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A SHORT NOTE ON THE PROBLEM OF SCIENTIFIC EQUIPMENT

by

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In the past, the impression was created that the nature of laboratory equipment inspired men to do research. The idolizing of equipment is understandable, especially in developing countries where resources are limited. These notions are now being destroyed, and the hand-made instrument that enabled Loewenhoek to discover the microbes is now being mass produced. Such instruments are not unduly expensive and can be acquired easily by individuals and institutions. The position is however different in the case of more sophisticated equipment such as the large atomic cracking machine, and the automatic scintillation counters, gas chromatographers with recorders, etc. These are very expensive.

We are not, at the present moment, concerned with research equipment, but this has a bearing on the equipment for science education. The accumulation of knowledge has broken the concept that primary and secondary school education was formative and higher education informative. Rapid scientific progress makes obsolete any knowledge a few years after graduation, and the university thus becomes more and more a school for the preparation of the student for self-instruction and critical evaluation. To this situation is being added post-graduate education - lacking in formality in most developing countries.

Unable to teach all the existing sciences, there is now a strong movement to instruct the student to understand and be able to face new situations. A good example is the teaching of physics. Gannot, a celebrated teacher, compiled for the first time during the last century, a book on physics. It contained all the physics worth knowing, and included all the apparatus of any value. This type of physics was taught for a century in the larger part of the now developed world. Until recently the major advances in science and its implications, such as atomic energy, were subjects for discussion in newspapers, but never in schools. Basic information such as the quantum theory and the theory of relativity, over two generations old, were subjects for the privileged few. Since physics education was simply a report of traditionally established fact, laboratory work was not needed. Maybe the high school or university teacher would wish to show, a century later, that he too could demonstrate special experiments, and when he requested students to do likewise, the aim was the same. The student was requested to demonstrate that it was possible to perform the same experiment with the available equipment, and if he did not succeed the experiment was considered wrong, the text book content being regarded as infallible.

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I have used physics, in our case a neutral subject, to illustrate a few basic attitudes towards laboratory equipment. With these attitudes the equipment was accordingly designed. It was fanciful, expensive and bulky, being built with a number of preconceived ideas, never to give a wrong or unexpected result. The student was never expected to be anything more than a mechanic, a device to initiate the experiment, and never really learnt any sound science. It is indeed common to find that a student believes that polarization of light only happens in the polarimeter, and not in nature!

The present concept of science education at any level is that the student should act and think for himself whilst the teacher remains a sort of guide and counsellor and an emergency information centre. The student is not expected to prove that he can repeat anything or demonstrate anything in the laboratory. Whenever possible he is presented with a problem to solve. He has to learn to act scientifically, face new situations, devise experiments and make conclusions. This can only be done by operating as a scientist.

Normally, one does not require too sophisticated apparatus to design experiments to solve particular problems in the field of general science, including medical science. This statement does not, however, apply to molecular biology where elaborate equipment is often required.

The acquisition of expensive equipment will not automatically ensure sound research and good teaching, the latter often being achieved with good experiments using simple apparatus. A good example is the high school biology, called BSSC, initiated by the famous biologist Bentley Glass. In the teachers' guide a number of very useful instruments are described that can be made using very simple component parts available anywhere. The laboratory books prepared by this group provide a good source of experiments for university classes and again require very little apparatus.

Laboratory equipment can be made locally for the use of medical schools. The design for physiology and pharmacology apparatus has remained unchanged for about a century, and a skilled instrument maker can make them without much difficulty. Simplified instruments are continuously being described in journals such as the Scientific American, Analytical Chemistry, Journal of Chemical Education, Journal of Applied Physiology, etc.

Where these instruments are manufactured locally, many difficulties related to importation are overcome. Some scientists, of course, prefer to make their own instruments and thereby facilitate their research activities. My personal experience is that one can help promote scientific research by making teaching equipment readily available particularly in the fields of physiology and experimental psychology. In Brazil such low cost equipment is employed.

In due course more advanced technology can be undertaken, and instruments such as electrocardiographs, spectrophotometers, photocolorimeters, now being produced in our Institute, will become more readily available. These activities are helping to produce skilled technicians.

This task of making teaching equipment readily available is closely linked with our aims in education. We often start by planning a number of basic experiments followed by designing the requisite equipment. The revision of courses require much effort and such activities cannot be left in the hands of a few teachers with no real scientific interest. Science education, in its present stage of development, and on account of its implications regarding the future of nations and mankind, deserves very high priority. Recent advances and discoveries cannot be added to the curricula as an appendix. There is need at present for a comprehensive review of the entire curricula content and the role of the university in regard to the education of the future scientist.