appear compatible with each other. *H. vernalis* was mentioned as being particularly tolerant of heavy alkaline soils.

Distylum racemosum had been suggested as a rootstock but had been shown to produce inferior plants with poor growth.

Quality of the rootstock was stressed, a young, straight, vigorous rootstock producing a stronger union and a higher percentage of "takes".

Liquidambar spp. and selected clones of *L. styraciflua* were grafted onto potted rootstocks (2 yr. seedlings) of *L. styraciflua*. Whip grafting in early spring under glass normally produced a high percentage of successful takes.

Parrotia persica 'Pendula' was grafted onto the type species which was normally produced from cuttings. This pendulous form could either be whip grafted onto a potted rootstock in the early spring or top-worked using a side graft onto a *Parrotia persica* stem "balled up" and brought under glass in the early Spring.

MICROPROPAGATION

It was noted that some work was in progress but so far no results were available.

CONCLUSION

It was felt that propagation of *Hamamelis* by cuttings may assume more importance in the future. Selection of easily-rooting clones for ornamental value and as rootstocks would increase the importance of cuttings as a standard method of production of *Hamamelis*.

DISCUSSION GROUP REPORT
PROPAGATION OF PICEA

DISCUSSION GROUP CHAIRMAN — BRUCE MacDONALD

The genus *Picea* has considerable economic importance, for example, within forestry, where *P. abies* and *P. sitchensis* are grown. *Picea sitchensis* is also used for wind protection of nursery stock in exposed sites. It may be interplanted with *Alnus incana* in order to give initial protection — the latter being removed when the *P. sitchensis* has grown enough to form a "permeable barrier". *Picea* gives some excellent specimen trees, with the species *P. breweriana* and the cultivar, *P. orientalis* 'Aurea'. There are also the slow growing forms which can be included in the design of rockeries and heather beds, for exam-

ple, *P. glauca* 'Conica' and *P. mariana* 'Nana'. Thus *Picea* gives both the nurseryman and private gardener an extreme in habit, form and color — for example the weeping *P. abies* 'Inversa' and the intense glaucous-blue of *P. pungens* 'Hoopsii'.

PROPAGATION BY SEED

The topic first discussed by the group was the importance related to the provenance of seed. It was stated that in Denmark, the Forestry Commission assist the nurseryman by initially procuring seed from a provenance best suited to their country. For example, the seed of *P. omorika* is obtained from Rumania and Finland. It is known that the provenance of *P. omorika* can affect the shape and depth of tree, together with its susceptibility of frost. Similarly with *P. pungens* 'Glauca', where it is important that the provenance gives one as high percentage as possible of the glaucous-blue colored seedlings. The question was raised whether the provenance of *P. abies* had an effect on the percentage success when bench grafting. An answer to this was not possible.

When one is collecting one's own seed, then cones are best removed just before they are ripe. The cones are then placed in a glasshouse after which they will break open to release the seed when shaken. Seed may be stored for up to three years in a sealed container within a refrigerator at 1° to 3°C (34° to 37°F). Sawdust is sometimes used to reduce the shrivelling of seed by placing it into the container with the seed, which is then shakened and stored.

Some species require a pre-sowing treatment of up to six weeks cold-moist stratification to overcome dormancy — for example *P. abies* where a three week period is given. If no cold-moist stratification is given, then all seed prior to sowing may be soaked in water for up to 24 hours in order that it is imbibed to ensure more even germination.

A sowing rate of between 400 and 500 seeds per square metre was given as an optimum sowing rate for *Picea abies*.

The discussion was then orientated towards the aftercare of seed and progeny, after the seed had been covered by a lime-free 3 to 5 mm graded grit. The major points highlighted were as follows:

1) Benefits gained from partial soil sterilization.
2) The susceptibility of new growth to late spring frost. In areas where this occurred, delay of sowing date was advised.
3) Losses incurred by damping-off diseases. A cover of the seed with grit would assist, but fungicidal seed dressings should also be considered.

