# LOW-COST SCIENCE EQUIPMENT CENTRES II

## KENYA SCIENCE EQUIPMENT PRODUCTION UNIT

Early in the 1960s almost all the science equipment used in schools in Kenya was imported from overseas. Its high cost precluded all but a few schools from buying the necessary quantity; even then this equipment failed to arrive on time and many items tended to be inappropriate to the conditions operating in Kenya.

With the launching of the School Science Project (SSP) in 1966 the existing shortage of equipment became even more acute as this new project was geared to individual experimentation and therefore required much apparatus.

At this time also the Kenya Science Teachers College (KSTC) - which had been set up with Swedish financial assistance in 1965 and whose programmes were in sympathy with the SSP trial syllabus - became concerned about how to motivate and assist their students to teach in the spirit of the SSP project in the face of existing shortages of equipment. It was at this point that the then senior technical physicist decided to develop a physics kit. Thus by 1969 a Production Unit had been set up within the Department of Industrial Arts of KSTC to design and produce this kit of equipment to meet the demands of the Kenya Junior Secondary Examination. Production proceeded on a small scale during the period 1969-1970.

### Science Equipment Production Unit (SEPU)

To make the production efforts more successful, it was found necessary to set up within the College a Production Unit which would aim to be independent and economically self-supporting. The workshop, occupying an area of 265$m^2$, was completed in 1970. It has since been expanded and now occupies an area of 960$m^2$.

The principal machine tools supplied for KSTC Production Unit are as follows:

Metal work: 3 lathes, 1 milling machine, 1 pillar drill, 1 band saw, 1 hack saw, 2 grinders, 1 oxyacetylene welding set, 1 arc welding set, 1 sheet metal roller, 1 manual guillotine, 1 bending machine.

Wood work: 1 circular saw, 1 band saw, 1 planer (3m), 1 thicknesser, 1 large belt sander, 1 spindle moulder, 1 bench mounted drill.

General: compressor (a recent addition).

### SEPU Subscribers

Towards the end of 1971 a KSTC policy decision led to the expansion of staff and the appointment of a full-time head of the Production Unit. Currently, SEPU is run as a company under a seven-man trusteeship. The trustees are the Director of Education, Ministry of Education; the Permanent Secretary,

Ministry of Finance and Planning; the Kenya Science Teachers College; the Kenya Institute of Education; the National Council for Science and Technology; the Jomo Kenyatta Foundation; and the Kenya Technical Teachers College.

According to a Kenya/Sweden agreement signed in June 1976, the Swedish government will continue to provide financial and personnel support to the company until 30 June 1979 when it is hoped SEPU will be completely self-supporting.

Production Strategy

In developing the various items in the physics kit, the following approach was adopted to ensure economic viability and efficiency of the project. As far as possible (this has subsequently been adopted for the production of the chemistry and biology kits).

(a) In consultation with the physics panel of the KIE, a list of the most acute apparatus needs of schools was produced by the head of the unit and the designer.

(b) The needs were then matched to the availability of raw materials, the amount of design work needed and the difficulty of production. At this stage an order of production priorities was agreed.

(c) For each item the Designer produced one or more prototypes and calculated an order of magnitude cost. The costing procedure adopted was as follows: cost of materials + 10%; cost of labour + 20%; running cost of machines + 40%.

The additions to the raw costs were to account for:

(a) The cost of materials lying on shelf awaiting use, or of finished items awaiting sale.

(b) The higher salaries paid to supervising and development staff.

(c) Sales costs.

(d) Wear and tear of machines.

(e) The technical working of the prototype was vetted by the Head of the Production Unit.

(f) The relevance of the item to current syllabuses and likely sales were vetted by the Head of the Production Unit, and the size of batch determined.

(g) The Designer prepared the jigs needed for production with the help of the Head of the Unit, and arranged the sequence in which operations should occur.

