Section 3 Sources of Reference

DESIGNS, DRAWINGS AND SPECIFICATIONS OF APPARATUS

A source for specifications, descriptions, suggestions and names of English manufacturers of primary level mathematics apparatus is 'Mathematics Apparatus for Primary Schools' (1). This also gives guidance on the use of the items. A similar source for primary science is 'Science for Primary Schools Part 4 - Materials and Equipment' (2). Guidance on this material is given in Part 1 in the same series and sources of 'software' are listed in Parts 2 and 3.

For designs of modern apparatus for teaching secondary level science, a good source is 'Nuffield Secondary Science - Apparatus Guide' (3). This contains 120 pages of very clear line drawings in accurate plan or isometric projection showing important dimensions, with descriptive notes beside each of them. Another section of the book gives guidance on where it all fits into the Nuffield Secondary Science curriculum with further notes on design, quantities needed, etc. A typical drawing is shown as photograph 39.

Some texts are good sources of designs. One with a lot of new ideas is 'Physics is Fun' by J. Jardine (4). Another, with peg-board mounting apparatus is 'Introductory Physical Science: Laboratory Equipment and Apparatus' (5).

Blueprints and dimensional engineering drawings have already been mentioned as produced by several production units. The largest series of these (outside the presumably unavailable designs of US, European and Japanese firms) is that of the NCERT, India. They have produced five large folders of 'Specifications and Manufacturing Drawings': Primary Science, Chemistry for middle stage, Biology for middle stage, and two Physics kits. (There may now be more.) An example is shown as photograph 25.

(1) Mathematics Apparatus for Primary Schools (Howson) published for CEDO (now British Council) by Heinemann Educational Books Limited, 48 Charles Street, London W1X 8AH, England.

(2) Science for Primary Schools Part 4 - Materials and Equipment published for the Association for Science Education by John Murray, 50 Albemarle Street, London W1X 4BD, England.

(3) Nuffield Secondary Science - Apparatus Guide
published by Longman Group Limited, Burnt Mill, Harlow, Essex, England.

(4) Physics is Fun series by J. Jardine
published by Heinemann Educational Books Limited, 48 Charles Street, London W1X 8AH, England.

(5) Introductory Physical Science: Laboratory Equipment and Apparatus
published by Prentice Hall Incorporated, Englewood Cliffs, New Jersey 07632, USA.

APPARATUS ASSESSMENT AND CRITIQUE

An important source of critiques of schools science apparatus along with much associated information of a helpful and practical kind is in the monthly bulletins of the Scottish School Science Equipment Research Centre (1). These have been produced since 1966 and the back copies constitute a mine of information.

(1) School Science Equipment Centre, 103 Broughton Street, Edinburgh EH1 3RZ, Scotland.

POTENTIALLY USEFUL BOOKS

Conferences, other than some of those arranged by INNOTECH, rarely look at the needs and problems of educational aid production as a system or part of a system - at least not in an analytical and realistic way. There are, however, books which do this, and although some of them are oblique to the purpose of this review, they throw light on pertinent but neglected aspects of the design and provision of school teaching aids.

The principles of designing any kind of equipment for satisfactory use by human beings are covered in 'Ergonomics' by K. F. H. Murrell (1). Although this is nominally about man in his working environment, much of it can be transferred with a little imagination to children working with apparatus at school. This study not only concerns itself with a worker handling a piece of equipment but with the design of working environments to encourage motivation, good working attitudes, and so on. It is enlightening because it reveals that many problems in school parallel those in industry. Though many of the problems have been solved or partially solved in industry little thought seems to have been given to applying these analyses and techniques to schools, whose problems grow daily.

An introductory book about which much of the foregoing also applies is 'Organization Theory' edited by D. S. Pugh (2). Again, although concerned with industrial organization, its approach suggests powerful techniques for helping children to work in school. It covers many basic considerations that apply to designing an organization for introducing teaching apparatus into schools. It is sad that errors long ago recognized and corrected in industrial management organization, and recounted as history in this book, are still current in the administration of many of the projects described in this review.

