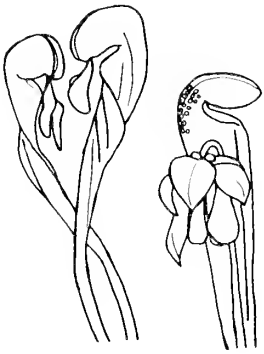
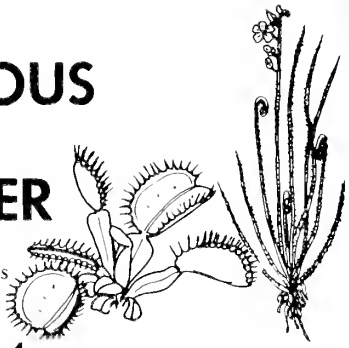
CARNIVOROUS PLANT NEWSLETTER

VOLUME 10, Number 4 DECEMBER 1981



CARNIVOROUS PLANT NEWSLETTER



Official Journal of the
International Carnivorous
Plant Society

Volume 10, Number 4
December, 1981

COVER

Drosera hilaris at Fernkloof, Republic of South Africa. For more details, please see article "A South African CP Trip" by Alain Christophe. Photo by author.

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. Kathy Fine, c/o The Fullerton Arboretum, Dept. of Biology, California State University, Fullerton, CA 92634. DO NOT SEND TO THE CO-EDITORS. Checks for subscriptions and reprints should be made payable to CSUF FOUNDATION-ARBORETUM.

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 March issue is February 1, 1982.

CO-EDITORS:
D. E. Schnell, Rt. 4, Box 275B, Statesville, NC 28677
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

BUSINESS MANAGER: Mrs. Kathy Fine, c/o The Fullerton Arboretum

PUBLISHER: The International Carnivorous Plant Society by the Fullerton Arboretum, California State University, Fullerton, CA 92634. Published quarterly with one volume annually. Printer: Kandid Litho, 129 Agostino Rd., San Gabriel, CA 91776. Circulation: 768 (184 new, 584 renewal). Dues: $10.00 annually, $15.00 foreign. Reprints available by volume only.

Editor's Corner

We the co-editors sincerely wish everyone a most joyful holiday season and are happy to announce that Society dues will remain unchanged for 1982. In order to forstall an increase in dues, several cost cutting options are now being explored. More details in the March 1982 issue. These changes will involve mainly mailing and not the quality of CPN.

International Carnivorous Plant Society
SEED BANK
($.75 per packet)
10/29/81

Byblis liniflora (10), *Darlingtonia californica, Dionaea muscipula* (10), *Drosera aliciae* (3), *D. aliciae* (pale fl.) (10), *D. arcturi* (15), *D. binata* (3), *D. binata multifida* (15), *D. burkeana* (11), *D. burmannii* (5), *D. capensis, D. capensis* (narrow), *D. capillaris* (6), *D. capillaris* (long) (3), *D. dielsiana* (3), *D. filiformis filiformis, D. intermedia, D. linearis, D. montana, D. montana* (white fl.) (5), *D. natalensis* (7), *D. pauciflora* (2), *D. peltata, D. pulchella* (3), *D. rotundifolia, D. rotundifolia* (Oregon), *D. spathulata* (Formosa) (5), *D. spathulata* (Kansai) (15), *D. spathulata* (Kanto) (5), *D. spathulata* (white fl.) (5), *Nepenthes gracilis, N. khasiana, N. mirabilis, N. rafflesiana, Pinguicula alpina* (Switz.) (5), *P. caerulea* (15), *P. grandiflora* (France) (10), *P. leptoceras* (Switz.) (15), *P. primuliflora, P. vulgaris* (Switz.) (15), *Sarracenia alata* (purple throat) (5), *S. flava, S. flava* (red vein) (1), *S. leucophylla, S. minor* (15), *S. psittacina* (10), *S. purpurea purpurea, S. purp. purp. heterophylla, S. rubra* (3), *S. rubra jonesii, Sa. sp.* mix (10), *S. flava* × *oreo* (10), *S. leuco.* × *flava* (3), *S. purp.* × *flava* (3), *S. [(purp.* × *leuco.)* × *(leuco.)* × *(leuco.)]* (3), *S. rubra* × *purp.* (1), *Utricularia subulata* (1), *U. sp.* (1).

SPECIAL ANNOUNCEMENTS

Steve Clancey (5350 Orangethorpe Ave. #68-W; La Palma, CA 90623) would like to form a local chapter of the ICPS. Interested persons should contact him at the above address.

A separately mailed renewal notice will be sent out to all current members.

The ICPS Bylaws will be published and mailed in the early part of 1982 for those of you who requested a copy. Any member desiring a copy please contact the Business Manager.

News and Views

BRUCE LEE BEDNAR (25 Lake Ct. Loop, Silver Springs Shores, Ocala, Fla. 32672) writes: In the spring of 1965, a year after I got hooked on CP by mail order, I found myself on my first field trip from Princeton to South Jersey. Heading south on 539, the hardwood and fertile farming land abruptly turns to a sandy low pine barrens. Blueberry groves and cranberry bogs are scattered throughout the area, west to a small speck on the map called Whitesbog. There tucked way back down roads through sphagnum bogs, is perhaps one of the largest populations of *Drosera filiformis filiformis* there is. Glistening red strings in the morning dew, millions strong; scattered *intermedia* and *rotundifolia* too. Perhaps some of the largest *rotundifolia* anywhere are here, (depending upon weather conditions in the spring) some better than three inches across.

Soon I came across the completely hidden bright green pitchers of *Sarracenia p. purpurea — p. venosa* intergrades in thick sphagnum moss and shrubs. One tends to get frenzied, almost hysterical, with a first encounter with carnivorous plants in the wild. Conservation was the last thing on this young person's enthusiastic mind.

Not taking time to think (at all), I pulled up every *purpurea* I could find. To make matters even worse, I returned that fall with a friend and removed the last four plants we found. Certainly very poor judgment on my part.

In my case it took years to realize what I had done. By then I was living in Miami, Florida, some 1,200 miles away, a place devoid of *Sarracenia.*

About five years later (1970), I got to return to New Jersey. Out of guilt I returned to the area I had devastated. To my complete surprise the intergrades were back in full force, as though they have never been disturbed. Thankfully, in my haste to remove the plants years before, I have unwittently broken the rhizomes halfway off. I'm sure it took a few seasons for them to put up growths and to mature again. Now they were in full flower with seedling activity not noticed the first time. I truly felt a great sense of relief.

I have returned to Jersey every year since then and the same colony remains healthy as always. It remains apparent to me that field collecting hurts plant populations, especially with man's tendency to drain and clear land with little or no concern for wildlife or flora. It is indeed a miracle many forms still remain.

But, carnivorous plants are successful plants. They have an incredible ability to recover when given a fair chance. I have been growing, buying and trading CP now for 17 years. I still have some clones of the original intergrades taken 16 years ago. *Sarracenia* never ceases to amaze me.

JEFF GOLD (13126 Anza Dr., Saratoga, CA 95070) was the main feature article in the Garden section of the San Jose News (Sept. 18) which was illustrated with his collection of CP along with a description of his background and interesting information about the plants.

J. W. KENT (17, Suffolk Crescent, Galmington, Tauton, Somerset, UK) says he has found no reference to the formation of adventitous buds on aerial Utricularia leaves, such as occurs with Droseras and Pinguiculas. This summer he noted spontaneous bud formation on aerial leaves of *U. prehensilis, U. racemosa* and *U. calycifida.* He wonders if this is a common phenomenon to which no one refers or if it is unusual. Buds also developed normally on stems of *U. calycifida.*

Please see **N/V** p. 101.

From
SINNESORGANE IM PFLANZENREICH
by Gottlieb Haberlandt
V. Insectivores: *Aldrovanda vesiculosa*

Translated by Carla R. Powell
Department of Chemistry and Foreign Languages
Lebanon Valley College, Annville, PA 17003

Continued from September, 1981.

The radial walls of the hinge cells are likewise thin, and have numerous very small pits shaped like transverse fissures, which are only apparant on bristles treated with Javelle water. When treated with zinc chloride-iodine, these walls turn light violet, like those of the elongated cells.

