winter; although I don't see that as being much of a problem for us as we have several other ideas lined up.

(iv) Finally, there is the problem of space, which is an ever-increasing concern as we think of more and more subjects which we would like to try on the extensive system.

Once we were content with a small mist house and a few cold frames; now our propagation area extends to nearly three acres and we're still looking for more but if it reduces the cost of production it will be well worth it.

A TECHNICAL DESCRIPTION OF THREE PROPAGATING UNITS IN GUERNSEY

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The past four years in Guernsey are remarkable from a plant propagation point-of-view because a large and concentrated horticultural area — some 2000 acres on a small island — took a great leap into the propagating business; because there was little experience in any aspect of this particular field there were many unexpected problems. In any event, out of over 30 nurserymen initially interested, less than 10 remain in business. However, one of the benefits of this lack of experience was an open mind — uncluttered by previous conceptions. We were fortunate in having a large equipment industry backing up the existing tomato and flower crops, and so the open mind and technical expertise got together and produced some most interesting and advanced propagation units. These units only worked when they had been evolved with the closest co-operation of someone experienced in propagating the particular plants concerned.

I shall describe the technical side of three propagating units that were built for very different purposes. You will notice many similarities in them because we all came to the same conclusions on many basic design points.

John Allen had the idea, which he developed with George Thorburn, of establishing from scratch a large wholesale business for hardy nursery stock. The site was a not too old tomato nursery in a fairly exposed situation. George Thorburn's experience stemmed from Holland and Germany and he knew only too well the importance of an extensive plant list. He embarked on the production of a wide range of plants including rhododendron, camellia, deciduous azalea, skimmia, mahonia, magnolia, miniature roses, hamamelis and so on. His propagation unit would have to cope with rooted cuttings and grafting. He has a 200 ft long by 30 ft wide 'traditional' Guernsey greenhouse on which he uses Rocolene shading.

Inside the house there is a wide central path for motorised trucks and the beds are placed on each side. The 6 ft wide beds are simply asbestos sides set into the soil with 18-inch gravel paths between. The ½-inch polythene heating coils were set directly into the soil, 2 inches below the plant boxes. The lack of drainage has recently caused problems and the use of sand would probably now be recommended. A main hot water feed pipe goes through a motorised valve into the flow manifold. The motorised valve is controlled by a detector set in the bed. The house is divided into several sections in case of different heat requirements. The ½-inch polythene tube is looped under the beds to ensure even temperature distribution. The return is sited on the opposite side of the house, the loops extending across the full width — under the central path. This very simple and cheap system has only one drawback in that the temperature cannot be accurately controlled. A more sophisticated system would require mixing valves and separate circulating pumps for each manifold.

There is no mist in this unit and all propagation is carried out on a closed case basis. The cuttings are covered with thin clear polythene film and the beds are covered with white polythene tunnels sealed at each end. This is very similar to methods used in the most advanced German nurseries. After rooting, the plants are weaned off in a greenhouse next door. A wide range of containers is used depending on the particular crop.

A 65 ft wide by 200 ft long Frampton Ferguson house was used by Eysturoy Nurseries Limited to produce rooted *Begonia* 'Elatior' cuttings. The entire production cycle was based on similar units in Denmark and was mounted on benches constructed to Danish plans for ease of working. The 1.8 metre wide benches were made from timber and asbestos. They were covered with Vattex and watered by a special Volmatic system. Vattex and similar systems have had problems in Guernsey because of the high salt levels in our water supply. The benches were raised off the floor on 4" cast-iron or terra-cotta drain pipes. Hot water heating pipes were suspended under the benches and controlled from a mixing valve. Aluminum strips were sprung across some of the beds and covered in white polythene or Dralon to provide the rooting areas. Dralon gives shading without high humidity and is useful during weaning.

Inside one of these mini-tunnels were several important features. The mist was supplied from galvanised mains and 50 cm plastic standpipes through DGT nozzles. The whole system worked at 4 atmospheres at the nozzle (60 lbs. per square inch) and the mist or fog produced was very even. Control was by a DGT mist controller activated by a piece of blotting type paper on a sensor. Heating was by four ½ inch polythene pipe loops set into 4 inches of sand and controlled by a mixing valve. The sand was covered with polythene sheet and 3 inches of peat. The sand was kept moist to ensure efficient heat transfer. The cuttings were rooted in open mesh OS pots held in the rack and could be quickly moved to the weaning benches. The rooted cuttings were thus produced at about 10,000 per week from this 1/3 of an acre greenhouse.

The control panel for the whole unit consisted fo a DGT mist controller which incorporated a timed delay so that a degree of "drying-out" could be achieved if desired. A Sarnia Controls unit sequenced the weaning and motherstock spray units and was started by the DGT Sol Integrator. I shall describe the detailed workings of this equipment when discussing my own nursery. There was a unit for controlling the automatic shading system by light intensity. Regrettably the market was not ready for the scale of production achieved at this nursery and the whole unit has been dismantled and sold.

Finally I come to my own nursery, Victoria Vineries Limited, where Raymond Evison and I have designed and built a specialised unit for the large scale productions of young clematis plants. Raymond described at last year's Conference the propagation techniques we use, so I shall confine my comments to the systems, equipment, their design and working.