Sources of reference

Very relevant and specific to such problems is 'The Emerging Dimensions of Indian Management' (3) by Professor A. N. Agarwala of the University of Allahabad, especially the chapter 'The Management of Small Businesses in India'. One paragraph in particular makes a point which production units with foreign advisers should consider seriously: as many small Indian businesses are badly managed, is it not part of the duty of production unit designers, who in some way or another make use of such local businesses, to help to educate them effectively in the techniques of good management? If a school equipment production unit, aided by foreign funds and having valuable expertise, merely makes use of cottage industries and the like for its main purpose (however valuable) but fails to aid their management (which it often could do relatively easily) it lays itself open to the same charge. Moreover, this is truly short-sighted, for its main purpose will not be served if the small industries on which the continuance of the project will depend, remain inefficient or go out of business. The disappearance rate in India is high but the principle applies to all countries. Professor Agarwala says:

> 'It is, therefore, important to determine the specific methods in which the management of small and tiny business units of various categories can be improved, and to make constructive endeavours to get these methods inserted into their working practices. India has not had time or resources to do much in this direction. It has nevertheless made, and is making, some efforts, though they are frankly of a casual or coincidental nature. Even in the case of small-scale industries, which are the proud and much-courted queens of this kingdom, such consideration as is given to management aspects is often a by-product of the thought devoted to administrative, technological or some other type of problems. Questions like the following have to be directly faced and answered: How can a small-scale industrial entrepreneur manage his enterprise better? How can the village artisan or urban handicrafts-man manage his cottage unit more satisfactorily? How can a small money-lender or road-transportation operator manage his affairs more efficiently? In all such cases, the immediate criterion of efficiency will have to be the profit made from the business pursuit. Answers to such questions can only be given after careful case studies, empirical surveys, a priori deductions, discriminatory consultancy projects, and trans-disciplinary researches, in which respect foreign experiences and research techniques should be most useful.'

Thus a school science apparatus production unit is, or should be, more deeply concerned in the wider educational processes of the country than it may, at first sight, realize.

(1) Ergonomics: Man in his Working Environment (Murrell) published by Chapman and Hall Limited, 11 New Fetter Lane, London EC4P 4EE, England.

(2) Organization Theory (editor Pugh) published by Penguin Books Limited, Harmondsworth, Middlesex, England.

(3) The Emerging Dimensions of Indian Management published by Asia Publishing House, 447 Strand, London WC2R 0QU, England.

REFERENCE BOOKS ON THE USE OF SIMPLE APPARATUS

There are many books which describe the use of common objects for teaching science. The classic is the original UNESCO 'Source Book for Science Teaching' (1). (The new version uses less common material and is at a rather higher level of sophistication. See photograph 40.) Such books usually include a lot of apparatus for teachers to construct for themselves. From such sources, production units can get innumerable ideas. The best such construction book series is the 'Guidebook to Constructing Inexpensive Science Teaching Equipment' (2), with separate volumes for chemistry, physics and biology. Photograph 41 shows a page from this. UNICEF's apparatus catalogue (Guide List EVE Science Revision (3)) includes a resource materials kit (photograph 42) to help teachers do such construction.

Other similar books are: 'Making Elementary Science Apparatus' (4); 'Experiments with Heat' (5) and others in the mimeographed series by the Don Bosco technical school in the Philippines; a series of leaflets from the Dryad Press on techniques such as 'Making Papier Mache' (6); the cyclostyled 'Elementary Economic Experiments in Physics' (7), which contains dimensioned line drawings for secondary level modern science apparatus; books from the 'Science 5/13' project in England, such as 'Working with Wood' (8); the Nuffield Junior Science Book on 'Apparatus' (9); the 'Elementary Science Study Series' (10), shown in photographs 44 and 47; books from the project on Elementary School Mathematics and Science of the University of Illinois, such as 'A Conglomeration of Gadgets and Gizmos' (11).

