

Odontoglossum Alliance Newsletter

Some Considerations in Growing Lemboglossums

by Sandro Cusi
Rio Verde Orchids
Mexico

Originally under the genus Odontoglossum; Lemboglossum (now called Rhynchostels) are plants found mainly in the Mexican highlands (13 species) spilling over to Central America, Costa Rica being the southern most country where they grow (2 species). They are found at altitudes that vary from 1500 to 3000 meters above sea level (5000 to 10,000 feet), preferring to grow on oak trees which is the predominant hardwood at these altitudes.

The purpose of this talk is to give an idea of how Lemboglossums grow in their natural habitat in order for growers to have more information to apply to the care of their plants. Here we will concentrate on the Mexican species.

1. Background

When describing the forest where they are found and therefor the climatic conditions which they like one must consider two main facts; whether they live on the Eastern or Western Sierra Madre mountains. Then we should also consider other factors such as the altitude above sea level and the altitude of the particular mountain compared with the surrounding low land.

Moist air from the Ocean

During the day moist air from the ocean travels inland and rises as the continent warms up; if you have mountains near the ocean that are high enough they will be in the way of this rising air and will force it to climb further. With enough altitude the temperature will drop, the moisture

in the air will condense forming clouds. Many times the top of the mountains will be hidden inside this clouds.

Monsoon type weather

The western Sierra Madres have a very well defined wet and dry season. From June until October it rains, from December to April it is very dry.

Oaks where Lemboglossums grow drop their leaves as any other deciduous tree, but at this latitude they do it in late winter or early spring during the dry season.

The eastern Sierra Madre mountains have the same rain season, but will have heavy cold winter and light spring rains coming from the gulf of Mexico.

High mountains or plateaus

A high mountain creates its own weather. From December to April the day/night temperature in the highlands of the Western Sierra Madres will vary significantly, it will be hot during the day because of the strong radiation from the sun but will drop fast at sunset because of the dry air. Above a certain altitude, the temperature drop at night will be significant enough that there will be condensation during the early morning hours.

Winds

The conditions described for the mountains create winds, usually being strong in the afternoon and they will blow almost all year long.

2. Habitat

When growing Lemboglossums we must then consider where do they come from !! All like cool weather but the ones coming from the western Sierra Madres go through a "rest period" during the winter. In their habitat the day will be warm and windy, atmospheric humidity will be below 40%, the nights will be cold but for some hours before sunrise the air will be saturated giving them some moisture that allow them to carry out their life functions without a net loss of

water. The high altitude Western Lemboglossums (*apterum*, *galleotianum*, and *candidulum*) have thick roots and grow them in a nest like fashion, few of them being actually attached to the tree, these nests provide extremely good ventilation. Where they are abundant you will find them on pines (no orchid likes pines). They can easily absorb moisture quickly through their thick roots but can rot easily if are not allowed to dry during the day. The lower altitude Western Lemboglossums, need the same "rest period" but will tolerate higher temperatures during the day. (*maculatum*, *madrense*)

Lemboglossum *cervantessi* also grows at high altitudes but will be found in mountains behind the ones facing the oceans, dryer places with "rain shadows".

All Western Lemboglossums always have their pseudobulbs clear above the growing medium, *maculatum*s sometimes make small root platforms that allow the pseudobulbs to "stand up".

Their host trees will lose their leaves during the late winter but only for a few weeks, during this period more light will reach them. Also this is the time when the winds are stronger in the late hours of the day.

The Eastern lemboglossums do not have this "rest period" since the mountains where they grow receive abundant moisture throughout the year, but from December to April (dry season) their habitat will be very windy from noon until late afternoon and can be sunny. In the early morning hours their habitat will be covered with fog.

The accompanying graphs on pages 3-5 give an idea of the growing conditions of Mexican lemboglossums.

3. Hybrids

Lemboglossums have good potential for hybridizing, the few hybrids we have seen, produce long lasting flowers with attractive colors.

A few generations of lemboglossum only hybrids, with the later and careful inclusion of other genuses should give us different shapes, color tones and size of plants from the "usual"

Odonts.

If the west (dry period) Lemboglossums are included in a hybridizing plan, their progeny should be more tolerant of warmer temperatures and dryer conditions as compared with other Odonts.

Some of the small ones (*rossii*, *maculatum*) produce hybrids with the habit of producing two leads as they grow, in a few years they can become specimens and will bloom with many flower spikes.

Please see the color photographs at the end of this newsletter. Page 21 and 22. Identification is on page 19.

Rio Verde Orchids
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Editors Note:

This material was delivered by Sandro Cusi in a lecture at the Odontoglossum Alliance meeting in Portland, Oregon, 28 April 1995.

Veitch and Video

We have been offering for sale the reprint of Veitch's Manual of Orchidaceous Plants 1887-The Oncidiinae. Our supply of these books, obtained from the New Zealand Odontoglossum Alliance, has now been exhausted. If members wish to obtain a copy they can write the editor who will determine if more copies can be obtained.

We have a video of the talks given at the Odontoglossum Alliance meeting in Portland in April 1995. These are available at a cost of \$50.00 for the two tape set. We will close out selling these in August, so if you want a set let the Odontoglossum Alliance know of your desire along with your check. We will only make enough tapes to fill orders.

Send for either or both items to:

Odontoglossum Alliance
P.O. Box 38
Westport Point, MA 02791

PLANT: *LENBOGLOSSUM CERVANTESSI*

Relative
Humidity %

100-I
90-I
80-I
70-I
60-I
50-I
40-I
30-I
20-I
10-I
-I

Temperature
° C.

