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CARNIVOROUS PLANT NEWSLETTER

VOLUME 12, Number 4

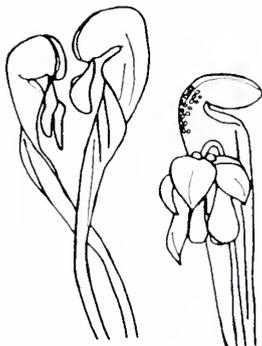
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CARNIVOROUS PLANT NEWSLETTER

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Volume 12, Number 4
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COVER PHOTOS

Front: 2.5 inch pitcher of *Nepenthes rajah*. (Photo by Thomas C. Gibson.)

Back: 5 inch seedling of *Nepenthes rajah*. Note increments of leaf size. (Photo by Thomas C. Gibson.)

See article, page 6.

The co-editors of CPN would like everyone to pay particular attention to the following policies regarding your dues to the ICPS.

All correspondence regarding dues, address changes and missing issues should be sent to Mrs. Pat Hansen, 3321 Hamell Rd., Fullerton, CA 92635. DO NOT SEND TO THE CO-EDITORS. Checks for subscriptions and reprints should be made payable to CSUF FOUNDATION-ICPS.

All material for publication, comments and general correspondence about your plants, field trips or special noteworthy events relating to CP should be directed to one of the co-editors. We are interested in all news related to carnivorous plants and rely on the membership to supply us with this information so that we can share it with others.

Views expressed in this publication are those of the authors, not necessarily the editorial staff.

Copy deadline for the June issue is April 1, 1984.

CO-EDITORS:

D. E. Schnell, Rt. 1, Box 145C, Pulaski, VA 24301

J. A. Mazrimas, 329 Helen Way, Livermore, CA 94550

T. L. Mellichamp, Dept. of Biology, UNCC, Charlotte, NC 28223

Leo Song, Dept. of Biology, California State University, Fullerton, CA 92634

Seed Bank: Patrick Dwyer, St. Michael's Episcopal Church, 49 Killlean Park, Albany, NY 12205, USA.

BUSINESS MANAGER: Mrs. Pat Hansen, c/o The Fullerton Arboretum

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News and Views

CLYDE BRAMBLETT (RR 2 Box 90), Miami, Florida 33187) writes: Enclosed are some pictures of the Metropolitan Miami Flower Show that took place March 11-13 showing the CP that we put in. There were 150 plants shown with about the same names as in the Fairchild show. A few of the Mexican Pinguiculas are in bloom. The show had a circus theme and our exhibit was supposed to be a large cage to enclose the wild carnivorous plants. However, the area we finally got shrunk in size from 100 sq. ft. to 70 sq. ft. and so we had to modify the cage. The show was well received!

KATHRYN BRINDERHOFF (P.O. Box 884, Provo, Utah 84603) writes: I am a new subscriber to *CPN* and am quite pleased with your newsletter. Because I am not able to grow any CP, I must try to satisfy my interest with books and articles—a poor substitute for experience. I am a homemaker with a Bache-

lor's Degree in zoology and botany. I have interrupted my education—I aspire to obtain a Ph.D in zoology, arachnology to be specific—to raise a family. To keep my interest up, I like to amuse myself by researching various items of interest. I am currently intrigued by animal associates of CP. I would like to write a paper on the subject and am compiling a bibliography.

I would like to enter a plea for any information regarding this subject from ICPS members—references, names of animals and plants involved in this kind of relationship, personal observations, anything. Perhaps I may even be spared the trouble of compiling a bibliography if one has already been done that I might use. I cannot offer much in exchange, perhaps a copy of the completed bibliography. I do not believe I will try to publish the paper, for, not only do I not study live CP, I do not even grow them. (I am always skeptical of articles



Ron Pratt awaits the crowd in front of the CP exhibit at the Metropolitan Miami Flower Show in March, 1983.

SEED BANK*

Byblis liniflora, *Darlingtonia californica*, *Dionaea muscipula*, *Drosera aliciae* (5), *D. anglica* (1), *D. auriculata*, *D. binata*, *D. burkeana* (3), *D. burmannii*, *D. capensis*, *D. capensis* (narrow leaf), *D. capillaris*, *D. dielsiana* (3), *D. erythrorhiza* (2), *D. indica* (5), *D. intermedia* (Roraima) (2), *D. montana* (4), *D. natalensis* (3), *D. peltata*, *D. pygmaea* (4), *D. ramellosa* (2), *D. rotundifolia*, *D. spathulata* (Kansai), *D. spath.* (Kanto), *D. spath.* (white fl.) (4), *Nepenthes gracilis*, *N. khasiana*, *N. mirabilis*, *Pinguicula alpina* (8), *P. corsica* (8), *P. lusitanica* (2), *P. vulgaris*, *Sarracenia alata* (8), *S. flava*, *S. leucophylla*, *S. purpurea purpurea*, *S. purpurea venosa* (5), *S. rubra* (2), *S. rubra* "Gulf" (1), *S. × catesbaei* (5), *S. × chelsonii* (8), *S. leuco × alata* (4), *S. purp. × psitt.* (3), *S. rubra × leuco* (4).

*For instructions on ordering and sending seed, see CPN, March 1983, p. 4.

News and Views

written about science by people who have no personal experience in the matter.) In conclusion, I will be indebted to anyone who can help me with my project. I hope to hear from many of you soon.

ALASTAIR CULHAM (Eldertree Cottage, Barrack Lane, Great Waltham, Chelmsford, Essex. CM3 1EP ENGLAND) writes: At the July meeting of the Carnivorous Plant Society the committee decided to set up a pen-friend scheme. The aim is to encourage carnivorous plant growers around the world to exchange information, seeds and possibly plants.

Any I.C.P.S. members interested in this scheme should write to me stating their experience in growing carnivorous plants and any group of C.P. they are particularly interested in. This information allows me to pair them up with someone of similar interests in this society.

NICHOLAS FLORA (P.O. Box 223, Deer Park, CA 95448) writes: For those *Sarracenia* hybridizers who have a problem storing pollen for later crosses, I have come up with a possible solution. To

store pollen, I use gelatin capsules that you can purchase at any health food or drug store. They work quite well and come in many different sizes depending on the amount of pollen one is storing. I would be careful on storing them near any moisture because if they get near any high humidity, they will promptly melt.

Also, I would like to add that I agree wholeheartedly with what Cliff Owens had to say in *CPN* 12(2) in the News and Views section.

ANTHONY REA (296 Precita Ave., San Francisco, CA 94110) writes: The San Francisco Flower and Garden show was again a big success which took place August 19-21. There were 45 entries and 11 exhibitors: Eric Imperiale, Harold Charns, Glenn Greenawalt, Jeanne Savarese, Raymond Triplitt, Mark Logoteta, Mike Morris, Joe Mazrimas, Mickey Urdea, Paul Morris and Larry Logoteta. Joe won the "Best of Show" award with his *Nepenthes × dyeriana* which was a huge plant sporting many large colorful pitchers. The Flower show President and Man-

ager were so impressed by our display this year that they decided to give us a prominent place in the main gallery next year. I hope to see everyone back again and I invite all growers of CP to join us next year.

CLAUS THIEDE (Goslarsche Str. 70, D-3300 Braunschweig, West Germany) plans to finish his studies next year and would like to take a long holiday (5-6 weeks) before beginning to work. He would like to collect Nepenthes in Malaysia, Borneo, or somewhere in that general area, and asks that anyone planning a field trip in May or June contact him.