Some other useful sources are: 'The Book of Experiments' (12) by Leonard de Vries and 'After-dinner Science' (13) by K. M. Swezey - these both use domestic items for science demonstration; the 'Junior Science Source Book' (14); the publications of Project Technology, which describe constructions and children's investigations of them, mainly at secondary level, such as 'School Technology Volume 1' (15). Both the old 'Demonstration Experiments in Physics', which may be difficult to obtain, and its huge recent two volume replacement 'Teaching Science with Everyday Things' (16) by Schmidt and Rockcastle, are valuable.

Some textbooks and teachers' guide books for older or new science courses are full of ideas for apparatus. In biology: 'Simple Experiments in Biology' (17) by C. Bibby; in chemistry: 'Gas Syringe Experiments' (18) by M. Rogers; and in integrated science: 'Teaching Science to the Ordinary Pupil' (19) by Laybourn and Bailey. The new English and US curriculum books in science also have useful ideas on new apparatus.

More unusual sources for designers looking for simple ideas, particularly those appropriate to situations needing low-level technology, are the hippie manuals for communes and the books which have grown from the simplified-life movement: 'The Foxfire Book' (20); 'The Last Complete Whole Earth Catalogue' (21); the 'Survival Scrapbook' (22) volumes on Tools and Energy - volume 3, 'Access to Tools', is particularly good for a design workshop. There are many books of similar intent; a good collection may be seen in the library of the Intermediate Technology Development Group, 9 King Street, London W.C.2., whose own books and pamphlets are likely to be valuable both for ideas for items and for their background philosophy of design.

Sources of reference

Books for home experiments by children sometimes provide model approaches which would be of interest to production unit designers and curriculum writers. Sometimes they also contain ideas for making or improvizing simple apparatus. The recently published 'Technicians Manuals' associated with the Schools Council Integrated Science Project 'Patterns' (23) scheme, provide a guide for the laboratory technician on what apparatus is required and what can be made. A very useful small book on apparatus storage in schools is 'Storage of Apparatus' by O. M. Stepan (24).

(1) Source Book for Science Teaching
published by UNESCO, 7 place de Fontenoy, 75700 Paris, France.

(2) Guidebook to Constructing Inexpensive Science Teaching Equipment
prepared by the Science Teaching Centre, University of Maryland, College Park, Maryland 20742, USA.

(3) EVE Science Revision
published by UNICEF, 866 United Nations Plaza, New York, N.Y. 10017, USA.

(4) Making Elementary Science Apparatus (Bowker and Hunt)
published by Thomas Nelson and Sons Limited, 36 Park Street, London W1Y 4DE, England.

(5) Experiments with Heat
series prepared and mimeographed by the Don Bosco Technical School, Philippines.

(6) Making Papier-Mâché
series published by the Dryad Press Limited, Northgates, Leicester, England.

(7) Elementary Economic Experiments in Physics (Melton)
available from the British Council, E.P.D., 10 Spring Gardens, London SW1A 2BN, England.

(8) Working with Wood
published by Macdonald Educational Limited, St Giles House, 49-50 Poland Street, London W1A 2LG, England.

(9) Nuffield Junior Science - Apparatus
published by Wm. Collins Limited, 144 Cathedral Street, Glasgow G4 0NB, Scotland.

(10) Elementary Science Study Series
published by McGraw Hill, 1221 Avenue of the Americas, New York, N.Y. 10036, USA.

(11) Project on Elementary School Mathematics and Science
available from Booker T. Washington School, 606 East Grove Street, Champaign, Illinois 61820, USA.

(12) The Book of Experiments (de Vries)
published by John Murray Limited, 50 Albemarle Street, London W1X 4BD, England.

(13) After-dinner Science (Swezey)
published by Kaye and Ward Limited, 21 New Street, London EC2M 4NT, England.

(14) Junior Science Source Book (Wastnedge)
published by Wm. Collins Limited, 144 Cathedral Street, Glasgow G4 0NB, Scotland.

