

Section 1

THE NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING: INDIA

Background

The predominant pattern of education in India comprises eight years of integrated elementary education, three years of secondary education with diversified courses to give it a vocational bias and make it a terminal point for entry into a trade or higher education, and three years of university education leading to a first degree. Some of the states have adopted a pattern of seven years of elementary education. However, in 1966 the Education Commission suggested a uniform pattern of 15 years' duration leading to the first degree (10 years of general education, two years of general or vocational education at the higher secondary level and three years for the first degree).

This pattern, referred to as the 10 + 2 system, has already been introduced in over half the states and will shortly be introduced in several more.

Statistics of Education

The First All-India Educational Survey was conducted in 1957 by the Ministry of Education. In 1965-66 the Second All-India Educational Survey was carried out by the National Council of Educational Research and Training (NCERT) for the Ministry of Education and Social Welfare and the Planning Commission. In 1973 the Ministry of Education decided to have the Third All-India Educational Survey. Though the full results of the survey have not been finally presented, some provisional data on school education have been released. These show that in 1973 there were 461,864 primary schools, 87,702 middle schools, 32,779 secondary schools, 6,805 higher secondary schools and 2,938 intermediate and junior colleges in the country. Altogether there were over 82 million pupils in school, of whom over 60 million were in classes I to V (primary).

National Curriculum Development

Traditionally, each state in India was free to decide its own policy for education and its own structure. But with a view to improving school education in the country as a whole, the National Council of Educational Research and Training (NCERT) was set up in 1961 by the Government of India. The NCERT is an autonomous body wholly financed by the Government. It functions as the academic adviser to the Ministry of Education and Social Welfare.

In the field of curriculum development the Council is involved in devising standard curricula in all the school subjects and in producing model syllabuses and teaching materials which are then offered to the states for adoption or adaptation to their requirements. Few other curriculum projects are in existence or have existed in recent times. The largest separate project was the Bombay Municipal Project, an activity developed by the All-India Science Teachers'

Association and assisted by the British Council with a Nuffield-based approach. As its name implies, this project was operative in the Municipality of Bombay. British Council assistance ceased in 1975. Another small project is in existence in Hoshangabad in Uttar Pradesh. This project is a rural education project based on an Institute for Rural Development. The project has been in existence for some three years, and is a science teaching project operating in 16 trial schools. The Physics Department of Delhi University is assisting with this project, particularly in its evaluation.

Both of these projects have incorporated material developed by the All-India Science Teachers' Association Study Groups.

The National Council of Educational Research and Training

The NCERT was established on 1 September 1961 with its headquarters in New Delhi. It undertakes, aids, promotes and co-ordinates research in all branches of education. It organizes extension services, and pre-service and in-service training mainly at advanced level. It undertakes and organizes studies, investigations and surveys relating to educational matters or the appraisal of educational programmes. It disseminates improved techniques and practices, and it acts as a clearing house for ideas and information on all matters relating to school education. It has its own publishing house, producing textbooks, supplementary readers, research monographs, educational journals and a variety of educational materials on a "no profit no loss" basis. It also has a large purpose-built workshop where science kits are designed and developed. Details of this workshop are given later.

The NCERT functions through six constituent units as shown in Diagram 1. These are the National Institute of Education (NIE) and