4) Roguing of the seed bed where one is selecting for color.
5) The importance for controlling red spider mite, green spruce aphid and adelgids.

Finally the raising of seedlings within glass or polythene structures was discussed using either seed trays or paper-pots into which the seed is sown. The uses for this technique were considered to be fourfold: Firstly, to raise forest tree seedlings for subsequent planting for timber, for example *P. sitchensis;* production of a liner within a peat pot for lining out or containerizing; thirdly for the germination of expensive seed, for example *P. breweriana* and; fourthly, to produce a rootstock suitable for bench grafting in two years instead of the traditional three year period, for example, *P. abies*.

BENCH GRAFTING

Propagation by bench grafting provoked a detailed discussion where it was noted that a range of different techniques produced successful results. The discussion was led along the following topics in relation to the grafting of *P. pungens* cultivars — for example, *P. p.* 'Koster', *P. p.* 'Montgomery', *P. p.* 'Compacta' and *P. p.* 'Hoopsii'.

Time of Year. Two periods during the year were used for bench grafting: namely August - September, and January - February. The advantages gained from grafting during August - September were considered to be threefold: Firstly, there was less risk of losses resulting from "flooding of the union" as one was grafting in a period towards the latter part of the growing season, where excessive sap rise would be much less likely to occur.

Secondly, improved scion growth the following year as the vascular tissue would likely to be more united between stock and scion prior to shoot growth, compared with January-February grafting. Thirdly, it relieved pressure on the traditional winter grafting period of January-February for woody plants.

Rootstocks. A three-year pot-grown *P. abies* seedling of "pencil thickness' was the rootstock most used. This could be achieved by growing for two years in an outside seed bed, then potting up into a 7.5 to 10.0 cm. diam. pot for the third year. The system mentioned earlier under "propagation by seed" over a two year period could be considered as an alternative.

Alternative rootstocks mentioned were *P. pungens* and *P. sitchensis*. Another variation mentioned was to lift a three to four year seedling from the field with a ball of soil which, in turn, was root-wrapped with a hessian square. There was one

warning expressed with this method in relation to the final percentage of successful grafts. This was losses due to excessive drying out of the root ball while in the grafting case. An illustration was related where a low percentage was achieved when, on subsequently cutting longitudinally through the rootball, root development had only developed up to 8 cm due to a shallow 'pan' in the soil profile, so when the grafts were watered in the closed case, little benefit was achieved.

Scions. Correct selection of scion material was necessary when grafting *P. pungens* cultivars. The aim should be to select a scion 10 to 15 cm long of terminal or axillary shoots with a well developed terminal bud, and not less than three axillary buds. For the specialist producer, long term planning was necessary for a source of scion wood, using the principles and benefits gained from "hardwood cutting hedges". Three to four year grafted plants lined out in rows in the field and, as from the second year after planting, cut back annually to a framework in order to produce a large number of suitable juvenile shoots for scion wood.

Procedures for Grafting. The basic essential discussed was the importance of having the rootstock dried off before grafting. The stocks should be placed in an optimum temperature of 10°C (50°F) for two to three weeks and, if necessary, the root ball removed for three days and then replaced into the pot to quicken the drying off process.

Excessively high temperatures and humid conditions can cause the rootstock buds to break which, in turn, can lead to subsequent problems related to excessive sap rise. Other details given can be summarized as follows:

1) The base of the rootstocks should be thoroughly 'cleaned-up' with a knife and coarse rag. Some of the rootstocks may require reducing in length so as to facilitate tying-in.

2) Avoid collecting at any one time more than sufficient scion wood to last more than one day.

3) The basal needles of the scion should be removed from where the cuts are to be made.

4) A cloth soaked in white spirit should be at hand to remove resin from the blade of the knife.

5) Length of cuts should be around 4.0 cm in length ensuring they are not made too deep.

