accommodation for students attending the Association's courses of professional training for community centre workers and youth leaders.

In the field of youth services, a principal event of the year has been the revival of a project for a residential clinic for difficult children, towards which the trustees have offered at least £5,000. This experiment, with the five-year investigation being financed at the Philanthropic Society's School at Redhill, is regarded by the Trustees as a piece of pioneer work in juvenile delinquency which may suggest new methods of dealing with young delinquents.

EDUCATING MEN OF SCIENCE

FOUR American men of science, representing the different departments of physics, social relations, mathematics and biostatistics, have been considering the problems and difficulties arising from over-specialization in science ("The Education of a Scientific Generalist", by Henrik Bode, Frederick Mosteller, John Tukey and Charles Winsor; *Science*, 109, June 3, 1949). These difficulties, they state, are most pressing in the borderline fields like physical chemistry, biophysics, biochemistry and the application of chemistry, physics and mathematics to medicine, and have led to a position where there is too much narrow specialization in which "one man can no longer cover a broad enough field". Yet, at all levels, decisions have to be made which involve consideration of more than a single field of science and indicate the need for a simpler, more unified approach to scientific problems. "We need men who can practise science—not a particular science—in a word, we need scientific generalists."

Before elaborating details of the training which they would suggest for scientific generalists, the authors indicate that the unification of science may reasonably start from the following ideas:

1. All science began as part of 'natural philosophy' and radiated outward. Even to-day it should be possible to recapture the universalist spirit of the early natural philosophers.
2. Scientific method is common to all sciences.
3. Almost every science is more easily taught by using some of the equipment of the others. (This is generally admitted to be true for mathematics in physics, less generally for chemistry and physics in biology, to name two examples.)
4. Statistics, as the doctrine of planning experiments and observations and of interpreting results, has a common relation to all sciences.
5. Unification will be more easily attained if the logical framework of the individual sciences can be identified and isolated from their factual content.

From this preliminary attempt to unify science, the authors discuss the kind of background which should be given to undergraduates to help them develop into scientific generalists. The scientific generalist is considered to be a man with training and a working sense in many fields of physical and biological science. His principal interests may be broad or sharply defined; but he is exceptional in his breadth of appreciation. He may be working in pure science, or in the application of science to engineering, business or industry. He may not be as good a physicist as a student who has been trained principally in physics, or as good an economist or engineer or psychologist as a specialist in those fields. But he has learned enough of these fields, and of the central tools of mathematics and statistics, to bring to problems of almost any kind the ideas and broad tools of any combination of these many subjects which will speed and improve the work.

Such men are needed as members of research teams, while any first-class administrator or policy-maker in fields related to science must be a generalist to a considerable degree. The value of such men was seen during the Second World War, when men of science who were able to carry over and apply their methods of thought to fields other than their own were able to assist largely in the solution of military problems Examples of the way in which such men have successfully tackled problems in the social sciences, economics, engineering, biological and medical science are also given.

During his four undergraduate years such a man should be given a broad foundation to open his mind to a wide range of scientific fields. On graduation he should go on with further studies which, at present, would presumably be in some special field but, eventually, might consist of postgraduate training as a generalist.

The education of a scientific generalist using present-day courses or those developed in the future must be based on at least three main principles. First, the pregeneralist must study many fields of science deeply enough to understand their logical framework and the approaches of their practitioners. Secondly, with the possible exception of a few tool subjects, the interest of the pregeneralist in factual information is of secondary importance. Thirdly, omitting all prerequisites is to be encouraged.

The training course itself would be split up into short courses, of which there would be four in biology, chemistry and statistics, six in mathematics and physics, two in psychology and English, and one each in industrial processes, 'judging' and surveying. There would also be eight courses in related subjects like history, philosophy, economics, the humanities and social sciences. 'Judging' would consist of a specially devised course to include the use of scientific method and aimed to help the student to bring his intelligence and education to bear on estimation and prediction, problems for which he has inadequate information.

The kinds of courses indicated under each main subject are suggested and, in biology for example, would include cellular biology or general physiology (from the point of view of transfer of energy, intermediary metabolism, physiology), comparative anatomy (from the developmental and truly comparative point of view), the problems of genetics (persistence and change of hereditary patterns), and evolution and evolutionary record. In physics the courses would include elementary physics, electricity, physical measurements and one or two advanced optional subjects. Psychology would include one course in experimental psychology, including laboratory work, and one in systematic psychology consisting of a study of psychological problems and theories with some emphasis on methodology and classic experiments.

The surveying course would be carried out in the summer term and, in addition, the students would then be required to reach proficiency in two languages useful for scientific purposes, preferably by study in the countries concerned. During the four years students would also be required to carry out two pieces of independent work, one dealing with economic problems and the other involving two or three different fields of science.