forms (which may roughly be called male and female) and in general the life-cycle cannot be completed unless these two forms come together with resultant nuclear fusion. It has been possible, on this account, to adapt the Mendelian method of study to fungi (including yeasts), so that there is now a flourishing line of fungal genetics. Fungal species in general consist of a cluster of strains, and it is possible to produce new ones by suitable mating. In this way new strains with enhanced value for industrial purposes—for example, yeasts for brewing, strains of *Penicillium notatum* for penicillin manufacture—have been developed.

The smaller fungi, especially moulds and yeasts, offer many conveniences for research on cell metabolism and on respiration in particular. The process of alcoholic fermentation by yeast has the special interest that it is closely related to anaerobic respiration, which is known to precede the normal aerobic respiration characteristic of all animals and most plants. Hence the wide biological significance of yeast biochemistry. Biochemical studies of fungi and bacteria, important from the fundamental point of view apart from their industrial interest (as in the preparation of citric acid, acetone, glycerol, certain vitamins, etc.) have become very active in recent years in connexion with the search for antibiotic substances, such as penicillin and streptomycin.

Two lines of physiological research on fungi have interesting parallels elsewhere. One of these concerns the response of fungi to minimal traces of certain metallic elements (zinc, copper, manganese and others), a response which is comparable to that of many higher plants; the other concerns the requirement by fungi of small quantities of special organic substances (biotin, aneurin, etc.), some of which are related to vitamin B. This behaviour is comparable with the dependence of animals on a vitamin-containing diet.

The interrelations of fungi and other plants are many and varied. Mutualistic effects between micro-organisms largely determine their localization in Nature and the frequency of their occurrence, and have been much studied in relation to the biology of soils. Beneficial effects (symbiosis) between micro-organisms and higher plants are shown in the fungus roots (mycorrhiza) of many plants such as grow in soils of high humus content (heath plants, orchids, many forest trees). Nodulation of the roots of leguminous plants is another example, and this is of the greatest importance in connexion with soil fertility. Harmful effects, which are not always sharply distinguished from symbiosis, are seen in the wide range of plant diseases caused by fungi. The development of plant pathological research on a nation-wide scale is one of the major mycological advances of the period under review.

MID-CENTURY—RETROSPECT AND PROSPECT IN EDUCATION

In his presidential address to Section L (Education), Sir Hector Hetherington points out that the development of public education in Great Britain over the past hundred years reflects the same impulses or ideas which have expressed themselves in the changing pattern of social, political and economic institutions and policies. The two dominating elements in that movement have been the coming to full maturity of the natural and applied sciences, and of the technological civilization founded thereon: and on the other hand, the wider operation of a principle best described by Dr. Gilbert Murray's word 'liberality'. The essential social history of the period is that of the effort to overcome the class divisions produced by the first impact of the Industrial Revolution, to diminish differences in economic status and in political responsibility, and therefore also in educational and social opportunity. The process has been gradual, undoctrinaire, experimental, controversial as to method but not as to broad objectives, and in the course of a hundred years has been carried a very long way.

The corresponding development in public education was influenced no doubt by the need of an expanding industry for more skilful, and therefore for better educated, workers, just as the movement fifty years ago towards wider secondary and technical education was influenced by the technical outpacing of Great Britain by Germany and the United States. But the main impulse undoubtedly was the force of the moral demand, and the main struggle was over the assertion of the State's direct responsibility. The State's concern for elementary education had been asserted in 1833. The State's full responsibility for it was not established until 1870. Its legalized and explicit participation in secondary education was not established until 1902, and its responsibility for the provision of a full educational experience—compulsory 'secondary education for all'—dates only from 1944.

Just as the century's changes in economic and political institutions and practice have left some obstinate problems still unsolved, so also in the field of education. Great progress has been made, beyond doubt; but it has been progress in the creation of opportunity rather than in its assured and effective use. Large material problems remain—a shortage of teachers and a scarcity of well-equipped schools. Perhaps even more urgent is the definition of the use to be made, especially for the non-academic pupil, of the longer school-life. At that stage vocational and technical education is of high personal and national importance. But the essence of the matter is to discover how best to use these instruments as an introduction to a free and intelligent participation in the interests and responsibilities of a civilized society. To that end, the linkage with voluntary adult education is of great significance.

The favourable elements in the situation are the gradual emergence not of a single organic structure of national education, but of closer and more co-operative relations between many different elements, old and new, government and voluntary, formal and informal, and the reinforcement of the State provision by youth services of all kinds. But it is important to recognize that under modern technological conditions there are strong influences making for mass emotion and mass action, and that the educational system has it in trust to preserve the values of a free society.

EXPERIMENTAL AGRICULTURE

Dr. E. M. CROWTHER, president of Section M (Agriculture), points out that the first critical review of the difficulties in obtaining reliable information in experimental agriculture was published a century ago by J. F. W. Johnston, who held the post of chemist to the Agricultural Chemistry Association of Scotland. Johnston realized the

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