Berichte

Forest Tree Breeding

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Introduction

The importance and need of forest tree breeding, a relatively young subject, is generally fairly well recognised to-day. Forests and natural vegetation have been exploited for commercial use by man for centuries without giving much attention to the matter of forest tree improvement by proper breeding. The recognition of local races of plant species adapted to certain localities and seed provenance studies in Europe in the end of the nineteenth century and later studies dawned upon the foresters the importance and need of forest tree breeding. As stated by Austin (1937), uncontrolled commercial exploitation of forests in North America and many other parts of the world has resulted in retrogressive selection of the original vegetation so that plant breeding is necessary not only to improve the quality of the existing trees but also to maintain it, at least, at the present level. The first planned and organised attempts for forest tree breeding started in the early twenties of this century (Austin, 1928, and Schreiner, 1937).

Natural selection has played the most dominant role in the evolution of tree species till foresters began to interfere with natural vegetation in the form of commercial exploitation and planned management. The law of natural selection by its operation over long periods results in the survival of forms best suited to a particular natural environment. Man's selection, on the other hand, by modifying the local environment can and has taken different course in many cases. The worst course of man's selection can be negative selection by removing the best forms and leaving behind the poorest types in uncontrolled felling of trees. On the other hand, as in the case of agricultural crops, man improve upon the wild forms through selection and various cultural operations. With intensive forest management foresters can and should exercise greater control over the breeding and the culture of forest trees. Man's selection can modifiy natural selection for tree improvement considerably. Especially, in the case of large scale plantations and artificial reforestation, plant breeding has an important role to play. The forest tree breeders have to evolve suitable strains and varieties for particular needs. Very fast growing tree species are required to meet the increasing demands of wood of the growing population, from the dwindling forest resources of the world. Drought and frost resistant strains are required for a successful reforestation of many denuded and eroded arid subtropical lands. Fast growing hybrid poplars, for the supply of cellulose and lignin, will be much favoured by the increasing use of plastics (Schreiner, 1949) in industry. Suitable races or strains of tree species resistant or immune to fungal diseases and insect pests are in much demand in various parts of the world.

In nature, it may happen that a genotype with a negative selection value contains valuable genes for certain plant characteristics. Whereas such an individual will be eliminated by natural selection, it, along with the valuable genes, can be preserved and utilized by man's selection. The plant breeder can thus modify and alter the course of natural selection in man's favour by employing artificial plant breeding methods.

However, the breeding and evolving of superior strains of plants is not an easy affair. Genetical studies have clearly shown that rarely any economic characters of plants are determined by the interaction of a few genes as in the case of simple alleles. On the other hand, there is no doubt that the yield and quality of timber are determined largely by the interaction of many genes and their multiple effects. The inheritance of quantitative economic characters is associated with polyploid nature of many plant species and is a very complex subject. The various methods of plant breeding, viz., selection, introduction, hybridization and induced polyploidy have definite potentialities and limitations. An attempt has been made in this paper to consider and review the various plant breeding methods as they have been employed for forest tree breeding in various parts of the world. This may give fresh stimulus and ideas to organise forest tree breeding research on a sound footing.

Selection and Improvement of the Local Species

On embarking upon a Programme of forest tree breeding, the forest geneticist should first of all consider the isolation and identification of the indigenous and local plant material. By doing so he can select suitable forms of trees which may turn out to be superior to ordinary individuals of a species. Changes occur in plant species and communities through natural selection of random mutations. Variation due to natural hybridization is a fairly common phenomenon in closely related forms and species which cross-pollinate. Mutations are also known to occur in seed and vegetative buds. However, mutations with negative selection value are generally eliminated sooner or later by natural selection and it is only mutations with positive or neutral selection value that survive or persist in plant populations. According to Vavilov (1950) the different plant species of the present day are in different stages of development and on account of this, they represent complexes of very different amplitude and content.

