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## SCIENCE IN GENERAL EDUCATION*

TO appreciate the place which scientific studies occupy in education, it would be well to consider two separate kinds of education: on the one hand, general education, and on the other, specialized or professional training. In the latter, science crops up in a number of ways according to the more or less technical character of the career chosen, whereas in general education its place is always the same.

In reality, then, there are two problems and the role of education is not identical at each stage. It is in the course of so-called higher or professional education that great differences appear in the study of the sciences. The need to acquire the vast assortment of technical and theoretical knowledge required for all the professions nowadays unhappily obliges most young people—and I do not know if this is inevitable or not—to bypass all other subjects except those essential for their particular training.

It is upon primary and above all upon secondary education that the onus falls of providing all young people with a grounding in science, not only in order to give them access to a technical or scientific career, but also to supply those destined for non-scientific activities with the minimum information necessary for life in modern society. It will save them from being non-plussed by the first problem with which their work itself will present them in a domain inevitably linked more or less closely with science. For future specialists, therefore, a judicious preparation at the secondary stage is extremely useful; but for those who do not intend to study science after matriculation, some scientific education before they reach that parting of the ways would seem to be really indispensable. It is thus especially for the benefit of the second group that we should endeavour to give all school children, before matriculation and while there is still time, a general outline of science, so as to awaken their interest in scientific achievements and thoroughly to acquaint their minds with scientific method. At this common stage of general education, it is much more important to develop the ability to learn than to accumulate items of knowledge.

If we are to succeed in this task, we must firmly reject every proposal for dividing science

* Abstract of the Address by Dr. Jaime Torres Bodet, Director-General of UNESCO, at the Conference on Public Education held in Geneva from 7th to 18th July.

subjects between secondary and higher education. There is no reason to tire and discourage students by obliging them to follow all the historical and technical by-paths that the pioneers had perforce to tread. Science as taught must be *living* science. Great highways have been marked out, and we must make use of these without hesitation.

The ideal would be to ensure that young people leave school or secondary school, or college, feeling that they have made a real contact, however brief, with the whole world of science; that they have enjoyed this contact, and that they are ready to renew it, without apprehension, whenever their profession or simply the course of events makes it necessary. By ceasing to be a mystery, science will not lose any of its prestige. It will gain in human value and without it, there will no longer be a general culture.

This project to make science a part of general culture in no way offends humanism in the strict sense. The traditional cultural values, if they are to hold their own against the imperialistic tendencies of technology, must be receptive to scientific knowledge, from which technology springs. They will not save themselves, nor preserve their influence, by isolation from research and discoveries which characterize modern thought. I have enough faith in the cultural values to know that they have nothing to fear from a broad contact with the sciences. For science has not only affected the material side of civilization but has also been a creative force in its own right.

## RADIATION AND MACROMOLECULES

AN International Symposium on the above subject was held in Strasbourg, France, from June 9 to June 12, 1952. The following points discussed during the session deserve special mention:

(*a*) The light-scattering method is based on absolute measurements of the scattered intensity by certain standard materials; they can be solutions of ordinary organic molecules of known constitution, selected polymeric materials of known molecular weight and molecular weight distribution or colloidal particles of great homogeneity and exactly known size. A thorough discussion of the relative merits of the different calibration procedures seems to indicate that well-defined organic molecules such as hexachlorabenzene in benzene or toluene offer a very good opportunity for reliable calibration.

(b) A thorough discussion of the best methods to purify polymer solutions and prepare them for precise light-scattering experiments led to the conclusion that each individual system polymer-solvent requires special study and discussion. In general it appears that a combination of filtration and centrifugation gives the best results. Special precautions were recommended to avoid contamination of the solutions during the filling of the cell.

(c) An animated discussion developed on the light-scattering from poly-electrolyte solutions and on the configuration of such molecules at different concentrations and at different pH values. The Alfrey-Morawetz solution of the Poisson-Boltzmann equation for rod-shaped particles in cylinder co-ordinates was presented and its consequences for the distribution of the mobile counter ions were discussed.

(*d*) New results on the optical analysis of soap solutions and of colloidal emulsions were presented; the size and shape of the soap micelles were determined for various soap concentrations, temperatures, pH values and various amounts of added neutral salts.

(*e*) Two new precision light-scattering instruments were described and numerical data obtained with them were presented; a new and very sensitive differential refractometer was described and its application was demonstrated.

(*f*) Polymethyl- and polyethyl-silicones ranging from very low (300) to very high (1,000,000) molecular weights were indicated by a combination of the osmotic, light-scattering and viscosity methods. The results together with the mechanical properties of these specimens indicate that polysilicones of this type consist not only of linear chain molecules but also contain interlaced rings of considerable size which cannot be separated from the linear components and are responsible for the unsatisfactory mechanical properties.

(*g*) The theory of small angle X-ray scattering was thoroughly discussed for the two extreme cases: (*a*) very dilute solutions of rod-like particles with cylindrical cross-section; and (*b*) closely packed systems of spheres and rigid rods.

(*h*) The intermicellar and intramicellar swelling of various types of cellulose with water was studied with X-rays and a significant difference in the behaviour of cellulose from cotton and various wood pulps was discovered.

The contributions will be published in one or two special issues of the *Journal of Polymer Science* late in 1952 or early in 1953.