JEROME WEXLER, 13 Langshire Drive, Madison, CT sends some advice on photo equipment: Most 35mm cameras come with a 50mm 'normal' lens. Generally, the lens focuses from infinity to a point where the image is about 1/10th lifesize. To obtain a larger image of a small object one of several things must be done: 1. a supplementary lens can be screwed in/out of the front of the lens. 2. Extension tubes can be placed between the camera body and the lens. 3. A bellows unit can be placed between the camera body and lens. Each method has its own advantages and disadvantages.

About a year ago the Vivitar Corporation brought out a piece of equipment that outweighs all of the above methods for close-up work *in the field*. It's called, VIVITAR 2X MACRO FOCUSING TELECONVERTER. It costs about \$60 and is placed between the camera body and the lens, but once it is on it can be left on all the time. It allows you to focus continuously from infinity to a point where the image is approximately lifesize without adding anything to or taking anything off your camera/lens outfit. (Great for field work—nothing to lose.)

The teleconverter converts the 50mm lens into a 100mm lens. This is a great advantage: it gives a little more working room between the front of the lens and the subject, it improves the perspective of the subject, it reduces the amount of background that is photographed. (This helps the subject to stand out from the background.)

There are many teleconverters on the market but only the above converter has a built-in focusing mechanism. Don't buy a teleconverter that does not have this feature!

A CP HAPPENING

The Fairchild Tropical Garden (Miami, FL), in its summer class schedule, published details of a carnivorous plant class taught by ICPS member Clyde Bramblett, carnivorous plant nurseryman and expert. The one-session class, held on August 20, included information on how plants trap their prey as well as instruction on cultivation and propagation.

CPN applauds efforts to publicize CP and welcomes news of other CP-related classes and events.

SPECIAL NOTICE

The book, *Carnivorous Plants of the World*, by K. Kondo, mentioned on page 3 of the March 1983 issue of CPN is still available directly from the author. The price listed in March was a group discounted price; individual orders must now be accompanied by \$12.00 U.S. Send orders to Dr. Katsuhiko Kondo, Dept. of Environmental Science, Faculty of Integrated Arts and Sciences, Hiroshima University, Higashi-Senda-Machi, Hiroshima City 730, JAPAN.

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ON THE CULTIVATION OF THE GIANT MALAYSIAN PITCHERPLANT (*NEPENTHES RAJAH*)

By Thomas C. Gibson

Department of Biology, University of Utah, Salt Lake City, Utah 84112

Nepenthes rajah ranks among the most spectacular pitcherplants in the world: large crimson traps with massive frilled rims (see Plate 19 in Kurata 1976). It also has a solid reputation for being difficult to grow (e.g. Douglas 1884). Miller (1906) states, "To grow the Rajah may well be regarded as the summit of the gardener's skill." Despite many introductions, the species remains extremely rare in cultivation. Failure to grow this remarkable carnivorous plant stems, in my opinion, from a poor understanding of its cloud forest environment on Mt. Kinabalu. In this article, I describe my limited success with *N. rajah*, particularly how I have tried to simulate its natural environment at the University of Utah. Since this pitcherplant is considered endangered, failure to cultivate it has important consequences for the conservation of wild populations on Mt. Kinabalu (see article by Dr. Faith T. Campbell in this issue).

Many years ago the Director of Sabah National Parks sent me a small packet of *N. rajah* seed for my research. I now have 12 robust plants, each over 9 inches in diameter. If they continue to grow at present rates (1 new leaf/month and 1.75x size increments), they should be mature within 1 year. I suspect this giant pitcherplant can be raised from seed to maturity in less than 4 years.

Natural Conditions on Mt. Kinabalu

N. rajah grows in cloud forest between 1650 and 2650 meters elevation on Mt. Kinabalu. Kurata (1976, page 61) describes its habitat as "sunny and wet" and "fond of wet places like swamps or the surroundings of a water fall." To

the best of my knowledge, this is the only published description of *N. rajah*'s habitat. For a general description of cloud forest environments, see Grubb (1977), Whitmore (1975), and Lawton (1983).

In 1972 I visited Mesilau Creek. Here the pitcherplants grow among short grasses on a steep slope under a stunted forest (15 feet tall) over Oligocene serpentine. Seedlings were common only on a recent landslide. *N. rajah*, like most carnivorous plants, colonizes semi-bare ground created by disturbance.

Due to the open canopy of the stunted forest, the pitcherplants are exposed to the full sky. At these elevations, light conditions are a bright haze with short periods of full sun, usually in the cool morning. The broad leaves of *N. rajah*, therefore, are rarely exposed to long periods of full hot sun. Throughout the day, frequent mist and cool air temperatures keep leaves from burning.

Rainfall at these elevations on Mt. Kinabalu may exceed 150 cm per year, distributed evenly throughout the year (data for Kambarangoh, see Lowry *et al.* 1973). During the day, humidity may fluctuate at ground level, but at night, as temperatures drop, local humidity may rise to saturation.

Unfortunately, I have not found data for day and night temperatures at any *N. rajah* site. From my brief visit to Mesilau Creek, however, I would guess 65°-70° (day) and 55°-60° (night).

In general, cloud forest soils are peaty, hence acidic, nutrient-poor, constantly wet, and sterile (see Grubb 1977). Due to serpentine, soils at *N. rajah* sites may also be toxic. Extended periods of heavy

rainfall may oxygenate the peat layer and hence release nutrients stored in organic matter.

A pitcher of *N. rajah* captures substantial amounts of insect biomass during its lifetime, as much as several grams for the largest traps (personal observation). Pitcher contents can only be described as a "foul swill" of putrid insect victims, dead leaves, and twigs.

Greenhouse Conditions at the University of Utah.

During those rare moments when the sun shines, the cloud forest environment feels like perpetual spring. It is like standing in the brilliance of the driving cool mist from a waterfall. This contrasts markedly with the dark, oppressive, hot, stuffy artificial greenhouse environments created by growers for lowland *Nepenthes* species.

In general, I grow *N. rajah* "hard" (high light, cool temperatures, fluctuating humidity, low soil nutrients). In my opinion, it is a serious mistake to grow this species "soft" (dark, warm, constant high humidity, fertilizer in soil). Under such soft conditions, plants produce thin, over-sized leaves and no traps. In this weakened state, they become prone to stress and disease. From correspondence with my trading buddies, I know of several scores of *N. rajah* plants which have died under soft conditions.

In my opinion, the 3 most critical aspects of cultivating *N. rajah* are:

1.) **Mist plants heavily, at least 5x per day.** This pitcherplant species will not produce traps unless heavily misted. In fact, its threshold for trap production occurs at much higher humidities than those of other *Nepenthes* species, probably because its open bowl pitcher form has high evaporation rates from it and will not function efficiently at lower humidities. Hence, there has been natural selection for plants which produce traps only at the highest humidities.

2.) **Increase light levels, just short of burning.** I find that traps form only at high light levels. In fact, trap size

increases with light intensity and appears due entirely to instantaneous photosynthetic input from its particular leaf. If leaves are misted regularly and air temperatures are lower, leaves will not burn as readily at higher light levels.

3.) **Feed traps insects, not fertilizer.** Once traps have formed under high mist and high light conditions, the only direct way to put nutrients into a plant is to feed traps with insects. *N. rajah* has a poorly-developed root system and therefore fertilizer on the soil will not get into the plant readily. Instead, it will promote microbial activity, which can cause the plant to rot, especially if grown soft. Obviously, feeding insects through pitchers does not risk the possible loss of an entire plant. I also find that putting fertilizer into traps causes an internal imbalance in nutrients, which eventually stops whole plant growth. Furthermore, it is difficult to know how much fertilizer to put into a given trap, whereas insect biomass can easily be estimated from natural capture rates. Fertilizer in pitchers can also increase microbial action and therefore wipe out important enzyme systems for insect digestion.

