depending on the time of year and the weather. The beds are never fully enclosed as I like to have one corner open at all times for ventilation. We have a very good striking rate considering our material and conditions that are not perfect.

Once the cuttings have developed into good sized plants, they are potted on into either 4 or 5 inch pots. The 4" has one single plant potted into it, selected for its size and species. Later they will be placed around tree fern totems ranging from 2 ft to 5 ft in height. The 5" pots have 5 or 6 plants selected for compatibility placed together, which are later potted on as a multiple without a totem in 6 or 7 inch pots.

When these plants have reached maturity, they once again return to decorate the city buildings to start the cycle over again.

SIMPLE GREENHOUSE CONSTRUCTION USING LIGHTWEIGHT MODULES

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Two years ago, Jack Paterson — a fellow nurseryman and I discussed the concept of modular greenhouses. We both became very enthusiastic about the many developments we envisaged possible, so here are some of our suggested objectives for such a "modular house".

1) That the "greenhouse" be of sufficient size to allow for economic nursery operation.

2) That the "greenhouse" can easily be erected by 2 or 3 persons in a short time.

3) That the "greenhouse" be made out of light-weight material, simple in construction, and long lasting, with good light transmission.

4) That the "greenhouse" be well insulated and include a built-in ventilation system.

5) That the "greenhouse" be of a design which provides sufficient strength to withstand damage from the elements, especially hail.

6) That under ideal conditions, the "greenhouse" be self-sufficient in terms of energy input required for heating and cooling.

With all these objectives in mind, we looked at them one by one, and also in relationship to each other, and arrived at a

structure which we consider meets most of our objectives.

1) That the greenhouse be of sufficient size to allow for economic nursery operation. When considering ventilation, heating and the building material to be used, we decided on an open-span greenhouse 12 metres (or approx 40 feet) wide, with a height of 5 metres (or approx. 16 feet) at the apex, and side walls of 2.5 metres (or approx 8 feet). The most ideal length for the greenhouse would be 30 metres (or approx 100 feet), but this could be altered in multiples of 0.5 metres.

2) That the greenhouse can easily be erected by 2 or 3 persons in a short time. When considering the handling capabilities of 2 or 3 persons and the material we planned to use, we designed a modular system 2 5 metres high, 6.5 metres long and 0.5 metres wide and a weight of approximately 50 kilos, with a tubular clip-lock system for easy assembly (Figure 1).

3) That the greenhouse be made out of lightweight material, simple in construction and long lasting, with good light transmission. The modules would be made out of fibreglass with a modified resin, which is long lasting, lightweight, and has good light transmission

4) That the greenhouse be well insulated and to include a built-in ventilation system. The module will have an inner and outer wall for insulation, with a vent on the *lower inside* of the module, and two vents in the top of the module, one on the *upper inside* and one on the *upper outside* wall for ventilation.

The air inside the module is heated by the sun, the hot air rises and escapes through the upper inside or upper outside vent, depending which is required. Air is drawn in through the lower vent.