(15) School Technology Volume 1
published by English Universities Press Limited, St Paul's House, Warwick Lane, London EC4P 4AH, England.

(16) Demonstration Experiments in Physics (Sutton) and Teaching Science with Everyday Things (Schmidt and Rockcastle)
published by McGraw Hill, 1221 Avenue of the Americas, New York, N.Y. 10036, USA.

(17) Simple Experiments in Biology (Bibby) and

(18) Gas Syringe Experiments (Rogers, Martin)
both published by Heinemann Educational Books Limited, 48 Charles Street, London W1X 8AH, England.

(19) Teaching Science to the Ordinary Pupil (Laybourn and Bailey)
published by the University of London Press Limited, St Paul's House, Warwick Lane, London EC4P 4AH, England.

(20) The Foxfire Book
published by Doubleday and Company Incorporated, Garden City, New York 11530, USA.

(21) The Last Complete Whole Earth Catalogue
published by Penguin Books Limited, Harmondsworth, Middlesex, England.

(22) Survival Scrapbook (Szczelkun)
published by the Unicorn Bookshop, Brighton, Sussex, England.

(23) Patterns Technicians' Manuals
published by the Longman Group, Burnt Mill, Harlow, Essex, England.

(24) Storage of Apparatus (Stepan)
published by the Association for Science Education, College Lane, Hatfield, Hertfordshire, England.

WIDE-RANGE REFERENCE BOOKS

There are, of course, many written sources of information about apparatus production. A world-wide listing of almost everything that is going on is: 'Report of the Clearing-house on Science and Mathematics Curricular Developments' (free to interested institutions from the Science Teaching Centre, University of Maryland, College Park, Maryland 20742, USA). This centre in Maryland contains most of the materials and many examples of apparatus from the projects listed. There is a great deal of information in the Briefing Room, Divison of Pre-University Science and Technology Education, UNESCO, Paris and in the libraries of UNESCO major field offices. The British Council has a display area at its Curriculum Information Service (Education, Information and Research Department, 10 Spring Gardens, London S.W.1.) where a wide range of apparatus and materials from projects all over the world can be seen. It has, for example, many of

the NCERT Indian kits. The British Council's 'Science Education Newsletter' (free to overseas institutions from local British Council offices) lists and describes world-wide educational projects, including apparatus production information.

An excellent critical review and appraisal of the provision of teaching equipment to schools is 'Problems of the Promotion and Production of Teaching Materials in Developing countries' edited by Edda Eisenlohr et al, and published by the German Foundation for International Development (DSE., 53 Bonn, Simrockstrasse, West Germany). It is the report of an international conference in Berlin in October 1971. There is a brief but good analysis of production problems facing apparatus makers and book publishers, and a perceptive outline plan for the production of teaching materials by Mats G. Hultin of the World Bank (IBRD). The report covers a wide range of world projects.

REFERENCE PEOPLE

There are a number of more or less single-person initiatives in apparatus design all over the world. These range from inidividual teachers working in their own school whose productions are not seen by a wider public unless perhaps in the pages of a local teachers' journal, to people who have published their designs in a book. The journals of the Association for Science Education (1) in the UK, and the publications of the National Science Teachers Association (2) of the USA are sources of the first type. An example of the second type is R. F. Simpson's 'Simple Physics Apparatus' (3) which shows a wide range of science teaching items made up from common hardware store goods, such as pencils, magnifying glasses, electric iron elements and bottles. The items - some of which are shown in photograph 48 - make up a kit which can be packed in a small case. A similar example which uses simpler apparatus for an elementary level is Bowker and Hunt's 'Making Elementary Science Apparatus' (4).

In a small scheme supported by the British Council and the Ministry of Overseas Development, R. M. Garratt in Colombia was (in 1972) developing materials and apparatus for schools of Latin American type. Its aims were to use local resources to create adaptable materials which could be gradually built up in range as the needs became better understood. There are 'modules' of apparatus and appropriate work-sheets.