Mutations, hybridization and natural selection exercise dominant influence on the composition of plant populations. It has been demonstrated mathematically that if a mutation increases the chances of survival by only 1 per cent, it would establish itself in half the population in about 100 generations (Huxley, 1943). The ecotypes and biotypes which are interfertile and are lumped together in the same taxonomic species arise by natural mutations and by their gradual accumulation. Some of these natural changes may also arise by the occurrence of structural changes such as translocations, alterations, additions and deletions of chromosomal parts. Additions and deletions of whole chromosomes are also known to have occurred. Thus natural populations of plants contain considerable amount of genetic variation within the so called taxonomic species.

The intraspecific or racial variation has been well demonstrated in species which have extensive latitudinal or altitudinal ranges. Champion (1933) considered that there is need of provenance tests and selective breeding in species like *Dalbergia* sissoo, Pinus *longifolia* and Pinus *excelsa*. Weidman (1939) recognised the existence of four racial strains in Ponderosa pine (Pinus ponderosa) which varied in their growth rates and hardiness. Schreiner (1937) states that seven apparently superior strains of

Ponderosa pine have been segregated at the Northern Rocky Mountain Forest Station. According to ISAAC (1949) Douglas fir *(Pseudotsuga taxifolia)* has many strains, with distinct climatic and soil limitations, which should not be used beyond the limits of each race in the western United States. It has long been recognized that in Europe Douglas fir from southern latitudes of the Pacific Coast dies of frost but that from northern latitudes or higher elevations flourishes well. The international provenance tests on Scotch pine *(Pinus sylvestris)* brought out abundantly well the occurrence of racial strains in this species with a wide range of distribution in Europe. The use of suitable provenances in the case of Scotch pine and European larch *(Larix decidua)* is well recognized in Europe to-day. The seed provenance tests especially in the case of species which are widely distributed in nature are of considerable importance in tree breeding work. MIROV et al. (1952) studied some altitudinal races of Ponderosa pine. Seeds were collected from 89 trees distributed from 125 to 6,919 feet above sea level on the west slope of the Sierra Nevada and were planted at 960, 2,730 and 5,650 feet above sea level. Plants, 2—12 years old showed a maximum height growth at all elevations, for seed trees occurring from 1,500 to 3,500 feet above sea level. They also report that no differential cold injury was noticed upto 13 years in the higher altitudinal plantations.

It is generally regarded safest to use seed from the locally indigenous trees. While undertaking natural regeneration of a species under a shelterwood felling the best mother or seed trees should be selected. For artificial sowing too, seed should be collected from elite individuals and the best stands. The practice of selecting elite trees and plus stands for seed collection is now universally adopted in Germany and Scandinavian countries (BALDWIN and SHIRLEY, 1936 a and b, and LINDQUIST, 1948). The German Forest Seed Law of 1934 distinguishes between the phenotype and the genotype in forest tree stands when judging their genetic value. It is, therefore, necessary that we exercise great care in the selection of seed trees and seed stands for maintenance and improvement of the quality of forest stands.

Both mass selection of suitable trees and single tree selection for superior seed will be better than no selection. However, to distinguish and isolate the superior genotype, single tree selection and progeny tests will have to be carried out for long periods. Such genotypic selection and progeny tests are underway in the Scandinavian countries. Seed certification of all forest seed giving the details of its date of collection, origin and climatic and soil conditions of its habitat is an important matter. All plantations raised from seed obtained from outside an habitat should have these details of seed in their records. Seed collection and seed distribution should be well organised and controlled so that the new plantations are better than the older ones.