All of the cells of the tactile bristles have a mature cytoplasmic tube with a more or less elongated nucleus pointed on both ends. In comparison, the protoplast of the hinge cells is even more strongly developed. The nuclei here are, as a rule, finely pointed only at the end facing the point of the bristle; the lower ends are rounded off (Plate VI, fig. 2).[3]

Because the hinge cells are undoubtedly the senstive elements, one may expect to find very fine pit channels with plasmodesmata in their lower transverse walls, through which the received stimulus is conducted downward. It is however, difficult to prove the existence of these plasmodesmata, because it is not easy to cause the transverse walls in question to swell sufficiently. After the fresh, intact leaves had been soaked in iodine-potassium iodine solution for 24 hours, they were pulled apart in water on the slides. The excess water was drawn off. Several drops of 50 percent sulfuric acid were added, and then after a few seconds, the slides were completely immersed in a glass dish filled with water. The rinsed leaf fragments together with the tactile bristles protruding over their edges were then treated for 24 hours with toluidine blue solution. After rinsing, glycerine may be added only with very great care, because the tactile bristles collapse easily.

The lower, as well as the upper transverse walls of the hinge cells have no pits. From their very thick periphery, they simply thin out toward the middle of the hinge. If treated in the previously described manner, most swell a great deal, some even swell too much. By contrast, if the soaking time is reduced, or if more dilute sulfuric acid is used, the swelling hardly occurs at all. Apparently it is difficult for the transverse walls to swell. When they do begin to swell however, swelling takes place so rapidly that the desired degree of swelling is easily exceeded. Nevertheless, it is possible now and then to obtain suitable preparations, in which the transverse walls are not too severely swollen. Then, using strong magnification, one can observe that the thin, unswollen portions of the transverse walls are penetrated by a few extremely delicate plasmodesmata. In a few cases in which the plasma filaments did appear clearly enough, I was not able to count more than three filaments (Plate VI, figs. 5-8).[4]

Touching the upper part of the hair does not cause it to bend evenly lengthwise. The sections above and below this hinge are stiff and resist bending because of their thickened outer walls. The hinge itself, with its thin and very flexible outer wall is easily bent. Touching the point of the bristle results in a distinct buckling of the hinge. One

Please see **ALDROVANDA** p. 92.

A NORTHWARD EXTENSION OF PINGUICULA PUMILA MICHX.

by
Jeannie Wilson
Hampton Mariners Museum
N.C. Museum of Natural History
Beaufort, NC 28516

This is a report of a northward siting for the dwarf butterwort, *Pinguicula pumila* Michx. in Carteret County, North Carolina.

On May 23, 1981, Ken Moore, superintendent of the North Carolina Botanical Garden, conducted a field trip to the Croatan National Forest, and had requested that I come along as a local botanist. It turned out to be a very rewarding day as I was pleasantly surprised to see *Pinguicula pumila*. Even though I make regular trips into the Croatan National Forest, I have seen the dwarf butterwort on only two previous occasions in 1977. On this earlier date, fewer than 5 plants were seen at each of two longleaf pine savannah and pocosin ecotones. Jim Snyder (1978) noted that the presence of *Pinguicula pumila* in the Croatan National Forest was a northward range extension. According to the *Manual of the Vascular Flora of the Carolinas, Pinguicula pumila* occurs only in Brunswick, New Hanover and Pender Counties to the south in North Carolina.

The typical habitat for *Pinguicula pumila* is wet soils of savannahs and low pinelands of the coastal plain. The range is from North Carolina to eastern Texas. Except in the gulf coast area, it is rare throughout its range.

The best time to look for *Pinguicula pumila* is when it flowers during April and May. The flowers make the plant more conspicuous because the leaves are rather indistinct unless one looks closely. It is not surprising that the plant is easily overlooked.

The group from the Botanical Garden observed about 25 flowering plants in an ecotonal area between a longleaf pine savannah and a pocosin. Several plants were also located along the roadside ditch. I believe that the wildfire that swept through this area in June of 1980, accounted for the unusual number observed. Frequently, small herbaceous plants, particularly carnivorous plants, will regenerate quickly after a fire. In addition to *Pinguicula pumila, Dionaea muscipula, Drosera capillaris, Sarracenia flava* and *S. purpurea* were numerous and quite vigorous.

This longleaf pine savannah is a site that John Fussell and I wrote an inventory report for the N.C. Natural Heritage Program. We suggested in the management plan that the area be burned every few years to promote many herbaceous species that are dependent on fire. It appears that *Pinguicula pumila* is one of the plants that requires fire for continued survival.

If anyone has seen *Pinguicula pumila* recently, I would be interested in information on the approximate number of plants, location and habitat.

References:

Correll, D.S. and H.B. Correll. 1975. *Aquatic and Wetland Plants of Southeastern United States.* Vol. II. Stanford Univ. Press, Stanford, Cal.

Fussell, John and Jeannie Wilson. 1980. Millis Road Longleaf Pine Savannah. Report submitted to the N.C. Natural Heritage Program, N.C. Dept. of Natural Resources and Community Development, Raleigh, N.C.

Radford, A.E., H. Ahles and C.R. Bell. 1968. *Manual of the Vascular Flora of*

Please see **PINGUICULA** p. 93.

ULTRASTRUCTURAL AND RADIOAUTOGRAPHIC STUDIES OF THE DEVELOPMENTAL SEQUENCE, AND OF SECRETORY MODIFICATIONS PRODUCED BY STIMULATION OF THE DIGESTIVE GLAND CELLS OF *DROSERA CAPENSIS* L. WITH REFERENCE TO THE GOLGI APPARATUS

by Robert Lynn Outenreath, Ph.D.
The University of Texas at Austin, 1980

Supervising Professor: W.G. Whaley

The modern definition of secretion, which among other things includes cell surface modification, is a concept which has been extensively studied in animal systems. Recognition of similar processes which may be at work in higher plant cells is, however, on a comparatively primitive level. For this reason, a study was undertaken of the digestive gland cells of *Drosera capensis* with the view of determining the role of the Golgi apparatus in the secretory process, and to use the data obtained in order to make comparisons with other secretory systems, both plant and animal.

The digestive glands are remarkably complex structures which are capable of a variety of responses. For this investigation two secretory phenomena were studied. The first involved changes taking place during maturation of the glands from a non-secreting state to fully mature glands having a full complement of trapping mucilage. Such studies were possible due to the discontinuous nature of gland population maturation, which permits selection of glands in different stages of maturity from the same leaf. Of special interest were the changes which take place when mature glands are stimulated to secrete additional mucilage after contact with living insects. These studies were carried out using electron microscopic and radioautographic techniques, using H^3-galactose as the radiosugar.

Morphologically, young, non-secreting glands exhibit inactive Golgi apparatus, which have few stacks of parallel cisternae. As the glands mature and commence mucilage secretion, certain digestive gland cells are often seen to be almost filled with cytoplasmic vesicles which are Golgi-associated. Even when such vesicles are not observed, the Golgi apparatus exhibit numerous cisternae which may be irregularly stacked or curled. When the full complement of mucilage has been exteriorized in mature glands, numerous vesicles are no longer seen, but the Golgi exhibit characteristics distinctive for this stage of development. In addition, certain cell wall characteristics were correlated with developmental stage. Radioautography revealed incorporation in young glands to occur primarily over the still immature central tracheary element. In mature glands, however, extensive labeling was observed over the outer periclinal cell walls. The long label times necessary to achieve sufficient incorporation did not make possible determination of other sites of organelle label accumulation, however, morphological evidence indicated the Golgi apparatus to be the major source of mucilage.

The most striking aspect of this study was the finding of the selective activation of the Golgi apparatus only in certain gland cells. When insects such as *Drosophila* are placed on the glands, a marked increase in the amount of mucilage exteriorized occurs. This is characterized by very active Golgi apparatus in these glands, reminiscent of the beginning of developmental secretion.

Please see GOLGI p. 93.