Other people who are creators, or repositories of information, in respect of apparatus ideas exist all over the world. Just a few are: Mrs Dora Whittaker (108 Parkside, Wollaton, Nottingham, England), chairman of the Schools Council committee on mathematics, who has until recently run a mathematics centre in Nottingham and is in touch with a wide range of sources for mathematics teaching apparatus. She herself is a creator, and a good source for US mathematics projects, with which she often works. Dr Ken Magnus (Chemistry Department, University of the West Indies, Kingston 7, Jamaica) is a source for Caribbean project information. Mr Brian Steven of City College, Leeds, England, is an inventor of apparatus from domestic materials. Many people in the Nuffield Science Teaching Project (Chelsea College of Science and Technology, Bridges Place, London S.W.6.) know about new apparatus for British schemes. Mr Norman Lowe, (97 Constance Road, Whitton, Twickenham, Middlesex, TW2 7HX, England) is a source of

for information on African science schemes. The Division of Pre-University Science and Technology Education, UNESCO, Paris, is another source of information, with two individuals in particular being Dr Nahum Joel and Mrs S. Haggis. Keith Warren (The Grange, Ripley, Derby, DE5 3FT, England) has undertaken several studies of apparatus use and production, from reviews and critiques to design studies and inventions for village school science (unpublished). The best source for practical experience and design of production units is Mr Soren Hakansson (sometime Asia Regional UNESCO Adviser on School Science Equipment, and now at UNESCO headquarters in Paris).

(1) Association for Science Education, College Lane, Hatfield, Hertfordshire, England.

(2) National Science Teachers Association, 1201 16 Street, N.W., Washington, D.C., 20036, USA.

(3) Simple Physics Apparatus (Simpson)
published by the Hong Kong University Book Store, Hong Kong.

(4) Making Elementary Science Apparatus (Bowker and Hunt)
published by Thomas Nelson Limited, 36 Park Street, London W1Y 4DE, England.

TOYS AS TEACHING APPARATUS

For young children, especially pre-school, play apparatus may be desirable for helping them to understand aspects of science through body movement and through acting-out their 'experiments'. A collection of such play apparatus and materials is in UNICEF's Guide List 'Pandora' (1) which gives guidance on the choice and use of such material and its place in the child's development. There are lists and guide lines applicable to children in four age ranges: under 1 year, 1 to 3 years, 3 to 6 years and 6 to 9 years old. Local resource material is stocked by UNICEF for supply to group programmes.

Production units wishing to know what materials are used in pre-school and early primary school education in European countries and the USA can consult catalogues of supply houses or of shops which deal in these. A two-page list of basic items (such as paper, paint, scissors, paste) which may be used for early mathematics experience is available from Childsplay, 112 Tooting High Street, London S.W.17., England.

(1) Pandora Guide List
published by UNICEF, 866 United Nations Plaza, New York, N.Y. 10017, USA.

KITS OF PLASTIC COMPONENTS

Kits come in many forms. They can be many-item collections - like the complete primary science kit of the NCERT - for teacher demonstrations. The CVK kit is for class use and is for a limited subject. Other types of collection, but still referred to as 'kits' are more limited: they may be, for instance, parts of a single device which is to be assembled; or a collection

of simple things for use by an individual child; or even a set of blocks for pre-school or primary school experience.

The sets of 'new maths' equipment for primary level are fairly simple to manufacture, because they are plain designs. They can be conceived in plastic, as can many of the components of science kits. Once machines are obtained, the facility with which many items may be made rapidly by plastic injection or vacuum-forming techniques should almost make their use obligatory in teaching apparatus production units. However, making moulds and dies is skilled work, and technicians need proper training; only a skilled machinist could make the brass and steel injection dies for the plastic nuts and bolts kit shown in photograph 46. A high degree of skill is also needed to achieve the necessary accuracy to make the Centicubes in photograph 45 clip together properly - a skill probably beyond the range of most production units outside Europe, Japan and the USA.

