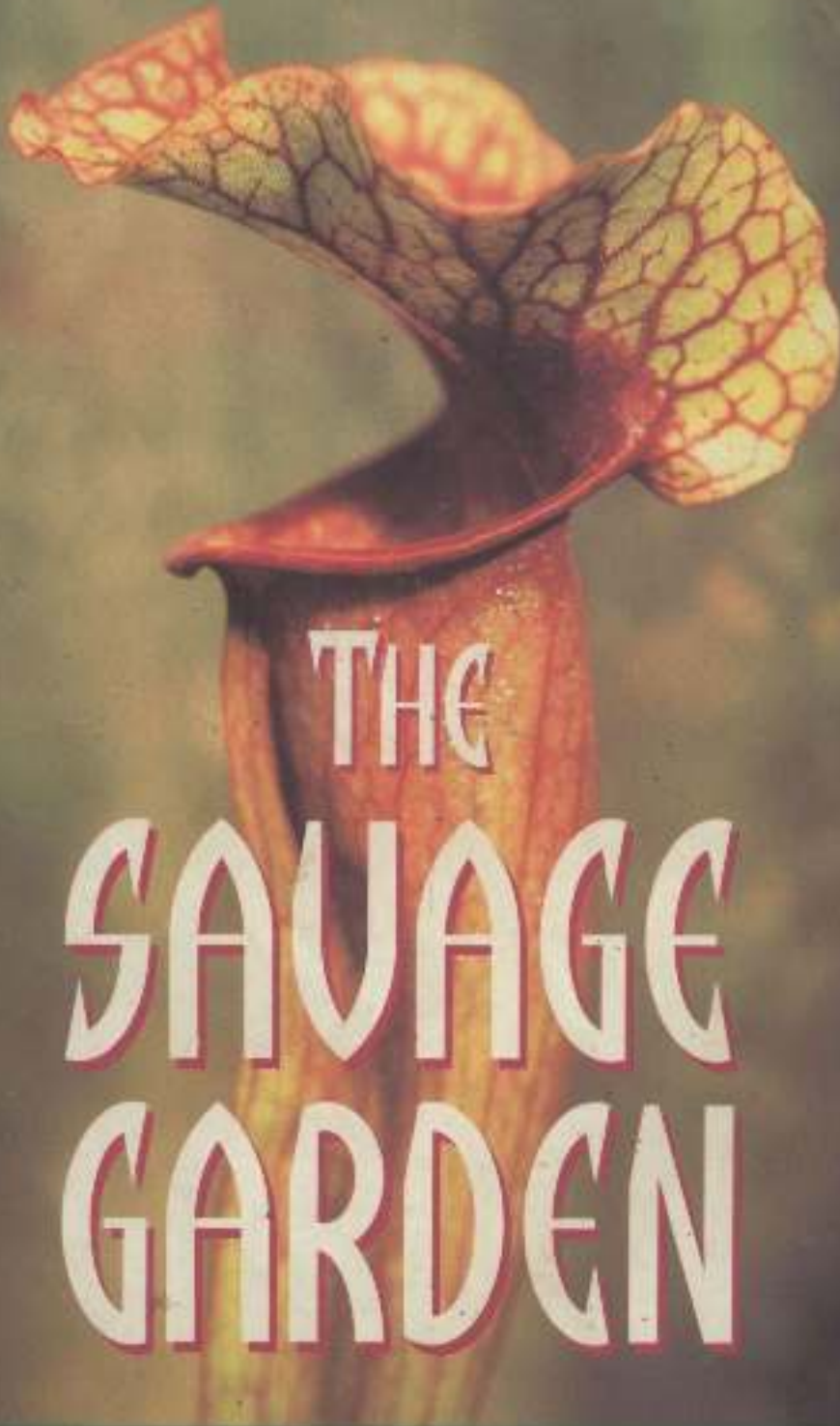


CULTIVATING CARNIVOROUS PLANTS



THE
SAVAGE
GARDEN

PETER D'AMATÓ

THE
SAVAGE
GARDEN



*"Ah, but we are splendid devils, aren't we?"
"Hunters of the Savage Garden," I said.*