I-2
I-4
I-6
I-8
I-10
I-12
I-14
I-16
I-18
I-20
I-
I-

DRY SEASON

RAIN SEASON

RAIN/DRY SEASON. TEMPERATURE AND RELATIVE HUMIDITY

PLANT: *LENBOGLOSSUM ROSSI*

Relative
Humidity %

100-I
90-I
80-I
70-I
60-I
50-I
40-I
30-I
20-I
10-I
-I

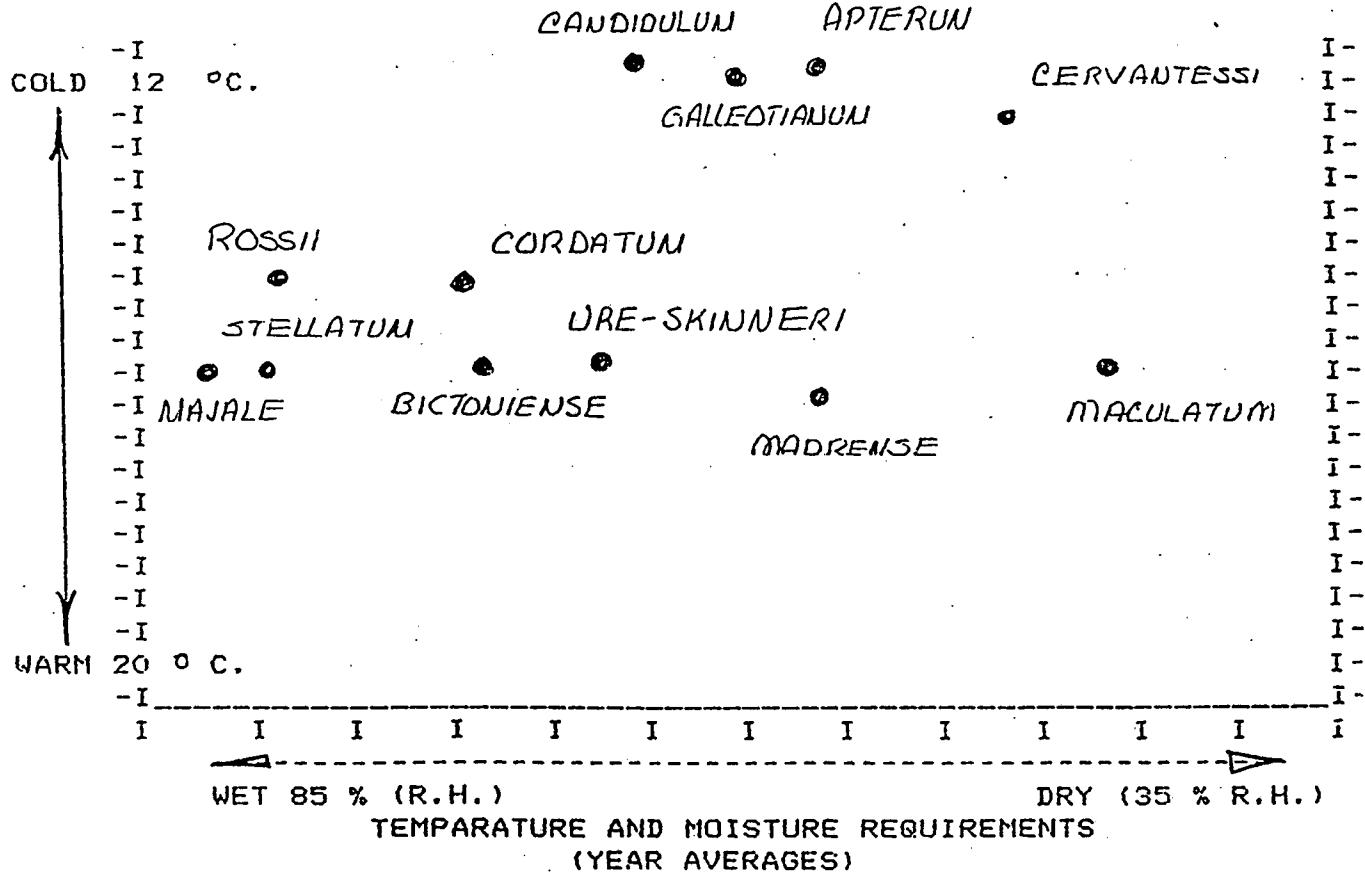
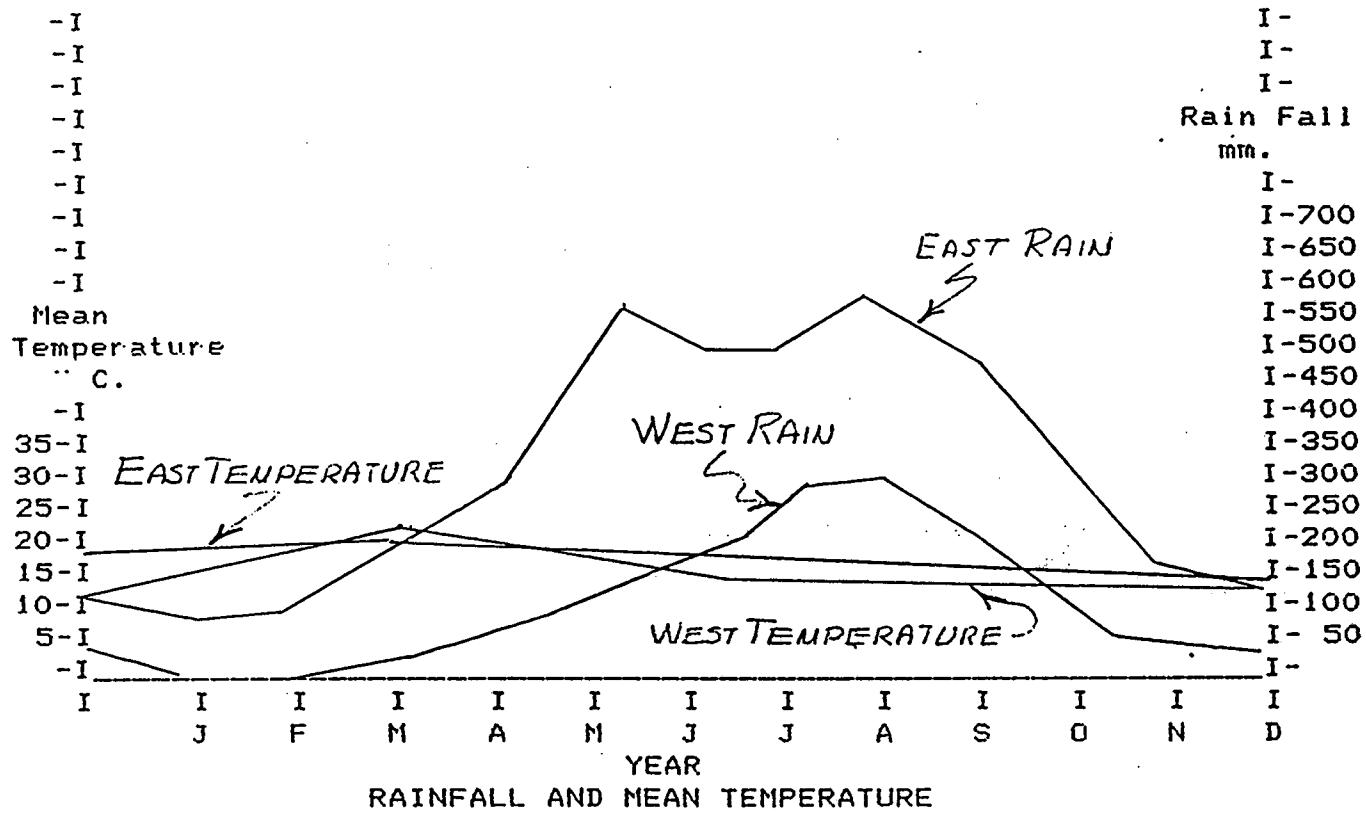
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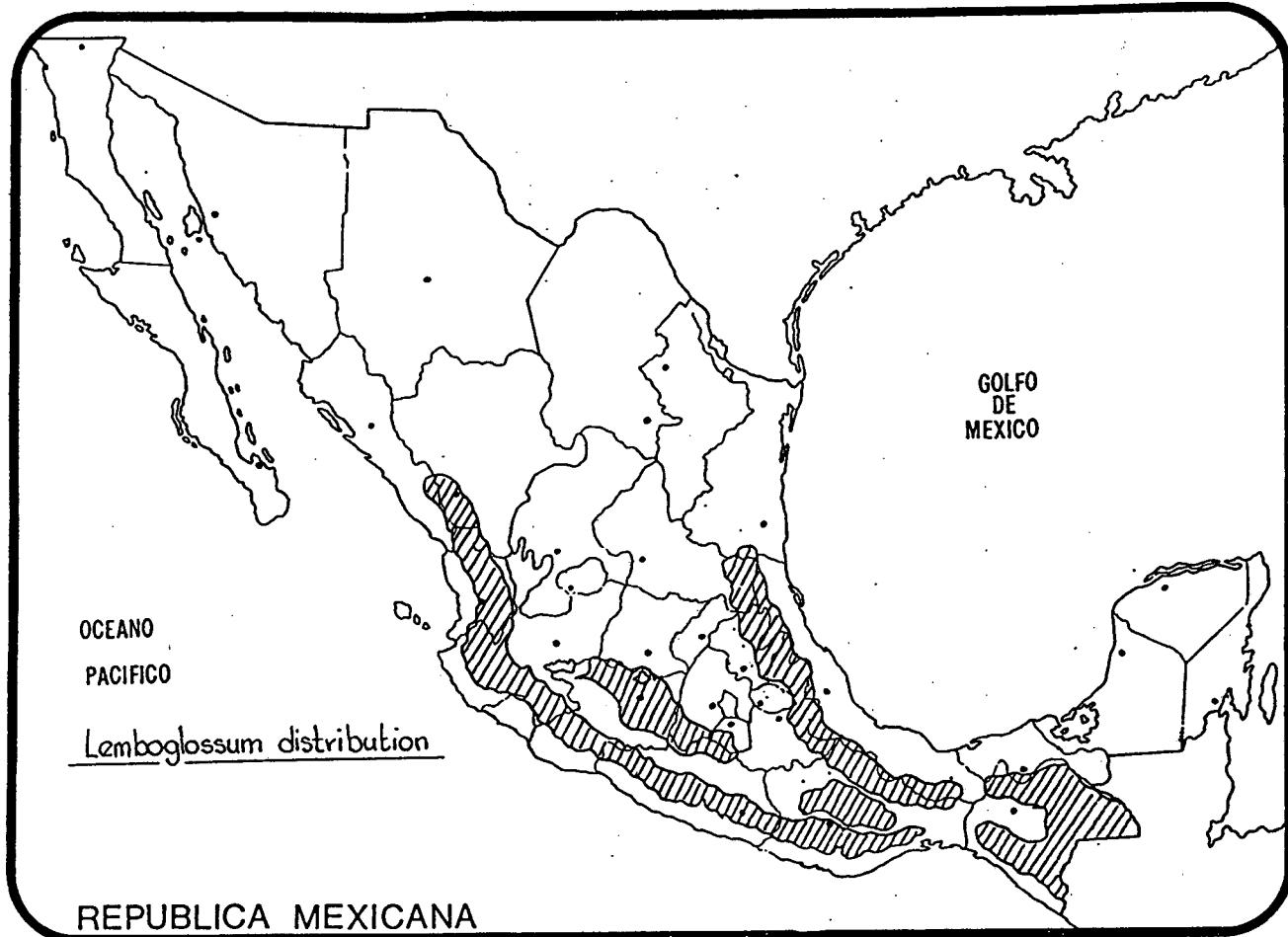
Temperature
° C.
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I-