It is quite possible that European firms would be willing to give advice, training or other aid. A helpful and informative source of advice on such matters is the Educational Division of Invicta Plastics (Oadby, Leicester England). This firm, the largest of its type in Europe, markets in all continents and has a philosophy concerning local production, apparatus input from foreign sources, and aspects of bilateral aid, which makes it important for any production unit proposing to use plastics to get in touch with them.

Mr Hakansson, who has helped production units in South-East Asia to get plastics production of science teaching apparatus started, has written 'Use of Plastics and Other Techniques for Production of Low-cost Science and Mathematics Equipment for Schools'. This was a document at the RECSAM workshop of October 3 - 12, 1973, reference: SEAMEO/DSE/PLCTM/7.

KITS OF SCIENCE APPARATUS

Macalaster Scientific Company, (Route 111 and Everett Turnpike, Nashua, New Hampshire, USA) have produced kits of physics items for student assembly. The materials are unpainted and unfinished where 'finish' is unimportant; for example, the bases of items are often raw chipboard. Nuts and bolts, and so on, are supplied in envelopes and there are assembly plans. There may have been some consumer-reaction against their somewhat crude appearance, but the items generally worked well and covered some very sophisiticated physics. Many of the items were designed for the PSSC course of the USA. They are worth study as a possible model for a production unit which can make and pack the items but has to leave their assembly, with its intricate processes, to teachers or even to pupils.

Some Japanese firms make small kits of parts for assembly into physics apparatus - such as electric motors and bells, balances and pumps. There are similar kits of lenses, rulers, screens, for a range of experiments on the topic of Light, and other experimental assemblies. These kits were easily available in England and the US until a short while ago, but seem to have disappeared from toy shops. (UNICEF headquarters in New York know the Japanese manufacturer). They are well worth study and possibly some kind of imitation. Some are shown, with instruction sheets, in photographs

49 - 55. Much of the material is injection-moulded plastic or stamped tin-plate. They are flimsy and look like toys, but they are astonishingly well-dimensioned for exact fit and were astonishingly cheap. Despite the recent rises in plastic prices, plastic construction is still an attractive consideration for production units, since the quantity of plastic involved is very small (for example the weight of all the plastic parts of the pump shown in photograph 54 is less than 50 grammes) - though it would be much chepaer to buy than to produce them.

Kits of this sort are often not created to serve a particular curriculum. Probably kits can be designed which will be pleasurable as a kind of informative toy, game or hobby, and also serve a teaching purpose in schools. A production unit making small kits might consider this dual role for their product. As well as increasing the education of middle-class children by providing a kind of homework which can be presented as a gift, it can also be a way of widening the market and perhaps subsidizing other aspects of the unit's production.

The importance of having adequate guidance (for teacher or pupils) in the form of 'software' accompanying science apparatus was urged at a RECSAM conference in October 1973. It was pointed out that it is much easier to provide software for kits than for individual items because the writers know the total set of materials with which the teacher will be working. Booklets accompanying kits are also usually fairly small, and this is in itself attractive to teachers who often feel daunted by a bulky book. UNICEF's EVE catalogue (see photograph 43), for example, presents many problems to teachers selecting apparatus for themselves. It is arranged in alphabetical order in English. (In French and in Spanish the order remains the same, which makes the list un-alphabetical.) In any case, an alphabetical arrangement makes selection of items for a particular science topic rather difficult, despite the guidance and notes provided for the items. UNICEF is publishing a teacher's guide 'Using Science Apparatus', which attempts to meet this difficulty by describing a typical use of each of the EVE items, collected under topics - but this makes a very large book.

Software should be in the appropriate local language. In the case of a single large book, translation becomes a long-term job. If, however, it can be produced in sections, these can be written, translated, published and printed in stages, allowing gradual correction and improvement as faults of style and presentation become apparent. This is important because any production unit or curriculum project has to feel its way, and a facility for the incorporation of improvements must be included. Any large, 'one shot' approach militates against this possibility.

As a model for software, the FUNBEC booklets are very good, and the sheets accompanying the other kits reviewed here are useful. The NCERT software (of which there are several versions and types) is more an example of the single-book type, since the kits are large and extensive. One reason for this - which will be of interest to other production units - is that distribution in India is a major problem, so kits produced in a timed series would present additional difficulties.