ALDROVANDA continued from p. 89.
can see this very clearly under the microscope. In this case, the cells or plasma membranes of the longitudinal wall are greatly stretched on the convex side, and they are highly compressed on the concave side. In the case of more severe buckling, the outer wall of the concave side turns inward, forming a transverse fold. (I have given an illustration of this in my *Physiol. Pflanzenanatomie*, 1896.) This results in extensive deformation of the protoplast of the hinge cells. The entire structure of the hair evidently is designed to concentrate the mechanical effect of any contract on one particular area on the hair. That this spot must be the sensitive part of the hair is the indisputable conclusion.[5]

Darwin assumed that the hinge had a purely mechanical significance: to protect the bristles from breaking when the leaves closed. But this is, at best, a secondary function, and would apply in any case, only to the peripheral tactile bristles. The tactile bristles located on both sides of the midrib are either not bent at all, or are only slightly bent when the leaves close. The bristles are at most 0.7 mm long, and the diameter of the bladder at its widest point is 1.2 to 1.7 mm. The distance from the midrib up to the closure is 1.2 to 1.5 mm. Indeed, if a closed leaf is made sufficiently transparent by extracting the chlorophyll with alcohol, one can see that the tactile bristles of the midrib in the bladder are completely straight. This is also true for those bristles which are located even nearer to the base or to the top of the leaf blade, where the bladder is considerably smaller.

Please see **ALDROVANDA** p. 93.

Endnotes
by Stephen E. Williams

1. An English translation of this work by M. Drummond has been published by MacMillan and Co., Ltd., London, in 1914 as G. Haberlandt, *Physiological Plant Anatomy.*
2. Javelle water is a solution of chlorinated potash. When freshly prepared, it contains about 2.5 percent active chlorine. *The Merck Index*, 8th Ed., Rahway, New Jersey (1968).
3. The histochemical and cytological work in the preceding three paragraphs is, to the best of my knowledge, the most thorough and up-to-date study of this subject. However, Lloyd (p. 200 and plate 19-Fig. 20) has added the important observation that there are four sensory cells and four elongated cells connected them to four basal cells. An electron microscopic investigation would be desirable.
4. Anyone who has worked with these tiny hairs can appreciate the magnitude of Haberlandt's accomplishment here. Plasmodesmata were observed by him in the sensory cells of *Dionaea.* Electron microscopic verification of his observations would be desirable.
5. It has since been demonstrated by Ashida (Mem. Coll. Sci. Kyoto Imp. Univ. Ser. B 9, 141-244, 1934) and Lloyd (Lloyd, pp. 200-201, Carnivorous Plants, 1942) that these hairs trigger the trap, that one stimulus suffices to close some young traps. Young, healthy traps sent to me by Joseph Mazrimas always closed with a single stimulus delivered to any sensory hair. The hairs bend at the hinge and, by analogy with *Dionaea,* the hinge cells should be the sensory elements; however, I know of no direct proof of this. Both Dr. Takao Sibaoka (in Skoog, *Plant Growth Substances 1979,* 462-469, 1980) and I (*Proc. Amer. Phil. Soc., 120,* 187-204, 1976) have independently confirmed that *Aldrovanda* trigger hairs initiate action potentials which spread through the lobes of the trap in a manner analogous to the action potentials of *Dionaea.* Dr. Sibaoka has a student who is presently doing further work on the physiology of this sensory mechanism so that the anatomical work of Professor Haberlandt should soon be supplemented with modern physiological information.

Translator's Acknowledgments:

I am truly indebted to Dr. James W. Scott, Professor of German at Lebanon Valley College, for his guidance in all aspects of the grammar and style of this translation. I must also thank Dr. Stephen E. Williams, Professor of Biology, for his expert technical advice and annotations.

ALDROVANDA continued from p. 92.

REFERENCES

Cohn, Ferd. 1875. "Über die Funktion der Blasen von *Aldrovanda* und *Utricularia*." *Beitrage zur Biologie der Pflanzen*[1] (3): 71-92.

Darwin, Ch. 1876. *Insektenfressende Pflanzen,* trans. V. Carus (Stuttgart, E. Schweizerbart), p. 293.

Goebel, K. 1891. *Pflanzenbiologische Schilderungen II* (Marburg, Elwert), 57-72.

Haberlandt, G. 1896. *Physiologischen Pflanzenanatomie* (2nd ed., Leipzig), p. 480 (3rd ed., p. 521).

Lassus, Auge de. 1861. "Analyse du memore de Gäetan Monti sur l'irritabilate des follicules de cette plante." *Bulletin de la Soc. Bot. de France* 8: 519-523.

Stein, B. circa 1876. Insektenfressende Pflanzen. Monotsschrift des Vereins zur Beförderung des Gartenbaues in den königl. preuss. Staaten.

GOLGI continued from p. 91.

In both cases, active Golgi were found to be located only in those gland cells located at the outer apical areas of the glands. Radioautography revealed intense labeling over the Golgi apparatus, with little incorporation occurring elsewhere. Additionally, the time necessary to achieve good label incorporation was drastically reduced in labeled glands, indicating a marked increase in radioprecursor utilization.

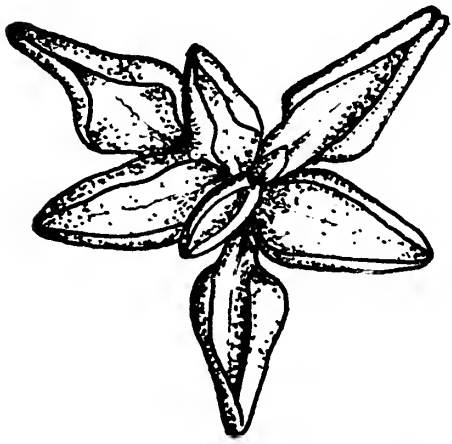
This investigation has resulted in a body of data which firmly establishes morphological criteria characteristic of the various developmental stages. In addition, several new techniques were developed to facilitate study of these glands. The finding of the selective activation of the Golgi apparatus only in the outer apicla digestive gland cells is most significant, and indicates a degree of specialization in this species not usually found in higher plants. These, and other findings, are discussed in the context of the universality of the secretory process which may be operative in all eukaryotic cells.

PINGUICULA continued from p. 90.

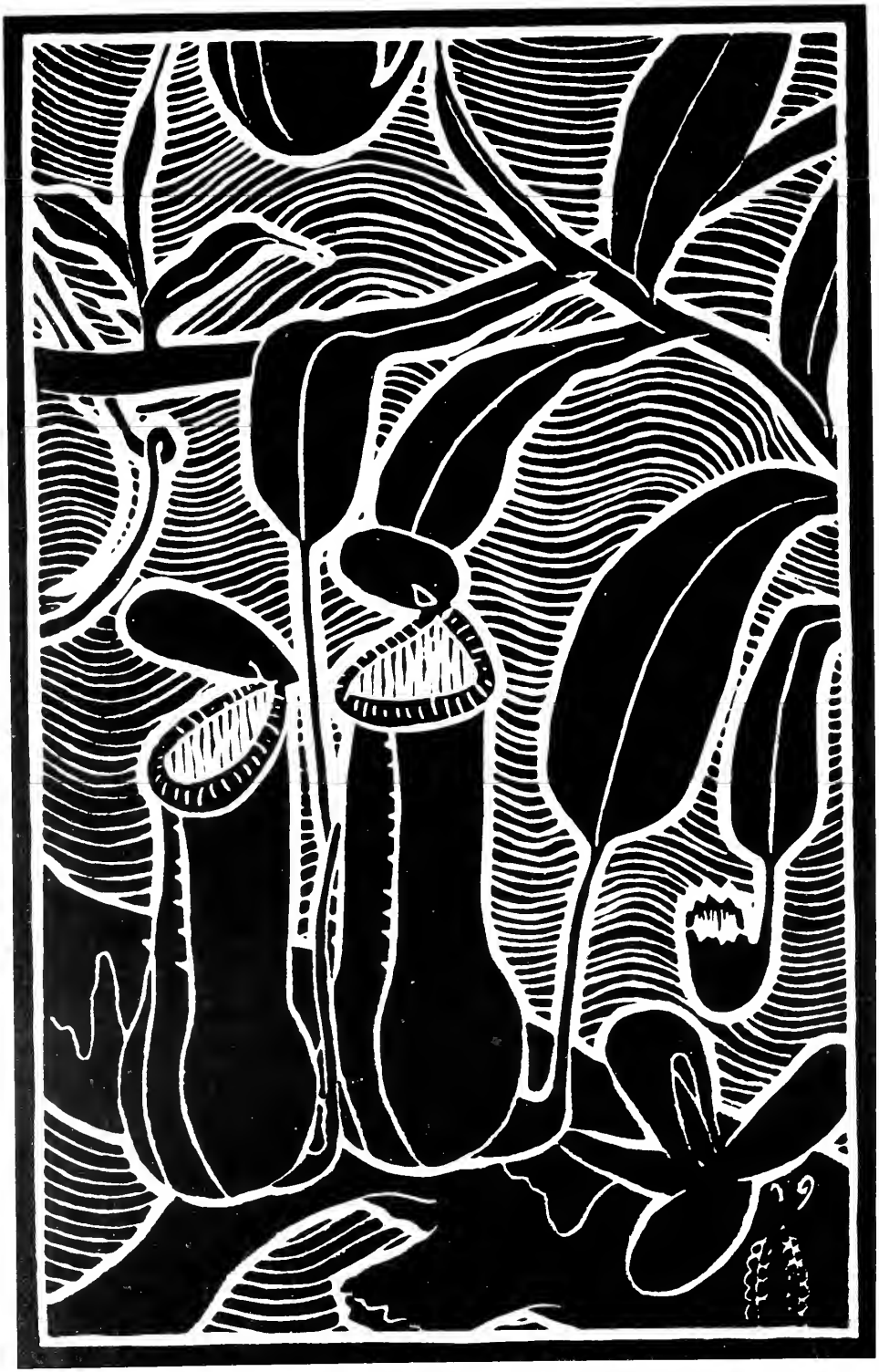
the Carolinas. UNC Press, Chapel Hill, N.C.