I feed $\frac{1}{3}$ of the pitcher volume with insects over 10 - 15 days, which grossly approximates natural capture rates. Small traps receive small ants and flies, whereas large traps get large insects, as many kinds as possible. I maintain fluid levels in traps with a pipette. If fed too much insect biomass, the top of a trap will die. Fed traps will turn from red to green. A UV light trap will catch pounds of insect biomass, which can then be frozen for future use.

Insect resources may be particularly important for *N. rajah*. This beast may be more-dependent on insect resources than other *Nepenthes* species. Undoubtedly, its large, long-lived, woody traps would have higher metabolic costs to produce than those of small, short-lived, flimsy traps, especially if they were less photosynthetic compared to green traps. By inference, the benefit derived from *N.*

rajah's traps must also be greater. To ascertain the truth of this hypothesis, I have been constructing growth rate curves for various *Nepenthes* species as a function of the amount of insect biomass fed to plants. The slopes appear to be steeper for *N. rajah*.

I pot my plants in Canadian peat moss and white quartz sand (1:1). As the peat breaks down, it releases nutrients to the plant. This may be particularly important for establishing small seedlings or weak plants. Since the sand is coarse (#8 sand blasting silica grit), drainage is fast. I repot every 2 years or whenever the peat breaks down. There will be little disturbance to fragile root systems when repotting if you wash the soil mixture away from the plant. Moss stabilizes the soil surface.

I water plants heavily each morning with 99.95% pure water (reverse osmosis, then deionized; 18 meg-ohm). I use a fog nozzle so that the water will be heavily oxygenated.

Day temperatures are about 70°. I have found that newly-expanding leaves will develop black blotches of sun-burn if exposed to higher temperatures, especially during the summer, when light levels are naturally highest. Night temperatures are between 55° and 60°. During the summer, an evaporative cooler maintains night temperatures about 70°. Cool night temperatures during the summer may be crucial for success with this species.

One word of caution: a weak *N. rajah* plant must adapt *gradually* to the limits of this "hard" environment. If grown "soft", it will be badly stressed under such harsh conditions. It will become yellow and re-veined, grow slowly, and probably back-slide in size. When first placed under my conditions, soft-grown *Nepenthes* typically shrink to 1/3 their size. I find that *N. rajah* adapts slowly. A plant will begin to change appearance only after 3 or 4 months of feeding traps with insects. It will produce larger, deeper green leaves and considerably larger traps. At this point, light levels can be increased again. Only a well-fed plant can tolerate higher light levels.

Readers who wish to obtain their own *N. rajah* plants should know that the Giant Malaysian Pitcherplant is considered an endangered species (only 2 small populations are known to exist within Kinabalu National Park). It is fully protected by Malaysian wildlife laws and by CITES. *Do not buy illegal field-collected plants*. Such plants invariably die within 3 months.

The author would like to correspond with other carnivorous plant enthusiasts who have attempted to grow *N. rajah* in order to learn better how to grow this remarkable beast. Since I plan to keep my 12 plants as stock to create hybrids with other *Nepenthes* species, I do not wish to trade or to sell any plants at this time.

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(See front and back covers, this issue, for photos of *N. rajah* grown by Thomas Gibson.

C.P.'s of the Southern Alps of New Zealand

by

Grant Birmingham
88 Sturrocks Rd.,
Christchurch 5,
NEW ZEALAND

&

Phil Cotter
7 Montgomery Tce.,
Christchurch 2,
NEW ZEALAND.

Editors of the N.Z.C.P.S. Journal.

INTRODUCTION

The Southern Alps are the major mountain range in New Zealand. They run from north to south, dividing the South Island into two. The plants with which this article deals grow in the alpine, sub-alpine and montane regions of these Alps. Most of this area is highly inaccessible and government legislation protects its flora and fauna. Over the last few years we have become familiar with the C.P.'s of this region through undertaking a number of field excursions, ranging from short walks off the road to those which necessitated spending a few nights in the bush, and from observing them in cultivation. Until now very little has been published on these plants.

In New Zealand there are six species of *Drosera*. We shall be dealing with *D. arcturi* Hook., *D. spathulata* Labill.-N.Z. and *D. stenopetala* Hook. f. *D. binata* Labill., *D. auriculata*, Backh. and *D. pygmaea* DC. are also native to New Zealand but grow outside of the area of concern. We shall also be dealing with *Utricularia monanthos* Hook. f., one of the nine *Utricularia* native to New Zealand. The number of *Utricularia* is by no means definitive, as the last taxonomic study made was in 1925 and since then there has been some speculation as to the status of a number of these plants.

D. arcturi

The range of this species also extends to S.E. Australia. In New Zealand it is found in scattered, isolated pockets of wetlands, mainly in the sub-alpine region but also extending into alpine and montane areas, predominantly in the South Island. The two locations that we have

found these plants growing in large numbers, were both sub-alpine tarns, refer to photo-Lewis Pass.

At the Lewis Pass site, *D. arcturi* was growing predominantly in *Sphagnum* and around the edges of the tarn was growing in peat in association with *D. spathulata*-N.Z. At Arthur's Pass it was growing in peat amongst a mat forming Sedge, *Donatia* sp., as shown in *U. monanthos* photo, in addition to *U. monanthos*, *D. spathulata*-N.Z. and a solitary *D. stenopetala*. In both tarns seepage occurred ensuring a slow, but constant supply of fresh water.

D. arcturi is a semi-upright plant with brown, strap-shaped leaves up to 12cm in length. Under good conditions the tentacles are usually long and coarse terminating in a large droplet of 'dew.'

Usually there is a solitary, large white flower produced in November-February. Each flower produces a large seed capsule, 1cm long, usually containing in excess of twenty coarse seed.

At the onset of winter the plants die back to a winter bud which is formed just under the surface of the substrate. The leaves are sheathed at the base, and when they die back in winter they form a protective layer around the winter bud. During the winter the buds are normally covered in ice, snow or a combination of the two. In addition they are often exposed to freeze-thaw conditions. The buds come away again in early spring. *D. spathulata*-N.Z.

This small, rosette *Drosera*, (refer to photo), is widespread in New Zealand, the other forms of it extend to Australia and Japan. We have found it growing

in a number of conditions ranging from water-logged peat to cracks in exposed rock. There appear to be a number of distinct populations within New Zealand, some of which exhibit distinct genetic variation. In a number of locations *D. spathulata*-N.Z. grows as an annual, being killed off at the onset of winter and appearing again in spring from seed.

D. stenopetala.

D. stenopetala is endemic to New Zealand and grows predominantly in the South Island. It is found only in a few isolated pockets mainly in the montane region, but also extending to the sub-alpine regions. It prefers areas of scrub, where it receives little or no direct sunlight, and has a preference for vertical faces where water either flows over it or percolates through it. This plant varies in size, considerably, according to habitat conditions.

D. stenopetala is a very attractive, semi-upright plant. It has a spathulate lamina at the end of a long, broad petiole, refer photo, growing to 8cm in length. This plant usually produces three or four summer leaves in the summer growth period. It produces a large, solitary white flower, similar to that of *D. arcturi*, usually in December or January.

Due to the plant growing in relatively sheltered conditions it does not die back for the winter but continues to produce leaves. In early autumn the plant starts to produce its short, thick winter leaves which are 1cm long terminating in a small, circular lamina, as broad as the petiole. The winter growth form is reminiscent of a Pygmy *Drosera*.

U. monanthos

We have only found *U. monanthos* growing at Arthur's Pass, in conditions as described in the section on *D. arcturi*. However it is known to grow in a number of other locations in New Zealand and Australia.