Introduction and Acclimatization of Exotic Species

Phytogeographical information about plant species is a matter of considerable importance for scientific plant breeding. While beginning his work with different plant groups, the plant breeder will be wise to consider the phytogeographic peculiarities of the species he is going to handle (VAVILOV, 1950). The greatest amount of variability or diversity is to be found either in the centres of species origin or at points where different floras meet (VAVILOV, 1950, and ANDERSON, 1952). It is worthwhile to collect plant materials from these centres which may contain potentially useful variability. The collections of exotic species in the form of arboreta are of utmost importance for the breeding of forest trees, SYRACH LARSEN (1934) signifies the same fact when he states. „The arboretum thus solves a problem which has been tackled in vain by libraries, archives and museums". The matter of introducing exotic species from suitable comparable regions in to West Pakistan was considered recently by the author (KHAN, 1954).

Indigenous vegetation which resulted from evolution, migration, succession and natural selection occurring over long periods, is, perhaps, best suited to its natural habitat. However, certain exotic species from distant and isolated regions and with suitable cultural operations have given remarkably good results in new places. The success of exotic species in newer habitats may be due to either their climatic changes or on account of the occurrence of suitable preadaptations in those species. The successful cultivation of Monterey pine *(Pinus radiata)* in Australia, New Zealand and South Africa well illustrates this point. The Monterey pine is in a precarious balance with its environment in Costal California between 37° 8' N and 35° 32' N (MOULDS, 1950), but in the new habitats, this almost extinct species, has shown better growth and form in artificial plantations. Australian wattles, and Eucalypts and Mexican pines are other well known examples of successful exotics.

The matter of seed origin and provenance is of great importance for the introduction of exotic species. It would seem that from a collection of a large number of ecotypes of the exotic species there will be a better chance of finding types that will succeed, in a new habitat. These types can then be used for later large scale introduction of the exotic species. The search for and identification of suitable seed provenances would need expert handling.

It will be worthwhile to have provenance control on an international basis. Several attempts have been made in the past by the international forestry congresses to organise and enforce some sort of control over seed provenances in different countries of the world. The F. A. O. seems to be in a better situation to plan and organise provenance control on a uniform basis for the member countries. The matter of plant quarantines is also closely associated with the exchange of seeds and planting materials. The F. A. O. could organise a uniform and suitable procedure of plant quarantine regulations. The transference of plant diseases and parasites to importing countries could do untold harm. It is gratifying to note quick transportation of grafting material and pollen by air between Denmark and the USA (SYRACH LARSEN, 1951).

As emphasised by VAVILOV (1950) the botanical study of the earth's vegetation is still very incomplete and the plant taxonomists, probably, have not identified and classified more than half of the species of flowering plants. Exotic species are important not only from direct introduction point of view, but they are also of considerable significance for forest tree breeding. Plant introduction is still full of potentialities and should be a constant tool in the hands of the plant breeder.

Hybridization

Hybridization occurs naturally between closely related cross-pollinated species or races. It can be brought about artificially by controlled pollination as intraspecific, interspecific or even in some case as intergeneric crosses. Natural hybrids in *Acacia* (KHAN, 1951) and *Pinus* (ZOBEL, 1951) in well differentiated species, for example, have been reported. Some of the species like *Eucalyptus* spp., *Acacia* spp., *Salix* spp., and *Populus* spp. are so much cross-pollinated and hybridized in nature that they have proved to be the toughest plant groups to differentiate and classify. PAULEY (1949) states that the confused classification and nomenclature in the genus *Populus* is chiefly due to ecotypic isolation of races and species and through natural and artificial hybridization.

