bat on the ball. We see the furious dash for the base, legs flying, arms pumping, the utmost in action. We, all of us, love to watch this sequence. We watch it again and again and never weary of it. We make national heroes of those who can observe, think, plan, decide and act all in a few seconds, at once, and on the instant

How many men do you know who observe, think, plan, decide and act, in other words, play ball every time you meet them?

These are the cardinal virtues which we should and must adopt in these times for our own salvation and that of our industry and I might add, for the salvation of the Nation as well.

Let us strive to rise above the common level of man, ever remembering that in the Trial Balance of Life, "It isn't the job we intended to do or the labor we've just begun that puts us right on the ledger sheet, it's the work we have really done. Our credit is built upon things we do, our debit on things we shirk The man who totals the biggest plus is the man who completes his work. Good intentions do not pay bills, it's easy enough to plan To wish, is the play of a stupid boy, to do, is the job of a man."

PRESIDENT VANDERBROOK. The first topic on our program is a symposium on "The Propagation of Spruce." At this time, I would like to have Dr. Robert P Meahl come forward and moderate this panel. Bob, I will give you my gavel and allow you to introduce your own panel members

MODERATOR MEAHL (Pennsylvania State University, Univ. Park, Pa.): I am very happy to have this opportunity to appear before you again and discuss the propagation of spruce.

As you will note from your program, we are to have a review of the literature followed by three people who will discuss the various aspects of spruce propagation. So, very briefly, I would like to go over some of the literature which we might find related to the propagation of spruce.

Dr. Meahl presented his paper on the "Propagation of the Genus *Picea.*" (Applause)

PROPAGATION OF THE GENUS PICEA

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The genus *Picea,* or spruce, is one of our important evergreen groups. Many species are valued for their use in reforestation, lumber and pulpwood, Christmas tree production, and general ornamental or landscape use The most efficient methods of propagation are then of primary importance to the nursery industry. The three primary methods of propagation are by seed for those species which will come true, and either grafting or cuttings for those which will not. These three areas will be considered separately

SEED PROPAGATION

One of the best sources of information on seed propagation is the Woody-Plant Seed Manual (10). If possible, it is best to collect the seed for one's own use. The cones should be collected in the fall, beginning just before the cone-scales start to open. After collecting, the cones may be spread out in thin layers to dry in the sun or in well ventilated cone sheds to prevent heating or molding.

After extraction, it may be necessary to store the seed for a period of time. In addition to the viability there are three factors related to good storage. These are the oxygen supply, moisture, and temperature. Seeds of *Picea glauca* and *P. rubens* have kept their viability for 10 years when stored dry in sealed containers at temperatures just above freezing (36° to 40°F.). *Picea abies* and *P mariana* seed have retained their viability for 5 years in sealed containers in cool cellars. *Picea abies* seed also retained satisfactorily viability for 5 years when stored in the cones in a dry loft. *Picea engelmanni* seed kept its viability for 3 years when stored in sealed containers in cool cellars, although germination dropped about 20 per cent at the end of 5 years. It is probable that when stored under proper conditions spruce seed can be kept viable for 10 years (10).

Of ten spruces reported (10) *P. abies, P. breweriana, P. engelmanni, P. glauca, P. glauca albertiana, P. mariana, P pungens, P rubens, P. sitchensis,* and *P. smithiana,* all except one had some degree of dormancy, although this may have changed after further testing. *Picea glauca albertiana* showed no internal dormancy. The dormancy may be broken by stratification at around 41°F. for 30 to 60 days, or the seeds may be sown in prepared seed beds in the fall. The lower winter temperatures (outside) provide the same general conditions as stratification.

GRAFTING

Grafting has been for many years a method of propagation of varieties of spruce which do not come true from seed. There is little in the literature regarding experimentation or research on grafting practices of spruce · Textbooks and bulletins usually give general or specific recommendations which, if followed, are effective. These are based for the most part on practices developed through experience and not upon specific research Wells (9) states that grafting is the normal method of producing Koster and others forms of Blue spruce. He recommends *Picea abies* as the most satisfactory understock and suggests grafting be done in February or early March. Terminal shoots should be used for the scions although the terminals of side branches can also be used.