(h) Once production started, continuity and quality remained in the hands of the Head of the Unit. At various stages in the production of a batch, items were subjected to tests devised by the Head of the Production Unit and the Designer. Any items failing these tests were either reworked or thrown away. In the early stages of 1972, the

initial failure rate was sometimes as high as 80% although the final wastage in a batch, after reworking was usually of the order of 7%.

## Prices: Local versus Imported Items

The table below shows the prices of some of the SEPU items with those of imported equivalents as of August, 1973:

| Item | Local Price (K Sh) | Imported Price (K Sh) | Type of Design |
|---|---|---|---|
| A.C. timer | 45 | 160 | Local |
| Dynamics trolley | 90 (per pair) | 165 (per pair) | Local |
| Wheatstone bridge | 80 | 202 | Conventional |
| 3-d Kinetic model | 85 | 430 | Local |
| Ray optics kit (including cylindrical lenses) | 53 | 110 | Local |
| Optics lamps | 30 | 84 | Local |

## SEPU Science Kits

Kits have been developed to allow students to have experience in as much individual practical work as possible in physics, chemistry and biology.

The hardware materials in each kit are accompanied by written materials for teachers and students. More recently these software materials have been strengthened by slides and tapes supported by leaflets. Still more recent are the radio programmes that have been prepared as support for the biology kit.

Majority of the items in the kits have been developed locally. Since the three separate kits have certain items in common, schools are able to to cut down costs by buying a box containing say, a physics/chemistry kit.

As an illustration of the usefulness of the kits in teaching, the chemistry one is described here as an example:

The basis of the kit (50% of which is glassware) is the pegboard stand. This is a board drilled with small holes at regular intervals and supported vertically by two feet. Each piece of apparatus is mounted on the stand by means of a special stainless steel clip. The clip has a base which can be fastened to the stand with a screw and nut, and its diameter can be adjusted to hold all the pieces of glassware from the thermometer up to the beaker.

The pegboard is useful and convenient in several respects. Compared to the more conventional retort stand it is stable and light. Moreover it possesses many features which allow flexibility. For instance, it is possible to mount apparatus anywhere on the stand and at the same time see where one piece of apparatus is in relation to one another. More important for work in chemistry, the apparatus can be mounted away from the stand when heating is required.

Again one could cite a few other useful characteristics of the kit. For instance there is no bent glass tubing provided. When collecting a gas over

Through mobile units located in ten centres, able science teachers travel around a province (particularly in deprived areas) helping science teachers with their teaching problems and introduce them to new methods and techniques in science education.

In general, a mobile unit consists of a van, science equipment and audio-visual aids. They also carry with them tools and small machines for repair and other equipment to carry out demonstrations in rural schools where at present it is impossible.

(b) It runs day and/or evening courses for apprentices as well as evening courses for people who intend to learn a trade.

The latter are adults or out-of-school youth. The courses concern machine tool operation, metal turning, die making, electricity, electronics, glassblowing, technical drawing and woodworking. Over 2,300 workers have, during the past ten years, received satisfactory training in this regard.

## Structure

Though the Centre started with only 25 workers and four teachers in what was originally a day Technical School, the DAYM now boasts of a new building in addition to the old one, 580 workers and 18 workshops (soon to be increased to 30) manned by 34 teachers. The administrative staff are all ex-classroom teachers and still belong to the Teaching Service. Of the 34 teachers, four are qualified Engineers and four are Higher Education Technicians. The administrative set up includes: a Director, a Deputy Director, Head of Research Development Unit, Laboratory Chief, five Assistant Directors responsible for Personnel, Education, Public Relations, Commercial matters, and Production, respectively, and 18 workshop chiefs.

## Financing of DAYM and Method of Distributing Equipment to Schools

DAYM is regarded as a Department and it is therefore financed as such by the Central Ministry of Education.

Each year, the Department of Educational Aids within the Ministry of Education receives lists of schools' requirements from the Secondary and Elementary Education Departments. These requests are processed and passed on to the DAYM which then produces and sends the equipment to schools through private transport companies. The schools report receipt of equipment to the Centre and to the particular Department under which it functions.