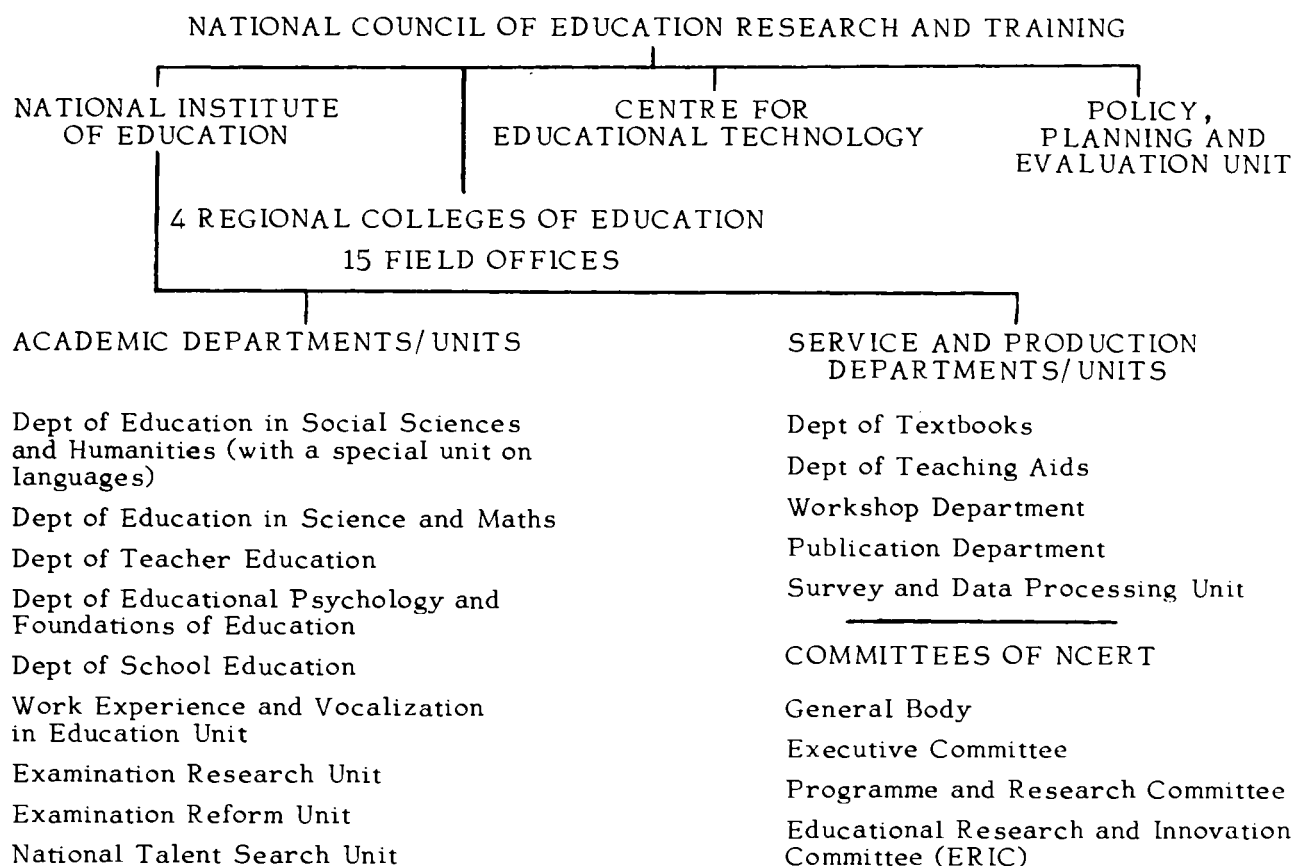


Diagram 1. The Structure of the NCERT

the Centre for Educational Technology (CET) at New Delhi, and the four Regional Colleges of Education (RCEs) at Ajmer, Bhopal, Bhubaneswar and Mysore. It maintains liaison with all relevant institutions furthering the aims of school education, and also with State Ministries of Education through a network of 15 field offices.

The National
Institute of Education

The National Institute of Education (NIE) is concerned mainly with conducting research on problems of school education. As the diagram shows, it works through a number of academic departments (e.g. education in science and mathematics) and service and production departments and units (e.g. the teaching aids department, and the survey and data processing unit).

The National Talent Search Unit conducts an annual competition for final-year secondary students and provides scholarships in the basic sciences and mathematics to successful participants. The NIE also organizes several training programmes, seminars and workshops for teachers, teacher educators, educational administrators, and others.

The Centre for
Educational
Technology

The Centre for Educational Technology (CET) was set up by NCERT in 1973. It is concerned with the development of innovation in education using the various communication media. At present CET is operating a Satellite Instructional Television Experiment (SITE) using the Applied Technology Satellite No.6 loaned by the U.S.A. for one year (August 1975 to July 1976). This experiment involves 2,400 villages located in six states, and is a two-fold programme of primary teacher re-orientation and adult education. For the first of these programmes, by developing a multi-media package for training science teachers at the primary level (with SITE as one component of the package), it is hoped that a twelve-day training course for 96,000 primary school teachers will be possible. Since upwards of a million primary teachers will need retraining to meet the demands of the NCERT primary science curriculum, the project is of high importance.

