluation by an independent committee, should be applied to all the research laboratories and institutes under the C.S.I.R.
51	128	The Committee cannot too strongly emphasise the need for closer collaboration among the scientists of the National Physical Laboratory in sharing their experience on projects of common interest and sharing their equipments, which will evidently lead to better out-put. The Committee have already observed in para 20 that excessive compartmentalisation of work in the National Physical Laboratory is due to the existence of a large number of Divisions and each division being unduly conscious of and eager for self-sufficiency. The Committee recommend that the CSIR should take effective steps to streamline the overall working of the National Physical Laboratory and bring about the much needed coordination amongst its various Divisions.
52	129	The Committee note that 30 laboratories have now been set up by C.S.I.R. in different disciplines. In view of the fact that there is inter relation and similarity in the work of some of the Divisons of National Physical Laboratory and other Institutions of the CSIR as well as of other research institutes and departments which have come into being after the NPL. the Committee would urge closer co-operation and coordination between them especially while selecting problems for research. The Committee welcome the steps taken by CSIR in organising inter-laboratory conference. They would further suggest that steps should be taken by CSIR to appoint conveners for each major item of research work which is being done in more than one laboratory so as to bring about close coordination. The Committee would also suggest that the NPL may drop some of the subjects for which separate laboratories and institutions have been set up.

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53	133	The Committee appreciate that a number of guest workers from various universities took advantage of the facilities at N.P.L. They suggest that guest workers from other universities, particularly those having Advanced Centres in Physics, should also be encouraged to avail of the facilities at N.P.L.
54	137	The Committee regret to note that the meetings of the Executive Council, which is the main body responsible to direct the research programmes of the National Physical Laboratory, have not been held at least twice a year as provided for in the Rules, and on an average the Executive Council has not met even once a year. Fourteen meetings in a period of 16 years can hardly provide the necessary guidance and supervision over the working of the Laboratory which is expected from such a body. Moreover the duration of the meetings of the Executive Council which is usually a day at a time, can hardly allow sufficient time to the Members to probe into the matters placed before them. The Committee consider that the past performance of the National Physical Laboratory may in part be attributable to the inadequate number of times the Executive Council has met. The Committee consider that the Executive Council should function energetically and effectively so as to give a clear lead in the formulation of the research programmes of the National Physical Laboratory and to watch zealously the progress made in research projects in implementation of its decisions. The Committee urge that the Executive Council should meet not less than twice a year, but it would be preferable if it meets once a quarter so as to deliberate promptly and critically over problems and give guidance.
55	138	The Committee are concerned to note that the Scientific Advisory Committee for the National Physical Laboratory has not been appointed so far although it has been specifically provided for in the Rules. It is surprising that neither any amendment to the Rules has been made by the C.S.I.R. nor has any exemption been sought from the provisions thereof. Apart from the question of compliance with the rules, which is a statutory obligation, the Committee do not

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		agree that the Scientific Sub-Committee which has been appointed by the Executive Council since 1963, can be a proper substitute for the Scientific Advisory Committee which is to be composed of scientists actually engaged in the particular subject, leading industrialists and representatives of the concerned Ministries of the Government of India. The Committee regret to observe that the CSIR has not been able to ensure that the provisions made in the Rules and Regulations are being observed by the Laboratory in actual practice. The Committee recommend that immediate action be taken to appoint Scientific Advisory Committee for the National Physical Laboratory as provided for in the Rules and also for other Laboratories where it has not been formed so far.
56	139	It is well known that the success of an organisation depends to a large extent on the direction and guidance provided by its Head, who should be a man of standing and proven administrative ability and possessing expert knowledge and experience of the subject matter dealt with by the organisation. This is all the more important in the case of research laboratories where senior scientists work. The Director of such a laboratory should have the ability to inspire team work and set a high example by his own dedication to research work. The Committee consider it extremely unfortunate that the NPL remained without an effective Director for a period of about 4 years i.e. from 1961 to 1965. This led to uncertainties about its future programmes and policies which affected the general morale of the scientists working in the N.P.L. The Committee hope that Government CSIR would benefit from the sad experience of National Physical Laboratory which has affected its reputation to a considerable extent. The Committee fully endorse the recommendation of the Reviewing Committee that the Directors of national laboratories be appointed as expeditiously as possible to ensure the proper functioning of the research organisations and interim and *ad hoc* arrangements extending over long periods should be avoided.