The flower of *U. monanthos* is violet-purple with a yellow eye, or rarely with a white eye*, and is particularly attractive when flowering en masse.

CULTIVATION

D. spathulata-N.Z. is easily grown from seed and plants grow equally well in peat or *Sphagnum*. It requires no special attention.

D. stenopetala and *U. monanthos* should be treated similarly. They both prefer a peat mix with a little sand. At all times a high water level should be maintained up to the surface of the substrate and not less than 3cm below it. The water should be changed, rather than added to, and must never be allowed to become stagnant. This is essential for the successful cultivation of these plants and is particularly important if you want your *U. monanthos* to flower. During the winter the temperature should not be allowed to drop below -4 C. during the night, and 0 C. during the day. However slightly warmer temperatures are desirable. During the summer, night temperatures should not drop below 0 C. and day temperatures should be around 20 C.

U. monanthos is a vigorous grower and hence easy to propagate. *D. stenopetala*, on the other hand, is extremely difficult to propagate. We have experimented with seed under various conditions, and the only success has been with seed sown amongst the parent plants.

D. arcturi should be cultivated, as above, with the exception that it prefers *Sphagnum* and requires winter temperatures below 0 C. We have had limited success with seed. We recommend heavy stratification.

*Allen, H.H., *Flora of New Zealand*. Vol. 1. Govt. Printer, Wellington, New Zealand. 1982.

SPECIAL NOTICE

CPN heartily welcomes slides and photos for consideration. Contributors should label *each* slide or photo with caption information as well as name of photographer. If contributors wish their photos or slides returned, it would be very helpful to pencil in a "please return" on each item. Thanks.



D. arcturi, habitat, Lewis Pass.

photos by P.D. Cotter



U. monanthos, habitat, Arthur's Pass.

Sabah Nepenthes Expeditions 1982 & 1983

By Allen Lowrie

6 Glenn Place, Duncraig, 6023, Western Australia

In March 1982 Robert Oliver and myself organised an expedition to Sabah. This trip was mildly successful. The second expedition in 1983 was highly successful. On the 1983 expedition Greg Russell (QLD), a long time C.P. mate of ours, joined us. Greg flew from Queensland to Perth where he joined Robert and myself for the flight to Sabah. There being no direct flights to Sabah, our first stop was Singapore, overnight. The trip to Singapore was a lot of fun as the jumbo had only 58 passengers and we had the back half of the plane to ourselves.

From Singapore to Kota Kinabalu only took a few hours. After we had passed through customs in K.K. we picked up our hire car and headed for the hills about a half hour out of town. The 1983 expedition was well prepared: 12' x 10' tent, three fold up beds, water barrels and cooking gear; you name it, we had it. This trip Robert and I decided to go Hollywood style. Our 1982 trip was a two-man tent (dog-box) and very little gear. No way can you rely on picking up the items you think you might need in Sabah. If the items you think you might need are there, they are surely hidden and scattered in K.K.

There are no road signs in Sabah and finding your way around is basically a hit and miss affair. You can't rely on the locals for directions as many of them don't speak English. The 1983 trip proved Robert and myself had a good memory as we didn't get lost once.

From K.K. we travelled south to the Sipitang area; it took us all of the day to travel 60 miles. The roads are kind of rough, like you can park your car in the pot holes and be shaded most of the day. In the early evening we reached the Sipitang area, pitched our tent, made a meal then got stuck into the scotch. Whisky, I believe, is a very important item one

should use when camping in the jungle. (Truly, I'm deadly serious.) All water must be chlorinated (we used Puratabs)—with whisky added it kills the chlorine taste and makes the drinking water more drinkable. We used whisky in our early morning cup of tea (a nice malty taste), in our large water bottle with Saminade (when hiking), and for knock out drops at night so we could get a good night's rest. I also believe it kills the bad belly bacteria which is very easily picked up in this part of the world. After the end of the 1982 expedition both Robert and myself had a bad dose of the Borneo Belly for two weeks, a sickness I wouldn't wish on anybody; it was hell. In 1983 none of us got sick, both during and after the trip.

Our first day in Sipitang area was our first encounter with *Nepenthes*, the plants we had travelled so far to find. *N. rafflesiana*, *N. gracilis* and *N. ampullaria* were discovered fairly quickly. The *N. rafflesiana* found in this part of the world are most varied both in pitcher shape and colour compared with the *N. rafflesiana* found on the Malaysian mainland and Singapore. In our opinion some of the *N. rafflesiana* we collected were truly top *Nepenthes*. *N. gracilis* varied little and only a few specimens were collected. Hybrids were found between *N. rafflesiana* × *N. gracilis*, *N. rafflesiana* × *N. ampullaria* = *N. trichocarpa*. Now and again *N. mirabilis* was found growing in the wetter areas, no hybrids were found with *N. mirabilis* as one of the parents, although later in the trip we were to have success in this area.

The following day we discovered *N. albomarginata*, an all light green form with the distinctive white band just below the peristome. Greg found one specimen—light purple/grey with maroon specks all over the pitcher. Combined with the snow white band it was truly an outstanding *Nepenthes*.

The *N. albo-marginata* from the Sipitang area, I believe are very different from the *N. albo-marginata* found on the Malaysian Mainland (in pitcher shape, colour and hairyness under the leaves). On the first expedition to Sabah I found what looked like a hybrid between *N. albo-marginata* × *N. rafflesiana* in this same area. I have this *Nepenthes* in cultivation and I'm waiting for a mature pitcher to develop so I can confirm this theory.

After the *N. albo-marginata* patch was properly investigated (all morning) we set off to find *N. bicalcarata* in the swamp forests around Mesapol. The jungle here was thick; we had to cut our way through every yard we traveled. One time Robert took a swipe at a small sapling with his jungle knife and was quickly covered in native hornets. Having stirred up a nasty little problem, Robert covered about thirty paces in one second; fortunately he didn't get stung. All afternoon until early evening set in we bombed through this thick jungle, high humidity and heat, biting insects, *Pandanus* Pahms (which cut like hell) we were completely tired when we gave up looking for *N. bicalcarata*.

The following day we tried another swamp forest not far from the previous day's location. After about three hours of bombing through the jungle we came across *N. bicalcarata*, and all joy broke loose with much yelling and screaming. We must have sounded like three Orang-utans in a dog fight. *N. bicalcarata*, what a plant. Some were thirty feet into the tree tops, most of the plants were growing in thick *Pandanus* groups. Greg and myself took twenty minutes to cut our way into one plant which was a distance of only three paces into the *Pandanus* thicket. In 1982 Robert and myself failed to find *N. bicalcarata*, but we discovered later (1983) that we were only about one mile away from where we looked for *N. bicalcarata* in 1982. From Sipitang area we headed back to Kota Kinabalu and jumped on a plane to Lahad Datu on the East coast of Sabah. We left most of our camping gear in K.K. as we were going to stay in a hotel in this

part of Sabah. (We wished we had taken the tent with us.) The hotel was rough to say the least: I got bitten by bed bugs on the first night. We couldn't have a shower or flush the toilet as Lahad Datu was in severe drought and the water was only turned on for twenty minutes a day. When the water was turned on we found that the tap water was sea water. Luckily we had brought water with us from K.K., with this water and Coca-Cola we managed to quench our thirst. On arrival we found there was a cholera epidemic in Lahad Datu, so we decided not to drink or eat any local food or water.