DRY SEASON

RAIN SEASON

RAIN/DRY SEASON TEMPERATURE AND REALTIVE HUMIDITY





Distribution of *Lemboglossum* and related

Genus	Species	Locality	Altitude (feet)	Range
<i>Lemboglossum</i>	<i>apterum</i>	West	6500	10000
<i>Lemboglossum</i>	<i>bicotoniense</i>	East	5900	9000
<i>Lemboglossum</i>	<i>candidulum</i>	West	7500	10000
<i>Lemboglossum</i>	<i>cervantessi</i>	West	4600	9900
<i>Lemboglossum</i>	<i>cordatum</i>	East	6200	8200
<i>Lemboglossum</i>	<i>ehrenbergii</i>	East	6600	7800
<i>Lemboglossum</i>	<i>galleotianum</i>	West	6700	10000
<i>Lemboglossum</i>	<i>maculatum</i>	West	6500	8800
<i>Lemboglossum</i>	<i>madrense</i>	West	6500	8800
<i>Lemboglossum</i>	<i>majale</i>	East	6900	8500
<i>Lemboglossum</i>	<i>rossii</i>	East	6600	7800
<i>Lemboglossum</i>	<i>ure-skinneri</i>	East	5900	7200
<i>Lemboglossum</i>	<i>stellatum</i>	East	5600	8200
<i>Rossioglossum</i>	<i>grande</i>	West	5000	6700
<i>Rossioglossum</i>	<i>insleayii</i>	West	5000	6700
<i>Rossioglossum</i>	<i>splendens</i>	West	4900	5900
<i>Mesoglossum</i>	<i>londesboroughianum</i>	West	3200	3900
<i>Cuitlauzinia</i>	<i>pendula</i>	West	5500	6500
<i>Amaparoa</i>	<i>beloglossa</i>	East	3600	4600
<i>Dignathe</i>	<i>pygmaeus</i>	East*	6500	7000

*Dry conditions grows in mountains with rain shadow

Trekking the Andes - Chapter II

Bob Hamilton

The route from Quito to the 1991 Ecuadorian Orchid Show at Guayaquil is southwest. Along the way there is a change in climate and altitude from 2850 meters to sea level. Most of this change takes place in the final hours so the final leg of this trip is a steep descent. Accompanying this descent is a dramatic change in climate. In the Andes, an altimeter is more important than a compass. My sister, who lives in Geneva Switzerland was kind enough to send me a top of the line Thommen metric altimeter. At least I knew my altitude data would be accurate.

We left Quito for Guayaquil via Guaranda, a town of 15,000 inhabitants and about half way to Guayaquil. This made Guaranda a good break in a tedious trip and offered us another collecting site. Walter Teague heard there was interesting native forest near Guaranda and the elevation, 2500 meters, would be an elevation where we would find temperate, cool growing orchids.

Walter called ahead to the one hotel in Guaranda where Yankees might feel at home Hotel La Colina: warm water, showers, etc. Walter received mixed news. This hotel could offer us rooms for one night however the next night of our proposed two day stay would require sharing two rooms amongst the five of us. Walter felt this was strange as the hotel, although small usually had few visitors. We accepted this fate.

The trip southwest was scenic. Leaving Quito, the Cotapaxi, Ecuador's most beautiful volcano, came into view. The Cotapaxi is a symmetrical cone, a beautiful sight covered in snow. Directions to the right route were good, however there are few road signs in Ecuador. Fortunately, in the densest, highly travelled areas traffic circles are common and the Ecuadorians have adorned these with indigenous art huge sculptures. Ecuadorians are skilled craftsman and excellent artists. They also treasure their rich culture, which is the theme of much of their art.

Our directions were simple. Find the circle with the humming bird and head in the direction of the maize cobs. This proved more difficult than it would seem.

Steve Beckendorf and I both insisted we ask locals for directions. Walter said this would be useless as most did not have a car or drive and no two answers would be the same. It seems Ecuadorians always try to be helpful and are quick to answer. Regrettably, their directions are abstract and often wrong. Eventually we found our route.

Along this road we stopped to inspect a groomed forest of fir trees. Walter explained this was a test forest of Scandinavian fir trees planted decades before. It seems Ecuador had been convinced of trying tree farming. After a quarter of a century of growth these firs were still bonsai, a failed experiment. What had been overlooked was the necessity for seasons for these Northern European trees to grow. There are no seasons at the Equator. These trees simply did not grow to maturity in the Andes.

The route to Guaranda required we climb to 4500 meters. The Chimbarazo, Ecuador's highest mountain at 6310 meters was supposed to be viewable at the summit but when we arrived all we saw were clouds. We stopped and climbed a bank and watched. Within minutes the clouds parted and a pristine view of the Chimaera appeared. We all took pictures and as mysteriously as the mountain appeared, it disappeared into the clouds. Steve explained the clouds actually don't move out of the way. Instead, the effect is one of condensation with clouds forming and un-forming. At any rate, the effect is dramatic and mystical. Clambering around at 4500 meters proved a challenge. The un-initiated can have serious health problems at this high altitude. I noted my heart valves clacking away trying to keep the oxygen coming. Seriously, you can hear the valves working.

After our descent to a more reasonable altitude

we came across an Indian market and stopped. We bought some woven baskets. Walter, who had known this route from childhood held out for lunch at a hostalaria which he knew had good food. As mentioned before, if you are looking for Yankee food, forget it but if you're willing to venture to the Ecuadorian cuisine you are in for a treat. We were hungry and lunch was great.

Further along the way we saw scenes of great environmental devastation, the result of erosion from deforestation. Some areas of Ecuador denuded of forest remain verdant while others simply turn to eroded desert.

We made another stop, which was not planned. The oil pressure in one of our two vehicles hit zero so we stopped to investigate. While stopped, Walter headed up a hillside. We quickly learned that Walter was part goat and could bolt up a hill faster than any of us. He would do this often during the next few weeks. The problem with the car turned out to be bad sensor connections. Most rental cars in Ecuador have seen better days. All removable items such as radio knobs, antennas, door handles and locks, etc. are long-gone.

A few honks of the horn and Walter returned with a survey of the orchids in the area. Unfortunately, after driving on we learned that Steve Beckendorf, at the site of our vehicle inspection, had lost a treasured Swiss Army knife, a veteran of other treks.

Guaranda is a small town, on the steep slopes of the Andes. We arrived at our hotel exhausted from a long travel day. It was dinner, a walk and off to bed. The next morning we headed northeast to a small village, one of the many Salinas' in Ecuador. Salinas means salt in Spanish. On the way out of town, I stopped and picked up a hitch-hiker, a young Indian waiting for the bus. Walter warned me this had consequences and the next thing I knew the car was surrounded by 10-15 others also waiting for the bus. They could not understand why we could not load up the roof, the hood and the bumpers with as many people as could hold on.

The route to Salinas was scenic and we began to gain altitude. If Guaranda at 2500 meters was cool then Salinas was higher. I would learn we were heading up again. We passed the alkali rift Salinas was named for, a place where salt was gathered for as many years as Ecuador had been inhabited. This was beautiful geography.

A volleyball game was in progress when we arrived in Salinas. The plan of cities in Ecuador is typically Spanish: a central square with one side faced by the church. Sometimes there's a gazebo. In Salinas there was a volleyball court. Our presence attracted friendly attention; we almost ended up on one side of the net. After some fresh fruit and a review of their game we headed further up the road. Eventually we ascended to 3400 meters. Our hitchhiker left us at this altitude, meeting some friends walking along the road. We stopped and did some exploring. Steve found a most interesting and unusual masdevallia at this high altitude. We also found many plants of Odm angustatum which were in bloom. These were quite common. John Leathers, Moises Behar and Walter Teague headed off while Steve Beckendorf and I stayed behind to explore.

Finding the area monotypic, Steve and I headed forward beginning a steep and continuous descent. The road was single lane, dirt and in poor condition. Every few hundred feet there were switch-backs. The drop to the left of the car was incredibly steep, perhaps a thousand meters or more. The steepness of the Andes is unfathomable until you are there and see it.

