RETROSPECT AND PROSPECT

Innovation in science education in the Caribbean is largely a phenomenon of the 1970s. Before that, the only Ministry of Education with a science education officer was Jamaica's, and the only UWI campus with any science teacher-educators was also Jamaica's until St Augustine in 1968 began the development of WISCIP. Accordingly, the only attempts to co-ordinate and improve the work of science teachers outside Jamaica came from the associations of science teachers themselves, BASE in Barbados and STAG in Guyana. In Jamaica in the 1960s, the honourable work of the ASTJ and of the Science Education Officer of the Ministry of Education was supplemented by a series of UWI staff who gave their spare time to the improvement of science education. Of these, George Bishop and Keith Warren have since become well known in other Third World countries for their ingenuity in the improvisation of science teaching equipment. But none of them were appointed to tackle the problems of science education at source, even in Jamaica itself, and they could do no more than help some science teachers with some of their day-to-day difficulties.

When Caribbean governments and universities recognised the need for projects in science education, and sought the assistance of international aid agencies, the innovations of the 1970s were introduced. At the beginning of the decade, the first priority in the immense task was to 'West Indianise' science teaching and to bring together teachers all round the Caribbean confident in the contributions they could make to solving the problems. Accordingly, the emphases were on curriculum development, associations for science education, and a variety of strategies for achieving teacher education and reorientation. These emphases account for the volume of curricula developed nationally and regionally, the growth of the science teachers' association concept, the books, monographs, reports and so on that have been written by science-educators. The consequence has been that the workload of the teacher-educators is now shared with hundreds of classroom and university teachers in the region, all speaking a common language in science education. The list of sources of information at the end of this paper represents only a fraction of those involved; ten years ago, it would have been difficult to list half a dozen. The number of science teachers in the region with postgraduate qualifications in education must now be approaching a thousand, where there were only a handful at the beginning of the decade.

The region, then, has become richer in human resources and in curricula and printed materials. In the matter of other material resources, very little progress has been made. Warren in the 1960s was the last to give much time to designing apparatus, and more recent science-educators have not found the time to utilise the audio-visual expertise and equipment that exist.

The Caribbean survey has shown that few science teachers are resourceful in attempting to meet their own needs. Richmond's deliberately provocative argument (1979) that laboratories are desirable luxuries and that school workshops might be a better investment is likely to meet an especially negative reception from Caribbean teachers. But D C Williams (1979) has pointed out that, in many countries, the teacher who does not organise the making of his own equipment will have none to use; this already seems to be the case in some Caribbean schools.

The laboratory experiences which are provided too often make little contribution to the learning of science, especially in physics. White (1979) has made reference to research which shows that the common type of physics laboratory exercise achieves no more than the improvement of manipulative skills. He and other participants at the 1978 Oxford Conference on the Role of the Laboratory in Physics Education have suggested how educational theory needs to be brought to bear on the design and selection of practical work in the learning of science. The Caribbean has no grounds for complacency in this respect.

Not the responsibility of educators, but one which is of very serious concern to them, is the very immediate danger of losing treasures which exist, namely the collection in the National Herbarium of Trinidad and the entomological and plant collections of the Institute of Jamaica. The Trinidad collection is decaying for want of adequate support, and there was recently a risk that the Jamaica collections would be dumped to make room for a collection of the art and culture of Jamaica. Science-educators do recognise their responsibility to make a contribution to the preservation of living natural resources and to prepare tomorrow's decision-makers. Scientists and science-educators are coming closer together in attempting to preserve the heritage of the countries of the Caribbean.

The decade since 1970, then, has moved science teaching from the closed world of the teacher's own classroom to a shared enterprise in which primary, secondary and tertiary teachers, as a cohesive regional group, work towards the improvement of science education, and in which scientists and educators work together in preserving threatened resources

Where should we go in the 1980s? The aims of science educators in the Caribbean might be summed up as follows :

1. Improving the teaching and learning of science in a local context, including the development of attitudes, values and decision-making abilities in children.

2. Enhancing the cohesiveness of Caribbean science educators and scientists.

3. Identifying and developing Caribbean talent so far untapped.

4. Coming to terms with governments' needs to save money and foreign exchange and to train technicians and technologists.