The following day we headed for the mountains outside of Lahad Datu. On one particular mountain we found a moss forest at 1600', rather low for a moss forest. In the moss forest we found *N. stenophylla*, *N. tentaculata* and a few hybrids of *N. stenophylla* × *N. tentaculata*. Robert and myself knew this hybrid was here as we had collected the same hybrid by accident the previous year. Below the moss forest we found *N. reinwardtiana*, both the all green form and an all maroon form. Between 1000' and 1400' we found *N. macrovulgaris*. *N. macrovulgaris* is a provisional name applied to this *Nepenthes* by John Trumbull and his wife Anne Middleton after they had discovered this new species. John and Anne will be describing this *Nepenthes* later, when they have gathered more information from herbariums around the world. *N. macrovulgaris* is a beautiful *Nepenthes* and rather variable in its shape and size. The colour of the pitchers, as with most *Nepenthes*, is also variable. In cultivation it is a good grower in cooler conditions. A good cross section of the variable plants was collected along with seed.

At the end of the day we headed back to the hotel. That night we decided to get out of Lahad Datu first thing in the morning. The reason for our change in plans was that we had been told by an English engineer who was working in the area that the cholera had gotten out of control. He reported that the day we



Nepenthes macrovulgaris (Turnbull)

Photos by Allen Lowrie



N. macrovulgaris. Upper and lower pitcher selection.



N. albo-marginata



N. macrovulgans (Turnbull)



N. rafflesiana



N. bicalcarata

arrived three people had died and today six people departed this world. In the local hospital there were 300 people with cholera with more people flooding in all the time.

The following morning we raced off to the local airline office and managed to book a flight out of Lahad Datu that morning to Sandakan. We couldn't get on a plane to K.K. direct but we could fly to Dandakan, stop 6 hours, then later in the day get a flight to Kota Kinabalu. When we arrived back in K.K., later that day, we were informed that Lahad Datu was in quarantine; in fact, the quarantine was applied to Lahad Datu one hour after we had flown out of the town. When we arrived back in Australia two weeks later we found out that Lahad Datu was still in quarantine; that is, no one into the town or out of the town. We thanked our lucky stars that we were not caught in Lahad Datu.

From K.K., in our hire car we headed through the Crocker Ranges to Ranau, here we made camp at one of the most beautiful places in Sabah. Some 10 miles out of Ranau there is a river junction with shallow fast running cool water, surrounded by jungle on all sides. Here we spent the day swimming, washing clothes and generally having a relaxing time; we needed it. The heat, the rough roads, the fast pace all got the better of us. We were dead tired.

After a day's rest and feeling refreshed, we headed up a mountain along native tracks east of Mt. Kinabalu. At the 4,500' elevation, we came across *N. fusca*, *N. stenophylla* and now and again *N. reinwardtiana*. The *N. stenophylla* on this mountain were different from the plants we had found at Lahad Datu. The hairs under the leaf of the *N. stenophylla* in Lahad Datu were longer and thicker. *N. tentaculata* was also found at this elevation, here again, the *N. tentaculata* found in Lahad Datu was different from the species found on this mountain. Further up the trail we found *N. burbridgeae*. Not a large population of these *Nepenthes* was found. As a

guess, I would say there were only about 30 plants in the group scattered over a 100 yards. In the *N. burbridgeae* patch there also were leeches. Everywhere we walked, we got covered with these nasty little creatures. As fast as we pulled them off our legs, there was another one to take its place. On the 1982 expedition, Robert got a leech in between his toes; when he removed the leech he couldn't stop the bleeding. To wash the wound clean he used the fluid out of an unopened *N. burbridgeae* pitcher. To his amazement and mine, the bleeding stopped. After our 1982 expedition, I caught up with John Turnbull and his wife Anne in Sydney, when I was on a business trip there. Anne told me she had a nasty experience with a jungle knife and cut her finger rather badly, as it happened, in a *N. burbridgeae* area. Anne also washed her wound in the fluid from a *N. burbridgeae* unopened pitcher to clean the wound, when she found also that the bleeding stopped. There must be something in the fluid of unopened *N. burbridgeae* pitchers (maybe other species as well) that has the ability to stop bleeding. Maybe researchers should take up these events—who knows, a new drug to help mankind may be discovered.

In the Ranau area in the mountains along with *N. fusca*, *N. tentaculata*, *N. stenophylla* and *N. reinwardtiana*, we found with *N. burbridgeae* hybrids of *N. burbridgeae* × *N. fusca*.

As on the first trip, Mt. Kinabalu was not explored since the fines for being caught in the National Park with plants collected legally outside of the park are very high. It's not worth the risk of having your legally collected plants confiscated by the authorities. All the *Nepenthes* that can be successfully cultivated, i.e. plants up to 5000' can be found outside of the National Park. We feel apart from *N. lowii* which is also found out of the Park (T. Trus Mardi and Mt. Mulu) all the other *Nepenthes*—*N. villosa*, *N. rajah*, *N. edwardsiana* are alpine plants and don't take to sea level cultivation all that well.

On returning to K.K. we then flew over to Kuala Lumpur (Malaysia) here we met up with Roger and Marjan Shivas who are from Brisbane. Roger and Marjan kindly put us up at their apartment and joined us on our daily field trips around K.L. Luckily they had a few free days off from their work at the university.

Our first field trip took us up to the highlands about an hour's drive from K.L. The mountains in this region were a bit over 6,000 ft. At the summit of one mountain we found *N. macfarlanei*, *N. gracillima* and *N. sanguinea*, including quite a few hybrids between these three species. Later in the day at 6000 ft. we were all caught in a heavy downpour of rain and we were all soaked to the skin. Lower down the mountain the temperature rose and we all managed to dry out.

Another day we explored the lowlands, in an area of swamp land surrounded by low hills we found: *N. mirabilis*, *N. ampullaria*, *N. gracilis*, all growing together. In amongst the true species we found *N.*

mirabilis × *N. ampullaria*, *N. gracilis* × *N. mirabilis*, and *N. ampullaria* × *N. gracilis* = *N. trichocarpa*. On a slight rise, in this same area I was fortunate enough to find a huge clump of a fantastic hybrid, which we feel could be *N. × hookeriana* × *N. mirabilis*. Although in the immediate area we found no *N. rafflesiana*, we felt it could be found if one explored the surrounding area more closely. The *N. mirabilis* around the K.L. region is rather varied and many of these plants sport rather wide peristomes. Roger showed me one photo he took of a *N. mirabilis* which had a peristome nearly ¼ inch wide.

As the final days of our trip drew to a close we said goodbye to Roger and Marjan and flew from K.L. to Singapore. We spent the last day shopping in Singapore and later that night we boarded the flight to Perth. The jumbo again was only slightly full (78 people). We had a smooth flight to Perth; on arrival in Perth we were all thoroughly searched by the customs

(Continued on page 95)



N. stenophylla



N. tentaculata



Author Allen Lowrie with giant *N. sanguinea* × *gracillima* hybrid. See article beginning on page 88. Photo by Rob Oliver.



Cephalotus follicularis
Grown and photographed by Andrew Hanlon

GROWING CEPHALOTUS IN AUSTRALIA

Andrew Hanlon

59 Dunoon Avenue, West Pymble 2073, N.S.W. AUSTRALIA

I have been growing *Cephalotus* for about 5 years now, using all sorts of "recommended" potting mixes and micro climates with varying results. Some method were good while others were disastrous. Last year I wrote to Allen Lowrie in Western Australia who specializes in these unique plants and he recommended using a good quality pure German peat moss as a medium. So I repotted all my adult *Cephalotus* into 6 inch full length plastic pots with about one inch of crocking in the bottom to allow for good drainage. I then moved all my plants into the *Nepenthes* hot house. The hot house has the following conditions: Winter minimum temperature is 55° F (12.8° C); summer maximum temperature, 100° F (37.8° C); humidity is 85-98%; shading is about 50-60% and there is a continuous air circulation system, automatic heating, venting and misting system. The misting jets do not spray directly onto the *Cephalotus*, however with the humidity of around 90%, the pots only require a little water around the edge every month or so in winter to keep the peat moss damp. It is important to remember that under cool or cold conditions during winter, when growth almost stops, not to allow the plants to get very wet or otherwise the roots will rot. In the summertime when temperatures rise up to about 90-100° F, I stand the *Cephalotus* in about ½ inch of water which allows the plants to draw water up through the crocking as required. When most of the water in the tray has been used or evaporated, I then add more.