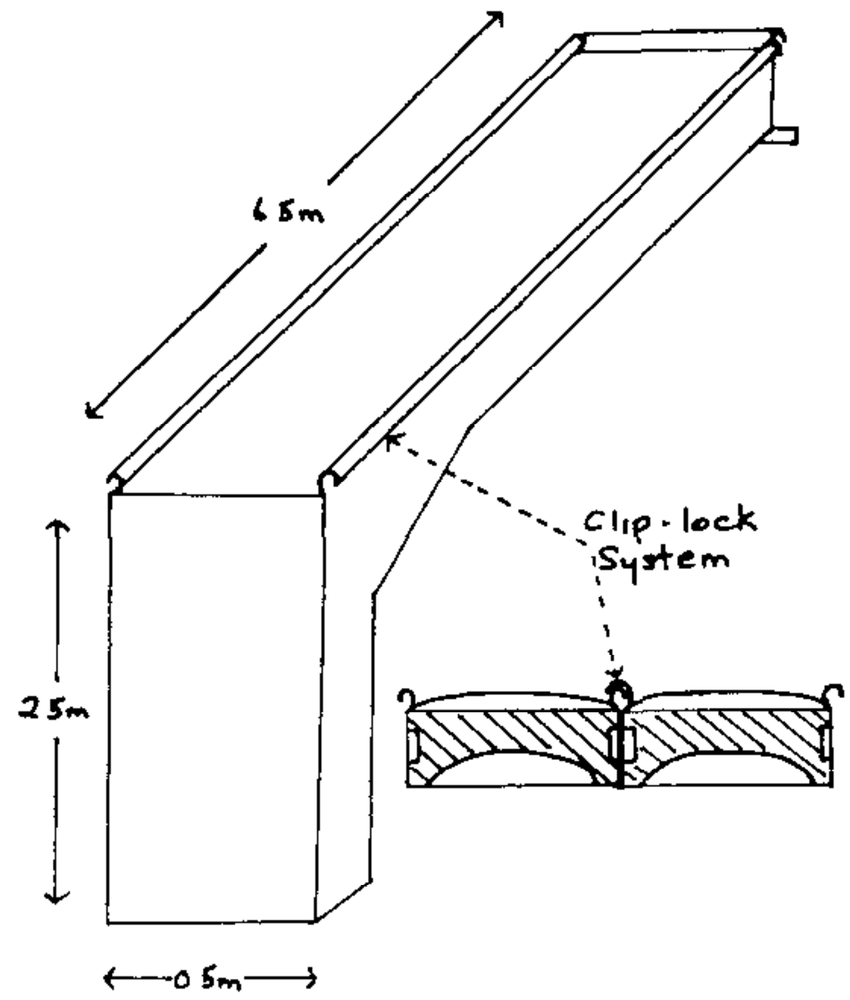

Figure 1. A module with clip lock system.

On a winter's day, when no venting is required, the *lower and upper internal* vents can be opened so that air in the greenhouse is continually circulated by convection, like a chimney.

On a hot summer's day, by opening the *lower inside* and *upper outside* vents, excellent natural venting will occur — hot air rises.

The greenhouse is almost air-tight and fresh air can be sucked in through evaporative cooling pads at the ends of the greenhouse (Figure 2).

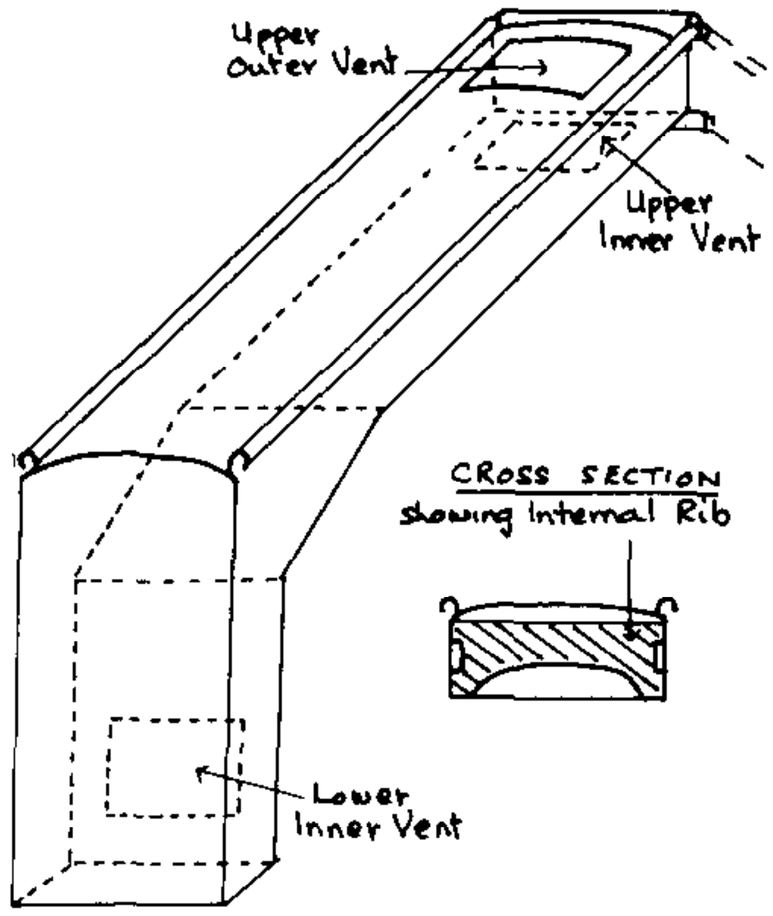

Figure 2. Module with Inner and Outer Vents and Convex Roof

5) That the greenhouse be of a design which provides sufficient strength to withstand damage from the elements, especially hail. The top of the module has a convex outer wall to withstand hail, and has internal ribs to provide for compression strength. The smooth surface and the steep angle of the roof will stop heavy snow-loading on the roof.

