Do the scaling in September or October. Select only the largest bulbs for scaling as these are the most likely to be healthy. Pull away the outer scales snapping them away from the bulb near the base. Discard any damaged or diseased scales and you can replant the center portion of the old bulb. Treat the scales with fungicide by soaking for 1/2 hour in Benlate (4 grams/litre) or in Captafol if Benlate-resistant penicilliums are likely to be present. Drain off and mix scales with an equal quantity of damp vermiculite or peat and seal up in a polythene bag. Use not more than about 2 bulbs per bag; large quantities of scales in one bag do not obtain sufficient oxygen and rot. Damp (not wet) vermiculite is important. Store the bags for about 2 months at a temperature of 70 - 75°F (the bottom of the airing cupboard is about right) until nice little pea-size bulblets have grown on the scales.

Harden off slightly by storing for a further month at about 60 to 65°F before opening the bags and planting out the scales together with the attached bulblets in 2 inch deep drills in an open frame or bed in December or January. Avoid deep planting since few of the scales bulbils will produce foliage the first year. We then cover the bed with 1 inch of sand and peat, this mulches the young plants and saves a lot of weeding.

Keep well hand-weeded, kill any greenfly, and bait regularly against slugs and you will have a large number of nice medium sized bulbs for planting out next year.

We have propagated Asiatic, Aurelian, and Oriental Section hybrids very successfully by this method. I did not have satisfactory results with one attempt with *Lilium superbum*, and the American hybrids may not be so successful. *L. testaceum* is satisfactory but, as it makes only basal leaves the first year, it must be planted very shallowly and sprayed regularly against *Botrytis*.

DOUBLE TUNNEL PROPAGATION

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Recent increases in oil and electricity prices have considerably raised the production costs of shrubs using traditional techniques. Glasshouse management, especially programmes involving the use of intermittent mist, have had to be reviewed in economic terms so that maximum returns can be achieved. Any alternative techniques requiring lower capital investment

and incurring lower running costs have therefore become attractive.

At Loughgall our interest turned to polythene as an acceptable alternative in terms of economic attractiveness. As a result of many variations on the theme we developed a simple and cheap method using the basic concept of small "inner" tunnels constructed inside a large tunnel giving the Double Tunnel effect. Over a number of seasons several combinations of milky and clear UVI polythene have been tried. Experience and results gained at Loughgall made it possible for a propagation programme to be recommended. Local growers adopted this technique with considerable commercial success. Subjects suitable for this technique are generally the wide range of popular shrubs produced from summer cuttings or traditionally rooted over-winter in a cold frame. However, following original recommendations, growers using this system have successfully rooted a range of subjects previously propagated with mist, e.g. conifers and some semi-hardy shrubs. Consequently any increase in propagating capacity has been through the use of this system.

Facilities. The main requirement is a ventilated walk-through polythene structure 5.0 m (16½ ft) wide clad in clear UVI 500 gauge (125 μ) polythene. Correct siting is an essential feature both for ventilation and protection of the structure. Preference should be given to a site with a slight slope (1 in 50) protected from extreme weather conditions yet allowing through ventilation at all times of the year. Flexibility in ventilation may be achieved by using door frames with the lower half covered in polythene to prevent damage from low level draughts and the top half with an open mesh type windbreak material. Inside the outer tunnel three rooting beds, each 1.2 m (4 ft) wide × 152 mm (6 in), are constructed using treated timber 152 × 38 mm (6 in × 1½ in). These beds are lined with 500 gauge (125 μ) builders grade polythene to isolate the rooting medium from the soil and also to minimize watering. The liner is turned up at the sides and attached either by timber lathes or tacked in place using an industrial tacking machine. Free drainage is ensured by leaving the liner flat at the lower end of the beds. Hoops of high tensile galvanized wire are spaced at one metre intervals over the beds. They may be pushed into the ground or attached to the timber, preferably on the inside of the beds. Spacing can be stabilized centrally using polypropylene string and the ends strengthened by inclining two hoops together. Hoop profiles must be 'D' shaped providing an average height across the beds between the rooting medium and cover of 356 mm (14 in). The beds are either filled to a depth of 125 mm (5 in) with the recommended rooting com-

post, or with loose moist peat if containers (pots, trays etc.) are to be used. A sheet 1.83 m (6 ft) wide of either clear UVI or 'milky' 250 gauge (65 μ) polythene depending on the season is laid over the hoops to form low inner tunnels. When the sheet is laid loosely over a correctly constructed bed, there should be an overlap of 150 mm (6 in) which is essential to make a condensation seal to maintain humidity. At each hoop, polypropylene string loops over the tunnel will prevent excess movement. Access and ventilation are gained from the side by sliding the polythene cover upwards on the hoops.