Artificial hybridization has been attempted in plant species to combine good characters of the parental species, to make use of hybrid vigour or to induce resistance to unfavourable environment. *Acacia decurrens* and *Acacia mollissima* have been hybridized in South Africa (PHILP and SHERRY, 1949) to combine the good qualities like easy germination, faster growth, better branching habit of *Acacia decurrens* and less red colouring matter in the bark and hardiness of *A. mollissima*. The hybrid progeny of both species has been found to have new combinations of characters and attempts are now being made to select strains with combination of suitable characters. KHAN (1951) studied the somatic chromosomes of certain *Acacia* spp. and hybrids and concluded that there seemed to be good scope of artificial hybridization in the genus *Acacia*. A cross between Monterey pine *(Pinus radiata)* and Knobcone pine *(Pinus attenuata)* produces a hybrid with the greater drought and frost hardiness of Knobcone pine and the rapid growth of Monterey pine (DUFFIELD and STOCKWELL, 1949). European larch *(Larix decidua)* and Japanese larch *(Larix kaempferi)* cross is long known to produce hybrid progeny with characters intermediate between the two parents. It has better bole form and branching habit of the European larch and fast growing habit, hardiness and resistance to canker of the Japanese larch.

The genera *Larix, Pinus* and *Populus* furnish the most striking examples of heterosis or hybrid vigour in their intra-specific and inter-specific crosses. HITT (1952) found that *Larix decidua* × *Larix kaempferi* hybrid plantation in Denmark about 15 years old had 30 per cent more cubic volume than that of *L. decidua* of the same age and on the same site. Similar hybrid vigour has been exhibited by the hybrid between *Larix decidua* and *L. sibirica*. Both at the Arnold Arboretum and at the Institute of Forest Genetics, Placerville, California, most of the pine hybrids, like eastern white pine *(Pinus strobus)* × western white pine *(Pinus monticola)* have exhibited more vigorous growth than either of the parents. It has been found that in the first 7 years, the hybrid put on double the height growth of parents (DUFFIELD and STOCKWELL, 1949). The Institute of Forest Genetics, Placerville, California, the leading pine breeding station in the world put out a pilot hybrid pine plantation consisting of 21,500 seedlings in 1952. The plantation includes five of the most promising hybrids produced at the institute in which 1 hybrid to 4 ordinary seedlings have been put out. The ordinary trees will come out in thinnings leaving behind the hybrids as the final crop. The European aspen *(Populus tremula)* × American quaking aspen *(P. tremuloides)* hybrid is known to be two to three times as vigorous as either parent species (HITT, 1952). On the basis of German and Swedish results, PAULEY (1949) thinks that intra-specific hybrids within the Asiatic and North American poplars hold bright promise of yielding valuable strains.

Some of the hybrids have been found to be resistant to fungal diseases and insect pests. *Larix decidua* × *L. kaempferi* hybrid is known to have a considerable amount of resistance to the larch canker *(Dasyscypha willkommii)*, although one of the parents, *L. decidua* is very susceptible to the larch canker. The blister rust resistance of the Balkan *(P. peuce)* and the Himalayan *(P. exelsa)* pines is expected to be introduced into the hybrids between these pines and the eastern and western white pines in the United States. Coulter pine *(P. coulteri)* × Jeffrey pine *(P. jeffreyi)* hybrid has been found to be as resistant to pine reproduction weevil as the coulter pine parent (MILLER, 1950).

Sometimes, the hybrids of very highly differentiated species prove to be sterile. They can be propagated either from vegetative parts or by doubling their chromosome number. In the case of poorly fertile hybrids, full fertility can be restored by back crossing to one of the parents. It has been attempted in *Acacia* hybrids (PHILP and SHERRY, 1949). It has also been noted that sometimes one of the reciprocal crosses gives better results than the other. It is borne out by some of the *Larix* crosses and may be due to cytoplasmic inheritance.

Polyploidy

Polyploidy has played a very important role in plant evolution. Most of our present day plants are secondarily balanced polyploids. Chance polyploids have been recorded in natural populations of the diploid or the secondarily balanced polyploid species (KHAN, 1951, and KIELLANDER, 1950). Somatic doubling of chromosomes has been observed in the roots of many species. The production of diploid gametes is known in certain plant hybrids which results in the production of triploids on fertilizing with haploid gametes or tetraploids by union among the diploid gametes (KHAN, 1951).