The Policy, Planning
and Evaluation Unit

The Policy, Planning and Evaluation Unit of NCERT acts as a clearing house for ideas and information on educational research and training, and an Educational Research and Innovation Committee (ERIC) was constituted to promote research and finance suitable research projects outside of NCERT.

Department of
Education in Science
and Mathematics

In 1963 the Government of India asked a UNESCO mission to report upon a desirable form of science and mathematics education for the country. The mission recommended a complete reform of the curriculum, and the provision of printed material and kits of equipment. The pattern of education for science and mathematics was suggested as being: Stage 1, Classes I-V; Stage 2, Classes VI-VIII; and Stage 3, Classes IX-XI.

At the first stage stress should be laid on obtaining information about the non-living nature, and arithmetic with some geometry. At the second stage a disciplinary approach to teaching Physics, Chemistry and Biology should be adopted. Biology and Physics should be introduced in Class IV, through to Class VI, whilst Chemistry should be introduced at Class V thereby allowing the basic Physics knowledge to allow a fuller development of the studies of the properties of matter in Chemistry. In the third stage a number of streams should be provided such as science, humanities, and technology. Only in the science stream would physics, chemistry and biology be taught.

Under the new twelve-year pattern of schooling (1975) the stages become: Stage 1, Classes I-V; Stage 2, Classes VI-VIII; Stage 3, Classes IX and X; and Stage 4, Classes XI and XII.

Science and mathematics will be taught to all up to the end of Stage 3, with streaming starting in Stage 4, thereby ensuring a general science background for all pupils.

Further recommendations made by the mission related to equipping schools for teaching science and mathematics. It was recommended that, since it would not be financially possible to provide science laboratories and equipment in all schools, at least a small demonstration bench should be provided. In addition a Central Science Workshop should be established which could carry out work along four major lines:

- (a) Studying the equipment for teaching science that is manufactured by industry, and exploring how its quality could be improved.
- (b) Designing, manufacturing and experimental testing of new teaching equipment.
- (c) Utilization of the best Indian and foreign experience for designing and producing teaching equipment.
- (d) Producing new designs for manufacture by industry.

Other recommendations included the training of science and mathematics teachers, and research in science and mathematics education.

Following these recommendations, a project for curriculum development materialized, and in September 1965 work began in the Department of Education in Science and Mathematics. UNESCO experts were made available to assist with the implementation of the curriculum development project, which was to develop not only the relevant syllabus but also textbooks, teachers' guides and kits of equipment related to the different subjects and levels of education. It was intended that the material should be as flexible as possible so that each state could adapt it to its own special needs without losing the spirit of the approach which was to be based upon experimentation and enquiry. To facilitate as widespread a representation as possible in the curriculum development work, 20 study groups were established in various university centres. They consisted not only of teachers but also of scientists. The tasks assigned to these study groups were to develop instructional material for the entire school stage in mathematics, and for the secondary stage from class V/VI upwards for physics, chemistry and biology.

These study groups appeared to have varying degrees of success, and a great deal of centralized co-ordination occurred to finalize the materials; for example the physics groups prepared separate materials and the final official version after some difficulties. (One set of materials developed by a study group is apparently the basis of the Bombay Municipality Project.)

The Central Science Workshop (now the Workshop Department) began designing and developing kits in 1968. The first were Physics 1, and a small chemistry kit for the middle schools. In 1969 a few prototypes of the primary science kit were developed, leading eventually to the comprehensive primary science kit which was contained in a box and had its own in-built demonstration table (flap) and chalk board. The kit also contained a set of hand tools to enable the teacher to improvise some items for himself. The kit was developed for the village primary school which would only have the minimum of classroom fittings.

Physics Kit 2 and Chemistry Kit, followed by Biology were next developed, with the Physics Kit 3 the last to be developed. These kits were of two types, one for demonstration to class sizes of 35 to 40 and pupils' kits for groups of four to six students.

Implementation of
the Science Education
Project

The government prepared a plan of operation in conjunction with UNICEF/UNESCO for the pilot project on a national basis for the improvement of science teaching. Under this plan, UNICEF agreed to provide funds for (a) translating and printing the syllabus and instructional materials, (b) science laboratory equipment for training

institutions, (c) teacher training, (d) the supply of kits to schools, and (d) a limited supply of paper for printing the instructional materials.