Along the way, the car took a quick, out-of-control turn. We slammed on the brakes and got out to investigate. Deliberately, someone had placed a barbed-wire barrier across the road. We untangled the car and looked at each other not knowing what to say. Were we on the right road and were we following our friends? Another half hour and perhaps 1000 meters and we came across John, Moi and Walter. They had stopped in an area that was being logged. I was angry

they had gotten so far ahead us without waiting. Frankly, I was shaken by the barricade and the danger it presented on this steep descent. I told them the story of the barricade and they shrugged their shoulders too much altitude was getting to Bob.

Our road eventually descended to a river bed at 1100 meters. The temperature was now hot and the fauna had changed. There were few native trees be found. Most of the area was pasture. Fortunately, on one native tree we found gorgeous plants of a small oncidium. The insects in this area were spectacular in color and size. We collected a few plants for our Ecuadorian friends, had our lunch and decided to head back. About 400 meters up the road John spotted some *Masdevallia lehmanii* like plants. These, unlike *lehmanii*, have no spots. These plants were also in exposure of full sun, on the side of some palms. We stopped and collected two plants. Another several hundred meters and we again stopped. This time there were trees and rocks blocking the road, the same road that was clear hours before. Our friends began to listen to Steve and my story more seriously!

We cleared the road and headed back to Guaranda. Along the way Walter spotted a beautiful *Oncidium macranthum* growing in the mud of a road-cut. The plant had a huge spike and Walter took some flowers. Arriving back at the hotel we found a tour bus. Upon entering we unexpectedly met friends from California. We had booked the same hotel Hank and Lil Severin had used for a tour they had organized. We knew most of the people in their tour. We showed one of them, Debra Buck the beautiful *macranthum* flowers Walter collected and she asked if she could have one. Debra placed this flower in her hair and when she sat down at dinner to the table with her companions they asked where she found that beautiful flower. Debra told them, 'I was walking in back of the hotel.....'. The table bolted. If we were not such nice companions we could have had more desert. Moi mentioned to Walter something in Spanish "morabunta!" Walter started laughing. When we asked for a

translation we learned this was Spanish for army-ant. Moi envisioned this bus tour of 30 or more Yankees stopping by a forest and streaming out stripping the forest of everything in sight. We would use the term "morabunta" again.

The next morning we headed for Chillianos, the opposite direction of Salinas. It was rumored there was an undisturbed forest where new things might be found. We drove on for most of the morning and eventually saw an expansive valley without a tree to be seen. The "forest" proved a bum steer, one of many yet to come. We decided to stop at a small forested area along the road back to Guaranda. We hiked into this forest which was rich in bromeliads and oncidiums. After about one half hour we were greeted by the land owner with his son, a dog and a rifle asking what we were doing. Walter explained and the owner proudly gave us a tour of this finca, pointing out interesting botany all the while. Ecuadorians know their landscape and plants. One plant of note was a spiranthes-type orchid, something I usually call a terrestrial. Well, call them as you wish, this spiranthes grew on the limb of a tree.

This man's dog was in bad shape. It had been hit by a car and its leg had a compound break. Clearly, the wound would never heal and the dog was doomed. The owner was ready to allow nature to take its course. We got back in the car with a decision to head back to town with only one more stop, a forest area which was being cleared and burned. We hiked up a muddy, steep ravine with areas of deep mud created by cattle dragging lumber. I did not dwell on the mud's content. A short ways up this ravine was a beautiful *telipogon* growing high above the ground attached to the bark of a large fir tree. It was in bright light and in full flower. This area had little else to offer as we climbed higher. It was forever ruined as a forest.

The hotel tour guests were anxious to hear about our day. Walter has a reputation as the discoverer of countless new and wonderful

orchids (fulfilled on this trip) and eagerly sought his explanation of the day. That evening was friendly and we were euphoric as we knew we would head for the show the following morning.

Upon waking Walter got the bad news. There was a national strike in protest over increasing school bus fares. All roads had been blocked and we would be prevented from leaving Guaranda. We hiked to the road above the city with an overview of the highway. There were tires burning in the streets and the army was present with their guns drawn. I thought this more dramatic than it turned out to be. Strikes like this are common and assault weapons dangle for the ubiquitous military everywhere in South America. Moises, in a crafty maneuver, chatted with the local police and learned about a back way out of town. It was adios muchachos! It was now apparent why we had been barricaded the day before.

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Editors Note:

Part I of Bob Hamilton's article was published in the February 1995 Odontoglossum Alliance Newsletter.

Material Wanted

I urge each reader to submit articles for publication in the Odontoglossum Alliance Newsletter. There are many areas of interest to our readers. Think about your own growing tips and ideas. If there is a show in your area, then a write up of the odontoglossum alliance material is welcome. Any awards on alliance material would be welcome. A description of plants - species or new hybrids is of great interest.

Send you material to the Editor:

John E. Miller
Odontoglossum Alliance
P.O. Box 38
Westport Point, MA 02791

Odontoglossum Alliance Meeting

The next meeting of the Odontoglossum Alliance will be held on 12 April 1996 in Vancouver, British Columbia, Canada. This will be in conjunction with the Western Orchid Congress 10-13 April 1996. The alliance meeting will be held on Saturday morning when there is not a conflict with any other lectures of the Congress. The meeting will commence at 8:30 am with a set of four lectures. Three of the lecturers are Alan Moon, Director of the Eric Young Orchid Foundation, Jersey; Philip Altman, Australia; and Dr. Howard Liebman, Los Angles. Following the lectures will be a luncheon, in the same hotel. We will have a business meeting, election of officers, and one of our most interesting events - an auction of fine odontoglossum alliance material. Last year over 45 items were auctioned, many of which were never available elsewhere.

The Alliance is also planning to have a dinner on Friday evening, 11 April 1996. This is planned to be a Chinese banquet. Vancouver has some wonderful Chinese restaurants. More details of this dinner will be announced in the November newsletter.

So mark your calendars and plan to attend the Western Orchid Congress and the Odontoglossum Alliance functions.

Lewis Knudson (1884-1958)

His Science, His Times, and His Legacy

By Joseph Arditti

Dedication

"In addition to being an account of scientific discovery and a life in science (Lewis Knudson) this is also a story of maternal devotion (Noel Bernard's mother to him and his wife's to their son), paternal love (Noel Bernard for his premature baby) and filial dedication (Giltner J. Knudson to his father). In this spirit I dedicate my efforts to my parents Salomon and Rebecca Arditti (87 and 84 years old as this is being written). They raised my brother Mordi and me during trying and dangerous times through persecution and two wars and gave us all they could, most of all love. JOSEPH ARDITTI

Foreword

A century ago, when orchid biology was still in its infancy, virtually nothing was known about relationships between orchids and mycorrhizal fungi in seed germination. Early anatomists observed fungal hyphae in the velamen and cortex of orchid roots but did not fully realize the implications. Even the great German physiologist/anatomist, Professor G. Haberlandt, reported the presence of a fungal mycelium in root cells of *Neottia nidus-avis* but attached no significance to it. Growers and hybridizers failed to understand the nutritional needs of orchid embryos, for which there is little or no endosperm tissue to support the germling: Following or at least believing that we were following Nature, so far as the altered circumstances of artificial cultivation allowed, every method or available means that could be thought of was brought into request to secure the

germination of the seed. It was sown upon blocks of wood, pieces of tree-fern stems, strips of cork, upon the moss that surfaced the pots of the growing plants, in fact, in any situation which seemed to promise favorable results. Among the most cogent causes of failure in the raising of seedling orchids there can be no doubt that the greatest are the altered conditions of climate, especially the deficiency of sunlight, and the artificial treatment to which the plants are necessarily subject in the glass-houses of Europe. (James A. Veitch & Sons, A Manual of Orchidaceous Plants, Volume 1: Epidendreae p. 141)

Under such conditions seed germination was unreliable, and germination time was prolonged. As a result, prices for orchids remained exorbitant. For all these reasons, orchids were not the plant material of choice for research in physiology and genetics - a legacy, I might add, that haunts would-be orchidologists even today. Early in the twentieth century, Noel Bernard grasped the necessity of the mycorrhizal relationship in Orchidaceae and undertook the first experiments in asymbiotic germination, using a culture medium supplemented with salep, a starch that occurs naturally in the tubers of many terrestrial orchids. Unfortunately, Bernard died before he could perfect the chemistry.

Lewis Knudson, at that time Professor of Plant Physiology, seized on Bernard's data and began experiments that would later prove orchid seeds can germinate on organic media containing simple sugars and without the presence of a fungus. For several reasons this discovery was one of the most revolutionary events in the whole of orchid science to date. First, seed germination rates increased exponentially and became more predictable. In turn, the number of orchid hybrids and orchid plants in circulation skyrocketed, forcing a drop on prices and a curtailment of imports from the tropics.

