

tioned that it might be well that our pupils should learn of the distinguished parts played by British men of science in exploring new fields, and also advocated bringing in historical matter at all stages of the course; he said that he is against anything that savoured of dividing up the subject into watertight compartments. He agreed that the formal study of the history of science at postgraduate level would be of great value to the intending teacher himself.

G. R. NOAKES

## FOREST GENETICS

FOREST genetics research is of comparatively recent origin in Great Britain, and the presence of two distinguished Continental workers at the British Association meeting at Birmingham did much to stimulate a lively interest in a meeting of Section K\* to discuss this subject. Dr. Syrach Larsen, director of the Horsholm Arboretum, Denmark, who is the pioneer European worker, described his method of tree breeding in general terms. Dr. Bertil Lindquist, director of the Botanical Gardens, Gothenburg, Sweden, dealt with the improvement of birch in Sweden, and a short description of the work in progress in Great Britain was given by J. D. Matthews.

The object of tree breeding research is to provide the forester with seed capable of producing the highest yielding crop of well-formed and healthy timber trees on the sites which are available. Both the guest speakers paid considerable attention to their improvement work based upon the variation found in Nature, and Dr. Syrach Larsen's description of his method of breeding based upon vegetative propagation is worthy of some discussion here.

The process commences with the selection of a number of individuals possessing outstanding vigour and form of growth. These are brought together into one central place by means of vegetative propagation (grafting, budding, and the rooting of cuttings). The genotype is determined in 'tree displays' in which several clones are planted in widely spaced lines. As the clones develop, the inherent shape and vigour of the selected trees become evident, and observations on date of flushing, flowering and leaf-fall, resistance to insect attack and disease can be made. The breeding qualities of the selected trees are next determined by means of controlled self- and cross-pollinations also made in the tree displays, and individuals of high combining ability may become evident at this stage. The subsequent progeny trials are followed for five years in great detail, and must be kept for reference for at least twenty years. Finally, special seed orchards are formed from those individuals which possess the desired characteristics.

These seed orchards are managed along the same lines as the modern fruit orchard, and selected rootstocks are used for establishing clones of the tested (élite) individuals in areas where the species under study is absent or rare, thus reducing the incidence of foreign pollination from trees of the same species. There is also the ripening of the seed to be considered, and specially favourable areas for seed production are selected as sites for these seed orchards.

Dr. Larsen pointed out that although the improvement of forest trees is apparently hampered by the slow succession of generations, in fact the long life-span of the parent tree has proved to be a great advantage. A good breeding parent can be preserved

as a seed producer for at least seventy years, and every improvement gained is available for a considerable period as a stepping stone for further work. Tree breeding also differs from agricultural breeding in that genetic uniformity is not so important in a tree crop as in an agricultural crop. More than ninety per cent of the population must be removed in thinnings during the development of the stand, and this gives opportunities for a continuous selection of improvement during the life of the crop.

Dr. Lindquist has worked for some years in Sweden in collaboration with Mr. Holger Jensen, a private owner. He described a seed orchard of *Betula verrucosa* sited in southern Sweden which contains ninety grafts each of nine élite trees spaced at approximately twelve feet apart. The first crops of seed have been obtained. The selection of the parent trees was based upon the study of the variation in the Scandinavian *Betula verrucosa* Ehrh., and Dr. Lindquist's account of this work proved of interest to the meeting as an example of the methods used by tree breeders.

Two main varieties of *Betula verrucosa* are recognized by Dr. Lindquist, the variety *saxatilis* Lindq., which is found throughout Central Europe and in the central and southern U.S.S.R., and the variety *lapponica* Lindq., which occurs in northern Europe. Timber quality within the latter variety has been correlated to some extent with the external appearance of the bark. Trees with smooth white bark generally yield a smooth mild timber with straight elastic fibres—a combination found suitable in the turnery industry. Individuals are found in southern Sweden which possess a rough, heavily fissured bark with hard timber and fibres not so straight or so elastic. This type of wood is used for furniture. Other types have been differentiated on the basis of figured grain, and these include the curly birch, the flamy birch, the ice birch and the brown curly birch, all identifiable by bark characteristics. Within these groups the individuals selected for inclusion in the seed orchards must have made very strong growth throughout their lives and must possess good form of growth. A number are chosen from within a specified provenance zone, there being a separate seed orchard for each zone.

The progress of work in Great Britain was described towards the end of the meeting and emphasis was laid upon the importance of the survey, now in progress, of the potential seed-producing population of the species chosen for study. The species being studied in Great Britain are beech, oak and ash, Scots pine, Corsican pine, Sitka spruce and the larches, and a number of seed sources have been located for each of these species. The selection of individuals from which seed orchards are to be formed is being made concurrently with the above survey, and some examples of the type of trees being selected were displayed to the audience.

In the discussion which followed the three papers it was emphasized that, if speedy progress towards the improved growing stock desired is to be made in Great Britain, the idea of the value of genetics in day-to-day forest practice must be repeatedly emphasized. It is perhaps one of Dr. Larsen's greatest achievements that he has obtained the goodwill of practising foresters in Denmark, who are now firmly convinced of the importance of the inherent qualities of trees, and who will take great trouble in the selection of seed parents for their future forest crops. Much can be done in a similar manner in Britain.

J. D. MATTHEWS