*THE VAMPIRE LUSTS
ANNE RICE*

THE SAVAGE GARDEN



CULTIVATING
CARNIVOROUS PLANTS

PETER D'AMATO



TEN SPEED PRESS
Berkeley, California

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*I would like to dedicate this book
to my longtime friend and biz partner
Marilee Maertz, who believes in
the magic of the plants,
and to Eleonore, my mother,
who believes in us.*

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PREFACE

NOT TOO LONG AGO, I was browsing through a local garden center and met with a familiar sight. There at the dark but spacious check-out stand, where nursery managers enjoy placing quick-selling impulse items, sat an open cardboard box of Venus flytraps. The plants were in little pots with clear plastic cups protecting their traps from curious fingers. The box was half empty, and of the remaining plants most had at least a couple of black leaves. Two plants looked entirely dead, and I could see that the soil in a few of the pots was so dry it was shrinking like a dried-out sponge. A small, handwritten sign read: "50% Off."

What a tragedy, I thought. Just then a young boy of about ten pushed up so closely that I had to step aside. "Oh wow!" he cried, "Look Mom, Venus flytraps! Can I get one?" His mother gently pulled him away. "Venus flytraps always die," I heard her say rather matter-of-factly, as she led her son away through the palms and olivander. Venus flytraps always die. I had heard such statements many times before.

I purchased those remaining flytraps and I saved their little lives. They sit now on my sunny porch—ten plants in a large pot. A mass of dozens of lush green and red traps, yawning patiently for food. A few of the traps hold the shriveled carcasses of digested flies. A neighbor just yesterday told me my flytraps were "absolutely beautiful."

With this book I hope to teach people how to grow a Venus flytrap. For if you can grow this plant successfully, a whole world will begin to be open to you. It is a world filled with wonder—a strange, strange world turned upside down; a world of plants that lure, catch, kill, and digest insects and other animals for food.

This fact in itself many people find startling. For while much of the general public may be vaguely aware of the Venus flytrap, they are often rather surprised to learn that this is only one of several hundred species

of carnivorous plants known to exist on our planet. When one considers the many subspecies, forms, hybrids, and cultivars of carnivorous plants in cultivation, the numbers move up into the many thousands.

There is a second surprise in store. Many folks assume that such weird vegetation certainly must come from some far-off, exotic and tropical country, necessitating a hot and steamy greenhouse in which to grow them. In truth, while some of the most popular carnivorous plants do indeed come from tropical places, most carnivorous plants grow in temperate climates, and there is at least one newly discovered species growing on glacial ice! The Venus flytrap, for instance, is native to the coasts of North and South Carolina, and the North American continent has the widest variety of ornamental carnivorous plant genera in the world. By comparison, tropical Africa and South America have only a few.

When the uninformed see well grown plants for the first time, a third surprise is in store for them. Many carnivorous plants are truly beautiful to behold, but that beauty often masks the underlying savageness of the natural world.

The purpose of this book is simple: how to grow carnivorous plants. If you are a hobbyist with a growing collection of plants or a beginner without a clue, I hope you'll find this book helpful and informative. This book will be a guide not only for the collector, but for the teacher who may want a terrarium of carnivorous plants in the classroom or children's museum; for the horticulturist at a public botanical garden whose specialty may be elsewhere; for the nursery manager who throws out more carnivorous plants than she sells; or for a young person whose mom just bought him a flytrap—at half price!

I first began to grow carnivorous plants when I was around eleven years old. Now, over three decades later, I have witnessed a gradual change in public opinion: what began as an "eccentric" interest of the very few has become a rewarding hobby for many. Unfortunately, finding good horticultural information on the plants has changed only slightly over the years. Books on carnivorous plants have come and gone and are often hard to find once they go out of print. Journals on the subject grow out-of-date, and researching old back issues can be tiresome for beginners. And even when some colorful and fascinating new book does appear, I still have found myself sighing in frustration and asking, "But how do I grow it?"

This book will tell you how.