Knudson, more than anyone else, popularized the orchid, and he did so without knowing it at the time. Finally, in our age of tropical deforestation and the most rapid orchid extinction rate that the world has ever known, Knudson's major contribution, asymbiotic germination, is still the

most practical and immediate way to preserve orchid species and desirable cultivars. Professor Joseph Arditti spent years researching, writing, and rewriting this definitive, objective, and highly readable biography of Knudson. The work can be appreciated at several levels: Knudson's personal life and career; his methodical but unhurried almost Darwinesque work habits; the nature of the scientific method; his many contributions to orchidology and plant physiology in general; and the historical context in which he conducted his experiments and defended his results and conclusions. Above it all, this is a celebration of science.

Alec M. Pridgeon.

Lewis Knudson (1884-1958)
HIS SCIENCE, HIS TIMES, AND HIS
LEGACY
Joseph Arditti
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Three noted Americans were born in 1884. One is President Harry S. Truman. Writer and sports reporter Damon Runyon is the second. The third, and for those interested in orchids the most important of the three is Lewis Knudson who was born on October 15, 1884, in Milwaukee, Wisconsin (a search of the records for 1872-1874 by the Milwaukee County Register of Deeds failed to locate his birth certificate). At present Knudson is remembered for the most commonly used medium, known as Knudson C, for the asymbiotic germination of orchid seeds. Knudson's other research and contributions have largely been forgotten. Few recall that he developed methods for the aseptic culture *in vitro* of whole plants at a time when the majority of plant physiologists did not think in these terms. Only a very small number of plant scientists, even those working in areas which arose from Knudson's research, know that he attempted to culture isolated cells not long after Haberlandt proposed the idea of culturing explants and before the discovery of auxins and cytokinins, the hormones which make such cultures possible.

Altogether Knudson is one of the forefathers of what is presently referred to as biotechnology. Knudson was also interested in and made important contributions to our understanding of enzyme action, osmotic relationships, fungal and flowering plant metabolism, plant nutrition, sugar utilization, and mycorrhiza. None of these was an isolated research topic for him. He always placed them in the context of the life of the whole plant and in relation to each other. This approach led to his work with heather and orchids (and to debates with a number of other scientists at home and abroad). Questions about the requirements for and the mode of action of mycorrhiza led to the development by Knudson of methods for the asymbiotic germination of orchid and heather seeds.

As a scientist and teacher Knudson spent his entire career (51 years) at one institution, Cornell University, where he rose from Instructor to Full Professor. He was chairman of the Department of Botany at Cornell University at a time when it was among the best in the world. Colleagues and students who remember those days report that Knudson was a good and compassionate, but hard and autocratic, chairman and administrator. Lewis Knudson the man was generally conservative, had charisma and concern for people, but could be somewhat aloof, stern, occasionally temperamental, and blunt when he had to be.

Family and Personality

Lewis Knudson's father was a Norwegian sea captain who came to the United States as an adult, married an American woman and settled in Milwaukee. They had three sons and one daughter. The father was off on ships most of the time, and Lewis was raised by his mother. At the time of Prof. Knudson's death, the daughter, Ann Stewart (according to her nephew, Giltner J. Knudson, but listed as Mrs. Ole Olsen in one of L. Knudson's obituaries), and one son Paul Knudson, lived in Milwaukee. The other son, Dr. Arthur Knudson, a Professor and later Dean of the medical school at Albany, New York, was in Thailand (but one obituary states Indonesia). Arthur died in 1959 in Beirut, Lebanon, on his way home from a medical mission in Burma.

Knudson met his wife, Carolyn Belle Ingels at the University of Missouri where she majored in home economics. According to her French identity card, Carolyn Ingels was born on March 23, 18?? (in her later years Mrs. Knudson erased the last two digits) in Paris, Kentucky, (daughter of George and Rosa Russell Ingels (born in 1863). They had two sons.

The elder son, Louis Ingels Knudson graduated from Cornell University in 1940 with a degree in electrical engineering. His specialty was advanced mathematics as it related to physics and engineering. This may be a result of the fact that Lewis Knudson was good in physics and even knew some engineering (on one occasion, for example, he told his son, Giltner, not to put chrome on a crankshaft because this will reduce the affinity of oil to it; it did). As a child Louis set off some explosives while playing with them and caused permanent damage to his hands. For this reason his parents were especially attentive to him. As an engineer Louis worked on the development of the Magnetron tube (basic to Radar), jet and rocket engine ignition, and alternators for aircraft. He held many patents in these areas. Louis Knudson spent much of life in Norwich, New York, and died there in 1983 at the age of 69.

Giltner (Gil) John Knudson, the second son, was born at the American Hospital in Neuilly, France, on December 22, 1919, when his father was 35 years old (Gil says that he was born in Paris which is close enough). He was a member of the Cornell University Class of 1942, but left in 1941 not wanting to become the lawyer his father wished him to be. After leaving Cornell University Gil Knudson went to work for the Bendix Corporation and spent 10 years in their engineering department designing ignitions for Pratt and Whitney engines. Gil moved into management in 1950 except for three special new design projects in automotive ignition and diesel and gasoline fuel metering systems. In 1960 he established manufacturing facilities in Santa Ana, California, to produce electrical connectors and cables for the missile, airframe, and space industries. He also developed a process for the production of cryogenic tanks for NASA. After

resigning from Bendix, Gil established his own marine hardware manufacturing business to produce equipment newly designed by himself and used novel approaches to do so. Gil holds many patents in his areas of specialty. The love of the sea and boats skipped a generation in that Prof. Knudson did not like them. However, Gil Knudson had boats hidden at a lake near their home since childhood and is a marine engineer and yachtsman. He and his first wife, Betty, have three children: Leigh John Knudson (a machine-shop owner in Costa Mesa, California), William Russell Knudson (a lawyer in Sacramento, California) and Linda Knudson Fisher (a school teacher in Stockton, California). Gil and his second wife, Lee, live in Costa Mesa, California. None of Prof. Knudson's children or grandchildren seems to have an interest in botany or orchids, but Gil and Lee have attended several orchid society meetings near their home.

Lewis and Carolyn lived on 502 Cayuga Heights Road, Ithaca, New York. Photographs of the house show a brick exterior and several stories. Professor Knudson's study was located at the south end of the first floor. Some of the rooms were decorated with large murals painted by Mrs. Knudson who was also a gifted writer. The house was completely surrounded by a garden which was Mrs. Knudson's province, although Prof. Knudson helped from time to time (Mrs. Knudson is said to have "ruled her husband silently" and one wonders if he really wanted to work in the garden or had to do it). Some of the grandchildren were hired as helpers, and Leigh John Knudson recalls that going to his grandparents house often meant work, but the pay was fair, and the marionette show with hand-held puppets put on by his grandfather was always a highlight.

A rabbit hutch was maintained on the grounds primarily by young Gil Knudson. Events in the hutch were reported in the Cloverville Daily founded and edited by Peter (aka Lewis) Knudson. The daily included news about unwelcome rats, trips to Europe, rainy days ("while we rabbits hate to get wet we enjoy the rain") and comments about the fish in the fish pond: "How any animal can enjoy bathing all day

long and swimming is beyond our comprehension." Offices of the daily were located on 30 Potato Street. Like every self respecting newspaper it carried stock quotations (Prof. Knudson was very interested and successfully active in the stock market), advertisements for companies like Cloverdale Fruit Co. (Prof. Knudson was a consultant to the United Fruit Co.), Rabbitland Steamships (Knudson sailed to Europe on a steamship), Bunny Telephone Co. (both "Bunny" and "Bell" start with a "B"), Luce's (a shortened Lucerne?) milk on which babies were supposed to thrive, Taste Rite Brand dried alfalfa, Supreme Hair Stimulator which was "...guaranteed to make hair grow and to produce a perfect coat of fur against the cold of winter," and Cottontail Foodstuffs.

The daily also carried the program of the local radio station, SQEEK, which was broadcast on a wavelength of 10 whiskers. Items on the program included lectures on education for rabbits (Knudson the teacher) and early rabbit civilization (Prof. Knudson was ever the scholar), bedtime stories like "Bunnies in Fairyland" (shades of "Babes in Fairyland"), and music by the Cloverdale band which was conducted by Peter K and included extra drums (Prof. Knudson liked classical music and played the piano, organ, and harmonica).