6) That under ideal conditions, the greenhouse be self sufficient in terms of energy input required for heating and cooling. The ventilation is based on convection and requires no energy input other than sun-light. The heating is obtained by the inclusion of solar heating pipes in every module to obtain solar energy, which in turn is stored in the floor of the greenhouse to a depth of 2 metres (Figure 3).

Some further points. Heating and cooling can also be obtained by drawing the hot air through the *top inner vent*, down through the module and out through the *lower internal vent* where it is blown or sucked through a propagation or nursery bed filled with gravel. The heat of the air is absorbed by the gravel, and cooled air is recirculated into the greenhouse, reheated by the sun, rises to the top and is drawn through the

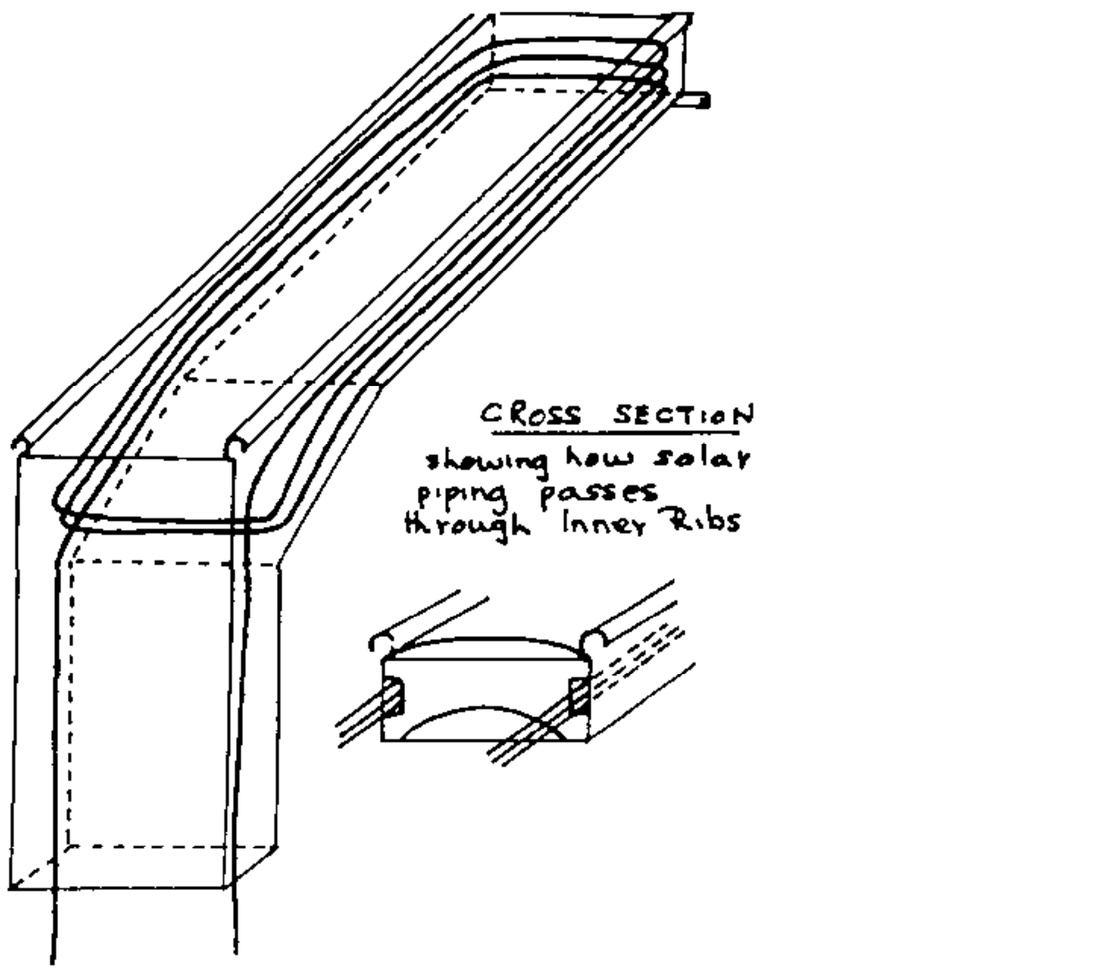

Figure 3. Pipes for Solar Heating in each module

module to the gravel bed again, repeatedly (Figure 4)

Additional insulation can be obtained at night by filling the cavity of the module with polystyrene or a similar lightweight material. This idea can also provide short day conditions for the production of certain plants, e.g. poinsettias.