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It was Barbara Stevens of the San Francisco Landscape and Garden Show who urged me to display some of my collection in 1989, and the response was overwhelming. The result was California Carnivores. Jacqui Giuffre of the Sonoma County Fair was always a delight to work with, and Betsy Fischer of Sonoma County Farm Trails offered complete enthusiasm and many a good laugh. Judy Boyce of the Russian River Chamber of Commerce was a tremendous source of help as well.

California Carnivores would not exist were it not for the help of

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INTRODUCTION:

WHAT ARE CARNIVOROUS PLANTS?

*"The Venus flytrap, a devouring organism,
aptly named for the goddess of love."*

—TENNESSEE WILLIAMS,
Suddenly Last Summer

I WAS A KID GROWING UP in the sixties when I had my first love affair with a Venus flytrap.

It was an advertisement in *Famous Monsters* magazine that first seduced me. The ad shouted something about the plant eating hamburger, and next to it was a fuzzy picture of Charles Darwin. As I already had pet turtles and a South American alligator trained to eat hamburger from a spoon, I convinced my mother that we could afford another mouth to feed and promptly had her write out a check.

The plants finally arrived in a Styrofoam pot wrapped in plastic. The pot was filled with dry peat moss and three or four "bulbs" with all of their leaves cut off. I followed the directions but nothing spectacular occurred. A few semideveloped leaves came up but soon all of the plants turned black.

It was my first experience with unrequited love. It never crossed my mind that the dim corner of my bedroom next to the heater in the month of December had anything to do with the plants' demise. Venus flytraps, I thought, must come from some dark, steamy, tropical jungle—didn't they?

I was surprised when the following spring a friend and fellow student whispered to me, "I know where Venus flycatchers grow." I had just raised my hand in science class and volunteered to do a report on the Venus flytrap. As love springs eternal, I figured doing a school report

was one way my mom would write out another check and I could give Venus flytraps a second try. Since we lived on the seashore of southern New Jersey, I found my friend's statement rather hard to believe.

He took me to the boggy edge of a small lake right in the middle of town. The ground was covered in billowy, spongy green moss that my friend called sphagnum. The moss hugged the bases of southern white cedars that grew in the shallow, tea-colored water. It was a beautiful sight.

"There they are," my friend said, pointing. I looked in awe at the strangest plants I had ever seen. Half buried in the moss were rosetted clumps of deeply purple hollow leaves, with spiny collars and strange reddish flowers rising from the center. "These aren't Venus flytraps," I said, but I was hardly disappointed.

When my friend assured me they still ate bugs, I peered into one of the hollow, leathery leaves, and sure enough I saw insects struggling in the wells of water that each leaf held.

"Look at this," my friend said. He plucked something from the moss and held it up in his fingers. It was an im-

age that would forever be imprinted upon my brain. A ray of sunlight broke through the cedars, shining directly on what he held in his hand. It was a small, circular green leaf covered with hundreds of red tentacles like a pincushion, each ending in a tiny drop of dew. Every drop caught the light of the sun, and they sparkled and glittered like jewels. These small plants were dotted with numerous dead and struggling insects, their circular leaves sometimes clenched like tight fists, with wings and antennae sticking out and twitching. I looked around in awe, for it was an unforgettable image: tea-colored water, grayish trunks of cedars, and spongy mounds of reddish green islands with strange plants that looked like they came from outer space!



"...I saw struggling insects in the wells of water each leaf held."



"It was an image that would forever be imprinted upon my brain."

My friend and I dug up some of the weird plants and took them to school the following week. Even our teachers were mystified. But soon I was led to the library and found several books that satisfied my curiosity. What we had found growing on the swampy edge of the lake were purple pitcher plants and sundews—carnivorous plants not unlike the famous Venus flytrap! I was also surprised to

learn that the pine barrens of southern New Jersey were practically teeming with flesh-eating plants, and that the flytrap was native only to the Carolinas, a mere day's drive south of where I lived. I was almost dumbfounded to discover that North America has probably the widest variety of carnivorous plants in the world: pitcher plants, sundews, butterworts, cobra plants, bladderworts, and Venus flytraps all grow here! I wouldn't have to fly to Madagascar after all.