To implement the Science Education Project the states were encouraged to set up State Institutes of Science Education (SISEs) or science wings to their State Institutes of Education (SIEs). Some states already had such institutes. It was envisaged that these institutes would provide in-service training and orientation programmes for teachers. In addition, a number of key teacher training institutions were identified to assist in the project implementation. The basis of selection was made upon the suitability of staff and facilities. Initially 579 institutions were identified and received science equipment provided by UNICEF. It consisted of imported kits of traditional apparatus intended to equip the laboratories to a given standard. A later evaluation revealed that some of the institutions were not suitable to utilize the equipment effectively, and it was decided that any future institutions would be selected only after inspection by NCERT field staff.

It was decided to try out the NCERT material in a number of experimental schools. Consequently some 1,200 primary and 700 middle schools were selected throughout the country representing 30 states of the union.

Responsibility for providing the science kits needed for the pilot project was taken by the Workshop Department of NCERT. As only limited funds were available for the project, it was decided to concentrate on the demonstration kits rather than the pupils' kits. The workshop was strengthened in various sections to meet the demands to be made on it, and the total number of kits provided up to the middle of 1975 was:

	<u>69/70</u>	<u>70/71</u>	<u>71/72</u>	<u>72/73</u>	<u>73/74</u>	<u>74/75</u>	<u>75/76</u>
Primary Science	-	760	188	155	61	110	47*
Physics 1	69	426	130	116	40	68	25
" 2	-	-	351	213	57	124	67
" 3	-	-	-	175	437	44	35
Biology 1	-	468	129	108	4	-	-
Biology Dem.	-	-	350	211	56	129	65
Chemistry Dem.	-	-	350	214	57	129	65
Physics Class	-	-	467	1,571	-	480	-

* 1,500 Primary Science Kits have been produced for the Republic of Afghanistan, and a further 800 for direct purchase by two states.

It is anticipated that some 8,000 primary kits will be produced for UNICEF during 1976.

The project plan was envisaged as having three phases - the pilot phase, the wider introduction phase, and universalization. The degree of progress through these phases has varied from state to state. UNICEF assistance at the wider introduction phase has been limited to primary education only, which in turn has affected its implementation in some states.

Workshop Department

The Workshop Department is in a purpose-built building in close proximity to the Science and Mathematics Department and is a single-storey building for the most part with a small first-floor area over part of the building.

The components of the Workshop Department are: main workshop; prototype design workshop; dies and sheet metal workshop; optics

glass workshop; wood workshop; plastic workshop; foundry; electroplating shop; paint shop; welding bay; electrical repair/maintenance shop; design/development office; display laboratory; main stores (material); stores (spares, stock and inspection); completed kit stores; assembly area; reproduction/duplicating area; general office and administration section.

The Department has approximately 100 members of staff and, depending on demand, it also employs a daily labour force. Diagram 2 outlines the staff structure, but it should be noted that a particular title does not necessarily reflect the actual duties of an individual. For example, of the Technical Officers, one is responsible for office administration, and, in the Fine Mechanic grade, two are in the packaging section.

Diagram 3 on page 9 indicates the layout of the Workshop Department (not to scale).

Staff are recruited through national advertising, and the successful applicants are appointed to their appropriate grade. A system exists whereby any individual who shows aptitude can apply for the relevant trade test and be up-graded. (Such a system promotes staff improvement and encourages harmonious working relationships.)

The policy of the workshop has apparently been towards flexibility of staffing. Besides each individual having his specific duties, personnel can also be co-opted to other duties as the demand necessitates. This enables the NCERT to supplement demand areas and remove bottlenecks when they look like occurring. Such a policy, although often written into civil service conditions of employment, is not always effectively enforceable and often rests on good employer/staff relations.