Despite its frivolity the Cloverdale Daily is an important document because it shows a side of Prof. Knudson which some say did not exist - light heartedness and humor. He obviously enjoyed writing the Daily, made sure it was funny, and used his intellect and imagination to base the humor on relevant items. The daily also showed Knudson as a father who was interested in his sons' activities and their development. According to Gil Knudson, typical dinner conversations when he and his brother were growing up dealt with how things work and matters which required thinking. Gil also recalls that there were always lots of chores for him and his brother. However, the sons also had very tangible benefits. When they grew up and needed flowers, Knudson brought home orchids which were made into corsages by their mother. This

gave them an advantage over boys, one of whom once asked: "Why don't you spend some money and buy a gardenia?"

Two other interesting documents regarding Knudson, the man, are memoirs written at my request by Prof. Randolph Wedding, one of Knudson's students who moved from Ithaca to "terra incognita" to live among the "uncivilized" and become Professor of Biochemistry at the University of California, Riverside (Appendix 1), and the other by Prof. Emeritus Arthur Bing of Long Island, New York (Appendix 2). What these memoirs and other recollections bring out is that Knudson was a somewhat arrogant and stern person, a very moral man, a hard but kind and understanding leader, and an individual with a good sense of humor who related well to people and got them to do what he wanted by the strength and quality of his personality. His son Gil gives a similar description.

Other reminiscences point to the same traits: "He tended to be aloof, and I rarely saw him outside of the lecture hall. As head of the Department of Botany he was highly respected, but I am uncertain whether he was well liked," and "while he was famous as a research investigator and teacher, his innate human friendliness is also a memorial in the minds of many." In one of his obituaries Knudson is described as "however occupied...with his own affairs..never too busy to listen sympathetically to the problems of others, and to offer kindly advice," and a person who "knew and loved many men of low and high degree, and they loved him..." But it is also possible that his associates did what he wanted knowing that there was "an iron fist in a steel glove" (Appendix 1). The fact that Knudson "was a great poker player" may have contributed to his quality as a leader and an administrator. A "poker face" is of great value in such activities. Knudson also loved to tell jokes, and this must have helped, too.

One of Knudson's associates wrote me once that the widening political gap between the United States and Germany before World War II may have been one reason for his arguments with Burgeff. This was not difficult to accept at first because according to some reports Burgeff

sympathized with the Nazi regime. However, Gil Knudson does not think his father mixed science and politics. In domestic matters Knudson was an avid and conservative Republican who voted for Dewey and was very much opposed to Franklin Roosevelt's policies, but he was open-minded and fair. Gil also points out that Prof. Knudson was oblivious to race at a time when this was much less common than at present. Proof of this is the fact that he had graduate students from Turkey and India living in the family home. The name of one of his coauthors also indicates that he had no religious prejudices. He gave heavily to charities and served on the local school board. Professor Knudson (5 feet 8 inches tall and about 160 pounds) got up early (about 6:30 a.m.) but also went to sleep early (10 p.m.) HE smoked two packs of Chesterfields and Old Gold cigarettes a day and drank a scotch-and-soda every evening on coming home around 5 p.m. Dinner was at 6:30 and after that he went to his study to work on and read scientific papers, the Wall Street Journal, and the Oil and Gas Journal. He studied the stock market (and as a result made money on it) until bedtime. Most of the time, even at home, he wore his hard-collar shirt, tie, vest, suit, and gold watch on a chain which was decorated with Sigma Xi, Phi Beta Kappa, and other keys. Few Recall seeing him in a sports coat and slacks.

Gil Knudson was kind enough to furnish the following recollections of his father in his spare time at home:

"He was an early riser and usually made the coffee in the morning. Dressed in casual clothes he often worked on improvements in the garden, tended to the coal furnace and hot water heater, and chopped wood for the fireplace. He also did some housework, but the family had a maid for many years. About 9:00 he showered, dressed in a three-piece suit complete with watch and chain across his vest. After a few hours at the office he would go to the local stock brokerage, shop for groceries (and "plan" meals by buying provisions) and his and the children's clothes. He went back to the office following a light meal.

"Evenings after work he usually enjoyed a drink with friends, at their home or his. In the summer

they would drink a Planter's Punch or two in a screen-covered porch overlooking the garden at the rear of the house. In the winter they drank scotch-and-soda in his study.

"In the thirties he listened to the Lowell Thomas news on the radio and then to the "Amos and Andy" comedy He would usually retire to his study where he would study the stock market (concentrating on the oil stocks), plot performance curves, and extrapolate what he believed would happen in the future. At about 9 p.m. the late edition of the Syracuse Herald became available with the final stock closings. He would frequently go to the downtown area (2-3 miles from the house) to purchase a copy and also buy a loaf of fresh Italian bread from a tiny bakery. This was consumed with honey and strawberry jam, mostly with Gil's help just before bedtime. Family relations were good. "He liked dining out very much. His favorite foods were Chinese and Italian, fresh fish, roast beef, steak, Spanish rice, and baked potatoes (but considered the skins to be bad news). His neighbor, Horace Whiteside, and he were interested in home-made wine before prohibition was lifted, and we always had wine in the house. "Father was a 'workaholic' and had no real hobbies except for music. He owned a piano and an organ which he played frequently. Enrico Caruso was his favorite singer, and he had classical music records for a wind-up phonograph, but did not listen to them often. At one time he collected stamps with an emphasis on the U.S.A. He did not read novels and limited his reading to science, financial journals, newspapers, the National Geographic magazine, Saturday Evening Post, and current events. Football was a sport he liked to watch in the stadium and listen to on the radio. He also liked to go to the movies and went every other week, favoring comedies and musicals. His favorite actors were Eddie Cantor, Will Rogers, and W.C. Fields. On occasion he fished with people he consulted for."

He liked to go for drives with his family during summer evenings or Sunday afternoons. When the family grew up and the sons moved away, he continued to go for drives and visited them and

their children in their homes, which were located about 80 miles from Ithaca.

His consulting job with the United Fruit Co. required him to travel a lot, usually two trips a year to Central America for about 20 years. He also consulted for the Thomas Young Nurseries in New Jersey regarding orchids and the Vanderbilt Company in New York, New Jersey, and elsewhere on reagents which prevented the growth of molds between layers of safety glass windows and windshields of cars and trucks, fungi which attacked bonded rubber tank threads, and mildew that grew on paints.

Knudson had many friends and liked to sit and talk with them over a cup of coffee. One of his favorite sayings was "salud y pesetas" which means "health and money" when translated directly, but his wife, Carolyn, interpreted it to mean "health, wealth, love, and the time to enjoy it." On weekends he went to the office for a few hours, worked around the house, chopped trees, and helped in the garden. At high school Knudson was a quarterback, ran track, and played tennis. As an adult he played golf, enjoyed skiing, and often skied cross-country with his children/ Altogether Knudson "...enjoyed life to the full..." .

Professor Knudson died suddenly of a heart attack in his home on Sunday evening August 31, 1958, while having his favorite scotch-and-soda. Funeral services were held at 11 a.m. on Wednesday, September 3, 1958 , at the Wagner Funeral Home, 421 North Aurora Street, Ithaca, New York. the Rev. Walter A. Dodds of the First Presbyterian Church officiated. Ironically, for a man who worked with orchids, which are so well known for their flowers, the Ithaca Journal requested: "Friends...to kindly omit flowers."

Mrs. Knudson lived alone in their house in Ithaca until 1961 and then moved to Orange County, California to be near her son, Gilner. She died at the age of 94.

Education and Career

Information about Knudson's early schooling is scarce. He attended seventh grade in the 12th district of the Milwaukee Public School system

where his grades (on an undated certificate) were 93, 83, and 85 (out of a possible 100) in history, geography, and physiology, respectively. He could have taken German instead of geography but chose the later. These grades (which average 87) exempted him "...from further study of the same..." Knudson graduated from the 12th district school on June 26, 1900 and went on to the South Division High School. He took the Classical course of study and graduated on July 1, 1904, with a grade-point average of 81, which is no more than a solid B (and one more proof that early performance is not always a good predictor of future achievements). His highest grade (88) was in civics and his lowest (73) in English classics.

After graduating from high school Knudson went to the University of Missouri and graduated on January 30, 1908, with a Bachelor of Science in Agriculture. He moved to the College of Agriculture at Cornell University as an assistant in plant physiology in the same year and started his teaching career there by teaching advanced plant physiology under Professor B.M. Duggar. All of the students in his first class were older than he. By the end of the first term at Cornell he was advanced to the rank of instructor and received his doctorate in 1911. He was appointed Assistant Professor of Plant Physiology in the same year and in 1912, as a very young man became acting head of the department after Prof. Duggar resigned from the post. When the Department of Plant Physiology was incorporated into the newly created Department of Botany with Prof. Karl M. Wiegand as head, Knudson became Professor of Botany. In 1941 on Wiegand's death Knudson became head of the department and remained at that position until his retirement on June 30, 1952.