For me, it was the beginning of a mind-boggling adventure that would change my life.



Our general impression is that plants are fairly passive forms of life. Insects and animals eat them. We chop down trees to build houses, shred cabbage for coleslaw, and decorate our homes with their sex organs, which we call flowers. We eat their fruit, pull "weeds," and make medicine out of their sap. We bleed trees for maple syrup and burn them in fireplaces. We bake them, boil them, and sauté or stir-fry them. We even smoke them.

Plants can't scream and run away, but some of them do fight back to an extent. Mushrooms can kill you and poison ivy can make you itch. Many plants defend themselves with needles and toxins or bitter tastes and bad smells.

Typically we are not afraid of plants, but humans love to project their own fears onto other life forms. That we can do this with plants,

seemingly the most passive and unthreatening of life-forms on earth, is obvious by just examining some of our more popular horror movies. *The Thing* featured an alien humanoid plant that fed on human blood. In *Day of the Triffids*, walking plants were stinging humans to death in their effort to take over the world. *Invasion of the Body Snatchers* had plant "pods" duplicating human beings and taking over their minds and bodies. In *Little Shop of Horrors*, a talking plant with a sense of humor swallows people whole. That these four famous horror movies were made—and remade—reflects the unconscious fear that we all have of pretty, pulpy, passive plants. Perhaps deep within our brains, tiny neurons still fire off flashbacks of ancient, inherited memories, horrible memories of the days when our ancestors had good reason to fear plants!

You might smirk and shake your head, but this primal fear may not be quite as far-fetched as you think. Just last year at the carnivorous plant nursery I own, where we have on public display over 500 varieties of flesh-eating plants, a well-to-do couple came in and were marveling at our collection of tropical pitcher plants, the *Nepenthes*. They told me with glee how they had recently returned from Malaysia, where they saw magnificent *Nepenthes* at a botanical garden. "We arrived early," the wife told me, "and we waited in line at the front gate. I peered through the fence, and saw these huge pitcher plants hanging in the trees. To my shock, an attendant was pulling tiny baby monkeys out of the traps! Most were alive, and scampered away. The dead ones he dropped in a pail." Her husband added that when they later caught up with the attendant and asked him about what he was doing, the embarrassed attendant explained that dead monkeys in the pitcher plants were upsetting to the tourists. While I have never been able to document this story, and suspect the prey were more akin to rodents, such tales have persisted for a very long time, a mythology that may have a basis in fact.

Thus, the following equation is not necessarily true: Plant eats monkey. Monkeys are primates. Humans are primates. Plant eats humans.

But surprisingly there was a brief time when some people truly believed in the Man-Eating Tree of Madagascar. It was in 1860 that Carle Liche wrote an article claiming he had witnessed a sacrifice of a young maiden to such a tree by natives of the island. Since he offered

grisly details and was published in scientific and popular magazines; the report was widely believed to be true. It was not.

During the same period Charles Darwin, among many others, studied and reported on the amazing carnivorous habits of many plants both familiar to them and being newly discovered around the world. Science was exploding in popularity during the nineteenth century, and explorations were uncovering many strange and exotic forms of life. Even plants long familiar to Europeans, like the sundews and butterworts common to local bogs and moors, were suddenly suspect.



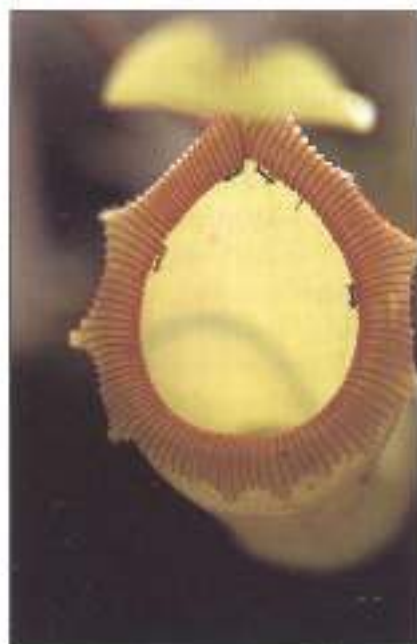
This suspicion over which plants are or are not carnivorous is a matter that is not quite settled even at the close of the twentieth century. "Carnivorous" means "flesh-eating." An older term, used by Darwin and sometimes referred to even today, was "insectivorous," or insect-eating. The latter term is not quite accurate and is rather limiting, for even though the vast majority of prey eaten by carnivorous plants are insects, this group of plants also consumes spiders, sow bugs, worms, tadpoles, frogs, lizards, and even rats, although admittedly the capture of larger animals such as mammals is a very rare event.