Under these conditions, *Cephalotus* really thrive, with pitchers 1.5-2 inches long and with good coloration. Last year, I had a number of seedlings that sprouted on their own, so this year I plan to do a little hand pollination and experiment with fertilizers. The *Cephalotus* in the photo is in a 6 inch pot and shows a

slightly different form, inasmuch as the inside of the pitcher lid turns completely red after 4-5 months while the peristome remains green. The pitcher on the left opened the end of last summer and is 1.65 inches (42mm) long. The pitcher in the middle opened mid-winter and is 1.5 inches (38mm) long and the pitcher on the right opened 6 weeks prior to the beginning of spring. It measures 1.9 inches (48mm) long, the lid is 1.1 inches (28mm) wide and the total length from the top of the lid to the toe of the pitcher is 2.3 inches (59mm) long. Most of the *Cephalotus* are similar to the center pitcher but the peristomes are also colored red. Finally, perhaps I should point out that I have been growing *Cephalotus* under the described conditions for about 15 months, so as yet I am not aware of any possible long term problems. However, I am not expecting any since without any help from me, the plants have produced seed, which germinated, and the seedlings are growing well.

Nepenthes (from p. 93)

guys (10 of them). No doubt these guys thought they had hit the jackpot—surely no one goes to the places we had in our passports, unless they're up to no good. Every tent pole and tooth paste tube was checked and tasted. Two hours later we were released.

The first and especially the second expedition overall were highly successful, with many new varieties added to our respective C.P. collections. We all look forward to the day when we can make new hybrids from our new mother stock.

NEW ADDRESS

World Insectivorous Plants
2690 Indian Lakes Dr., N.E.
Marietta, GA 30062

Carnivorous Plants Deserve Protection

by Faith Thompson Campbell, Ph.D.

Natural Resources Defense Council, Inc., 1725 I St., N.W., Suite 600,
Washington, D.C. 20006

Readers of the *Carnivorous Plant Newsletter* surely know that the world's wonderful wild plants are in grave danger. Habitat loss, competition from introduced species, and overexploitation are driving an estimated 25,000 plant species to the brink of extinction. If we do not reverse these trends, we will lose sources of endless delight as well as valuable resources: raw materials for medicine, improved agricultural crops, and industry.

The carnivorous plants which we find so fascinating are no exception to this alarming situation. One, *Sarracenia oreophila*, is officially listed as Endangered under the U.S. Endangered Species Act; it has declined or been extirpated from over 70% of its historic colonies. Several other species of *Sarracenia* are also severely depleted, although bureaucratic delays have prevented their receiving federal legal protection. Some are protected by state laws. Outside the United States are found numerous other rare species, including some of the spectacular *Nepenthes* from Malaysia.

Lovers of wild plants, united in their voluntary societies, are potentially the most powerful advocates for effective conservation programs to prevent extinction of plant species. Who better knows and appreciates their many values—esthetic, scientific, practical? Who can more persuasively argue for their conservation? Who better knows their locations, the threats to their survival, and, often, the actions necessary to conserve them? Unfortunately, most plant societies have been slow to respond to this challenge.

The International Carnivorous Plant Society should speak out on plant conservation: it should help alert the public around the world to threats to plants' survival, and support strong conservation programs.

Carnivorous plants face two major threats, habitat loss and overexploitation by the horticultural trade.

In the United States, habitat loss is the primary cause of endangerment. Most carnivorous plants are confined to low-lying bogs which are rapidly being drained for plantation forestry and agriculture, poisoned by water pollution, or allowed to grow into tangles of vegetation as a result of fire suppression.

The major concentration of pitcher plant bogs occurs along the Gulf Coast. These bogs once covered almost 3,000 km² in natural condition and another 60 km² in altered condition. This severe loss—97%—of habitat is all the more alarming because of the great species diversity of these spectacular bogs. They contain over half the approximately 45 species of carnivorous plants found in North America.

The important bogs of coastal North Carolina, home of the unique Venus fly-trap, are under similar pressure. About 40% of the coastal savannahs and wetlands remain; only about 20% of the pocosins, and very few of the bays. New technologies allow more extensive draining of the savannahs for forestry, so these areas will face added conversion in the near future. Peat mining threatens the remaining pocosins.

A second cause of severe depletion of wild populations of carnivorous plant species is overexploitation. In the U.S., this factor plays largely a supplementary role: once habitat loss has reduced a species, eager collecting can decimate the remaining populations. For example, in the late 1960s there were eight to ten recorded populations of *Sarracenia jonesii*, now there are only two. Of the six populations extirpated, at least one was collected out. Even the more plentiful

species may be suffering long-term effects from massive collecting, however. Botanists still dispute the impacts of the annual collecting of up to four million Venus flytraps in the late 1970s.

Outside the United States, collecting assumes much greater importance as a cause of extinction of carnivorous plants. In tropical countries, the lowland species of carnivorous plants thrive in degraded forests, so they are not as threatened by the rapid destruction of the virgin tropical forests as are certain other plant types. The more rare species tend to be found in seeps on steep hillsides and cliffs and in other mountainous areas unsuitable to agriculture or forest exploitation. Some of these, including some *Nepenthes* species, are also protected by their inclusion in national parks.

Eager collectors seek out these species, ignoring expense, physical discomfort, and frequently the law. This spring, Australian authorities seized a shipment of *Nepenthes rajah* which had been stolen from Kinabalu National Park in Malaysia and exported in violation of an international treaty.

In recent years, several programs have been instituted to control these threats to rare plant species. The U.S. has a particularly extensive network of protective programs aimed at both curbing habitat loss and controlling exploitation.

The Endangered Species Act requires all federal agencies to ensure that activities financed or permitted by them do not disrupt a species' habitat or jeopardize the species' continued survival. This law also prohibits collecting of listed plants from federal lands.

State heritage programs, operated in cooperation with the Nature Conservancy, identify unique or high quality representative ecosystems, some of which are then acquired or protected under other agreements. A number of states, mostly in the Midwest, have enacted natural area programs, which provide various mechanisms for protecting small but biologically important areas.

Many states, including Florida and North Carolina, have enacted their own endangered species laws which identify and provide some protection for rare plants. Florida prohibits the willful injury or destruction of a plant of a species listed as endangered if it is found on another's or public land; it also prohibits collection of three or more of such plants from public land. Included in this protection are all species of *Sarracenia* native to the state. The North Carolina statute prohibits the sale or barter of protected plants, including *S. jonesii*.

These state laws are now reinforced by the Lacey Act, which imposes federal penalties of up to five years in jail and a fine up to \$20,000 for interstate or foreign sale of plants taken in violation of the state law.

The United States also seeks to protect its wetlands. The most important legal protection stems from Section 404 of the Clean Water Act, which requires that anyone wishing to dredge or fill a wetland must obtain a permit from the U.S. Army Corps of Engineers. Such permit applications are reviewed for their impact on wildlife by the Fish and Wildlife Service.

The federal government has also purchased considerable wetland areas, although at least until recently these acquisitions focused on areas of importance to migratory waterfowl. Some of these purchases were financed by waterfowl hunters through the "duck stamp."

