

# GEOHERMAL ORCHIDS

Alistair McLachlan  
Geotherm Exports New Zealand Ltd.  
Taupo, New Zealand

## LOCATION

Geotherm Exports is located on Tukairangi Road, approximately 5 km from the Taupo Township. It is situated on the Wairakei Geothermal Reservoir.

## HISTORY

Geotherm Exports was formed in 1981 to grow the tropical orchid *Phalaenopsis*.

*Phalaenopsis* grow in the wild in the jungles of southwest Asia with a few species extending northwards to Taiwan and Sikkim, and southward to northern Australia. The plants are epiphytic (living on the surface) on trees and they grow upside down (in nature) with the flow stems hanging downward, and the leaves arranged in a spiral fashion. Under cultivated conditions, the flower stems are tied vertically.



Figure 1. Orchid *Phalaenopsis*.

They are shade-loving plants, requiring a light intensity of only 1000 foot candles or 1/10th of full sunlight.

This orchid was first discovered by western botanists in 1750 when a German botanist, Rumphius, found them on the island of Ambon (now call Sulawesi). Two years later, they were discovered on the island of Teneli, west of Java, where only Princesses were allowed to wear the blossoms. The name *Phalaenopsis* was given by Dr. C. C. Blume in 1825 because he mistook the flowers for a flock of butterflies when he first saw them through his field glasses.

The flowers are also known as moth orchid, mariposa, butterflies, and are also known in Indonesia as the moon orchid.

## GEOHERM EXPORTS

Geotherm Exports has the largest single concentration of these orchids grown for cut-flower production in the world and the only one using geothermal energy for heating. There are two other growers in the United States who grow more plants; but, these are sold as potted plants.

The company has created a world first by inducing artificial monsoon conditions, similar to those experienced by the plants in their natural habitat. This enables us to produce crops at any time of the year to meet market requirements in Japan and elsewhere.

The company has approximately 250,000 plants in its greenhouses, laboratory and quarantine area; of these, 30,000 are mature plants. Each plant produces on average two stems of blooms per annum upon reaching maturity (two years old), and these blooms are packed using the most modern inspection and packing techniques to produce the best possible return from overseas markets.



Figure 2. Potted plants with lighting system.

A further world-first in commercial orchid production has been the plant-performance recording system introduced by Geotherm to enable individual records of production and performance for every mature plant to be kept. This now enables the company to breed selectively from plants identified by this method. In addition to good breeding, parent plants must also have good color, shape of bloom, and be prolific in their bloom production per stem, to qualify as breeding stock. The company now produces its own replacement stock through its laboratory and plant-breeding system.

## CONTROL SYSTEMS AND FEEDING

### Computers

The company uses an Apple Ile Computer for controlling day-to-day growing conditions in the production greenhouses, laboratory, growing-on room and plant quarantine area.

This computer enables accurate monitoring of temperature (day and night), humidity, watering, fertilizing, ventilation, the addition of CO<sub>2</sub> and the application of artificial light.

In addition to the Apple Ile, the company also has two Mac XL computers used for accounting and analysis work, and a Macintosh II business computer used for word processing, spreadsheet projections and drafting.

### Heating

Heat is controlled by the Apple Ile computer, and is supplied to the greenhouse by large hot water heaters (using fans and finned heat extractors) or by steam radiators and fans. The geothermal energy used in this way was the first geothermal-horticulture system in New Zealand.



**Figure 3. Forced air heat exchanger.**

The company originally had two geothermal hot-water wells to 300 meters in depth, and a dry steam well to 250 meters in depth which produced steam at 200 psi (13.8 bar) and 210°C. The greenhouses now receive their steam from three wells used for the Mercury Geotherm power plant. These well are 450 to 500 m deep and each can produce 120

tonnes/hour at 7.2 bar. Some of the steam is supplied to the greenhouse through a shell-and-tube heat exchanger (Figure 4). The energy supplied to the greenhouse is equivalent to 20 average homes or about 200 MJ/hr (peak). This is equivalent to an installed capacity of about 55 kW. The greenhouses, which cover two acres (0.8 ha), are kept at 26°C during the day and 21°C at night.