A typical "normal" plant works in the following way: the roots in the soil absorb water, including minerals. The leaves in the air absorb carbon dioxide. Through the complex process of photosynthesis, chlorophyll in the leaves uses the energy of sunlight to transform the carbon dioxide and minerals into carbohydrates and other organic compounds, which give the plant energy to grow.

But what if the soil a plant lives in is low in minerals, particularly nitrogen, phosphorous, or potassium, which are vital to the plant's health?

Most carnivorous plants grow in mineral-deficient soils. More often than not, these soils are very wet. The water moving through the ground carries away most of the much-needed minerals. Even nitrogen, returned to the soil by the slow decay of older, dying leaves, does not remain for long. A plant living in such an environment might be able to survive year after year, but wouldn't be able to manufacture the energy needed to produce flowers, seed, or offshoots.

Carnivorous plants have an answer to that survival dilemma. All around them are little, moving packets of minerals and nutrients, like



Small ants getting drunk on *Nepenthes ventricosa*

vitamin pills with legs and wings. We call them animals. All the plant has to do is catch them and somehow absorb through their leaves what they would normally take up through their roots. The development of leaves for such a purpose is what makes carnivorous plants so bizarre and beautiful.

Even "normal" plants can absorb minerals through their leaves. You can spray your rosebush with a watery solution of Miracle Grow and watch it take off. If you made a fertilizer solution for your rose bush by pulverizing dried crickets, mixing them in water, and spraying the solution on your plants, would you have a carnivorous rose? In fact, root fertilizers for plants such as palms do often have ground-up crickets, oyster, and crab shells in

them. Do you then have an insectivorous or seafoodivorous or—God forbid—shellfishivorous palm tree? Maybe...maybe not.

The confusion over which plants are or are not carnivorous stems from how we define the term. It has been generally assumed that to be called carnivorous a plant needed to do several things: lure prey, somehow catch it, kill it, and then digest it, usually through the production of enzymes and acids used to dissolve the victim into palatable form. It's this "digesting" that's the controversial part.

Some plants are included under the heading of "carnivorous" even though they don't produce actual



Pinguicula esseriana snacking on fungus gnats

digestive enzymes. *Darlingtonia* and *Heliamphora* are two examples of pitcher plants that apparently rely on bacterial action to dissolve their prey. This "digestion by proxy" can make the discussion of carnivores a rather complicated thing. If we simply defined a carnivorous plant as one that possibly benefited from the absorption of minerals obtained from captured and killed animals, instead of several hundred species, we might be talking about many thousands!

Petunias catch and kill insects. So do potato plants, tobacco, rhododendrons, and teasels. But they do so, it is believed, for defensive purposes. Plants like petunias are covered with sticky hairs, which make life difficult for insects like aphids who wish to eat them. Many insects become caught in these hairs and die. Potato plants also are covered with hairs. If an aphid breaks one of these hairs, a glue is secreted that cements the aphid to the spot. The common teasel has leaves that form "cups" where they join the stem. Rainwater collects in the cups, insects fall in, drown, and eventually dissolve. All of these plants, at one time or another, were viewed with suspicion by scientists studying carnivores. All of these plants probably absorb some nitrogen or other trace minerals through their leaves as the insects decompose. The rest of the minerals are possibly taken up through their root systems after rain. But they are not considered carnivorous because they lack the process of digestion.