Shading can be obtained by an aluminium venetian blind type of shading, or the inner wall of the module could be tinted to obtain the desired shading Because of its smooth surface, shade cloth could be mechanically rolled on the outside of the greenhouse to provide shading.

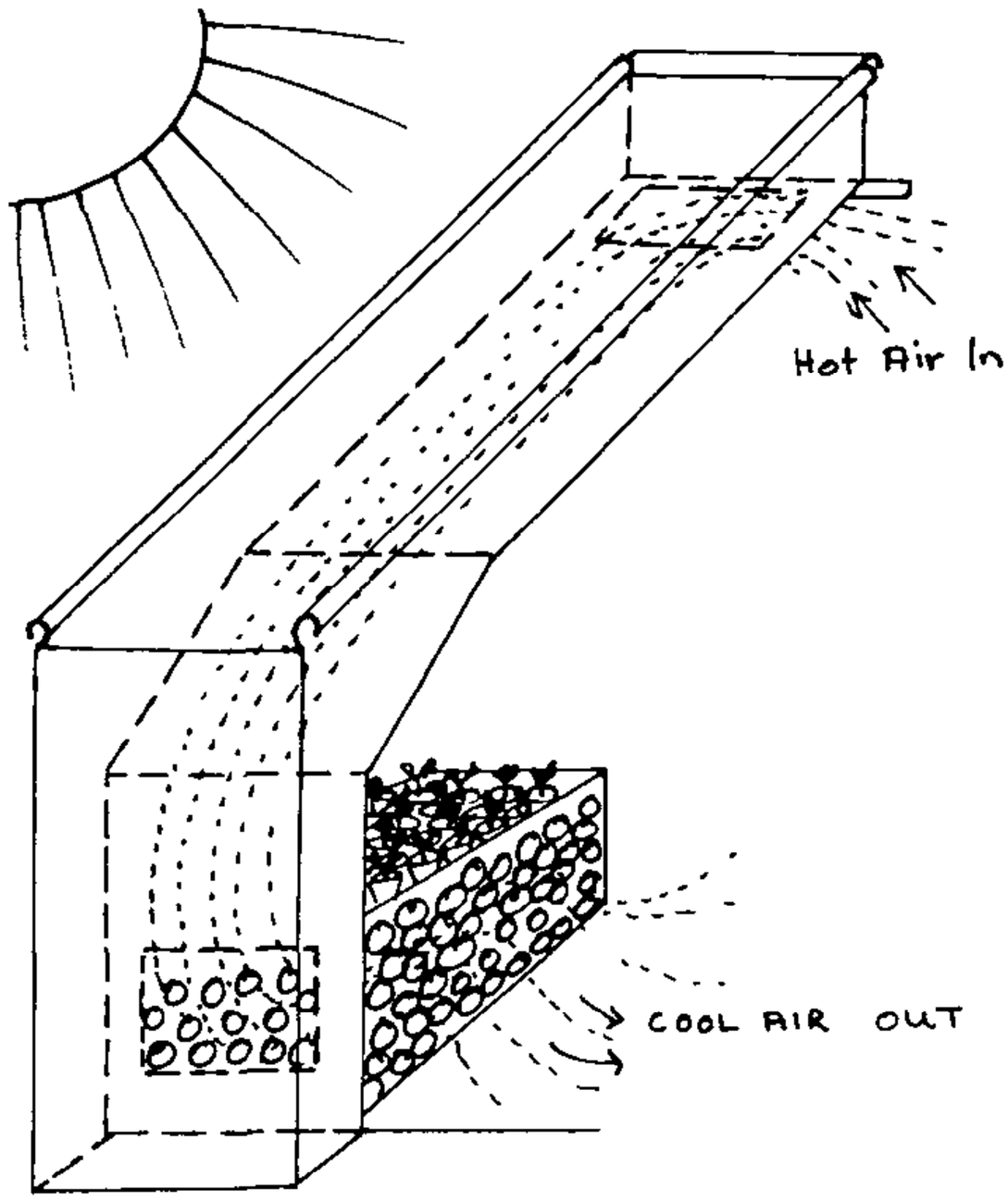

Figure 4. Air cooling