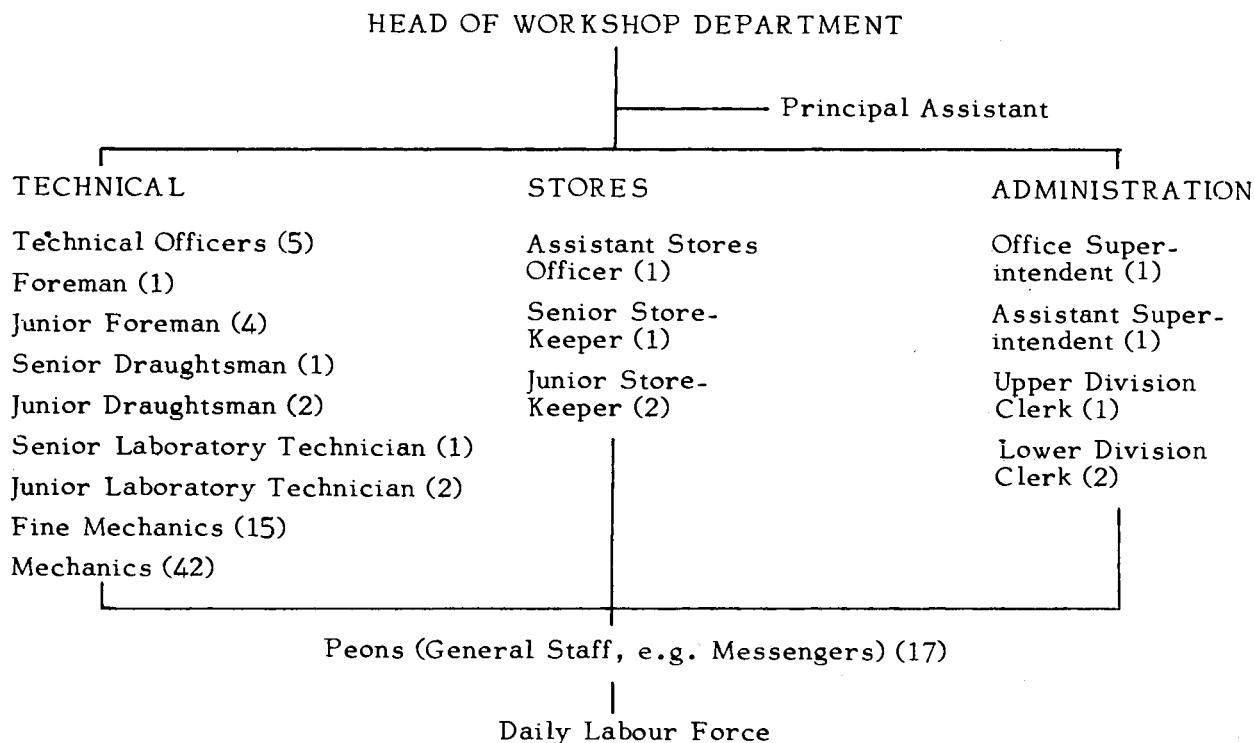
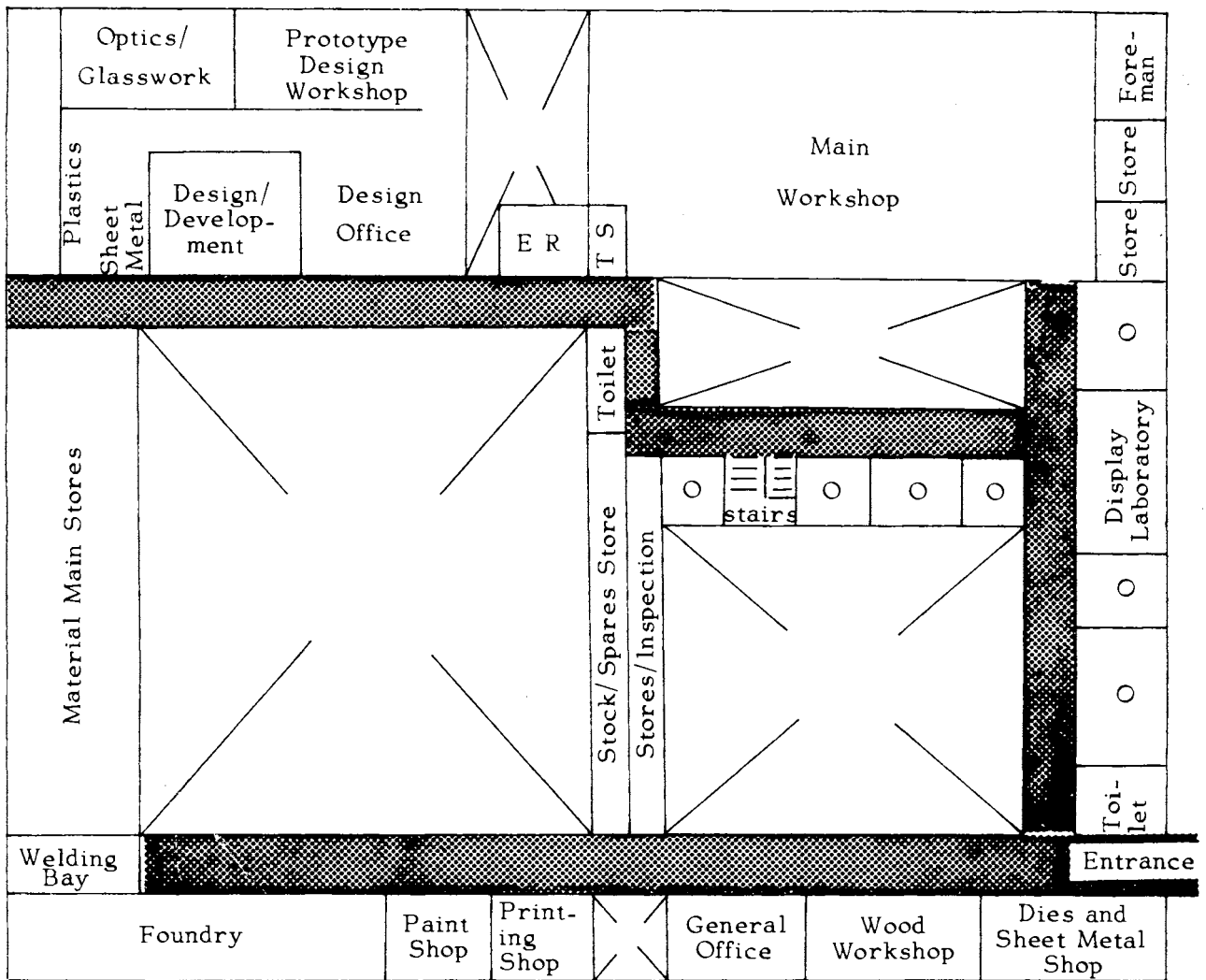