UPCOTT (1936) furnishes an interesting example of an amphidiploid tree species. She states that *Aesculus carnea* ($2\ n = 80$) arose more than a century ago, very likely, as a chance hybrid between the European horse chestnut, *A. Hippocastanum* ($2\ n = 40$), and the North American buckeye, *A. pavia* ($2\ n = 40$). The hybrid became fertile by doubling its chromosome number. She could distinguish the chromosome complements of the parental species in that of the amphidiploid. Triploid giant aspen is easily produced by crossing the common diploid aspen with the tetraploid aspen. The diploid parent provides the haploid chromosome set and the tetraploid parent contributes gametes with diploid chromosome set and the resultant hybrid is a giant triploid which grows much faster than either of the parents. As stated by PAULEY (1949), triploidy seems to be the natural limit of heteroploidy in the genus *Populus*, as with further increase in chromosome number, the size and growth rate of the heteroploids generally falls below that of the triploids.

Polyploidy can be artificially induced in plants as done by colchicine treatment in the case of pines (MIROV and STOCKWELL, 1939) and *Sequoia gigantea* (JENSEN and LEVAN, 1941). Exposing plant material to various kinds of radiation, temperature shocks and certain chemicals, is known to produce chromosome doubling. There is, perhaps, a natural limit to chromosome increase in different plant species. MÜNTZING (1933) stated that chromosome doubling or polyploidy in nature was preserved on account of incompatibility or infertility between the original parents and the new polyploids. The more basic conditions responsible for polyploidy are stated by DARLINGTON (1937) who considers that increase in chromosome number or polyploidy is conditioned by the size of the metaphase plate and the availability of extra space in the cell to permit an increase in the bulk of the chromosomes. He states that polyploidy is very common in dicotyledonous plants where chromosomes are small and does not occur in genera like *Lillium* and *Fritillaria* where the chromosomes are very large. There seems to be little scope of induced polyploidy in conifers. MIROV and STOCKWELL (1939) having produced myxoploids of pine with colchicine treatment observed that it was doubtful if the myxoploid pines will be of practical value except to produce stable slow growing polyploids that could be used in plant breeding. KIELLANDER (1950) found that tetraploid and triploid races of *Picea abies* were remarkably slow growing. According to him the optimum chromosome number in *Picea abies* would seem to be the diploid or perhaps, secondarily balanced chromosome number, $2n = 24$. Any increase of chromosomes above this number, results in poor growth and lowering of vitality in *Picea abies*. Thus induced polyploidy has its possibilities and limitations. KHAN (1951) after studying the somatic chromosomes of some *Acacia* species and hybrids concluded that there is scope of induced polyploidy in the genus *Acacia*.

On account of its inter-relation with quantitative inheritance polyploidy is considered to be an important matter for the improvement of economic characters of plants. Genetical studies of *Acacia decurrens* and *A. mollissima* show the presence of poly-genes in the genic complex of these species. KHAN (1951) studying the nucleoli and nucleolar chromosomes of these two species concluded that they are secondarily balanced tetraploids. As stated above, in plants upto a certain limit which varies with different plant species, the size and rate of growth increase with an increase in the chromosome number. But after that limit of chromosome number is reached, polyploidy seems to have adverse effect on plant growth.

Breeding Techniques and Basic Research

Plant breeding techniques necessitated by the special conditions associated with forest trees and basic plant cyto-genetical research must go hand in hand with various plant breeding methods discussed above. Controlled pollination for crossing or selfing should be worked out for each plant species. These techniques for pine and Douglas fir (DUFFIELD, 1950) have been worked out at the Institute of Forest Genetics, Placerville, California. Flowering and fruiting habits of the plants to be bred should also be studied thoroughly. MIROV (1937) states that growth and its phasic development in plant species should be carefully studied which may give clues to induce early flowering and fruiting in them. A suitable physiological treatment may modify their thermo- or photo-periodic behaviour and thus may enable a plant to flower in a new habitat outside its natural range. STONE and DUFFIELD (1950) were able to facilitate the germination of certain pine hybrid seeds by a modified embryo culture technique. SAMOFAL (1938) states that vernalization of forest tree seeds makes the seedlings sturdier in their development when summer heat and drought set in and that vernalization of a seedling results in obtaining 2 years growth in about one year.