6) Four different side grafts are as follows:

a) *Side veneer graft.* This graft probably is the most widely used.

b) *Side veneer graft with an extended lip (1.5 cm).* It was

claimed this helped to avoid the base of the scion from being bruised after tying-in.

c) *Modified side veneer graft.* A flap on the rootstock is made to equal the length of exposed wood. The scion is prepared on both sides so as to form a thin wedge. It was felt that unless the grafts were waxed there was a greater chance of desiccation of the scion.

d) *Oblique side graft.* Here a flap is made into which a scion, cut as for an inlay graft, is tucked inside the flap of rind. This was claimed to be a useful technique when the scion was considerably smaller in diameter than the rootstock.

7) Tie firmly with a rubber strip to give an even tension over the graft; as the strip gives, a gap of the scion, the very base of the graft is left exposed.

8) The importance of correct aftercare was emphasized. For January-February grafting, the grafts can be placed in a grafting case so the base of the pot is standing in moist peat. The grafts are covered by shaded glass or milky polythene.

The grafts are kept very much on the dry side with very limited application of water until after around three weeks when callusing between scion and stock has commenced. The grafts could then be gradually ventilated until, after around six weeks, the glass or polythene could be replaced by a woven *plastic material.*

For August-September grafting, again a grafting case could be used or, alternatively, they could be callused in a cold frame. For the latter, the grafts should be waxed over the union.

Snagging back of the rootstock was normally carried out up to three times for August-September grafting, and twice for January-February grafting. To give greater strength to the union the final snagging back may be carried out so that a 0.5 cm "church window" of exposed scion is obtained, to encourage further callusing between scion and rootstock.

PROPAGATION BY CUTTINGS

Owing to a limitation of time this technique was only briefly discussed. This technique was liked mainly for the slow-growing forms. *Picea glauca* 'Conica' was raised from softwood cuttings in two ways. The first was to bring containerized stock plants into the glasshouse in February. These were placed at a temperature of around 10°C (50°F) to promote early breaking of the dormant buds in order to provide suitable cutting material in late April-early May. Secondly, was to take cutting material in June from outdoor stock plants. However greater success was claimed to occur when semi-hardwood cut-

tings were taken in July and placed within a shaded cold frame. A proprietary rooting hormone applied as a talc at 0.8% IBA was recommended. These cuttings were then left in the cold frame until the following March when they were potted off.

Success achieved with dwarf *Picea* after mid-August seemed to drop when rooted under mist. Due to the tendency of *Picea* cuttings to "damp-off", a fungicidal liquid dip was recommended before the cuttings were placed within the rooting compost. Some success was claimed from rooting *Picea pungens* cvs. in a compost with a high ratio of sand; however the problem is in establishment after potting off and subsequent successful over-wintering.

DISCUSSION GROUP REPORT
OBTAINING AND TREATING SEEDS OF HARDY WOODY PLANTS

CHAIRMAN — P.D.A. McMILLAN BROWSE

Discussion on this subject proved to be somewhat limited as the majority of the group had attended in order to seek information rather than be able to offer experience.

Obtaining Seeds. A list was circulated of commercial seed houses and comments made on the extent of their lists and reliability of supply.

Some discussion took place on the merits of collecting one's own seed where it was possible. It was emphasized that this was not necessarily a cheap alternative as labor requirements were extensive if seed was to be brought to the state of being a clean, well presented sample. It did, however, permit the collector to positively identify his material, to be able to select parent trees for superior, typical, or desirable characteristics and collect at any particular time that was deemed to be advantageous. It was also emphasized that seed bearing, unusual, ornamental woody plants were, more often than not, present in most localities and it was merely a matter of locating such specimens.

Treating Seeds. A brief discussion was held on the two major seed treatments — stratification and acid scarification. It was emphasized that, provided standard techniques were developed and adhered to, there was probably much less variation about a norm in terms of treatment time, than would be expected by reference to revelant literature. It is important to standardize seed condition, treatment technique, real starting point and practical end point.