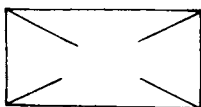
Diagram 2. Staff Structure of the Workshop Department



GROUND FLOOR

FIRST FLOOR

KEY



Open Space



Walkway

O = Office

E R = Electrical Repairs

T S = Tool Store

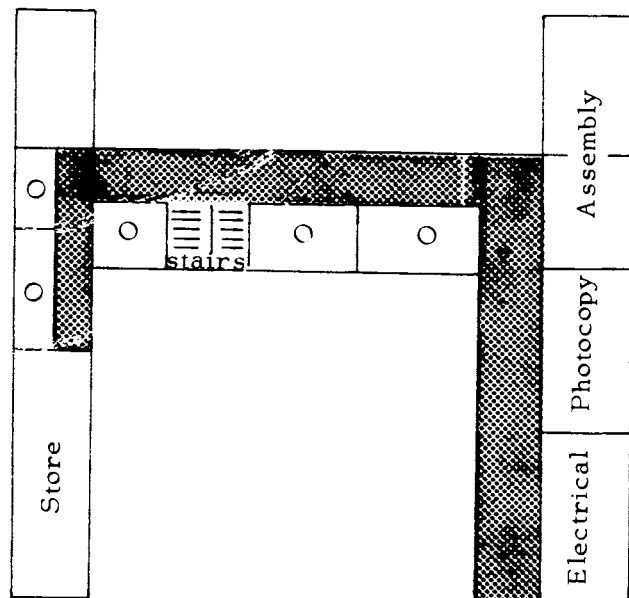


Diagram 3. Sketch of the Workshop Department (not to scale)

Financing

The NCERT is wholly financed by the Government of India. From the budget the workshop has been allocated 500,000 rupees for 1975/76 fiscal year, with a further 50,000 rupees for research and development. Of the 500,000 rupees, 60% is spent on the purchasing of raw materials, and the sale of the kits is normally expected to replace this expenditure. It is expected that the workshop will eventually be self-supporting financially, selling its products on a no-profit no-loss basis, which is not the case at present. A 'labour cost' figure is included in the price of the kits and this amount is reckoned at 60% of the staff costs. (Full staff costs are not included since the workshop also undertakes maintenance for the whole of the NCERT.)