Early flowering has been induced in many plants by strangulation, ringing, freezing and artificial illumination and by using cuttings and grafts. Vegetative propagation has also been studied and developed for the identification and multiplication of suitable genotypes (SYRACH LARSEN, 1951). Vegetative propagation is also needed for the preservation of infertile or unstable hybrids. All these techniques which are of immense help to the plant breeder have to be developed for different plant species as required by the circumstances for forest tree breeding. SYRACH LARSEN (1951) reports his success with the transportation of grafting plant material and pollen quickly by air over long distances.

Cyto-genetic studies are of basis importance to the plant breeder in order to understand the inner processes which are responsible for genetic variation and may be utilized for the improvement of trees. The cytological studies bring out the information of chromosome numbers, occurrence of polyploidy, chromosome pairing in the species hybrids etc. This gives clues to the possibility of success in hybridization or inducing polyploidy among certain plant species (KHAN, 1951). Genetical studies throw light on the nature and inheritance of desirable plant characters and the genetical differences between and within the different plant species. As a result of their genetical studies PHILP and SHERRY (1949) outlined a suitable breeding programme consisting of selecting hybrids and crossing between green and black wattles, back-crossing the hybrids and crossing between inbred lines of black wattle to create hybrid vigour. The green and black wattle differ from each other principally in having different systems of polygenes and produce fertile hybrids.

The field of induced mutations has been studied very little as yet. Artificial mutations have been induced in plants and animals with different kinds of radiations such as X-rays, neutrons, α-particles, β-particles and ultraviolet radiation, temperature shocks and certain chemical agents like colchicine. SINNOTT et al. (1950) state that gene mutations result ultimately from intraatomic disturbances in the genes. Mutations induced by ultra-violet radiation seem to resemble the spontaneous ones more closely than mutations induced by X-rays. However, the mutation process has not been yet fully understood and utilized by man. More basic research in this field, which may lead to better understanding and control of the mutation process, is greatly desired to-day.

Zusammenfassung

Titel der Arbeit: *Forstpflanzenzüchtung.* — In Form eines Sammelreferates wird eine Anzahl von Veröffentlichungen aus dem Gebiete der Forstpflanzenzüchtung besprochen und an Hand der zitierten Arbeiten auf die allgemeine Notwendigkeit der Forstpflanzenzüchtung hingewiesen. Im einzelnen gliedert sich der speziell behandelte Stoff in folgende Abschnitte: Auslese und Erforschung von Lokal-Arten, Einführung und Akklimatisation von Exoten, Bastardierung, Polyploidie, Züchtungstechnik und Grundlagenforschung.

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Notizen zum 8. Internationalen Botanikerkongreß in Paris 1954

Der Kongreß fand in der Zeit vom 2. bis 14. Juli 1954 in Anlehnung an die Sorbonne in Paris statt. Der zu bearbeitende Stoff gliederte sich in 27 Sektionen. Die Sektion 13 faßte die Themen der Forstbotanik zusammen. PH. GUINIER stand der Sektion vor. In seiner Einleitung erläuterte er, in welchem Umfang es berechtigt erscheint, die Forstbotanik als selbständiges Teilgebiet abzuhandeln. — Die Sektion selbst war aus sachlichen Gründen weiterhin in zwei Sub-Sektionen unterteilt worden:

13 a — Botanique forestière générale,

13 b — Anatomie du bois.