5. Providing classroom teachers with the right kind of help so that they are confident that it is within their power, as individuals, to do a worthwhile job.

To these ends, the following are suggested as priority areas for attention.

Teacher-Educators

Science teacher-educators in universities, ministries of education and the UWI Science Education Centre should continue with much the same kind of work they are already doing, with perhaps less intensive work in the development of integrated science curricula. They should be freed as much as possible from more general duties which could be carried out just as well by teacher-educators in other disciplines. Examples of these general duties are teaching foundation courses in universities and general administrative duties in ministries. Teachers' college tutors should reduce their dependence on conventional laboratory equipment, and all teacher-educators should find ways of stimulating their students to improvise and improve on apparatus.

There is a need for very much increased attention to physics and primary science teaching, and to this end it may be necessary to send promising teachers abroad for further experience and training.

Curricula

Teachers' college curricula should move a long way from the current pattern, which is not unlike GCE, towards courses which prepare teachers to give effective science teaching in primary schools. (In Trinidad and Tobago a new examination emphasising process angered students and tutors at the first encounter but achieved a dramatic change in teaching during the following year). For secondary schools, physics, chemistry and biology courses, in that order of priority, need to be brought more into line with matters of scientific interest in the 1980s. (For example, alternative energy sources, which was the theme of the 1979 NSTA/CROASE conference in Barbados.) The current process of developing CISC for CXC, by classroom teachers in their spare time, is too slow and the curriculum does not hang together well. The CXC integrated science syllabus, while well intentioned, is not clear for teachers. These needs, long recognised, have been tackled by ad hoc one-day or one-week meetings with too many leaders and very little finance. All of them could be met by an ambitious residential workshop, lasting up to two months, with one experienced co-ordinator and an assistant co-ordinator for each of the separate areas. Adequate incentives for participants should be provided and commercial publishers should be invited to co-operate. This would be an expensive exercise but, at a stroke, could go a long way towards providing appropriate curricula for the Caribbean. The initiative for this might come from the USAID Project, which might find it necessary to seek aid from CARICOM, OAS, CIDA and/or UNESCO. Caribbean educators and regional organisations are ready for such an exercise.

The new Independent Learning A Level curricula developed in Britain deserve serious consideration, not only for their intrinsic excellence but also because they could allow the more qualified and experienced teachers to devote more time to younger children. The Trinidad and Tobago trials of APPIL should show whether Caribbean teachers and pupils can come to terms with such an approach. These curricula should also help teachers to take a fresh view of their own sciences and to develop their own concepts more soundly.

The need for regular re-training of teachers should be recognised. This may be achieved by residential courses or by distance learning of the Open University type. The UWI Communications Project may be able to provide suitable strategies.

Apparatus Manufacture

Without attempting to replace entirely the import of apparatus from overseas suppliers who can absorb research and development costs, there are good educational and economic reasons for Caribbean design and fabrication of a limited number of items of science teaching equipment, beginning with plastics, materials for primary science, and power packs. The Caribbean Development Bank might commission studies towards such a regional enterprise. A number of firms which at present confine their activities to acting as agents for overseas suppliers may become involved in the distribution of the products. Such an enterprise would do well to draw on experience elsewhere, for example from RECSAM of Southeast Asia, NCERT of India and SEPU of Kenya. Particular attention should be paid to the importance of feasibility studies, criteria of excellence, and educators with a strong background in science and teacher training, issues mentioned by Khoo (1979).

Audiovisual Software

Problems in the development of such materials are relatively non-existent. All that is needed is for science teachers associations, ministries of education, and teacher-educators to turn their attention to the issue on a national basis. Regional accessibility should follow without too much difficulty. Since those who are described as educational technologists have not so far done much to seek help from the science-educators, it looks as if the latter should initiate discussions with the former.