Finally, the United States and 80 other countries have signed a treaty which regulates international trade in certain protected species of plants and animals. Four U.S. pitcher plants (*Sarracenia oreophila*, *S. alabamensis*, *S. jonesii*, and *Darlingtonia californica*), and *Nepenthes rajah* are protected by this Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). People wishing to exchange these plants with colleagues in other countries must obtain permits from their government. In the case of the most threatened species, the three *Sarracenia* and the *Nepenthes*, such permits are

granted only for scientific purposes.

Enactment of these programs has not completed the work of plant conservationists, however. All suffer from inadequate budgets and lagging implementation; some come under periodic attack by economic interests and must be defended. The Endangered Species Act survived such an attack last year. The wetland protection program is still in danger, however. Last year, some in Congress tried to restrict the permit requirements to wetlands directly associated with navigable waters. Such a change would have reduced the total area protected from 148 million to 22 million acres, and would have exempted virtually all bogs containing carnivorous plants. These Congressional efforts continue. In the meantime, the Reagan Administration has weakened the existing law by giving a blanket authorization for dredging and filling of inland wetlands, including freshwater bogs; and by carrying out only cursory reviews of developments affecting intermittent streams and other such "functionally limited" wetlands.

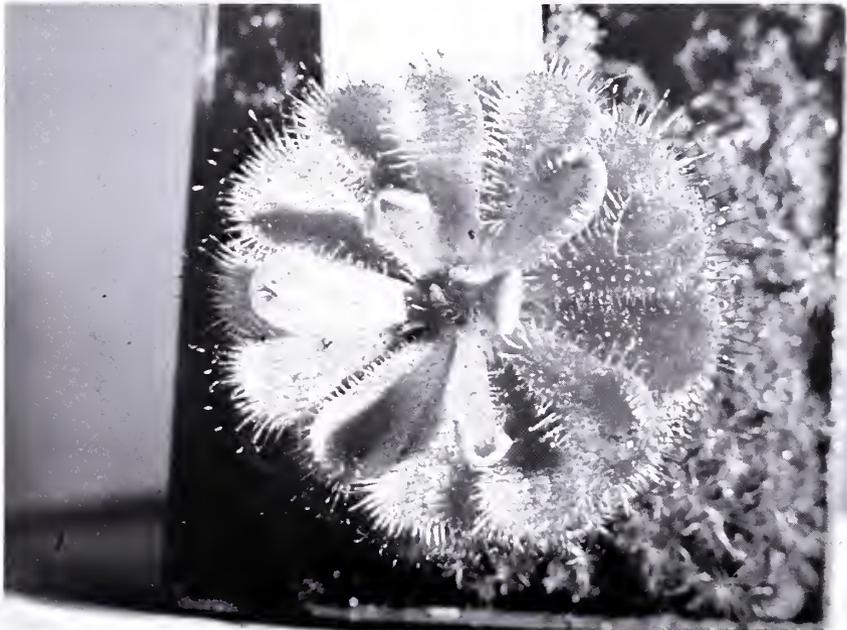
Conservation organizations are fighting the Congressional attacks and the Reagan

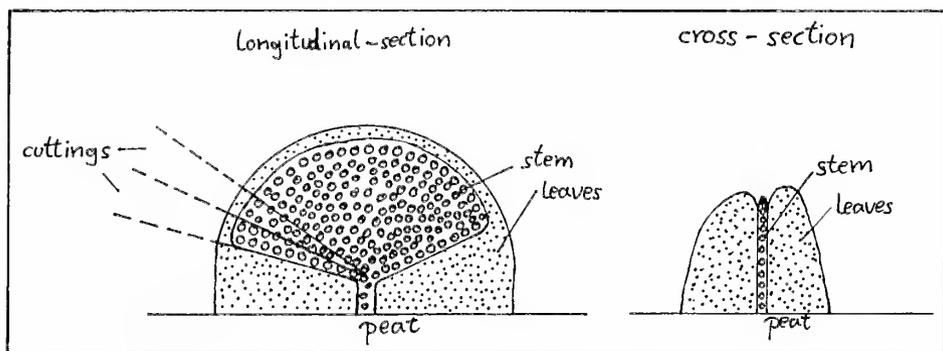
proposals. But they need more allies, especially carnivorous plant lovers who appreciate the values of small, shallow bogs which do not support ducks and geese.

In other words, there is much for the International Carnivorous Plant Society to do to further conservation of wild populations of these plants. You could lobby in support of existing legal protections and for increased funds to implement land acquisition and other programs. You might consider establishing a conservation fund to purchase land or finance research. At a minimum, the ICPS should take a strong stand on the ethical issue of collecting wild carnivorous plants. It should make it clear that it will not tolerate violators of local, national, or international laws. It should encourage propagation for exchange or sale.

Put your expertise and energy to work for the cause we all support: preserving healthy wild populations of carnivorous plants around the world.

* "The Gulf Coast Pitcher Plant Bogs" by George W. Folkerts, *American Scientists*, Volume 70, pp. 260-267





A 'Forma Crestata' of *Drosera*.

Andreas Wistuba, Mudauer-Ring 227, D-6800
Mannheim 52, West Germany

In the spring of 1982, a South African *Drosera* I was growing (perhaps a new species) showed a strange change at the growth point. The growth area broadened into a line. At first, I thought it was dichotomous branching, but after a short time I became certain that it was a crestate change as is sometimes seen in cacti. This occurred after having the plant about half a year. I had not yet brought the plants to flowering, either the normal or crestate forms.

The growing line got longer and leaves became smaller. After a time, the growing line became somewhat serpiginous. A longitudinal section showed a semicircle and the stem was fan-shaped (see figure). Leaf cuttings from the crestate form budded into normal plants.

I thought of a root illness as a cause of this change and therefore decided to experiment with propagating the plant in cristate form. I made cuttings of the growing line at right angles, the cuttings being wedge-shaped (see figure). The cuttings were planted upright in a pot filled with very moist peat. The pots were placed in clear plastic bags under fluorescent lights.

After about two weeks, the cuttings were rooted and new leaves were growing. The cuttings themselves rapidly developed a

crestate growing line similar to the parent plant. As soon as these cutting plants are large enough, I plan to propagate them in a similar manner to keep the crestate form going.

In conclusion, the crestate form cannot be propagated from leaf cuttings, but can from growth line cuttings.



LEFT: Normal *Drosera* plant.

Photos by Andreas Wistuba.

Crestate form of *Drosera*.



Crestate form of *Drosera*.

Photo by Andreas Wistuba.

CP PEOPLE DEPARTMENT: STEVE SMITH

My interest in CP began back in my high school Biology class. The first plant to catch my attention was the Venus flytrap, and shortly behind was *Sarracenia*, *Drosera*, and *Pinguicula*. My first plants were purchased from Carolina Biological Supply that same year. Unfortunately, they all died when they were placed in direct sun in a sealed container. It was not until the summer of 1973 that I again attempted to grow CP again. While on vacation in North Carolina with my wife, we decided to drive into the Holly Shelter swamp to see what we could locate. We found VFT's, *S. flava*, *D. capillaris*, *D. brevifolia*, and *P. lutea*. These plants survived and needless to say, I had been bitten by the bug. I have no formal training in

horticulture or botany, and have learned from reading and experimenting. The early issues of CPN were the most helpful, as they contained a wealth of information. Other information came from correspondence with growers around the globe. Since these early days my collection has grown to over 175 species and hybrids. This spring I designed and built a 12' x 20' greenhouse, and now have more room to expand. My pride and joy is my *Nepenthes* collection (over 40 species and hybrids), my Mexican *Pinguicula* collection (over 28 species and hybrids), and my *Heliamphora* collection (three species). I enjoy attempting to make hybrids. It is exciting to produce a new plant for the first time.