Unter der Überschrift: „*Applications de la génétique à la sylviculture et au reboisement*" kamen innerhalb der Sub-Sektion 13a eine Reihe forstgenetischer Themen zum Vortrag. Den Vorsitz hatten E. BJORKMAN (Schweden) und R. ROL (Nancy), die Schrift- und Geschäftsführung besorgten POURTET und BOUVAREL (Nancy).

Von allen angemeldeten Vorträgen und Referaten lagen beim Kongreßbeginn zusammengefaßte Texte in einem mehrbändigen Werk vor. Die hier besonders interessierenden Beiträge finden sich in „*Rapports et communications parvenus avant le congrès à la section 13*" (152 pp.). Der Band gliedert sich in folgende Kapitel: Applications de la génétique à la sylviculture et au reboisement (pp. 1—30), Applications de la phytosociologie à la sylviculture et au reboisement (pp. 31—59), Phytosociologie et classification des types forestiers tropicaux (pp. 60—64), Bases écologique de la sylviculture (pp. 65—111), Données nouvelles en phyto-pathologie forestière (pp. 112—122), Physiologie des mycorrhizes (pp. 123—138) und Communications diverses (pp. 139—151). — Nicht alle Autoren waren auf dem Kongreß anwesend; ein Teil der Beiträge wurde nach eingereichten Manuskripten von Vertretern verlesen. Alle vollständigen Vortragstexte mit den stattgefundenen Diskussionen sollen in einem vorgesehenen endgültigen Kongreßbericht in nächster Zeit publiziert werden. Sein Erscheinen wird ebenfalls an dieser Stelle bekanntgegeben werden. Wir beschränken uns jetzt auf einige kurze Hinweise, aus denen die in Paris aus dem Sektor der Forstgenetik vorgetragenen Themen ersehen werden können.

Dem forstgenetischen Abschnitt wurde ein Abriß von C. SYRACH LARSEN „*Forestry and genetics*" vorangestellt (pp. 1—9), der nach dem Manuskript zur Verlesung gekommen ist.