The young plants are grown-on on the floor of a 30 ft wide greenhouse and here, for economic reasons, we have had to use the existing 4 inch cast-iron hot water heating system although it does affect the overall space utilisation. The overhead irrigation system uses DGT nozzles and a Volmatic barrel diluter — an even distribution of 1 millelitre per 3 inch pot per minute is achieved across the whole area. The floor is covered in black polythene and the tomato trays holding 18 three-inch pots rest on bamboo canes to ensure good drainage. Cuttings are taken from these plants using one-sided razor blades and placed into specially made aluminum trays. The trays are lines and covered with Captan soaked linen to inhibit flagging of material. The label is written at this stage. Optimum working conditions are important in any production unit; the girls can sit comfortably whilst making the inter-nodal cuttings. The prepared cuttings are placed in specially made nylon coated trays which are dipped in Captan before the cuttings are struck in seed trays. Once full, the trays are stockpiled on a two-tier slotted angle trolley before being moved out, 10 at a time, to the 4 mist beds. These are arranged so that we can change the climate every 2-3 weeks without moving the cuttings.

The plant density is over 100 per square foot and as nearly 100% rooting is achieved, we have not been able to find a more convenient system, although we have looked at modular types including rockwool blocks, Jiffy strips, peat blocks and so on.

The beds are 9 feet wide and have a 500 gauge polythene base to give weed protection. This is covered with 1-inch thick expanded polystyrene to discourage vertical heat transfer; this material is cambered to provide drainage at the bed edges. Two inches of sand were then laid on top and levelled forming a base for the loops of ½ inch polythene pipes. These pipes are covered with a further 2 inches of sand. They are 9 inches apart and have a return and flow arrangement to ensure absolutely even heat distribution. One man did all the pipe laying and fitting alone, taking approximately 1 hour per bed. The mains congregate at the flow and return manifolds which are valved for isolation in case of damage and so that during weaning, bottom heat can be lowered against the 'control' bed. It is cheaper to run the polythene tube to a compact manifold than to extend the manifold to the bed, and more flexible in case of change.

The hot water is supplied from the boiler through a 'DGT' mixing valve and circulated continuously through the pipe system. The calculations for the heat required are based on giving the greenhouse itself a 30°F lift. We also have 4 inch perimeter pipes for air heating. The controller has a string of five detectors spread across the bed to ensure that a representative temperature is maintained and this can be moved to each of the four beds as the 'control' bed moves during the production cycle. These are normally covered by trays of plants.

The mist nozzles are set in two rows, 2 metres apart, into the roof of the greenhouse at 1½ metre intervals. A Grundfoss CP 8-60 draws filtered rainwater from a hundred gallon tank through a 2 inch polythene pipe and, running continuously, supplies water under pressure at 6 atmospheres to this manifold. There is a capillary bleed-off returning to the tank to prevent the pump overheating. When the controller turns on the Danfoss solenoid valve for a particular bed to be misted, the water flows into two ¾ inch polythene pipes, one for each row of nozzles. The header pipe, as it is known, is punched at 1.5 metre intervals and a capillary tube takes the water to the DGT nozzle through a specially made plastic block.

All the fixings are push fit and in fact we did all the fitting work ourselves without skilled labor. The block is held in position by a ¼-inch aluminum rod pushed through a hole drilled in a 2 by 1 wooden batten. A small capillary tube leads down from the header to provide a drain off, thus preventing excessive drips. One of the beneifts of this system is its flexibility, lack of corrosion and, of course, its cheapness, about £ 1.50 per nozzle, excluding the pump. We have already moved the system once and expect to do so again. The overhead mist is 1½ metres above the cuttings and gives the most even distribution that we have achieved after trying many types of nozzles in various positions.

The shading materials is a Scandinavian dacron which allows 80% of the light to pass through but only 50% of the heat.

We have a most sophisticated control system. A DGT Sol Integrator unit measures the calorific value of the available light — or in other words the energy reaching the greenhouse from the sun, even on cloudy days. This is totalled on a counter and in turn operates a count-down procedure against pre-determined levels on two other counters. In other words, if we set one of these counters at 15 calories, for every 15 calories of energy received a pulse will be initiated by the unit and this will trigger the timing mechanism in a specially made Sarnia Controls unit. A sophistication is a filter which cuts the count-down on a second channel on dull days — we use this for our weaning programme. On the timing unit we can set a length of mist pulse from 2 to 30 seconds; we can also set the time clock for night misting, which we use. We therefore have four programmes available to us and we can switch any one of our four beds into any programme.

We have a continuous programme of research both in Guernsey and Tenbury Wells and lighting is a most promising feature. It is always difficult to evaluate results on a commercial trial but an eight tube gantry enables us to root even normally difficult cuttings in 10 days. We use other lighting systems for day length extension in the autumn — thereby extending our season well into winter.

Finally, I would like to say that much of the equipment has not been readily available. I have been assisted by many skilled and experienced technicians who willingly produced special units for our needs. I believe that we, as propagators, must not feel restricted by the equipment currently on the market, but that we must go out and develop whatever we think will fulfill our future requirements.