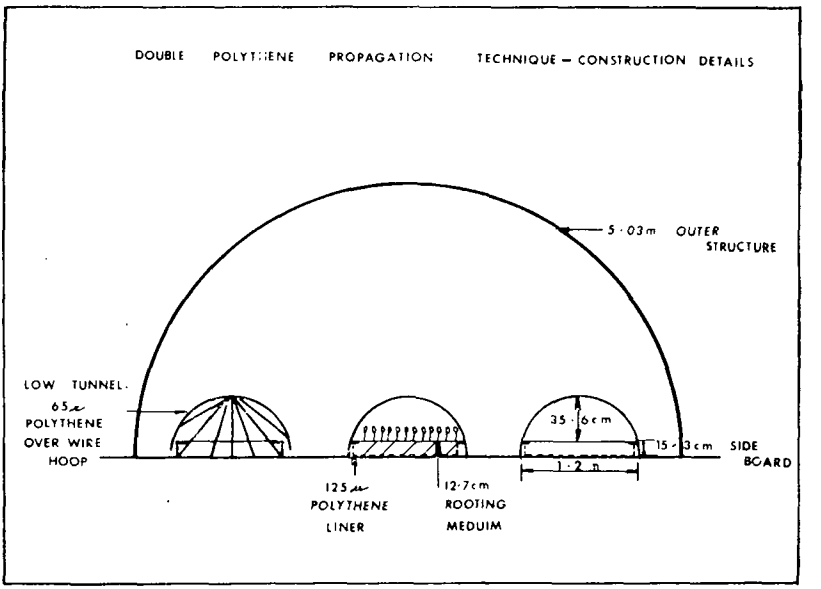

Figure 1. Diagram showing construction of "double tunnel".

Propagation material. Cuttings taken from vigorous juvenile current season's growth should be an average of 100 to 150 mm (4 to 6 in) long after any soft tip growth has been removed. In this technique the bases of the summer cuttings should be semi-ripe i.e., lignification having commenced. The cuttings are larger and more robust than mist type material so that the use of stock plants or hedges is recommended. Winter cuttings can also be rooted using this technique but material should be at a semi-hard to hardwood stage, i.e., lignification advanced. Growth has normally ceased and bud dormancy, especially on evergreen species, is established.

Preparation of cuttings. The majority of species are prepared as nodal cuttings. Foliage removal is minimal and only

shallow insertion is required. Material must be collected and trimmed as quickly as possible to reduce loss of turgidity before insertion. If delays are likely to occur then cuttings can be stored at 3 to 4°C in polythene bags. Storage time however should not exceed two days for maximum success.

Insertion. Cuttings can either be inserted directly into the prepared moistened rooting medium or into containers depending on the growing system employed on the nursery. In order to achieve and maintain the correct microclimate within the inner tunnels frequent hand sprayings to maintain humidity are recommended. Initially inner tunnels, once prepared and covered, must only be opened to allow access for insertion. In this way the inner microclimate is preserved and no internal watering equipment should be necessary.

Density and Microclimate. Shallow insertion should be employed for all species. Cuttings should be spaced with foliage just touching in and between rows. No standard spacing recommendation can be given as leaf size varies widely. Failure to insert at the correct spacing will result in slower rooting and possible disease problems. The desired microclimate within the inner tunnel is obtained only if foliage is present from the surface of the rooting medium upwards thus leaving no dry areas. The outer tunnel during the rooting period is ventilated freely except for bottom draught exclusion.

Programme. The rooting medium and inner tunnel coverage will depend on the season, type of cutting and species. Over a number of years it was found that it should be practicable to root two batches of summer cuttings in early July and mid-August. No hormone treatment is necessary if material has been correctly selected and trimmed. A third batch of hardwood cuttings of a more limited range of species may be inserted in Sept-Nov. This type of material will generally need treatment with 0.8% IBA or its equivalent. Summer propagation is normally carried out in a rooting medium of 3:1 peat/sand, as a result of media comparisons. The inner tunnels are covered with 'milky' polythene to prevent scorching. Results from the other three combinations of clear and white inner and outer tunnels showed either reduced rooting under low light conditions or scorch damage in higher light conditions with double clear coverage. Rooting the summer batches will take approximately 3 to 4 weeks. A slow increase in ventilation of the inner tunnels allows rooted material to be weaned off and subsequently containerized or lined out. Winter propagation requires a more open compost of equal parts of peat and grit (coarse 3mm). Other media tried, including pure peat, sand and peat/sand mixtures, reduced rooting markedly. Unlike summer batches, clear inner tunnels have proved most effective. High light in-

tensity was found to be desirable as rooting is slower at this time and callus develops before rooting commences in early spring. The outer tunnel is always kept ventilated to avoid temperature inversion due to radiation frosts.