Printed Resources

Those who produce printed resources should seek to emulate the quality of reproduction which is standard in Guyana. The same people should be alert to the fact that teachers who are given a great deal of printed material are likely to read it little and use it less. Government publication units should do more than they do at present to publish materials unattractive to commercial publishers, who do not show interest if less than 10,000 copies are required. Equally, ministries of education should facilitate the publication and local distribution of Science in the Press booklets, and CROASE should explore ways to cover the cost of preparing electronic stencils for distribution to its member associations.

Science Centres

If the Jamaica Science Education Centre is to serve a regional co-ordination function, it must have some regional finance. While the Centre is no doubt exploring such support, its case for a regional service would be much enhanced if a variety of organisations in the region would give public recognition to the actual or potential contribution available from the Centre. Especially, UWI Cave Hill, CROASE, CXC and national groups could stimuate and actively share in this resource. Finance for regional activities could be available from CDB, CARICOM, OAS, UWI/USAID, to name only some organisations with money set aside for educational development in the Caribbean as

a region.

Meanwhile, each country needs its own science education centre, primarily to act as an information centre and as a depot of laboratory equipment and other materials, which, for financial reasons, cannot be provided for each school. To provide an effective service, the centre needs a full-time custodian whom teachers can be sure to find on duty after school hours. Such a custodian will reduce by one, at least, the number of excellent teachers of science in schools. Ministries of education could nevertheless consider the centre and its custodian an excellent investment.

Servicing of Equipment

For some reason which has not emerged from the survey, provision of maintenance and repair services has received almost no attention from either educators or commerce. Such services would appear to be one of the best investments that could be made by any government, especially one which needs to spread its foreign exchange as far as possible. The literature on science education worldwide appears to have paid equally scant attention to a problem which science teachers consider one of their most pressing. If a ministry of education cannot find the expertise and finance to set up a fully staffed maintenance and repair unit, it should at least provide a clearing-house which will distribute defective apparatus to repair centres, and pay for restoring them to serviceable condition.

Science Teachers' Associations

Unless a national science teachers' association can keep itself alive and active, it does not deserve to exist. However, science teachers' associations take over much of the work that usually is considered as the province of the ministry of education and university. This of course is all to the good of education, but the associations are supposed to carry out this work from the subscriptions of its members, which is unfair and impossible, given the size of these subscriptions. It is not that governments do not recognise the associations - on the contrary, they value them highly - but that government administrative procedures are not always fast and flexible enough, so that a science teachers' association project is often a thing of the past before the government gives an assurance that the costs will be covered. Education ministry science education officers should work out a strategy for more speedy processing of approaches from professional associations.

CROASE, as a regional association, has no funds at all beyond token subscriptions from its members. Its executive, and its member associations, should become more active in soliciting support from organisations with a regional interest and in producing marketable materials. The experience of the Hong Kong Association for Science and Mathematics Education (Tao, 1979), may provide a lead.

Documentation and Preservation of Existing Knowledge

The ASTJ ecological studies over the past 20 years should be published. The Faculty of Natural Sciences of UWI Mona might appoint a Research Fellow and provide funds specifically to undertake this task; if it is ever completed, he should go on to co-ordinate further ecological studies by the ASTJ and other national associations. Science educators should make better use of the Institute of Jamaica science museum and

the Trinidad National Herbarium, and should add their own voices to those of the scientists who seek more adequate support for these.

Research into Science Education

University science educators have so far found very little time for research into science education in the region. The time may now have come for them to hand over some of their teaching and development activities to the next generation, and to turn their attention to research, perhaps using some of the members of this new generation as research assistants. The School of Education of UWI should set up a small committee of its science teacher-educators and those from UG, in order to identify issues which deserve investigation. Reading levels and Piagetian stages of primary teachers, and the impact of educational broadcasting have so far been suggested.

Science Education for the Less Able

CXC should treat as a matter of urgency the development of a syllabus and examination in integrated science for the children in such schools as Jamaica's new secondaries, Trinidad and Tobago's senior comprehensives and Guyana's multilaterals; that is to say, CXC should take immediate action on offering a science examination at the basic level. The examination could be brought that much nearer if the CXC group would begin from the Jamaica Core Curriculum.

Laboratory Design

School architects should consult science educators when designing laboratories. And older schools should give consideration to cutting down existing benches into flexible tables.