Schnell, Donald E. 1976. *Carnivorous Plants of the United States and Canada.* John Blair, Pub. Winston-Salem, N.C.

Snyder, James R. 1978. Analysis of Coastal Plain Vegetation, Croatan National Forest, North Carolina. Master's Thesis, UNC, Chapel Hill, N.C.



Pinguicula pumila
Drawing by Ron Fleming



Nepenthes alata block print by Dietrich Varez, Jr., 1981.

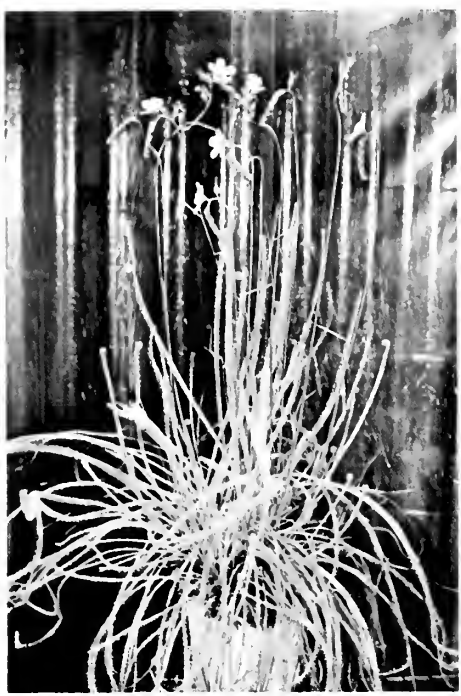
New CP Cultivar Received in 1980

by James T. Robinson
Box 1625, Connecticut College Arboretum
New London, CT 06320

The following cultivar has been received for publication in CPN during 1980:
Drosera filiformis (California g.)
'California Sunset'

Originated by Joseph A. Mazrimas, 329 Helen Way, Livermore, CA 94550; received July 17, 1980. California grex resulted from crossing *Drosera filiformis* var. *filiformis* × *Drosera filiformis* var. *tracyi*. The cross was originally made in spring 1973 when the parents bloomed at the same time. about 50 flowers were pollinated. In resulting hybrids "leaves grow up to 0.5 m. long; tentacles are light red or deep pink in color. Flowers are large like v. *tracyi,* color is rose pink and they are borne on tall scapes. Outer margins of flowers are scalloped. The anther lobes are separate and stamen filament is green. Hibernacula seem to be more hairy than v. *tracyi* and more like v. *filiformis*." 'California Sunset' is the only selection thus far from the cross and it possesses characteristics of the group as a whole. Known synonyms (invalid alternate names): *Drosera* × *californica, Drosera* 'Californica.' (January 5, 1981)

For background information on the creation of the above new names, readers may refer to Articles 18, 19, 26, and 27a of the ICNCP. Readers with new cultivars for publication in CPN are urged to submit them to the above address. Reference: Publication of New CP Cultivars, CPN ((1):20.



Drosera filiformis (California g.)
'California Sunset'

Photo by J. A. Mazrimas

A SOUTH AFRICAN INSECTIVOROUS PLANT TRIP

by Alain Christophe
Avenue Turgot
77330 Ozoir-la-Ferriere
FRANCE

The choice of a place for traveling is always difficult, especially when the purpose is the study of the flora, since there are so many beautiful places in the world.

I have chosen South Africa because it is the land where you can find the greatest diversity of plants. Out of some 200 orders in the vegetal kingdom, 180 of them exist here with 18,000 species. This great variety is mainly due to the great diversity of climates. On the northwest coast, the Atlantic Ocean, with its cold stream of Benguela from the Antartic, inhibits precipitation on a strip of land between the sea and mountains and intercepts nearly all the humidity that the wind brings from the open sea. Beyond the mountain barrier, we discover the aridity of Namaqualand and Karoo with the famous Kalahari desert in the north. (Fig. 1)

The southwest portion has a Mediterranean climate with remarkable landscape. In the inland, the ground rises up to form a high plateau (Highveld) attaining a height of 2,000 meters. Although the sun shines during the day in the winter, the ground is frosty at night. Further east, the land becomes flat and tends to be warmer (Lowveld); it is the land of the African animals. Meanwhile, the east coast enjoys a semitropical climate because it is heated by the warm air flows off the Mozambique current.

The flora is very characteristic of the varying climates. In the arid portion, it's mainly the succulents but near the cape there are many examples of the *Proteacae, Ericaceae, Amaryllidaceae, Compositae, Geraniaceae, Liliaceae, Orchidaceae* . . . and *Droseraceae, Roridulaceae,* and *Lentibulariaceae*!

In South Africa, there are 18 species of *Drosera* and many are easy to find. My trip took place between August and October, 1980, which is the best time to view these plants. In October, most of the *Droseras* can be observed to bloom in the spring.

The first species that I discovered was on Table Mountain, near Cape Town. It was *Drosera trinervia* which grows on wet places on the south side along the trail that takes you to the top (Level Traverse). This plant grows in a rosette 3 to 4 cm in diameter and its name comes from the ribs which are evident on the inferior epidermis of the leaf when not unfolded. The flowers are either white or pink. This mountain is a plateua and *D. trinervia* is even more abundant on the summit. Near the catchment area there was plenty of *Drosera cuneifolia*, with some giant specimens having diameters of 6 cm. On the east side, a natural park belonging to the Kirstenbosch Botanical Garden has some *Drosera hilaris* growing in a shady spot which looked like and were as large as *D. capensis* with pubescent leaves. Normally, *D. capensis* is seen on the west side since it is easy to confuse these two species, though I have never seen it personally. Also, I saw *Utricularia capensis* with white flowers.