It seems that Knudson spent the first 7-8 years in Ithaca mostly teaching and engaging in research. He was obviously successful in these endeavors because in 1921 Albert W. Smith, Acting President of Cornell, referred him as Professor of Plant Physiology. This means that Knudson advanced from Assistant Professor to full professor in approximately 10 years, which is a respectable even if not meteoric rise.

Between 1919 and 1920 Knudson visited France and Spain. His second son, Giltner, was born in Paris during this trip (a strange coincidence is that Mrs. Knudson was born in Paris, Kentucky). The family left Cornell in September 1919. While in France he spent five months in Paris where he carried out research at the Sorbonne, lectured at the Pasteur Institute in French, and attended lectures by Madame Curie on radium. On March 1, 1920, the family left for Madrid. He lectured there during that month and in April (in Spanish from notes in French; He also had command of German and some Norwegian) and engaged in research. Later he went to Barcelona for three weeks and gave several lectures (also in Spanish) at the college of agriculture. In addition to lecturing in Spain, Knudson established plant pathology courses and a plant physiology department at the National Museum of Natural Science. Altogether he spent six months in Spain before returning to Paris on his way home, Professor Knudson, his wife, their eldest son, and newly born baby, Giltner returned to New York on board the steamship Savoie.

Knudson paid a return visit to Spain and France in 1921. He lectured at the National Museum of France, and again in Madrid (April 1921) and Barcelona. On April 25, 1921, Knudson attended the first anniversary session of the Royal Spanish Society for Natural History. His majesty the King of Spain presided.

Knudson's interest in tropical botany took him many times to Central and South America including Honduras and Guatemala where he acted as a consultant to the United fruit Company. Fortuitously perhaps, his duties in these tropical countries required that he depart from Ithaca just after Christmas (i.e. in the dead of winter) and return in spring. That these trips were not entirely without danger is suggested by special safe-conduct documents Knudson obtained in 1922 and 1923 from local commanders in Guatemala for trips to the capital. On one of his trips to Guatemala, Knudson was accompanied by Livingston Farrand, then President of Cornell University, and Prof. F. H. Bosworth, former Dean of the College of Agriculture. They inspected archaeological ruins

in Guatemala and returned by way of Havana where they were entertained by Mario Garcia Manocal, former President of Cuba and a Cornell graduate. The trip lasted three weeks mostly in the month of February.

As Professor Knudson's name became better known, the governor of Puerto Rico, H. M. Towner, invited Knudson, Cornell President Livingston Farrand, and Albert R. Mann, Dean of the College of Agriculture, to survey tropical agricultural conditions and research on the island. The group sailed on the first of March and returned three weeks later having attended Puerto Rico's 25th anniversary in addition to making the survey. They recommended the establishment of a school of tropical agriculture. Knudson left for Guatemala one week after returning to Ithaca. Professor Knudson was an effective teacher on both the elementary and advanced levels in both plant physiology and botany. Doctor Anton M. Kofranek (my floriculture Professor between 1955 and 1959 and who introduced me to orchids; he is now retired) provided me with copies of notes he took in Floriculture 126, a course taught by Knudson and Dr. Kenneth Post in the spring of 1949.

The notes are a clear indication that Knudson was well organized and thorough in his lectures. These attributes alone would have been sufficient to make him a good teacher, but he was an excellent one due to his ability to explain matters well and be a bit of a showman (according to yet another former student): "He used to stand in front of the class, casually sprinkle something into his hand from a small vial, hold his flat hand out towards the class, and blow. Then he remarked casually: 'There's \$10,000 worth of orchid seed.' 'What's \$10,000 to me'!"

The Botany Department at Cornell University was at that time one of the best in the country, but Knudson stood out even when compared to other professors. This is clear from a recollection by one student: "It was a rather interesting show.. <Knudson's> plant physiology course. Knudson would teach one semester and Otis Curtis would teach the other. They were totally different personalities, and I think that although they respected each other, they did not have

much personal rapport. Knudson gave a formal presentation of his part of the course and Curtis gave an informal presentation of his part. Knudson was superior to his own colleagues in some ways. He had a very intelligent mind and although he kept his distance from us as students, he was sympathetic and I found him understanding."

On the other hand, a very well-known American horticulturalist who as freshman took one of the last courses Knudson taught claims that he was not a very good teacher at that time. If so, this would not be unusual because some professors are better teachers during their early years than toward the end of their careers. Although it is safe to state that "Dr. Knudson's distinguished contributions to science are in the record, and his inspiring lectures will live long in the memory of his students." As a graduate advisor he guided 25 students through successful completion of their doctorate studies. He also served as committee member of graduate students who worked with other professors. One of these students (and another of my professors of floriculture) recalled in a letter that Knudson would not go over his thesis when it was ready (for reasons my former professor did not describe) and added "He was, at best, a prima donna." Giltner Knudson's reaction to this description was: "Yes, you can say that." With all that it is interesting to note that Knudson produced fewer notable students than other great American plant scientists (James Bonner and Kenneth Thimann are two examples of those who had many graduate students a very large proportion of which became well known). One who does stand out is Professor Randolph Wedding at the University of California, Riverside. Others have not made a point of indicating that they were his students. During his career at Cornell Knudson was appointed to many of the most important committees. In 1942 Cornell President Edmund Ezra Day appointed Knudson to the Advisory Board of the Bailey Hortorium first as a member (April) and later as Chairman (June). His son, Giltner, feels that this is somewhat ironic because Knudson and Liberty Hyde Bailey did not get along while the latter was alive.

In 1908 Knudson was elected to membership in the Society of Sigma Xi. He was elected Fellow of The American Association for the Advancement of Science in 1914. The American Orchid Society elected him an Honorary Vice President, and he served in this post for many years.

Professor Knudson held membership in a number of learned societies including the Botanical Society of America, American Society of Naturalists, Real Sociedad Espanola de Historia Natural, American Society of Plant Physiologists, Orchid Society of Venezuela, Orchid Society of Brazil, Phi Kappa Phi, Alpha Zeta, Gamma Alpha, and the Presbyterian Church (though he was not a churchgoer and apparently not religious according to Giltner). After his retirement Knudson was awarded the Gold Medal of the Federated Garden Clubs of New York in 1956 for "distinguished service in scientific research on the physiology and nutrition of plants". In 1957 his alma mater, the University of Missouri, awarded Knudson an honorary Doctor of science.

After retiring Knudson continued to visit his laboratory regularly until his death. His association with Cornell spanned a total of 51 years.

Research with Plants Other than Orchids

Knudson was interested in fungi: the culture of whole plants and detachable root-cap cells under aseptic conditions; carbohydrate nutrition; the growth of nitrogen-fixing and nodule-forming organisms; mineral nutrition (though it has been suggested that his work gave him the excellent but missed opportunity to study micronutrients); fungi as pathogens; X-ray effects on chloroplasts and fern prothalli and spores germination of *Calluna vulgaris*; ferns; tannic acid fermentation and tannins, 1 commercial production of vanilla; hybridization and diseases of the 'Gros Michel' bananas; and rubber-producing plants. He and his graduate students also developed the first reliable methods for the culture of nitrogen-fixing bacteria that could be used to inoculate legumes. Approximately 200,000 such cultures were used by farmers in New York State for the inoculation of beans, peas, alfalfa, and other crops. A

modification of Knudson's method was still being used at the time of his death.

There was a parallel between Knudson's work on orchid and heather, *Calluna vulgaris* (*Erica vulgaris*, Ericaceae) seed germination. He believed that the heather seeds, like those of orchids, do not require fungal infection for germination whereas M.C. Rayner (whom he pointedly insisted on calling "Miss Rayner" and whose name he misspelled as Raynor in 1928) claimed the opposite. As with orchids, Knudson proved his point, but it is not certain if Rayner was convinced.

Knudson's attempt to culture root-cap cells was ahead of its time and demonstrates yet again that he had a fertile, far-reaching mind and that he was an excellent scientist. He used "water cultures" and a modified Pfeffer solution (monobasic potassium phosphate instead of dibasic and with or without 0.5% sucrose) in an attempt to culture root-cap cells which sloughed off the roots of corn and Canada field pea. Some of the Canada pea cells survived for 50 days when plants (i.e. roots) were present in the culture medium. They lived for another 21 days after the plants were removed despite contamination of the medium by molds and yeasts. Plant hormones and other additives which make cell cultures possible at present were not known then (8 and 35 years were to pass before auxins and cytokinins, respectively, were to be discovered). Therefore, Knudson used media which did not contain hormones and vitamins, and it is not surprising that his cells survived for relatively short periods. The culture of isolated cells may be easier at present, but plantlet regeneration is still difficult with many species. Isolated cells and protoplasts of orchids have yet to be cultured successfully.