Management. If adequate moisture has been provided in the initial medium, little additional attention is necessary other than an occasional light spray. Maintenance of humidity in this technique is a key factor and depends on the propagator's skill replacing the automatic but expensive control of misting. In summer, maximum humidity must be maintained. This should be a simple process with the "canopy" effect of foliage creating the microclimate and maintained by the "sealing" effect of condensation on the inner polythene tunnel. Lower levels of humidity are required during the winter period.

Good hygiene requires removal of any soft or dead material such as flowers, buds and leaves before and after insertion which may lead to problems with *Botrytis cinerea* (grey mould). Preventative fungicidal sprays can be applied at regular intervals if necessary.

Weaning in summer must commence immediately after maximum rooting to avoid "drawing" of the plants as new growth occurs. The type of root system produced is fine and fibrous while winter cuttings have rooted over a longer period with hormone treatment produce a more fleshy brittle root system.

Removal of summer rooted material means employing some method of growing on either by lining out, containerizing, or "rolling" in polythene rolls and overwintering under protection. This will produce "liners", field or pot grown, the following spring. Winter batches in a similar way will produce autumn "liners", saleable size container-grown material or bare root shrubs for the following season, depending on species.

Conclusion. It is possible to insert an average of 15 to 20,000 cuttings per bed size 16.15 × 1.2 m (53 × 4 ft). This simple system can handle large quantities of propagating material in a small intensive area. Costings of this technique compare favorably with traditional mist propagation under glass. Initial expenditure on the "Double Tunnel" system (one tunnel 5.0 × 16.5 m (16½ × 54 ft) containing three beds) is £7.78 per square metre compared to £67.50 per square metre for mist propagation. The "Double Tunnel' system has proved popular with growers because it conveniently fits the existing management pattern on the holding. This system although not recommended for use with high value shrubs, e.g. *Magnolia*, *Camellia*, *Rhododendron* (including azalea), etc. appears, however, to fill a definite propagation need. Therefore, if this simple tech-

nique can be applied in the production of the popular shrub range then the more highly capitalized systems can be put to more efficient use in the propagation of high value "difficult" subjects.

SEEDLING OAK PRODUCTION IN CONTAINERS

PETE WELLS

E.F.G. (Nurseries) Limited
Fordham, Cambridgeshire

Species of oak grown are: *Quercus robur* (Common oak or Pedunculate oak) 80%; *Quercus petraea* (Sessile oak) 5%; *Quercus rubra* (Red oak) 5%; *Quercus ilex* (Evergreen oak) 5%; *Quercus cerris* (Turkey oak) 5%.

WHY GROW THEM?

To fulfill the demand. E.F.G. produces up to 100,000 units per annum; there is little promotion of the product and I am sure there is scope for further development.

REASONS FOR THE DEMAND.

Vegetational Climax. The planners are attempting to re-create the vegetational climax of which the oak is the classic example in Great Britain. The Sessile oak being dominant on the acid soils in the west and north and the Pedunculate oak dominating the vegetation on the basic soil of the south and east. Sessile and Common oak interbreed freely and there are numerous hybrids occurring naturally throughout Great Britain. One interesting fact about oak trees which supports the planners choice is that 287 different species of invertebrates are dependent upon the oak tree at some stage in their life cycle. This diversity demonstrates the longevity of the oak as the dominant tree species in the environment and also serves to indicate the stability which it lends to a woodland habitat. Some oaks live to a great age, with a typical hedgerow specimen reaching 200 years and pollarded trees reaching an age of 300 to 400 years. Most oak trees in the U.K. are approximately 70 years old. This means that the oak trees in Britain are now middle aged and also that no plantings of oak have taken place over the last century.

In natural woodland, e.g. the New Forest, the average density of standard oak trees is 1-1/2 trees per acre. So relatively low numbers of mature trees are required for the oak to exert its dominant influence over a landscape. The best site for oak would support, on average, 25 standard trees per acre. However, it should be pointed out that good sites for oak trees are also