The American 'Elementary Science Study' series consists of a wide range of pupils' kits, teachers' kits, pupils' books, teachers' guides, work-sheets, problem cards, and film loops, for elementary school use. There are about

60 main unit titles, such as: Bones, Gases and Airs, Growing Seeds. Whistles and Strings, Clay Boats, Match and Measure, Primary Balancing, and Pond Water. A unit is designed to be used for an average of six weeks. Some examples of these kits in use are shown in photographs 44 and 47. The principle might well be imitated by production units.

There are several somewhat similar mini-science kits around the world. In England the Precision Jigs Company Limited, (79 Caterham Avenue, Ilford, Essex) make nine types of kit for electricity experiments (with instructional leaflets). They use simple materials and are easily built up and used by English 12-year-olds. Photographs 56 and 57 show examples. Also in England, the Advisory Centre for Education (ACE) of 32 Trumpington Street, Cambridge, produces kits and packs called 'Things of Science'. Some are as simple as an instruction sheet for a game, with a little pack of nuts or seeds for play (photograph 15). Others may be as complex as a 20-piece geological collection with plastic magnifier and some equipment for testing samples, or a 'research pack' for investigating the pollution of streams (photographs 59 and 60). All of them contain interesting instructional material well-designed for children.

One of the most extensive range of kits is that produced in Brazil, (in Portuguese) designed by FUNBEC (Fundacao Brasiliera paro o Desenvolvimento do Ensino de Ciencias, Caixa Postal 2921, San Paulo, Brazil) and marketed by Abril S.A. Cultural e Industrial (Caixa Postal 2372, Sao Paulo). There are fifty kits, each in a pocket-sized box containing apparatus, usually fairly simple but often capable of being used in quite an advanced way (photograph 58). Each kit is associated with the work of a scientist, for example 'Newton and the Laws of Movement', 'Benjamin Franklin and Static Electricity', 'W. H. Carothers and Nylon'. Each has a booklet of some 20 pages containing constructional information and questions. There are plenty of photographs, small but clear, and several diagrams. There are three volumes of text, provided separately. Not only each kit with its text, but the whole system, evidences a creative imagination allied to careful design. It is all interesting and lively, and deserves widespread popularity.

KITS FOR TECHNICAL STUDIES

Kits of apparatus for secondary level technical studies are produced by Griffin and George Limited, in England. In the form in which this firm markets them they are extensive, and therefore costly relative to the budget of schools in poor countries. However, the concept and the specific ideas are well worth study by any production unit concerned with designing apparatus, and possibly kits, for a country which wants some of its school leavers to have had some practical technological experience. There are kits on Homecraft, Detergents, Human Mechanics, Dyeing, Cosmetics, and similar topics useful to home-makers; and there are science kits such as those on Microscopy, Crystals and Colour in Nature.

Production units supplying not only the conventional type of academic school but also those with technical biases, or even vocational schools, will also find the Griffin technical studies kits very valuable as examplars in various ways. Some of these are: Adhesives Kit, Metallurgy Kit, Plastics Casting Kit, Paper Kit, Fibres Kit, Glassmaking Kit, Photographic Kit, Flow Kit, Surfaces Kit, Corrosion Kit and Computer Games.

(1) Griffin and George Limited, Ealing Road, Alperton, Wembley, Middlesex, England.

MINI-SCIENCE AND OVERHEAD PROJECTORS

There are not many schools in the world with overhead projectors - at least not at primary and lower secondary level. However, production units might find much of interest (because the techniques are suggestive for different applications) in the 'Tested Overhead Projection Series' of small-scale chemistry experiments for overhead projection, using small quantities of chemicals and reagents in small square-section transparent tubes. There is a kit and a guide full of diagrams and experiments. The address is TOPS, Hubert N. Alyea, 337 Harrison Street, Princeton 08540, Massachusetts, USA.