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57	140	The Committee stress that National Physical Laboratory should make concerted efforts to remove the imbalance between the scientific staff and non-scientific staff existing in the Laboratory and effect economy by reducing the administrative and Class IV staff to the barest minimum. The Committee would like C.S.I.R. and the Executive Council of National Physical Laboratory to take urgent action in the matter. The Committee would like C.S.I.R. to lay down norms about the proportion of scientists, technical and non-technical staff for each laboratory so that the strength of staff is regulated accordingly.
58	141	The Committee regret that a large number of scientists, have left the National Physical Laboratory during the last four years, thereby adversely affecting the progress of research work in the laboratory. The Committee feel that this may partly be due to lack of proper scientific atmosphere in the laboratory. The Committee would urge that National Physical Laboratory should immediately take remedial measures to retain the scientists engaged in specific projects so that the important research projects which were being carried out by these scientists, may continue without interruption.
59	142	The Committee are unhappy to note that a large number of research fellows left the National Physical Laboratory without completing their assigned work. The Committee would like the C.S.I.R. to investigate the causes for this phenomenon in this and other laboratories and take suitable remedial measures. It appears that all was not well in the N.P.L. with the result that quite a large number of scientists and research fellows have left the Laboratory. They hope that the CSIR will make a proper study into the causes of so many desertions.
60	143	The Committee note that while many C.S.I.R. laboratories are bringing out annual reports and technical bulletins to inform the scientists, industrialists and the public of their activities and the facilities they can extend, National Physical Laboratory has not done so till very recently

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		in spite of the directive of the C.S.I.R. The Committee, however, note that the National Physical Laboratory has begun to publish a quarterly Technical Bulletin since January, 1966. The Committee strongly recommend that National Physical Laboratory should regularly and in time bring out its Annual Report and circulate it amongst industry and other laboratories/institutions and universities who are interested in the subject.
		They commend the new practice of observing on 'Open Day', as done in January, 1965, to acquaint the public and industry with the work done at the National Physical Laboratory. The Committee hope that this practice would be continued in future also.
	147	The National Physical Laboratory has now a new Director and a shift has been effected to applied research programme oriented towards industry, defence, import substitution etc. The Laboratory now enters into the Fourth Plan period along with the rest of the country. The Committee expect that the National Physical Laboratory would be able to fulfil satisfactorily the research programme envisaged for it during the Fourth Plan period. The Committee hope that the NPL will be able to turn a new leaf in the near future, achieve concrete and quick results for the benefit of the industrial and economic development of the country and above all build up an *esprit de corps* and win for itself laurels of achievement in applied research.

APPENDIX XIII

Analysis of Recommendations/Conclusions contained in the Report.

I. CLASSIFICATION OF RECOMMENDATIONS

A. Recommendations for improving the organisation and working:

Serial Nos. 5, 6, 7, 8, 9, 11, 12, 13, 16, 19, 22, 28, 29, 31, 33, 34, 35, 37, 41, 43, 45, 48, 49, 50, 51, 53, 54, 55, 56, 58, 59 and 60.

B. Recommendations for effecting economy:
Serial Nos. 3, 10, 27, 36, 38, 39, 40, 42, 44, 47, 52 and 57.

C. Miscellaneous recommendations:
Serial Nos. 1, 2, 4, 14, 15, 17, 18, 20, 21, 23, 24, 25, 26, 30, 32, 46 and 61.

II. ANALYSIS OF MORE IMPORTANT RECOMMENDATIONS DIRECTED TOWARDS ECONOMY

S.No.	S. No. as per Summary of recommendations (Appendix XII)	Particulars
1	2	3
1	3	The work of the existing 22 divisions of National Physical Laboratory should be critically reviewed to effect coordination and economy.
2	10	Methods of accounting in the national laboratories should be reoriented in such a way as to ensure that estimated and actual costs of individual research projects are available.
	27	Work relating to maintenance of the standard and developmental testing should be grouped together. Routine testing should not be undertaken.
4	36	Radio propagation unit should not be continued as a part of the N.P.L.
5	38	Work of Applied Mechanics Division should be transferred to Central Mechanical Engineering Research Institute.

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6	39	Staff strength of the Division of Theoretical Physics should be reviewed by CSIR.
7	40	Staff position of the Analytical Chemistry Division should be reviewed immediately to effect economy.
8	42	Glass Technology Section should be constituted into an independent manufacturing unit.
9	44	Rain and Cloud Physics Research Unit should be transferred to the India Meteorological Department without delay.
10	47	The role of the workshop in the NPL should be primarily one of service to the Divisions of the Laboratory and should not be enlarged to include service to other Government departments and institutions.
11	52	NPL should drop some of the subjects for which separate laboratories and institutions have been set up.
12	57	The administrative and Class IV staff should be reduced to the barest minimum.

GMGIPND—LSI—66 (Aii)LS—21-4-66—1139.