CUTTINGS

Attempts to root cuttings of spruce have been made for many years in an effort to simplify the production of those types which do not come true from seed. Rooting results have varied and no one procedure has been developed which will guarantee satisfactory results.

Deuber (1) conducting experiments with cuttings of Norway spruce, Eastern White pine, Red pine, Lace-bark pine, Japanese red pine, and Canadian hemlock, found that roots formed more readily on

some species than others. He concluded that the rooting process was influenced by internal and external factors. Those of greatest significance appeared to be the season at which the cuttings were collected, the age of the parent stock, and the clonal variation in rooting capacity.

That the age of the parent plant greatly influenced the rooting of difficult to propagate plants, was reported by Gardner (5). He discovered by chance, in the winter of 1927 - 28, that stem cuttings of apple from 1 year-old seedlings rooted very easily in contrast to older wood. Additional studies with other species showed a definite relationship between the age of the plant and rooting. Cuttings from 2 year old plants of *Picea abies* rooted 90 per cent while cuttings from old plants rooted 50 per cent. The same relationship was found with *Pinus strobus.* Cuttings from 1 year old plants rooted 98 per cent, from 2 year plants 50 per cent, and from 3 year plants 12 per cent

Another important factor influencing rooting is the position on the plant from which cuttings are taken. Grace (6) working with Norway spruce, took dormant cuttings from the upper and lower regions of a tree to determine whether there was any relationship to ease of rooting. He treated the cuttings with talc, and talc containing 1000 parts per million of indolebutyric acid, using sand as a rooting medium In 10 weeks the rooting was 75 per cent from cuttings of the lower region while only 43 per cent from the upper region. After 19 weeks the rooting percentages were 86 for the lower and 48 for the upper regions. In addition, cuttings from the lower region produced roots twice the length of those from the upper.

Although the cuttings from the lower portion of the plants gave better rooting, the resulting growth of the young plants was not as desirable. Deuber (2) reported a tendency for the growth on plants from the lower branches to be somewhat horizontal. Such plants eventually assumed upright growth, although in some cases this did not occur for 3 years.

Farrar and Grace (3) conducted extensive experiments on the season of taking cuttings of Norway spruce as related to rooting response. They found that cuttings taken from mid-July to October gave good rooting with percentages ranging from 82 to 98. Rooting was not as satisfactory on cuttings taken later Those taken in April rooted 78 per cent. June cuttings rooted poorly. Kirkpatrick (7) reported that cuttings of *Picea pungens* rooted best when taken in February and March

The type of cutting and rooting was studied by Farrar and Grace (4). They found that simple cuttings rooted better than those with heels whether taken in July, August, September or October. They also found that a rooting medium of sedge peat was superior to sphagnum peat or sand.

In 1956 Teuscher (8) reported on the rooting of the Montgomery Blue spruce. This originated as a chance seedling and is grayish-blue in color and is very symmetrial and dwarf in habit. Best rooting was secured in medium-fine, slightly acid, sand kept moderately moist. Any addition of peat moss decreased the rooting percentage. He found that the needles at the base must be left on and that additional wounding was harmful. Rooting hormones were not helpful, in fact, all those

tested caused injury or death. Cuttings taken towards the end of June, when the young shoots were well formed but not fully hardened, gave 60 to 75 per cent rooting. Those taken after August 1 to January did not root until the following spring and by then many had died. However, cuttings taken towards the end of February and early March, given bottom heat of 50 to 55 degrees and an air temperature of 40 to 45 degrees, callused quickly and rooted 90 per cent or more by early May.

It is thus apparent that further work needs to be done to determine the proper procedures for rooting spruce cuttings.

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MODERATOR MEAHL: That completes our review of the literature and since we are not going to have questions at this time we will go directly into the specific phases of propagation of spruce. The first method we are going to have discussed is the propagation of spruce by seed, and to tell about that we have Thomas S. Pinney, Jr.

MR. THOMAS S. PINNEY, JR. (Evergreen Nursery Co., Sturgeon Bay, Wisconsin) : Maybe some of you are rather surprised and I was too, to find myself as a replacement for my father. We are sorry he couldn't be here.

Mr. Pinney presented his paper entitled "The Propagation of *Picea* by Seed" (Applause)