Perhaps our definitions should be revamped. Many plants might fall under the category of "semicarnivorous." Take for example the long-standing problem of *Roridula*. The two species of this genus grow in South Africa. They look and behave so much like sundews they were originally included under the genus *Drosera*. Their leaves are covered with sticky glands that catch enormous amounts of insects. But earlier in this century *Roridula* was excluded from the carnivores because it did not produce digestive enzymes. And so it stood until the 1990s, when two surprising discoveries were made. The first was by Steve Williams. Through DNA research, he discovered that *Roridula* was more closely related to *Sarracenia*, the pitcher plants on the other side of the Atlantic, than they were to *Drosera*. He jokingly suggested that *Roridula* be included in the family Sarraceniaceae and that its carnivorous nature be re-explored. It was, which led to the second surprise. It has been long known that *Roridula* plays host to a curious insect called the assassin bug. These bugs live on the plant, and for reasons still unknown can

traverse the sticky glands with no problem at all. When other insects become caught, the assassin bugs close in, stab their needle-like mouths into the struggling prey, and suck out the juices. Alan Ellis and Jeremy Midgely discovered the amazing reason for this cooperative venture. Assassin bugs, after sucking dry *Roridula's* prey, secrete a nutritious substance onto the plant that the leaves then absorb—true carnivore by proxy! *Roridula* plays host to assassin bugs who act as a “surrogate gut.” This discovery led Oxford carnivorous plant specialist Barry Juniper to comment on petunias, potatoes, and tobacco: “They’re all killing machines. I wouldn’t be surprised if they absorb decayed products from their prey.”

How have such plants evolved? Definite theories on the evolution of carnivorous plants are few; the almost complete lack of fossil evidence coupled with the current shifting of ideology among evolutionists may make theorizing an exercise in futility. Uniformitarianism, or gradualism, as popularized by Darwin, Wallace, and other nineteenth century scientists, holds that evolutionary change in both biology and geology is a very slow progression of events that occurs even as we speak. Darwin’s theory of the origin of species by natural selection relied on rare and random mutation giving rise to new traits that, if beneficial to the species, allowed it to compete better among its peers and pass those traits down to its offspring. Darwin’s dream that the fossil evidence for such transitional forms were simply missing from the evolutionary record has turned out to be mere wish fulfillment, for most scientists today agree that there are no transitional forms.

Thus, under gradualism, Darwinists imagined how a basic oval leaf slowly evolved, step by step, into the simple, rolled up, funnel shape of something like a *Heliamphora* leaf; then through random, accidental mutations over aeons of time, added genes to eventually produce the drug



Roridula gorgonius covered with prey—but is it carnivorous?

conine in *Sarracenia flava* or the light windows of *Drosera* or the symbiotic relationship of *Roridula* and assassin bugs...well okay, maybe it's not so easy to imagine! Or, in the words of Francis Lloyd, who in his 1942 book, *The Carnivorous Plants*, mused on how the complex trap of *Utricularia* could have possibly evolved under gradualism: "Since we cannot answer these questions, it is perhaps as well to say no more."

Currently, beliefs in gradualism are eroding. Scientists are realizing that for long periods of time species of life on earth are stabilized, with little or no evolutionary progress. Then periodically and very suddenly, geological and biological changes take place. Older species suddenly vanish, while new ones appear quickly with no transitional forms. Others remain unchanged. While research in areas such as DNA may lead to conclusions concerning relationships between species, including carnivorous plants, how those species actually evolved is still the deepest of mysteries. The answers may come over the next century—maybe through the theories of punctuated equilibrium, but more likely through cosmic catastrophism; possibly through the studies of DNA or population genetics, or perhaps through some new theory no one has thought about yet.



Tropical pitcher plants, such as this *Nepenthes sanguinea*, were popular greenhouse specimens in Victorian England.

the invention of the greenhouse in the early 1800s and its growing popularity during the Victorian age among Europe's upper classes allowed for the first time exotic plants from around the world to be successfully grown under controlled conditions. Commercial nurseries were developed to cater to the demand for exotic plants. Some of these firms, such as the famous Vitch and Sons in England, financed expeditions to far-off lands around the world to collect unusual plant life. Their fanciful catalogues in the late 1800s boasted palms, orchids, hoyas, succulents, and carnivores. Among the most popular insect-eating plants offered were the *Nepenthes*, but such firms also sold *Sarrace-*



nia, *Drosera*, *Dionaea*, and *Cephalotus*. Breeding programs developed showy hybrids that competed—along with roses and orchids—for prestigious awards at the Chelsea Flower Show. Magazines like the *Gardener's Chronicle* popularized the plants and offered cultural techniques. Usually, exotic plants were very expensive and during the 1800s were affordable only to the very rich. But hardly a greenhouse existed on the estates of the wealthy that didn't have *Nepenthes* hanging from the rafters along with the palms and the orchids.

