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Tipularia 2001

The Journal of the Georgia Botanical Society

In this issue: Quillworts, Orchids and Grasses

From the Editor

This issue marks the fifteenth year of *Tipularia*. Over these years, orchids as a group have had more than their share of its pages with at least seven articles largely devoted to them. Now why would one say such a thing? After all, the name of the journal comes from perhaps the most common orchid in Georgia, the cranefly, found in virtually all of our 159 counties! It is illustrated here from the cover of the inaugural issue.

The answer, while complex, is fascinating. And it is the reason this issue has orchids at its center, framed by plants few people show as much interest, excitement, fervor and passion in as orchids.

Litton John Musselman, Mary Payne Hogan Professor of Botany at Old Dominion University in Norfolk, Virginia, as you will learn, has a passion for quillworts. He admits freely they are not a spectacular bunch, and one must delve deeply into their biology and structure just to place a name on them! Economically they don't even raise a blip on the radar screen, and even when they do, it's only when someone brings up some "rare plant" that threatens to stop some development. I don't recall a single field trip in my two decades of membership devoted to quillworts. You'll enjoy his folksy technicality with these fern allies.

Elaine Nash, one of our own from Rockdale County, has a passion for grasses. If any care to peruse my well-worn copy of Radford, Ahles and Bell's *Manual of the Vascular Flora of the Carolinas*, they will find the pages including the grasses, sedges and rushes as pristinely white as the day the book came off the press. And I'm not alone! On a pilgrimage field trip to Torreya State Park in Florida, several of us made a big deal when David Emory actually got *exited* over a grass! It was a giant cane, *Arundinaria tecta*, actually blooming—a very unusual sight.

When Elaine is on a field trip, any questions regarding grasses immediately are passed on to her. She gives enthusiastic answers to anyone who will listen. If she and Al Good get together, other topics might as well be forgotten!

So we have two articles—one very major, a significant departure from previous *Tipularia* articles— on groups of plants that even the most intrepid of casual to serious botanizers walk by without passing a thought.

Tipularia

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Georgia Quillworts

Litton John Musselman

The Isoetes, *insignificant and apparently sterile as they are, were long overlooked or ignored by our botanists, so that until thirty or forty years ago very few specimens were collected, and none were distinguished from* I. lacustris, *if we except Nuttall's guess at his Oregon discovery; but the genus has attracted so much attention, and lately so many forms have become known, that it seems to me an interesting task to trace up the history of the discovery of the different species and their varieties, and of the area of their distribution, and then the date of their publication, before I enter into their scientific description.*

George Engelmann, Father of American *Isoetes* taxonomy, writing in 1882.

Introduction

To paraphrase the song, Georgia is on the mind of quillwort researchers. Most people acquainted with ferns and fern allies know more about the unique quillwort flora of the Peach State than any other state. Why? Because Georgia has the greatest diversity of quillworts in North America and one of the richest quillwort floras anywhere in the world. Rich in interest, quillworts are poor in features useful for identification though the genus has been recognized for more than two centuries—since the days of the great Swedish botanist Linnaeus who used the name *Isoetes*. Quillwort is the common name in English, in allusion to the leaves which resemble old-fashioned writing quills. Wort is from the Old German word *wyrt,* meaning plant.

In contrast the origin of the scientific name is uncertain but may refer to the evergreen condition of some species (*iso*, equal; *etes*, seasons) because the leaves do not die back during the winter. Or, the name may come from an ancient name of leek to which *Isoetes* bears a fanciful resemblance. Unlike other showy state endemics such as *Elliottia racemosa* and *Gordonia altamaha* or even leeks—the quillworts are modest plants, to the point of being furtive.

". . .long overlooked or ignored by our botanists . . ."

Not only are they easily overlooked, quillworts are ignored even by experienced botanists. I know. I was one of them. Hidden in places that are wet at least part of the year, quillworts are allies of ferns. But quillworts don't look anything like a fern. In fact, they look deceptively like grass. Not much to an *Isoetes* plant. Streamlined to the point of simplicity, the most obvious features of the plant are the leaves. The quill shaped leaves make *Isoetes* species look more like sedges and rushes than like ferns. Their unassuming growth form requires dedicated searching.