Steve Smith



Steve Smith's *Pinguicula* Collection

Review of Recent Literature

Angerilli, N.P.D. and Beirne, B.P. Mortality of introduced mosquito larvae in natural and artificial ponds containing aquatic vegetation. *Prot. Ecol.* 4(4): 381-386 1982.

Utricularia minor was one of the tested plants that limits or prevents mosquito larvae from developing to the adult stage.

Broussaud, F. and Vintejeux, C. Ultrastructural and cytochemical studies in superficial tissues of the entrance of *Utricularia* trap (*Lentibulariaceae*). *Bull. Soc. Bot. Fr. Lett. Bot.* 129(3): 191-202 1982.

The outer portion of the trap entrance produced long wall expansions with superposed layers of lipid and polysaccharidic substances which seems to play a prominent part in the mechanism of the trap.

Fontaine, T.D. III and Nigh, D.G. Characteristics of epiphyte communities on natural and artificial submersed lotic plants: substrate effects. *Hydrobiol.* 96(3): 293-301 1983.

Utricularia fibrosa was one of the plants tested as a substrate for epiphytic growth of communities of organisms.

Gray, N.F. 1983. Ecology of nematophagous fungi: distribution and habitat. *Ann. Appl. Biol.* 102:501-509.

In Ireland, 161 soil samples from varied sites disclosed 205 isolations of nematophagous fungi. The numbers of each species and trapping type are tabulated, and relations of various species to "soil" types is discussed with ten broad habitat types delineated. DES

Hilton, D.F.J. The biology of *Endothenia daeckiana* (*Lepidoptera: Olethreutidae*), an inhabitant of the ovaries of the northern pitcher plant, *Sarracenia purpurea* (*Sarraceniaceae*). *Can. Entomol.* 114(3): 269-274, 1982

Around July 1, eggs are laid singly on the flower bracts of *S.p.purpurea* and

the newly-hatched larvae bore into the ovary base to reach the carpels. Seeds are consumed from the inside and outside the ovary. The 4th or 5th instars overwinter in the pithy flower stalk and emerge in Spring as adults. Egg and larvae parasites infest and parasitize some of the organisms.

Keddy, P.A. Shoreline vegetation in Axe Lake, Ontario (Canada): Effects of exposure on zonation patterns. *Ecology* 64(2): 331-344 1983

Species richness changes according to the environmental disturbance especially in the zonation patterns of lakeshore vegetation. The range of water depths tolerated by individual species changed with exposure. *Utricularia cornuta* reached their maximum population on exposed shores. Other plants like *Drosera intermedia* did best at intermediate exposure. Species richness peaked significantly at intermediate levels of exposure.

Tezean, S.S. and G.L. Barron. 1983. A new predatory hyphomycete capturing bdelloid rotifers in soil. *Can. J. Bot.* 61:1345-1348.

The new species is described as *Cephalophora naviicularis* and utilizes special adhesive pegs to capture bdelloid rotifers. Conidia formation after capture is also described. Photos are included. DES

WANT ADS

Claus Thiede (Goslarsche Str. 70, D-3300 Braunschweig, W. Germany) (WB) *Nepenthes truncata*, *villosa*, *maxima*, *macfarlanei*, *lowii*, *edwardsiana* plants/rooted cuttings.

Steve Smith (1159 Trim St., Kirkwood, NY 13795). For sale or trade for other rare CP: *Heliamphora heterodoxa* and *H. minor* (limited quantity). Send SASE for prices and list of CP if interested in trade.

Title Index

Carnivorous plants deserve protection	96
CP's of the southern alps of New Zealand	85
Cultivation of the giant Malaysian pitcherplant <i>Nepenthes rajah</i>	82
'Forma crestatata' of <i>Drosera</i>	99
Growing <i>Cephalotus</i> in Australia	95
Influence of different forms of <i>Sarracenia</i> species on their hybrids	68
<i>Nepenthes</i> of Gunung Ulu Kali	65
<i>Nepenthes mirabilis</i> variation	64
Photographic primer of the Pinguiculas of the Southeastern U.S.	41
Photographic study of . . . <i>Drosera capensis</i>	69
Preliminary report on pollination of a <i>Sarracenia purpurea</i>	60
Preservation of <i>Nepenthes</i> pitchers	62
Re-Visit to Florida and Georgia	51
Sabah <i>Nepenthes</i> expeditions	88
Seed structure of carnivorous plants	8, 33
<i>Utricularia menziesii</i> : an amazing plant	39

Genera Index

(Photos and drawings are italicized)

Aldrovanda	6, 9, 10, 11, 55
Byblis	5, 9, 10, 15
Cephalotus	9, 11, 31, 94, 95
Darlingtonia	3, 9, 10, 16, 28, 97
Dionaea	5, 7, 9, 10, 14, 31, 32
Drosera	1, 7, 8, 9, 10, 11, 22, 32, 33, 34, 35, 36, 37, 38, 45, 46, 54, 55, 59, 69, 70-73, 85-86, 87, 98-100, 101
Drosophyllum	9, 10, 15
Genlisea	8, 9, 10, 12
Heliamphora	9, 10, 11
Nepenthes	3, 6, 9, 10, 11, 16, 17, 18, 21, 31, 32, 55, 57, 62-63, 64, 65, 66-67, 77, 82, 84, 88-89, 90-91, 92, 93, 94, 95, 96, 97, 104
Pinguicula	7, 8, 9, 10, 12, 29, 31, 41, 42-43, 44, 47, 48, 52, 56, 101
Polypompholyx	7, 8, 9, 10
Sarracenia	1, 3, 5, 9, 10, 21, 31, 49-50, 51, 59, 60-62, 65, 67, 68-69, 74, 80, 96, 97, 101
Utricularia	1, 4, 8, 9, 10, 13, 19, 20, 21, 31, 39, 40, 59, 85-86, 87

Author, Photographer and Artist Index

Abel, H. - 2	Gagliardo, R. - 5	Randall, J. - 17, 19, 33, 34, 37, 45-48, 50
Bednar, B. - 64	Gibson, T. - 77, 82, 104	
Beebe, J. - 69	Hanlon, A. - 95	Rea, A. - 80
Birmingham, G. - 85	Hicks, G. - 31	Savignano, M. - 5
Bramblett, C. - 4, 79	Homick, M. - 5	Schnell, D. - 3, 5, 41
Brinderhoff, K. - 79	Huber, D. - 29	Shivas, R. - 57, 62, 65
Campbell, F. - 96	Jacobs, J. - 31	Sikes, S. - 6
Carpenter, T. - 59	Kusakabe, I. - 6, 31	Smith, S. - 7, 32, 100
Clemensha, S. - 68	Laminack, S. - 31	Temple, P. - 39
Cotter, P.D. - 85, 87	Lecoufle, M. - 6	Thiede, C. - 81
Culliam, A. - 80	Lowrie, A. - 88	Tolman, D. - 7, 15, 19, 33, 34, 37, 45-48, 50
De Puy, G. - 51	Luhdorff, C. - 59	
Dolatowski, L. - 4	Mazrimas, J. - 28, 56, 59	Van Dragt, R. - 69
Dwyer, P. - 8	Mellichamp, L. - 5	Wexler, J. - 32, 81
Elzinga, G. - 69	O'Neil, W. - 60	Wilson, J. - 7
Fleming, R. - 59	Owens, C. - 31	Wistuba, A. - 99
Flora, N. - 80		