Drosera are frequently seen on the mountains in the southwest, but it is at the Fernkleef Nature Reserve (at Hermanus at about 100 km from Cape Town) that I saw the greatest number of species. At the reserve the spring and winter seasons are humid and cool but without frost. The summers are warm and dry except on the mountains, where clouds maintain a high humidity. However, autumn is the best season since it is not as warm as summer. For the most part, the ground rises

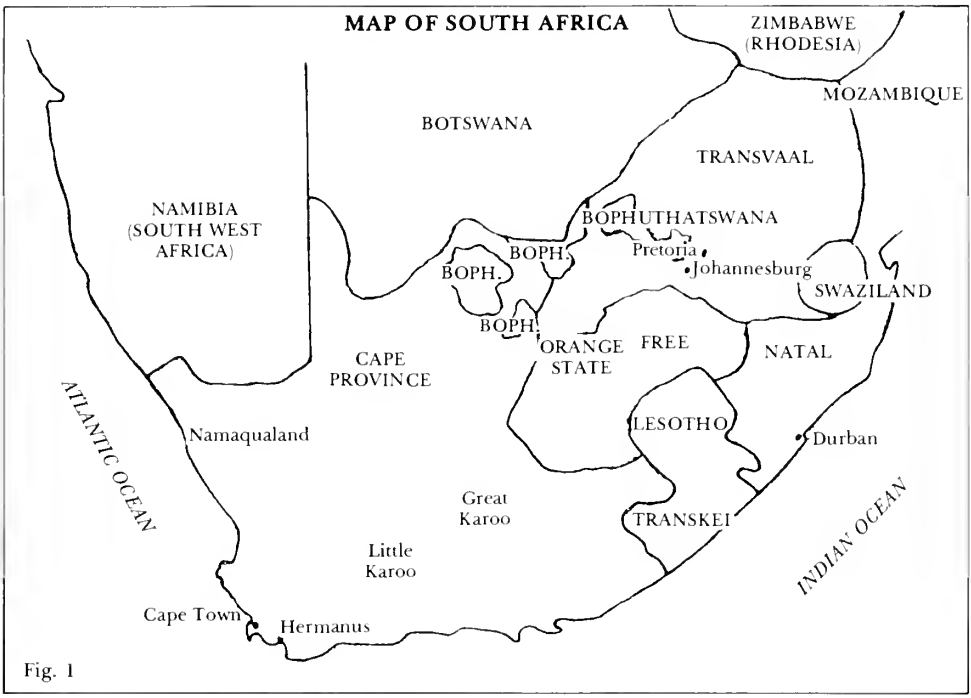


Fig. 1

steeply along the south facing escarpment in a manner typical of the geography developed on Table Mountain sandstone in the Western Cape. (Fig. 2)

By far the major part of the reserve lies above 300 m. and there are several peaks of approximately 600 m., the highest being 825 m. The area is extensively dissected by steep, mainly south-facing ravines and kloofs and offers a wide range of habitats; from moist wooded kloofs through which small streams trickle even in summer, to steep rock faces in hot dry valleys; to extensive areas of marshy black ground to boulder-strewn sandy plateaus. It is this variety and range of habitats which contributes to wealth of the funbos even in such a relatively small area.

SOIL. Because of the generally steep topography and the slow rate of weathering of the quartzitic sandstone, there is little possibility for soil development. Most of the soil is clay-free and consists of coarse sandy residue which is rarely deeper than 30 cm and is comprised of gravel and small boulders. Organic residues slowly decompose because of the acidic conditions and it is dispersed in the sandy soil and seems to play an important role in improving water holding capacity. This soil mixture serves to minimize moisture loss by drainage and evaporation and accounts for the green appearance of fynbos vegetation even in the hot mid-summer period. On permanently wet sites, peat moss accumulates and characteristic flora may develop.

FLORA. The same type here exists on Table Mountain. We can see beautiful *Erica, Berzelia, Protea* and numerous *Drosera* species such as *D. cistiflora* with white to pale pink flowers. This plant grows 20 to 30 cm high. It is well distributed in the reserve, although it is rare to find more than 4 to 6 specimens together. During the summer, the plant disappears and renews growth in the winter. Another species which is frequently seen is *D. glabripes* which exists all year but I have not seen flowers since I think they appear in summer. This plant has a stem,

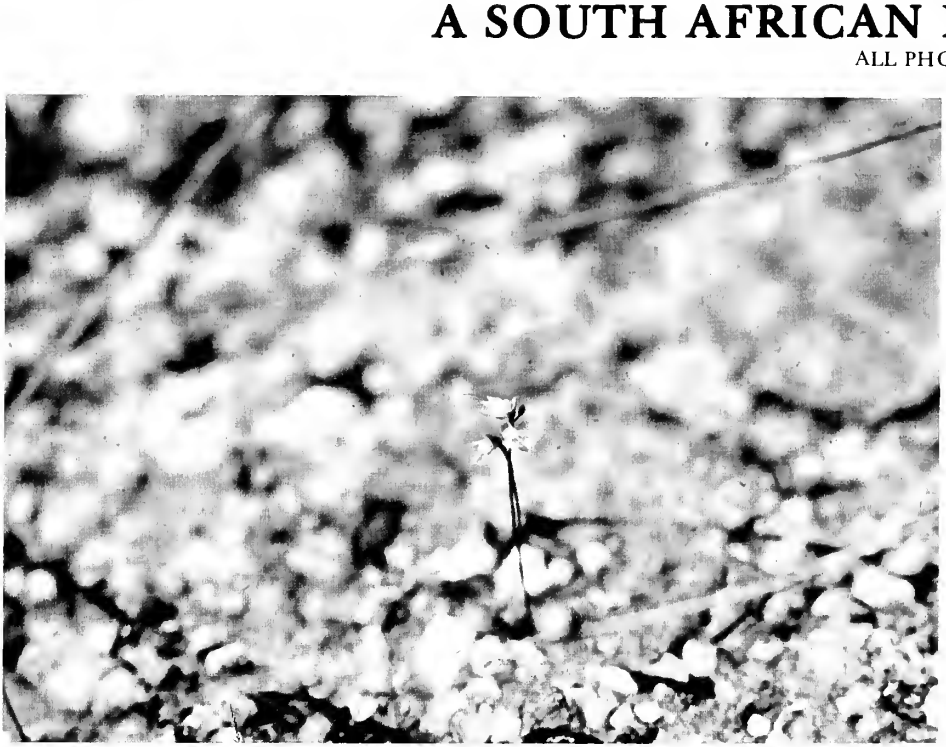
Please see **TRIP** p. 100.

Drosera trinervia at Table Mountain, R.S.A.

Drosera glabripes at Fernkloof, R.S.A.
Utricularia capensis, purple flower at Fernkloof.

A SOUTH AFRICAN INS

ALL PHOTOS BY



Utricularia capensis, purple flower at Fernloof.

Drosera cistiflora at Table Mountain.

Drosera aliciae at Fernkloof growing mainly on the paths.

CTIVOROUS PLANT TRIP

.IN CHRISTOPHE

Roridula gorgonias at Fernkloof.

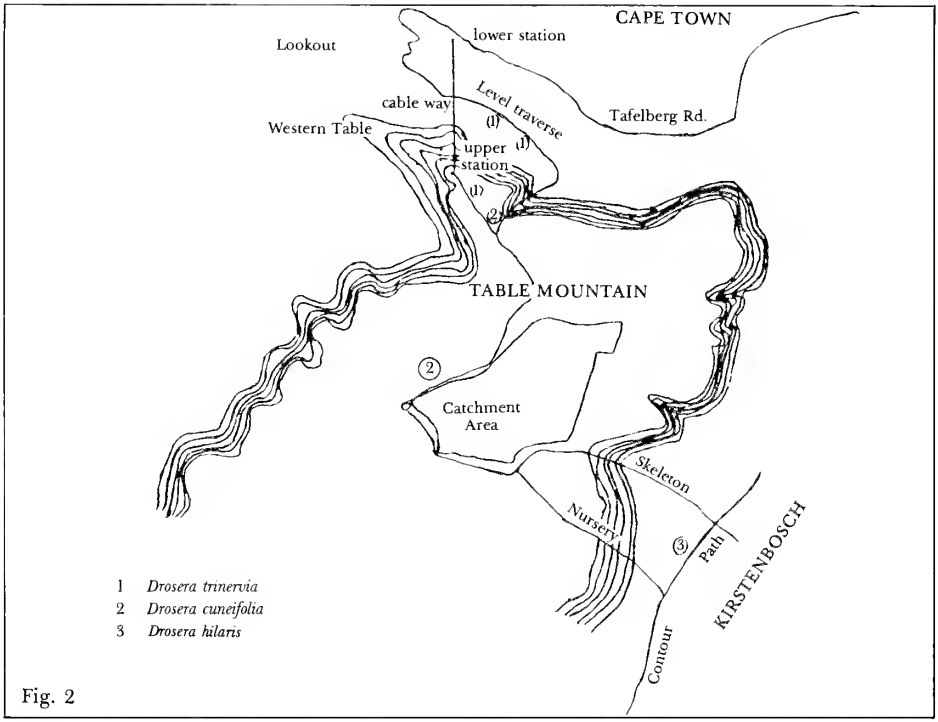


Fig. 2

TRIP continued from p. 97.
with old leaves of about 25 cm in length, but most of the time it is prostrate next to the ground.