Kits are purchased through each State Ministry of Education. Direct purchases cannot be made by schools, nor is it possible for them to obtain spare parts or replacement items at the moment.

The cost in rupees of the kit was quoted as being :

Primary Science Kit	210
Physics Kit 1	206
Physics Kit 2	250
Physics Kit 3	350
Chemistry Kit	420
" " (pupils)	224
Biology Kit	350

(Pupils' Kits have been discontinued due to the emphasis on primary work.)

(January 1976, £1 = 17.9 rupees.)

Development of Science Kits

In general the kits were developed by close liaison with the staff groups of the Science and Mathematics Department, as well as with the UNESCO specialists supplied under the UNDP/UNESCO assistance to the NCERT. From the workshop design staff's point of view, interchange of staff took place when developing a piece of apparatus, thereby allowing more than one individual to participate in the design at various stages. Materials were tried out in a local school, and, where necessary, modified prior to inclusion in the kits.

During the process of development, the production aspect of the apparatus was kept in mind, thereby facilitating a minimum of change between the form of the prototype and the form of the finished production item. On completion of development of the item, workshop production drawings were produced. They are available for anyone wishing to construct the apparatus.

Production of Kits

In addition to the facilities for constructing apparatus provided in the Workshop Department, a number of items are constructed by local manufacturers. Currently there are some twelve commercial manufacturers who tender for the batch requirements of the kits. The system is to request tenders for a fixed number of items with the suppliers working to the strict requirements of the Department. Poor quality control has been experienced in the past, and all items submitted to the workshop are inspected by selected members of the workshop staff prior to acceptance.

By maintaining their own quality control standards, the reliability of the manufacturers has improved, particularly since each manufacturer's tender rests heavily on the quality of his past product. New tender companies have to supply sample products prior to

approval for tender. In addition to supplying the needs of the Department, these companies also offer their products on the open market for purchase by schools, etc. The Department supplies a list of such suppliers to all schools who write to the NCERT for information on the availability of the kits (see page 13).

Under the course work activities of the Science and Mathematics Department the workshop has held two courses on quality control. These have been for members of state Ministries of Education who have provided Quality Control Officers to specifically monitor the quality of products when purchased from commercial suppliers. The participants have been instructed in the requirements of their duties and have been provided with a kit of instruments and with samples purchased out of UNICEF funds.

AN EXAMPLE OF MATERIAL RELATED TO PRIMARY SCIENCE

REFERENCE BOOKS PUBLISHED (NCERT)

Textbooks

"Science is Doing" for Class III
"Science is Doing" for Class IV
"Science is Doing" for Class V

Teacher's Guides

Teacher's Guide to "Science is Doing" for Class III
Teacher's Guide to "Science is Doing" for Class IV
Teacher's Guide to "Science is Doing" for Class V

Teacher's Handbooks of Activities

General Science - A Handbook of Activities for Primary Schools Vol. 1
General Science - A Handbook of Activities for Primary Schools Vol. 2
General Science - A Handbook of Activities for Primary Schools Vol. 3

Kit Guide

SCIENTIFIC TOPICS COVERED UNDER NEW CURRICULUM

1. Our Universe. 2. Air, Water and Weather. 3. Rocks, Soils and Minerals. 4. Forces and Work. 5. Matter and Materials. 6. Housing and Clothing. 7. Living Things. 8. Plant Life. 9. Animal Life, including a separate chapter on Birds in Class III. 10. Man and His World (In Class V only). 11. Human Body Health and Hygiene.