But World War I changed all of that. The shortage of fuels to heat the greenhouses caused the sudden death of vast botanical collections. Many prized cultivars and species disappeared forever. Only here and there, hidden away in public botanical gardens and universities, did some of the plants survive.

It wasn't until after World War II that the hobby of growing carnivorous plants began to make a modest comeback. During the war Francis Lloyd published his scientific work *The Carnivorous Plants* in America, the first such work since Darwin's 1860 *Insectivorous Plants*. In Japan, where the love of cultivating exotic plants (such as dwarf rhaps palms and bonsai) suffered heavily during the world war, the first carnivorous plant society was begun in 1948. It still thrives.

During the fifties and sixties, the cultivation of ornamental plants steadily increased with the booming economies worldwide. But except for a handful of interested individuals, carnivorous plants remained obscure to the general public. Venus flytraps, dug up out of their native North Carolina habitat and sold as an occasional novelty, were the only insect-eating plant available on the mass market. No popular literature on the plants appeared except for occasional articles in magazines such as *National Geographic*.

The modern carnivorous plant hobby began in earnest during the seventies. Two hobbyists, Joe Mazrimas in California and Don Schnell in North Carolina, began to communicate with other collectors around the world. This developed into the International Carnivorous Plant Society (ICPS) and its publication: *The Carnivorous Plant Newsletter*. For the first time, enthusiasts had an organized format to exchange cultural information as well as seed and plant material from around the world.

The seventies and eighties also saw the publication of several books on the subject, as well as a few nurseries and collectors that began to take the ecology of carnivorous plants seriously. Instead of removing

plants from their rapidly diminishing native habitat, they began to propagate them. Three nurserymen who helped distribute hundreds of rare, sought-after carnivores were Adrian Slack in England, Marcel Lecoufle in France, and Bob Hanrahan in the United States. Plants that many hobbyists never dreamed they would see in their lifetimes were suddenly becoming available.

The nineties have seen a steady increase in the popularity of carnivorous plants. Smaller local societies, usually associated with the ICPS, have sprung up in various parts of the United States, Europe, and Australia. Tissue culture propagation has made many once rare plants common and affordable. Numerous nature programs on cable television are making carnivorous plants more visible to the general public. The plants are beginning to appear more often at flower shows and public botanical gardens. General nurseries are retailing a wider variety than just the familiar Venus flytrap.

So how does one use this book?

I have written *The Savage Garden* as a practical guide to growing carnivorous plants (which, for the sake of brevity, I will refer to as "CPs" throughout the rest of the book). It is divided into three main parts: Part 1 covers the primary points of cultivation, including hard goods. Part 2 outlines the various places you can grow CPs, from greenhouses to bog gardens. Part 3 introduces all the popular genera of insect-eating plants, as well as their history, habitats, and habits, including their specific cultivation requirements. This is followed by a brief section on resources.

∞ PART ONE ∞

THE BASICS OF CULTIVATION



Sarracenia flava "red tube form" with *Drosera filiformis* ssp. *tracyi* and *Pinguicula* species in an open, wet, sunny habitat in the Florida panhandle.

DR. LARRY MELLICHAMP of the University of North Carolina once told me, "Whenever I have seen carnivorous plants in the wild, whether it was in South Africa, the Florida panhandle, or Northern California, the habitats were often strikingly similar." Broadly speaking, this is a rather true statement, although of course some CP habitats are vastly different from others. I have been struck by the similarity of pygmy forest bogs in Mendocino County, California, to those I had explored as a youngster clear across the continent in the pine barrens of New Jersey. If someone were to show me photos of each, they

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