If in addition to this free supply of equipment certain schools need additional apparatus, they make direct contact with DAYM or local companies and pay out of their own school science vote. Records reveal that school requests are dealt with promptly and with very minimum delay.

## School Science Equipment

Science equipment for primary, secondary and teacher levels in all types of materials - wood, plastics, steel and glass - are produced.

Also, apart from certain sophisticated equipment like miscroscopes and thermometers which are imported from Germany, the United States, Israel and Japan, most of the bulk of school science equipment is produced by DAYM. For instance, over 80% of the equipment required for teaching the adapted

Turkish PSSC-Physics (94 pieces of equipment which can be used to carry out 200 demonstration experiments) is produced by DAYM.

The table below indicates the number of sets of equipment and aid produced by DAYM and supplied to schools during the period 1970 to 1973.

Instructional Tools Given to Schools in the Years 1970-1973

| Type of Instructional Tool | Number of Sets Given | | | | |
|---|---|---|---|---|---|
| | 1970 | 1971 | 1972 | 1973 | Total |
| Lycee Modern Physics | 88 | 94 | 105 | 100 | 387 |
| Lycee Modern Chemistry | 88 | 94 | 105 | 100 | 387 |
| Lycee Modern Biology | 70 | 76 | 90 | 100 | 336 |
| Lycee Mathematics | 125 | 126 | 150 | 100 | 501 |
| Lycee Social Studies | 115 | 445 | 200 | 100 | 860 |
| General Science (Lycee + middle school) | 60 | 670 | 220 | 500 | 1,450 |
| Middle School Physics | 100 | 40 | 340 | - | 480 |
| Middle School Chemistry | 120 | 40 | 340 | - | 500 |
| Middle School Natural Science | 100 | 40 | 340 | - | 480 |
| Middle School Social Studies | 100 | 210 | 350 | 500 | 1,160 |
| Middle School Mathematics | 125 | 152 | 300 | 500 | 1,077 |
| Middle School Handicrafts | - | 50 | - | 200 | 250 |
| Primary School General Science and Natural Science | 3,000 | 3,600 | 4,000 | 4,000 | 14,600 |
| Primary School Social Studies | - | 3,500 | 4,000 | 4,000 | 11,500 |
| Primary School Handicrafts | 350 | - | 400 | 400 | 1,150 |
| Pre-School Education Instructional Tools | 100 | 100 | 100 | 100 | 400 |
| Middle School-Lycee, Lycee Level College Language Laboratory | - | 9 | 10 | 10 | 29 |
| Vocational - Technical Schools General Science | - | 75 | 50 | - | 125 |
| Grand Total | 4,541 | 9,321 | 11,100 | 10,710 | 35,672 |

In the production of the above, the main raw materials imported are: optical glasses; chemicals for metal plating; resistance wires (chrome oxide); magnets (horse-shoe and bar types); Fe-Ni Aku Components (pure potassium hydroxide); semi-manufactured musical instruments components.

Maintenance of the Equipment in the Schools

Teachers are taught how to store and repair the equipment during in-service courses. Thus most of the small repairs are dealt with locally and major

repairs are carried out at the Centre. Machines at DAYM include the following:

| | Quantity |
|---|---|
| Automatic coil winding machine | 4 |
| Diffusion pump (for glass blowing) | 1 |
| Machines for optical workshops | 1 set |
| Checking and control devices for optics shop | 1 set |
| Work dies for optics shop | 1 set |
| Spring winding machine | 2 |
| Plastic injection press (for 2 kg. capacity) | 1 |
| Plastic injection press (for 1 kg. capacity) | 1 |
| Plastic injection press (for 1/2 kg. capacity) | 1 |
| Plastic blowing press (for bottle making - 2 litres capacity) | 1 |
| Lathe | 3 |
| Polyester spraying machine | 1 |
| Checking and control instruments for electric and electronic workshops | 1 set |
| Special machines for the production of musical instruments | 1 set |