(An Hand geschichtlicher Daten wird die selbständige Entwicklung des Wissensgebietes, die Eigentümlichkeiten der zu bearbeitenden Objekte sowie die anzuwendende Methodik dargestellt und eine enge Zusammenarbeit mit den anderen Spezialgebieten der Botanik unbedingt für notwendig erachtet.) — Es folgt ein Referat von G. HOUTZAGERS „*Application of genetics in forestry and reafforestation*". (In den Niederlanden ist vor zwei Jahren zur Koordinierung der forstgenetischen Arbeiten eine Forschungsstiftung gegründet worden, der alle vorhandenen Institutionen dieses Forschungsgebietes angehören; die Einrichtung hat u. a. auch beratenden Charakter. Die Aufgaben werden im einzelnen erläutert. Die Besonderheit des Landes charakterisiert die Bemerkung, daß in den Niederlanden 48 000 km Straßenpflanzungen existieren, die 20% des jährlichen Holzanfalles produzieren.) — S. S. PAULEY referiert über „*The photoperiodic response and its importance in tree improvement*". (Die Variation der Tageslänge wirkt sich bei Holzpflanzen entscheidend auf den jährlichen Wachstumsverlauf aus. Testversuche mit verschiedenen Holzarten unter verschiedenen Tageslängen zeigen das, und es wird hier besonders über die Versuche mit *Populus trichocarpa*-Klonen berichtet. Vier allgemeine Erfahrungssätze wurden aufgestellt.) — Ein Referat von W. WETTSTEIN und H. GRÜLL über „*Das photoperiodische Verhalten von Kiefernherkünften (Pinus silvestris L.)*" kam zur Verlesung. (Verdunkelungsversuche mit Jungpflanzen zeigen, daß mit der Methodik Frühselektionen durchführbar sind, wenn man Herkünfte aus tieferen Lagen in höhere Lagen verbringen will.) — O. LANGLET trug vor „Importance d'une spécification rigoureuse de l'origine des semences". (Die Sektion Genetik der Schwedischen Forstlichen Forschungsanstalt befaßt sich u. a. auch mit der Einführung fremdländischer Holzarten. Zu ihrer Prüfung ist in Bogesund bei Stockholm ein Arboretum von 500 ha begründet worden. Unter Beobachtung stehen dort u. a. Herkünfte von *Abies lasiocarpa, Larix occidentalis, Pinus contorta, Pinus latifolia* und *Thuya plicata*. Es kamen nur Samenherkünfte zur Verwendung, deren Ursprung genau bekannt ist.) — A. F. v. D. SCHULENBURG ließ einen Bericht übermitteln über „*Probleme um Provenienzfragen bei Vorwaldholzarten für die Neubewaldung von Ödlandsböden*". (Es wird darin zum Ausdruck gebracht, daß *Betula*-Provenienzen aus dem luftfeuchten atlantischen Klima versagen, wenn sie auch nur 300 km ins Binnenland verbracht werden.) — A. J. RIKER und R. F. PATTON referieren über „*Breeding of Pinus strobus for quality and resistance to blister rust*". (Der Anbau der Strobe im NO der USA wird durch den Befall mit *Cronartium ribicola* ernstlich gefährdet. Über das Resistenzzüchtungsprogramm wird berichtet.) — C. MUHLE LARSEN spricht zuerst „*Du rapport entre le sexe et le développement chez les arbres dioiques*". (Im Winter 1951/52 waren größere Kreuzungsnachkommenschaften von *Populus tremula* × *tremuloides* auf einen sehr trockenen und armen Boden verpflanzt worden. Im Jahre darauf blühten diese Sämlinge überreich. Die einzelnen Nachkommenschaften waren zahlenmäßig verschieden aus männlichen, weiblichen und zwittrigen Individuen zusammengesetzt. Es ergab sich eine positive Korrelation zwischen der Anzahl der entstandenen Männchen und der guten Entwicklung der jeweiligen Nachkommenschaft.) — Es folgte ein Vortrag von C. MUHLE LARSEN über „*Étude relative aux variations de la grandeur des stomates dans le genre Populus*". (Untersuchungen ergaben, daß jede der *Leuce*-Arten eine charakteristische mittlere Spaltöffnungsgröße besitzt; *P. alba* und *grandidentata* haben die kleinsten und *P. tremuloides* haben die größten Stomata. Artbastarde verhalten sich intermediär.) — F. W. SEITZ sprach über „*Die Bewertung eines Norm-Abweichers aus der Graupappel-Mannigfaltigkeit als Züchtungsmittel*". (Durch Bestäubungen mit dem Pollen eines zwittrigen Graupappelklones, der ein Gemisch aus haploiden und diploiden Pollenkörnern darstellt, sind Selbstungen und Kreuzungen durchgeführt worden. Es wurden in allen Nachkommenschaften in verschiedenem Umfang neben diploiden auch triploide Individuen erhalten.) — W. SCHMIDT lieferte ein Referat über „*Physiologische Teste im Keimlingsalter*". (Frühtestmethoden bei Kiefernkeimlingen, die für die Forstpflanzenzüchtung nutzbar gemacht werden können, wurden skizziert.) — Nach dieser Vortragsgruppe folgten Themen über die angewandte Pflanzensoziologie im Waldbau, zu denen A. GALOUX („*Phytosociologie et applications silvicoles*") einleitete. — Es sei ferner ein Vortrag von Y. DE FERRÉ angeführt, dessen vervielfältigter Text zur Verteilung gekommen ist, mit dem Thema „*Résistance de quelques éspèces de Pseudotsuga au Phaeocryptopus Gäumanni (Rohde) Petrak*". (Im Verlaufe des Jahres 1953 erkrankten die Douglasien im Gebiet der französischen Pyrenäen plötzlich. Untersuchungen im dort liegenden Arboretum Jouéou ergaben, daß besonders eine Sorte der