The most prevalent *Drosera* is certainly *D. trinervia* which, as on Table Mountain, is everywhere but the plants are smaller and flowers are only white. *Drosera aliciae* is seen sometimes in the reserve, but it resembles mostly the description in the Bulletin of the Botanical Society of S.A. when the former name was *D. curviscapa var. esterhuysenae* rather than *D. curviscapa,* which is nearly identical to *D. cuneifolia.* It may be that the variety was joined to *D. aliciae* and *D. curviscapa* has become *D. cuneifolia* but I'm not sure.

D. hilaris is less abundant but it is a more beautiful species. Here, the plant is redder because it receives more sun than at Kirstenbosch. The flowers are magenta and they began to open in mid-September. I have seen here another species that appears only in the reserve and it's probably a hybrid between *D. cistiflora* (tuberous) with a rosette of leaves. The stem was shorter (5 to 7 cm) with only one cauline leaf (*D. cistiflora* is 20 cm). Unfortunately, the flowers were already over, but it may be a new *D. cistiflora* form.

On passing a small stream where the soil was very sandy, I noticed some *Utricularia capensis* with pink flowers. These plants have the same height as the white ones have on Table Mountain.

the white ones have on Table Mountain (3 to 4 cm). The leaves are almost impossible to see without the flowers. Leaves are 1 mm long.

Another plant that can be found in the reserve is *Roridula gorgonias* (giant fly catcher), which was once considered to be an insectivorous shrub. If it catches insects, it doesn't digest them. It is interesting that a small beetle lives on this plant and feeds itself on the trapped insects that are caught by the extremely sticky resin. This plant and its smaller cousin *R. dentata* belong to the *Roridulaceae* which comprises two species endemic in S.A. This shrub can reach 100 cm tall and leaves are found at the ex-

tremity of the branches. The flowers are pinkin color and the plant is rare and localized to the Hermanus location in small clumps and in a few other parts in west South Africa.

I have seen all of the above species in the Cape Province. It is also possible to find *D. alba, ramentacea, capensis, regia, pauciflora, Roridula* and other *Lentibulariacea.* All other *Drosera* sp. *(burkeana, collinsiae, dielsiana, natalensis, madagascariensis* and *indica)* are situated in the east (Natal, Transvaal).

My interest here was also for succulents and *Proteacea* and so I did not have time to find other CP species. I hope next year I'll be able to return and do it.

NOTES:

Botanical Society of South Africa

Botanical Society of South Africa
Kirstenbosch, Claremont 7735,Cape
Republic of South Africa
Journal=Veld & Flora

Namaqualand: a semi-desert area where succulents grow and where in spring, after the winter rains, thousands of wild flowers appear.

Karoo: a semi-desert area.

Fynbos: a low-growing, woody shrub that is characteristic of the Cape. The word is derived from Africans which means "short-lived" and these drought resistant plants live rarely more than 25 years. Fires allow the regeneration of these plants which are a significant element in the Cape flora.

A nursery who sells seeds of indigenous and Australian shrubs and trees maybe will be able to sell some *Drosera* seeds *(hilaris, cistiflora, . . .)*. Write for seed list to:

WOODSEED (PVT) LTD
P.O. Box 28
Veelklip
7203
Republic of South Africa

I would like to extend my gratitude to Mr. Woodvine for the help in elaborating this article. Mr. Woodvine is the owner of this listed nursery.

NEWS AND VIEWS

continued from p. 88.

JOE MAZRIMAS reports that the recent San Francisco Flower Show was a rousing success again this year. It took place Aug. 21-23 and we had 9 exhibitors showing off their CP which numbered about 38 plants. The Best of Show award was given this year to Eileen Masterson for a beautiful and large *Nepenthes alata* plant. Others in the show were: Paul and Mike Morris, Leo Carrillo, Joe Mazrimas, Ilse and Allan Ber, Irene Dowmen and Jeff Gold. Entering the show is very simple and we urge the 50 or so CPN members living within 75 miles of S. F. to enter their favorite plants next August. You will be sent a Premium Schedule book and application next summer. All you have to do is to fill out the list of plants you intend to bring and send this along with $1.00 to the manager for Carnivorous plants listed in the book. Bring the plants on Wednesday or Thursday up to 12 noon to the Hall of Flowers in Golden Gate Park so your plants may be judged. That is all there is to it. Pick your plants up Sunday evening or Monday after the show is over. We like to see a large number of you there next show so good luck with your growing!

LAURIE WATSON (33 Ashgrove Ave., Ashgrove, Queensland 4060, Australia) visited the United States this summer and revealed some good news regarding the start of a CP newsletter called "CP News" of which he is publisher. This 24-page CP News whose format and size is similar to our CPN is full of interesting articles about CP and people that grow them. Send A$10.00 to CP News, P.O. Box 214 in Ashgrove if you wish to subscribe to this quarterly. Send $5.00 extra for airmail service. U.S. Subscribers should send international bank or postal money order.

The Northern Rainbow Plant — Byblis liniflora

by Dr. P. S. Lavarack
Queensland National Parks and Wildlife Service
Pallarenda 4810
AUSTRALIA

The genus *Byblis* consists of two species—*B. gigantea*, a species restricted in range to southwest Western Australia, and *B. liniflora*, which occurs across the northern part of the Australian continent and also Papua New Guinea. These two species are the only members of the family Byblidaceae. Although superficially resembling *Drosera* to a marked degree, *Byblis* is now almost always placed in a separate family which is not usually seen as being closely related to *Drosera* by most modern taxonomists. In northern Australia, where *B. liniflora* occurs, it is frequently mistaken for *Drosera indica*, one example of this being in a recently published book ("A Wilderness in Bloom," by Bill and Betty Hinton).

B. liniflora is a plant of sandy situations, usually in areas which are moist for at least part of the year. The climate over northern Australia is monsoonal with a wet season in the hot part of the year from about December to April. The remainder of the year ranges from dry to very dry and remains warm to hot even in winter. *B. liniflora* is abundant around soaks or seasonal water holes, usually in areas at least partly shaded by herbs or larger plants. In permanently moist situations this species may be a perennial, but in areas subject to drying out it is more commonly an

Typical habitat of *Byblis liniflora*. This was photographed at the end of the wet season. A few months late this area would be dry and no plants of *Byblis* would be visible.

Byblis liniflora

annual.

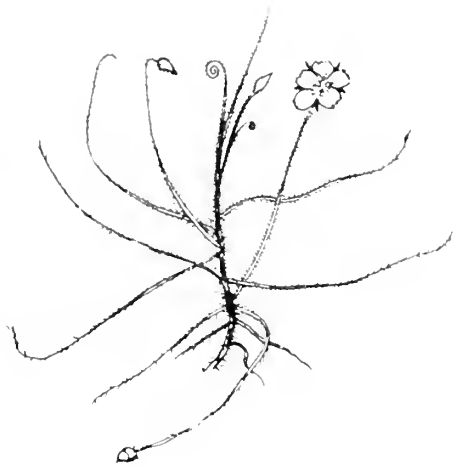
It is an abundant species in coastal Queensland north from Rockhampton, in Cape York Peninsula, the northern part of the northern Territory, and in the Kimberley area of Western Australia, but is often overlooked as it is hidden by the prolific growth of the ground layer in the wet season. It also occurs in the Western Province of Papua, New Guinea and presumably in West New Guinea (Irian Jaya) as well. In New Guinea it grows in low altitude monsoonal savanna woodlands similar to those in northern Australia.