**Figure 4. Main heat exchanger.**

### Fertilizer

Fertilizer is applied every day through a series of electric solenoids by the computer so that each plant can take both water and fertilizer up through the capillary watering system used on the growing tables. This enables the plants to be fed and watered without lying in the leaf joints, which would cause plant rot and subsequent death.

### Lighting

The imported Phillips lighting system is the most sophisticated available in the world. The light fittings produce light in an oblong pattern, so that light is not wasted on the pathways. The amount of light applied is measured by comparing light received by an exterior light sensor and light sensors in each growing area. If light does not reach a pre-set level in each growing area, the computer turns on the lighting system, until the amount of light applied reaches the required level for maximum growth.

### CO<sub>2</sub>

CO<sub>2</sub> is required by the plant to enable cell growth. Geotherm has installed systems originally built in the United States for the space shuttle, designed to work in extremely harsh conditions in space, and for periods of many years with no maintenance. The CO<sub>2</sub> system consists of a vacuum pump which draws samples of air from selected plants in each greenhouse every 15 minutes, passes these samples through a gas analyzer and assesses the level in each greenhouse compared with pre-set levels in the computer. If additional CO<sub>2</sub> is required, this is applied to each orchid table through micro tubes.

## MARKETING

The company has designed its packaging system to enable the blooms to be displayed in the best possible manner. Extra cost is incurred by using boxes with a white interior and exterior, because white to Japanese symbolizes purity. Only first-grade flowers are exported, and every bloom (8-10 per stem) is inspected under a 10x magnifying light to ensure that it is top quality. Approximately 55 blooms are packed per box.

Shipments are from Taupo to Auckland by company truck, and then by jet from Auckland to Tokyo. Time elapsed from picking to marketing is 3 days.

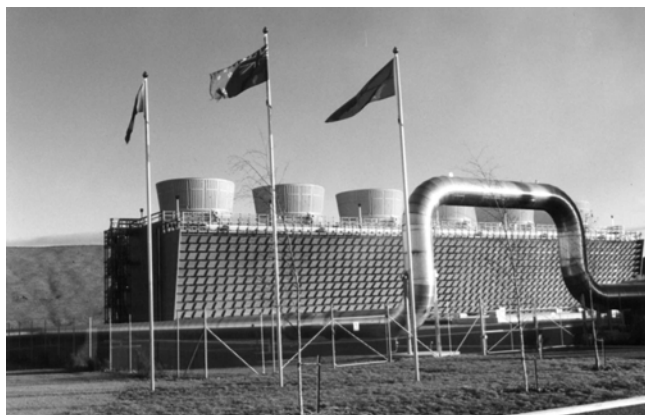
The company employs a manager and part-time staff in Tokyo. Blooms are sold every week through 25 outlets in Japan. Flowers are produced each week of the year, but are not exported for two weeks at Christmas, and one other week which is a Buddhist "green week," when only green colored items can be purchased by Buddhists. The majority of Japanese are Buddhists.

## ELECTRIC POWER PLANT

A geothermal electric power plant, operated by Mercury Geotherm, Ltd., is located about one kilometer from the greenhouses. The greenhouses receive their steam supply for the power plant wells as mentioned earlier—wells #4, 5 and 6 located in the Waioara Valley. The power plant has a capacity of 55 MW and was purchased from the Northern California Water Board. California Governor Jerry Brown had planned to install the plant at the Geysers; but, this did not happen. Instead, it was purchased, moved to New Zealand and commissioned in 1996.



**Figure 5. Mercury Geotherm turbine-generator building.**



**Figure 6. Mercury Geotherm cooling tower.**