Another concept in which Knudson's ideas were ahead of his time was the permeability of chloroplast membranes. the conventional view in those days was that chloroplasts do not have a semipermeable membrane. On the basis of his experiments with plastids, X-rays and sugar solutions, he concluded that plastids exhibit "definite osmotic properties and must possess a semipermeable membrane". Physiological and

ultrastructural research since then has shown that this is indeed the case.

In 1916 Knudson became interested in comparing methods used at the time to measure the osmotic pressure of plant cells. He and S. Ginsberg 1) devised a piston-cylinder apparatus for the expression of cell sap, 2) recommended the use of "standard materials-testing machinery," 3) found that a pressure of 50,000 pounds yields a more concentrated sap than 10,000 pounds, 4) detected no differences between sap from leaves frozen with liquid air or ice-salt mixture, and 5) reported considerable differences between osmotic pressure determinations through plasmolysis or the cryogenic method. This work must have provided him with the background necessary to refute later claims that sugar affects orchid seed germination through changes in the osmotic concentrations of the medium.

In retrospect, it seems that several of Knudson's research interests led him to orchids. One of these was fungal nutrition as it related to tannic acid fermentation and the utilization of sugars. He showed that *Aspergillus niger* and a species of *Penicillium* could produce gallic acid by fermenting tannic acid with the enzyme tannase. Cane sugar reduced the production of tannase probably because it was a preferred source of carbon. This research, published eight years before the first orchid paper probably taught Knudson that fungi can break down molecules and metabolize sugars.

More directly relevant to Knudson's work with orchids was his research on the utilizations of sugars by angiosperms in vitro and his attempt to culture root cells. In one set of experiments he showed that aseptically grown plants of vetch (*Vicia villosa*) and Canada field pea (*Pisum sativum*) can grow on a mineral medium supplemented with glucose, lactose, raffinose, sucrose, and maltose. Galactose and mannose were toxic, but their toxicity could be reversed by glucose, fructose, and sucrose. He autoclaved his culture media, which means that some of the sucrose was hydrolysed into its components, glucose and fructose, probably explaining its effects. *Aspergillus niger*, several species of *Penicillium*, one species of *Fusarium* and a

species of Nucor were not injured by galactose. A much more extensive study with corn (*Zea mays*) plants and embryos, Canada field pea (*Pisum sativum*), timothy (*Phleum pratense*), vetch (*Vicia villosa*), radish (*Raphanus sativus*), cabbage (*Brassica oleracea*), and clover (*Melilotus alba*) produced similar results. In these experiments Knudson decontaminated the plant material with a saturated calcium hypochlorite using what was then a newly formulated method. He added sugars to Pfeffer's solution. Perhaps the most important aspect in terms of Knudson's subsequent orchid research was the culture of corn embryos. The ideas and techniques (calcium hypochlorite utilization, Pfeffer's solution with added sugar, and embryo culture) used in and developed for these experiments were eventually employed for the invitro culture of albino corn, studies of amylase secretion by roots of *Zea mays* and *Pisum sativum*, and the first asymbiotic germination of orchid seeds.

(To be continued)

Editors Note:

This complete (except for illustrations and bibliography) and interesting biography of Lewis Knudson was reprinted here with permission of the Author, Dr. Joseph Arditti, and the American Orchid Society, Lindleyana publication (The issue for March (1:1-80) published March 29, 1990). The original publication contains a number of interesting photographs, none of which are reproduced here. Also the complete bibliography is omitted. Readers who wish to see either of these items are referred to the original publication. Other than that this is a true and accurate reproduction of the original material. It is planned that this will be printed in the Odontoglossum Alliance Newsletter in five (5) parts. The Odontoglossum Alliance is grateful to Dr. Arditti for his generous permission to publish the story of Lewis Knudson

Color Plate Identification

Plant Identification of the Photographs on page 20. These are all part of Sandro Cusi's article on Lemboglossums

Page 21

Starting on the upper left hand corner and proceeding clockwise:

Lemboglossum apertum

Cymbiglossum vexativum

Rossioglossum splendins

Lemboglossum rossii 'O'ecrum AM/AOS

Lemboglossum ure-skinneri

Lemboglossum majale

Mesoglossum londesboroughianum

Page 22

Starting at the upper left hand corner and proceeding clockwise:

Cuitlauzinia pendula

Lemboglossum stellatum

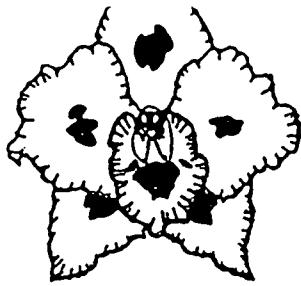
Lemboglossum cervantessi

Lemboglossum madrense

Lemboglossum cervantessi 'Seleccion'

Cuitlauzinia pendula 'Rio Verde'

Rossioglossum insleayii 'Rio Verde' AM/AOS



SUNSET ORCHIDS

The following Odont seedlings are near flowering size and should bloom on their current growth. They are two bulb & growth plants or larger. Plants are offered subject to being unsold. No substitutions will be made. All plants will be shipped in pot by Priority Mail unless otherwise requested. Payment in the form of check or money order must accompany order and include 10% (\$5 minimum) for packing and shipping in the USA. California residents must add 8.25% sales tax. Overseas customers will be invoiced for required documentation costs and estimated packing and shipping.

167	Odm. bictoniense album	A sibling cross. Solid bronze flowers with pure white lips.	\$ 12
286	Oda. Queen of Hearts 'Sunset Ruby' HCC x Jan's Pride 'Red Baron'	Good quality red flowers.	\$ 12
287	Oda. Queen of Hearts 'Sunset Ruby' HCC x Oda. Lippestern 'Red Ruby' AM	Good quality red flowers.	\$ 15
289	Oda. Lippestern 'Red Ruby' AM x Jan's Pride 'Red Baron'	Good quality red flowers.	\$ 12
327	Odm. Stropheon 'Pacific' FCC x Odm. Durham Pursuit 'Snow Leopard'	Pristine white flowers with wine spots.	\$ 12
397	Odm. Parade 'Goldilocks' AM x Odm. Charles 'Janet' AM	Golden yellow flowers with mahogany spots, some have been xanthic.	\$ 18
407	Odm. crispum 'Sheila' AM x Odm. crispum 'Sunset Crystal'	Pure white flowers with yellow crested lips.	\$ 18
409	Odm. crispum 'Sheila' AM x Oda. Lillian Dugger 'Sally Lee'	Pinks, lavenders, or whites some with spots.	\$ 12
410	Odm. Quistrum 'Lyoth Angelo' FCC x Odm. crispum 'Sheila' AM	Pristine whites some with purple spots.	\$ 15
414	Oda. Lippestadt 'Sunset Dalmatian' x Odm. Mt. Diablo 'Sunset Dalmatian'	Pure whites with maroon spots or patterns.	\$ 12
417	Oda. Saint Clement 'Mark Daniel' AM x Oda. Danilo 'SantaBarbara Sunset' HCC	Huge red/purple patterns on lavender or white. (Limit 1 per \$100 of order)	\$ 25
418	Oda. Saint Clement 'Mark Daniel' AM x Oda. Strator 'Sunset Giant'	Whites some with purple spots.	\$ 15
428	Oda. Saint Clement 'Sunset Mist' AM x Odm. Lippestadt 'Sunset Dalmatian'	Whites with mahogany spots or patterns.	\$ 12
432	Oda. (Joe's Drum x Floricon) x Oda. Point Nepean 'Sunset Jaguar' AM	Red-purple markings on white background with lavender margins.	\$ 12
444	Oda. Point Nepean 'Sunset Jaguar' AM x Oda. Saint Clement 'Mark Daniel' AM	Heavy red/purple patterns on lavender.	\$ 18
446	Oda. Point Nepean 'Sunset Jaguar' AM x Oda. Lillian Dugger 'Supercalifragilistic'	Red/purple patterns on lavender.	\$ 18
459	Oda. Floocalo 'Abundance' x Oda. Mont a l' Abbe 'Sunset Orchids'	Huge whites some with spots. The Mont a l' Abbe is Sunset Orchids' logo.	\$ 15
468	Oda. Fresnillio 'Royal Sunset' x Oda. Saint Clement 'Sheila'	Whites with heavy red patterns.	\$ 12

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