step to the clarification of the moral and ethical questions of to-day.

For such reasons, Dr. Fosdick considers that studies in the social sciences present an intellectual challenge of central importance; and his appeal for adequate support, for the development of the highly specialized and complex methods necessary by highly skilled men and women working under the most favourable conditions, no less than his searching analysis of the handicaps under which the social scientist at present works, merits the close attention of the scientific worker even at the present time of crisis and strain. Unless we surrender the idea or resolve of victory, we must face now the issues involved in the ordering of a new society in which creative intelligence and human personality find full expression. We must free our social scientists to think with all possible penetration wherever their thinking may lead, and assist the minority of pioneers whose work in the social studies is reaching up to new levels of scientific achievement.

Intense as may be our immediate concern with our war effort, we must still spare thought for the future if that effort is to reap its full reward. We may still attempt the removal of those handicaps on social investigations to which Dr. Fosdick refers —the establishment of a sound balance between the extension and the transmission of knowledge in this field, the extent and manner of endowment of social research, the training of the social scientist on broader lines, and the establishment of effective relations between the social scientist and the world of action which is his laboratory. The solution of the problems confronting society is the task of all its intellectual and moral agencies. Society may, however, fairly expect of the social scientist that as part of his contribution to our war effort he should be objective and technically competent, and deepen and make more definite our understanding of fact and relationship in the social world.

Nor are these words for the social scientist alone. It is well to be reminded in this fateful hour of the supreme values for which we contend, the importance of creative thought and of the free expression of human personality. We may well be grateful that there are those of our race across the Atlantic who see so clearly as Dr. Fosdick the real issues before us, and can define the task with a lucidity and precision which at least hint at comradeship in its discharge.

PRACTICAL SCIENCE IN SCHOOLS

THE publication of a communication from Mr. A. G. Lowndes, formerly biology master at Marlborough College, on page 863 of this issue raises a problem which has for long exercised heads of schools and administrators: the problem is whether the money spent on science laboratories and their equipment is justified by the results achieved, especially in the teaching of biological science. Essentially this problem resolves itself into two parts: first, what is the aim of science teaching, and secondly, how may this aim be best achieved?

The aims of science teaching have been well stated in the Spens Report; to give pupils some knowledge of natural laws and of their application; "to reveal the influence of scientific thought and achievement in the evolution of our present day civilization"—an appeal to social interest and social utility; and to give an introduction to scientific methods of thought and investigation. There can be little disagreement among science teachers on these aims; they are, indeed, those which have been held to be valid for so long as science has been a subject in school curricula. There is, however, some disagreement on how they may be achieved; for it has in the past been widely held that practical laboratory work is essential. Impetus to this view was given by Prof. H. E. Armstrong, whose influence on the teaching of science at the end of the last century was profound, and who insisted that pupils must be placed in the attitude of discoverers, and must, therefore, be given opportunities for discovering, in the form of a laboratory and apparatus. Sir Percy Nunn has expressed this view thus: "to make our pupils feel, so far as they may, what it is to be, so to speak, inside the skin of the man of science, looking out through his eyes as well as using his tools, experiencing not only something of his labours, but also something of his sense of joyous intellectual activity". In its official publications, the Board of Education has frequently stressed the importance of practical work in science, but has invariably qualified this by

pointing out that other methods of presentation are complementary.

There is considerable difference between the practical work possible in physical science and that in biological science. The metrical aspect of physical science (as taught in schools) makes laboratory work comparatively easy to arrange and organize with large classes, and there is a wealth of experiments which can be completed in the space of a double school period. In biological science much more time has usually been spent on observation and laboratory technique (notably dissection and section cutting), and much of the experimental work occupies days and even weeks before conclusions can be reached. There are, however, physiological experiments which can be carried out without taking up excessive time, for example, on plant and animal tropisms and on bacterial cultures.

The attempt to get pupils "inside the skin of the man of science" by means of practical laboratory work cannot be said to have been wholly successful. Dr. Michael West (*Educational India*, 6, No. 4; 1939) has stated that "it is perfectly possible for these expensively educated children to pass right through a school science course and remain at least fifty years out of date in scientific knowledge, to be ignorant indeed of all that really matters in the science of to-day". Much the same view is expressed by Prof. J. D. Bernal, in "The Social Function of Science", in a reference to the report of the Science Masters' Association on the teaching of general science: "Only in the last year year does the outlook become modern, but even then nothing later than 1890 is introduced"; and, "The chemistry is worse; the whole course contains nothing not known in 1810." Bernal also stresses that nearly all practical work in schools is "either preparation, measurement, or description, all operations essential to science but by themselves entirely insufficient".

There is evidence from American research that factual knowledge and knowledge of scientific method can be imparted as successfully by demonstration as by practical work, and demonstration certainly has the advantage of being less expensive, in time and money, and of setting a standard of work which is not achieved when pupils themselves carry out experimental work. Nor need demonstration be didactic, for every learner is encouraged by the skilful teacher to play a part, by suggestions and observations, in the demonstration as it proceeds. In this connexion the Spens Report mentions that "by a greater use of good demonstration we believe that science teachers will more commonly stimulate wonder and imagination".

That the place of practical work in the biology syllabus is being subjected to increasing criticism is borne out by the fact that recently a strong representation from the teaching profession has suggested to certain examining bodies that the amount of practical work in the syllabus should be considerably diminished, and that failure in practical work at the examination should no longer involve failure in the biology examination as a whole.

It is not suggested that all practical work should be jettisoned, but rather that the warning issued in 1933 by the Board of Education in "Science in Senior Schools" should be headed: "Many schools are in danger of falling into superstition and treating practical work as a ritual." A new stimulus to real scientific investigation, involving purposeful practical work, has come from the development of rural activities in an increasing number of schools, particularly public elementary schools. Wherever a garden is maintained, and wherever live-stock is kept (poultry and pigs are popular), real problems capable of scientific solution by pupils at once crop up. How to obtain the maximum yield from a soil as yet unanalysed; how to feed a pig in order to obtain the maximum weight at a certain age; how to house hens so that they are healthy; these and kindred problems involve observation, measurement, recording and, most important, *planning* and the proper use of controls. (At least one influential university teacher has stated that his scholarship pupils seem often unable to *plan* their experimental work.) The problems arising out of rural activities are susceptible to laboratory treatment, though the laboratory may sometimes be out of doors; they are real first-hand problems, with educational, social and utilitarian values, which cannot equally be said to be true of the routine experiments so frequently carried out in school laboratories.

A final point to bear in mind, especially during present circumstances, is the difficulty in obtaining material (especially biological) for laboratory examination and experimentation. This difficulty has always been present and never satisfactorily solved. Now is the time, therefore, to tackle this problem, not as a temporary measure, but with the view of eliminating the necessity of at any rate certain kinds of material altogether.