LIST OF THE KIT CONTENTS

General Items

- | | |
|---|--|
| 1. Aluminium Katori (a cup without handle) 100 mm. dia. - 2 | 7. Enamelled copper wire 24 gauge - 2 metres |
| 2. Balls (rubber) 80 mm. and 50 mm. dia. - 1 each | 8. Football pump - 1 |
| 3. Beaker 150 ml. and 100 ml. - 1 each | 9. Glass marbles - 50 |
| 4. Hard glass test tube - 1 | 10. Glass jar or empty jam bottle - 1 |
| 5. Compass needle - 1 | 11. Glass rod 15 mm. dia. x 150 mm. long - 1 |
| 6. Electric circuit-board with battery, bulb and switch - 1 | 12. Hand fan - 1 |
| | 13. Hand lens (mag. 4X) with plastic frame - 1 |

14. Hard board 200 x 200 x 3 mm. with rectangular slot of 80 x 80 mm. in centre - 1
15. Hollow polythene rectangular containers of same capacity but different sizes - 1 each
 - (a) 120 x 60 x 30 mm. height (red)
 - (b) 90 x 30 x 80 mm. height (blue)
16. Kitchen strainer (wire-net) - 1
17. Bar magnet - 1 pair
18. Measuring cylinder 100 ml. - 1
19. Aluminium tube 60 mm. dia. x 125 mm. long - 3
20. Soft iron nails 6 mm. dia. x 130 mm. long - 2
21. Mounting needles - 2
22. Plane mirror mounted on wooden base 100 mm. x 61 mm. - 1
23. Plastic comb - 1
24. Plastic funnel 75 mm. dia. - 1
25. Tubing 7.5 mm. dia. (Polytene) - 1 metre
26. Plastic tumbler 100 mm. high - 2
27. Plastic syringe - 1
28. Polythene bags assorted - 6
29. Pulley - 1
30. Rubber stoppers assorted for item number 4 - 2
31. Rubber stoppers assorted for item number 36 - 3
32. Scale half-metre with five holes - 1
33. Sieve 125 mm. dia. - 1
34. Lamp (kerosene) - 1
35. Spring balance - 1
36. Test tubes 15 mm. dia. x 125 mm. long - 6
37. Thermometer 0-110° C on wooden base - 1
38. Thermometer clinical - 1
39. Torch with 2 cells - 1
40. Tripod stand with wire gauze - 1 each
41. Water wheel - 1
42. Wedge - 1
43. Wind-vane - 1
44. 1 kg. weight - 1
45. M. S. Wire 3 mm. dia. 200 mm. long - 1
46. Glider - 1
47. Top pan spring balance 2 kg. - 1
48. Model of lift pump - 1
49. Toy electric motor - 1
50. Kit box

Hand Tools

1. File triangular (100 mm.) - 1
2. Hammer with claw (250 gms.) - 1
3. Hand drill (6 mm. dia. capacity) with drill bits - 1

COMMERCIAL SUPPLIERS OF SCIENCE KITS

M/s. Delta Laboratory Equipments, 6438 Bagichi Ishwari Pershad, Bara Hindu Rao, Delhi 110006	Primary Science	III to V
M/s. Gaupad Chemicals, Kaithal Gate, Chandausi, UP	Primary Science	III to V
M/s. Optika & Chemico, 28-B Industrial Estate, Gwalior, MP	Physics I/Physics III	VI/VIII
M/s. Hargolal & Sons, Hargolal Building, Hargolal Road, Ambala Cantt.	Physics II/Physics III	VII/VIII
M/s. Metro Scientific Industries, Mori Gate, Delhi 110006	Physics I	VI
M/s. Dynam Engineering Corporation, 6 Haudin Road, Bangalore 560042	Physics I	VI
M/s. Arun Chemicals & Scientific Industries, 11/5495 Basti Harphool Singh, Sadar Thana Road, Delhi 110006	Chemistry	VII to VIII
M/s. Sisbro Scientific Industries, (New) 47, UA Lawahar Magar, Delhi 110006	Biology Composite/ Biology Non-Composite	VI to VIII/ VII to VIII
M/s. Mittal Sales Corporation, Chand Tara Building, G. T. Road, Shahdara	Biology Composite/ Biology Non-Composite	VI to VIII/ VII to VIII
M/s. Gadget House, Bhagat Ki Kothi, Jodhpur, Rajasthan	Biology Composite	VI to VIII
M/s. The Haryana State Small Industries & Export Corporation Ltd., Bank of India Building, (2nd Floor) Sector 17-B, Chandigarh	Biology I	VI
M/s. Educational Kit Manufactuer, 255/300 Mangal Pass Building, Kitchen Garden Lane, Bombay 400002	Biology Non-Composite	VII to VIII