Each flower is borne on a long slender peduncle. They are bluish-pink or occasionally white, and are about one cm in diameter, with five broad petals. The leaves are thread-like, up to several cm long, and are relatively sparsely covered with glandular hairs. The whole plant is commonly about six to ten cm tall but may be as large as 30 cm. The plants tend to have a weak root system and larger plants often lie along the surface of the soil with the apex bent upwards. Flowering time is irregular but mainly in the wet season from December to April. Plants growing in permanently moist situations may flower at any time of the year.

As mentioned earlier it is easy to confuse this species with even more abundant *Drosera indica*. However, the many flowered inflorescence and the coarser leaves of the latter are useful field characteristics to separate these species. As well as *Drosera indica*, *B. liniflora* often grows in association with other carnivorous plants such as *D. petiolaris*, *D. spathulata*, *D. burmanni*, *Utricularia chrysantha* and in northern parts of the Peninsula, *Nepenthes mirabilis*.

Cultivation. Plants collected in the wild rarely seem to survive and they certainly do not travel well. Propagation is best achieved from seed which germinates readily on a damp sand and peat mix. The plants grow well and will last for several years if not kept overly wet and if given half shade and humid, warm conditions. As an insurance it is a good idea to harvest seed each year and treat as an annual. Some more information on cultivation is available in a useful article in an earlier CPN. (J. Mazrimas: The Byblis Family. CPN IV (2): 30, 31, 1975).

Conservation. This is one carnivorous plant species which is not subject to threats of extinction. In some areas of Cape York Peninsula with which I am familiar this plant is abundant and, even in the dry season, plants may be found. It occurs in most, if not all of the large Cape York National Parks and would certainly be in several Parks and Reserves in the northern Territory and Western Australia.



Byblis liniflora
Drawing by Ron Fleming

Beginner's Corner

UNUSUAL AND SOMETIMES WORRISOME GROWTH PATTERNS IN SARRACENIA PITCHERS

by Donald E. Schnell

It would be nice if all cultivated plants behaved themselves all of the time, and with proper cultural techniques they usually do. However, occasionally something unusual happens in a growth pattern and the observant grower quite properly becomes concerned. The author, Joe Mazrimas, and several other growers have noted some pitcher growth habits or shapes in Sarracenias that have not been reported previously and we felt that the readership might benefit by these observations and perhaps send some comments about their experiences to share with others.

There is an interesting growth pattern noted in *Sarracenia leucophylla* rather regularly each season, and sometimes also in *S. alata* and *S. rubra* ssp. *gulfensis*. In plants of *S. leucophylla* in outdoor or even greenhouse cultivation in the temperated zone, the spring pitchers are not usually the best. They are often elongate with relatively little hood and mouth expansion, and many are ensiform. Later in the summer and into autumn—often just weeks before the first killing frost!—a beautiful crop of large, nicely formed typical pitchers appears only to be laid low by a hard freeze. Greenhouse plants, of course, retain these pitchers nicely through most of the winter, as do more protected outdoor plants further south. This pattern seems to be of no consequence to the overall health of the plant and in fact very often occurs in nature where the three taxa mentioned grown on the US Gulf Coast. Above ground plant structures usually appear in response to complex situations regarding photo-period (length of light exposure each day), temperatures, water availability, etc. Study of this phenomenon by a student using controlled environment such as in a growth chamber might be very enlightening. Intuitively, the author feels the answer will be found in the pattern of photoperiod and temperature among the many possible variables.

And now to another interesting situation. This one is fortunately more sporadic. During the spring and early summer of 1981, the author received several anxious phone calls and letters from *Sarracenia* growers stating that the pitchers of many of their species growing outdoors and sometimes in greenhouses were severely deformed. The author and Joe Mazrimas discussed this occurence and both had noted it occasionally in previous years as well. The unusual pitchers consisted of elongate, twisted or spiral, narrow forms with incompletely expanded hoods. Many of the pitchers had depressed dimples or lines across them at intervals, and sometimes only ensiform leaves were produced by species that usually do not produce them in the spring. Nothing had changed with water or potting medium used, and several plants were lifted from the pots to check for root disease, soil parasites, etc., and sample leaves were carefully examined microscopically for mites. None were found. The author noted this abnormality in his moderately heated greenhouse as well as outdoor plants. Joe Mazrimas did not note it as much in his unheated greenhouse but did see it in his outdoor plants. The species mostly affected were

S. flava, S. alata, S. rubra (note that all subspecies often produce a different spring pitcher than summer pitchers, but these were more bizarre than usual), *S. purpurea* and sometimes *S. leucophylla.*

Two clues were helpful in defining the problem to some extent. One very obvious one was the thankful appearance of completely normal pitchers quite suddenly with the passage of early spring into late spring and early summer. The second was noting the character of the weather during the troublesome early springs.

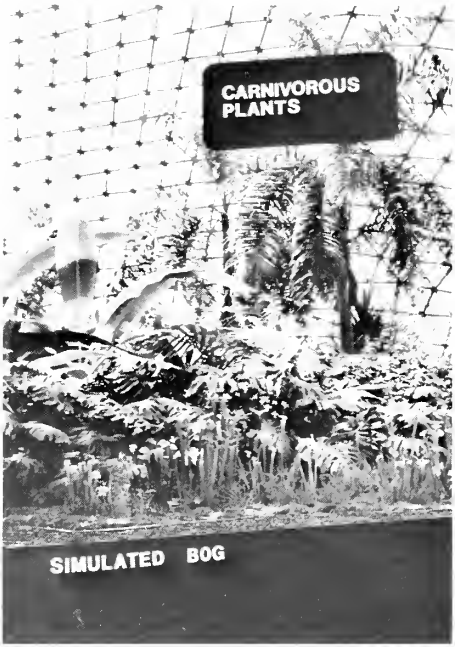
In both widely separated areas (California and North Carolina), warm weather had come earlier than usual in spring while there was still a relatively short photoperiod. In addition, the warm weather pattern was erratic: Nights were cool, sometimes near or at freezing, and days were quite warm, more like later spring and early summer. This was all coupled with a tendency to less cloudy weather than usual for the season. These warm day/cold night cycles were sometimes interrupted by a brief run of uniformly cool days, but then the warm periods began agiain.

Since the problem cured itself as the weather and day length fell into more usual patterns as the season went on, we felt that the problem was indeed related to the earlier spring weather. It seems a classical case of a variation on etiolation due to warm stimulus to growth with inadequate light during the day, and very cool nights arresting or slowing growth. Once the photoperiod lengthened and the nights became warmer, normal pitchers appeared.

Meterologists inform us that the regular cycles of seasonal weather we have grown used to are in fact aberrant in terms of the long term weather pattern, and that we can expect more cycles as we had in the spring of 1981 (and a few earlier ones), so growers should be aware of this pitcher habit pattern.

We and the readers would certainly like to hear comments and experiences with either of the growth patterns mentioned above, particularly from different parts of the US and the world. The author has also noted the same problems mentioned in letters from folks in England and Australia, so the phenomena are certainly not isolated!

S. flava grown by J. A. Mazrimas with 42 inch/103 cm pitchers. Yardstick for scale. Photo by J. A. Mazrimas.



Overall view of bog with Climatron plantings and dome in background.

View of part of bog with *Sarracenia* sps.

CP SHOW AT THE MISS

ALL PHOTOS SUPPLIED BY MISSO

View of part of bog with plexiglass dome in background displaying unusual or smaller CP.

View of part of bog with *Sarracenia* sps. and *Drosera* sps. visible.

JRI BOTANICAL GARDEN

I BOTANICAL GARDEN, ST. LOUIS

Close-up view of part of bog.

REVIEW OF RECENT LITERATURE

Earley, Lawrence S. 1981. Cloning endangered plants. Wildlife in North Carolina 45:20.

A brief introductory article featuring ICPS member Bill Carroll discussing his work with plant tissue culture of rare and endangered native species, including CP. Features a photo of Bill with some of his progeny *en flasque*. The work is conducted at the North Carolina Botanical Gardens.