UNICEF SCHOOL SCIENCE SUPPLIES

The United Nations Children's Fund (UNICEF) stocks and supplies a wide range of materials within the fields of education, agriculture, health and child care. The items are available to UN agencies. They are catalogued in some seventeen lists, including vocational training materials and tools, audio-visual equipment, school subject items, and agricultural implements.

A revision of the science teaching sections of one of the Guide Lists (EVE Science Revision: OSU-6000) has been undertaken in conjunction with UNESCO. This provides a wide range of apparatus consisting of:

(1) Primary Science and Mathematics (93 items)
(2) Tools for the Primary Science Workshop (15 items)
(3) Secondary Science: Biology, Chemistry and Physics (327 items)
(4) Tools for the Secondary Science Workshop (32 items)
(5) Chemicals and Reagents for Secondary Science (160 items)
(6) Curriculum Development Equipment for Teacher Training Institutions: Biology, Chemistry and Physics (76 items)

The items are listed as fairly detailed specifications, generally in a form suitable for commercial tendering purposes. Thus they form a good reference list of basic standard items and chemicals, with detailed notes on many aspects of their selection for schools.

A supplement ('Illustrations of Science Teaching Apparatus and Equipment', available from UNICEF as OSU-6000 Supplement 1) provides line diagrams of all items except tools. Examples from the EVE catalogue are shown in photographs 42 and 43.

The items have been carefully selected to cover most science teaching requirements except those that are highly sophisticated and very expensive. Items shown by previous experience to be too breakable in transit have also been omitted.

The main lists: (a) show suggested quantities per school stream at the various levels; (b) indicate an 'economy' selection of the most essential items; (c) show which laboratory (biology, etc.) each item is needed for;

(d) indicate by notes beside entries ancillary apparatus which will be needed, what the item is for and similar helpful information; and (e) give the UNICEF price.

Introductory pages provide guidance to field officers on estimating requirements, new attitudes in science teaching, the use of local resource materials and tools, curricular developments, and so on.

UNICEF's practice of buying for the Copenhagen Warehouse (UNIPAC) in large quantities from actual manufacturers is reflected in appreciably lower prices for a given quality than those of commercial apparatus supply houses. Other advantages are the UNESCO surveillance of the items, single-source supply of wide range, easy control of delivery dates, ready access to spares and replacements, and suitability of the items to the situation in developing countries.

A Teacher's Guide to the EVE items, 'Using Science Apparatus' is being published by UNICEF, covering use of the items, maintenance, repair and the supplementing of them from local resources.

UNICEF SUPPORT FOR WRITING AND PUBLICATION OF BOOKS

Requests may be made for the support of local schemes to write or to translate textbooks, and to publish, print, and obtain supplies of paper in connection with such schemes.

USEFUL ADDRESSES

United Nations Children's Fund (UNICEF)
United Nations Plaza, New York, N.Y.10017, USA.

Regional Centre for Education in Science and Mathematics (RECSAM)
c/o Malayan Teachers' College, Penang, Malaysia. - (established under the South-East Asian Ministers of Education Organization).

Regional Centre for Educational Innovation and Technology (INNOTECH)
P. O. Box 3049, Saigon, Republic of Vietnam. - (established under the South-East Asian Ministers of Education Organization).

Science Education Programme of Africa (SEPA)
c/o P. O. Box M-188, Accra, Ghana.

National Council for Educational Research and Training (NCERT)
Sri Aurobindo Marg, New Delhi-16, India.

Institute for the Promotion of Teaching of Science and Technology (IPTST)
c/o Physics Building, Chulalongkorn University, Bangkok, Thailand.

German Foundation for International Development (DSE)
53, Bonn, Simrockstrassel, West Germany.

UNESCO, 7 place de Fontenoy, 75700 Paris, France.

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UNESCO Regional Office for Science and Technology in South-East Asia, U.N. Building, 2nd Floor, Jalam Thamrin 14, 273/JKT Tromolpos, Jakarta, Indonesia.

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