Fineran, B. A. & Gilbertson, J. M. Application of lanthanum and uranyl salts as tracers to demonstrate apoplastic pathways for transport in glands of the carnivorous plant *Utricularia monathos*. Eur. J. Cell Biol. 23910: 66-72 1980.

The electron microscope tracers mentioned above reveal that deposits of these salts occurred in the cells walls, but not in the protoplasts of intact cells.

Fineran, B. A. Ontogeny of external glands in the bladderwort *U. monathos*. Protoplasma 105 (½): 9-26. 1980.

The author used electron microscopy to study early differentiation of the external glands which are mainly used to absorb solutes from the external medium before any traps were present in very young plants. When traps developed, the external gland became modified for water secretion.

Fromm-Trinta, E. Revision of the species of the genus *Genlisea* (Lentibulariaceae) in the southeastern and southern regions of Brazil. Rodriguesia 31(49): 17-140. 1979.

Genlisea and *Utricularia* belong to the same family; the former has a flower calyx that is 5-lobed and the trap leaf is a straight body attached by a pedicel to the rhizome, with a middle bladder and an elongated neck with two twisted arms. *Utricularia* is differentiated by a 2-lobed calyx and urn-like bladders. There are five species of *Genlisea* in Brazil: *G. violacea, aurea, filiformis, repens* and *pygmaea*.

Kingsolver, J. 1981. The effect of environmental uncertainty on morphological design and fluid balance in *Sarracenia purpurea* L. Oecologia 48: 364-370.

This rather ephemeral paper uses engineering analysis techniques and wax models of leaves and bowls of the same volume to determine the resistance of *S. purpurea* pitchers to dry weather dessication stress as a function of the "design" of the pitcher. The work indeed concludes that the design is efficient, and that larger pitchers are more resistant to dessication than smaller. There is also a discussion of some fine points of ecologic jargon and semantics.

Moeller, R., The temperature-determined growing season of a submerged hydrophyte: Tissue chemistry and biomass turnover of *Utricularia purpurea*. Freshw. Biol. 10(5): 391-400. 1980.

At Mirror Lake, New Hampshire, USA, the dynamics of thermal stratification limit the growing season depending on depth. At 6 m depth the growing season is about 8 weeks and at 2 m it is 17 weeks. Light may limit the growth at 6 m but not at 2-4 m. This species is unusually rich in zinc, relatively rich in nitrogen, but quite poor in phosphorus.

Reznick, A. A., John Goldie. 1891. Collecting site near Lake Simcoe, Ontario, Canada. Can. Field-Nat. 94(4): 439-442. 1980.

Goldie travelled in 1819 near Lake Simcoe by the present town of Hol-

land Landing. He reported *Drosera linearis* as growing here. In 1976, this site was rediscovered, but *D. anglica* was nowhere to be found. Another rare plant is gone.

Toth, R. and D. Toth. 1980. Cytochemical localization of acid phosphatase in the nematode-trapping fungus *Arthrobotrys oligospora*. Mycologica 72: 813-817.

The function of lysosomes intracellularly in digestive processes is well-known, and the commonly associated acid phosphatase enzymes in these organelles was selected as an indicator of lysosomal activity. Acid phosphatase was virtually absent prior to prey capture, increased subsequent to capture, and then appeared in the nematode body gradually. This points toward active digestion rather than autolysis of the captured prey.

MISSOURI BOTANICAL GARDEN'S FIRST ANNUAL CARNIVOROUS PLANT EXHIBIT

by Marilyn Maupin
Staff horticulturist and
curator of CP

Missouri Botanical Garden in St. Louis held its first carnivorous plant exhibit in the Climatron April 25 to May 17. It was very well attended by curious visitors, many of whom previously had no idea that there are so many different kinds of CP.

The main feature of the exhibit was a simulated bog environment. We used a free-form fiberglass pool, 7′ × 13′ at its maximum points, and elevated it on a platform for easier viewing. Long-fiber sphagnum moss was used inside the pool as a filler between the potted carnivorous plants. Sheet moss that had been sprayed with a waterproof green florists' dye was used over the top of the bog to hide the

Please see **EXHIBIT** on p. 111.

Nepenthes display at Missouri Botanical Garden CP Show. Photo supplied by MBG.

INDEX

TITLE INDEX

1981 CPN GENERA INDEX

AUTHOR & PHOTOGRAPHER INDEX

WANT ADS

When submitting Want Ads, please be sure to print clearly for best results and to eliminate mistakes. Please circle the correct letter before each item (Want, Trade, Sell or Buy). Want ads are limited to carnivorous plants, terrariums, greenhouses and moss. There is a charge of ten cents per item, with no limit to the number of items you may submit per issue.

Send coin or check to:
Arboretum, Want Ads
California State University
Fullerton, CA 92634

Jim Comia (18701 San Rufino Dr.; Irvine, CA 92715) (B) *Cephalotus, Drosera binata, Pinguicula caudata, P. mexicana,* and *Sarracenia leucophylla.*

Mark Forster (c/o Buckley Hutton; 167 Collins St.; Melbourne Vic 3000; Australia) (WB) mature plants of *Darlingtonia californica, Sarracenia* sp. & hybrids, *Drosera regia* seed, (Plants sphagnum grown). (T) seed of *D. peltata* & *auriculata* for Mexican *Pinguicula* seed.

Ron Gagliardo (1216 Cooper Dr.; Raleigh, NC 27607) (WTB) *Heliamphora tatei, nutans, minor,* etc. tuberous *Drosera, Byblis gigantea* seed, *Genlisea* sps., temperate pinguiculas, *Sarracenia* hybrids, large *Darlingtonia, Nepenthes wittei,* dried *Nepenthes* pitchers.

Jeff Grothaus (1265 Iliff Ave.; Cincinnati, OH 45205) (TS) *N. gracillima* cuttings.

Steve Smith (Rd. #1, Box 2976; Kirkwood, N.Y. 13795) (T) Small division *Heliamphora heterodoxa* to trade ONLY for *H. minor, nutans* or any other *Heliamphora.* (S) *N. gracilis* $7.50 each, 2 for $12.00.

Phillip van de Velde (829 Main St.; Kangaroo Point, Brisbane; Qld 4169; Australia). (BT) any seeds of the following: *Nepenthes, Heliamphora, Pinguicula, Sarracenia* hybrids, *Drosera anglica, D. linearis, D. regia, D. cistiflora, D. breviflolia, D. trinervia, D. villosa, D. affinis, D. andicola, D. pauciflora* and *D. flexicaulis.*

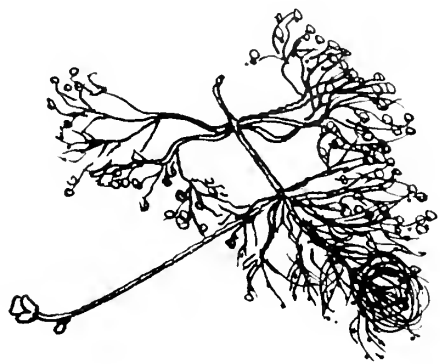
West Australian Carnivores (P. O. Box 62; Vinton, VA 24012) (S) *Byblis gigantea, Cephalotus follicularis, Utricularia menziesii, Polypompholyx multifida,* assorted tuberous droseras. Price list 50¢ USA only.

EXHIBIT continued from p. 109.

pots and to give the appearance of live moss. Many of the potted sarracenias also had live sphagnum growing in them which added bright green touches to the bog. Thirty-seven different species and hybrids were used in the bog for a total of 110 pots of CP.

Additional features in the show included two plexiglass domes which displayed some of our more unusual or smaller CP. We also had a small *Nepenthes* display next to the waterfall in the Climatron. In addition, located near the bog display was a sample CP terrarium showing people how a finished terrarium may look and a brochure describing the procedure in planting one. Several panels of educational material were on display also, to tell people more about the plants and how they trap and digest insects. Another brochure describing CP trap types and home culture was also available.

In all, there were forty-seven different species and hybrids belonging to nine genera in Missouri Botanical Garden's first carnivorous exhibit. Next year we hope to have an even bigger and better display.



Utricularia purpurea

Drawing by Ron Fleming

Drosera cuneifolia at Table Mountain, Republic of South Africa.
Photo by Alain Christophe