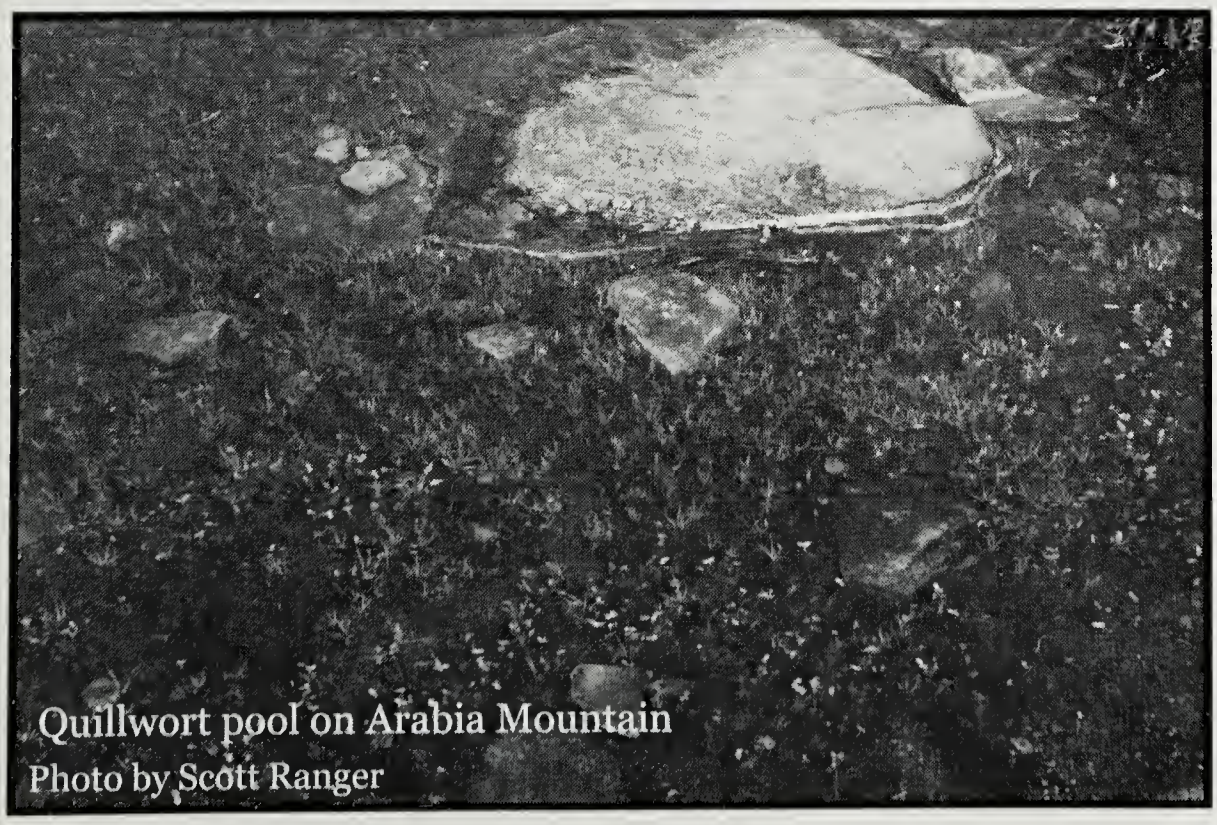
Encouraged by knowledgeable, enthusiastic field botanists (see acknowledgments), I have slogged through cypress swamps, baked on granite outcrops, struggled through fortifications of greenbrier and bramble, waded in mud, and climbed in the mountains to search for Georgia quillworts. This is part of a larger project to understand the genus in the southern United States but, I confess, Georgia is my favorite place to look for

these plants. Most quillwort specialists would agree. (Rumor that I favor Georgia because of the ecological landscape involving barbecue is exaggerated slightly).

My interest in the genus began when I was a graduate student at the University of North Carolina so long ago that another president was being threatened with impeachment. As a northerner I was learning that the boundaries of the southeastern flora could comfortably be ascertained by being in places where grits were served for breakfast. During these formative years, I was encouraged to take a better look at the lower vascular plants, including *Isoetes*.

". . .it seems to me an interesting task to trace up the history of the discovery of the different species . . ."

My "interesting task," to quote Engelmann, is to encourage a closer look at quillworts in Georgia. One of my objectives is to raise awareness of the urgent need for habitat protection for these poorly known yet engaging denizens of a diversity of habitats. This urgency cannot be over emphasized because Georgia is obviously one of the centers of diversity in the genus. I predict new species will be found in addition to those novelties I note in this paper.



Quillwort pool on Arabia Mountain
Photo by Scott Ranger

I will outline, in a cursory manner, the morphology of the plant, describe reproduction, and then briefly discuss the species known from the state. Figures were selected to provide an introduction to the genus, emphasizing those which are seldom if ever illustrated. All of the pictures were taken by me.

"The Isoetes, insignificant as. . . . they are . . ."

Simply elegant, rather than insignificant, is how I would describe quillworts. Their plant body is so reduced that botanists struggle to find enough features to recognize species. A flurry of recent research is showing that there is more to the quillwort body than meets the eye.

Take a Closer Look at Quillworts

Several years ago, I was in a tidal marsh with W. Carl Taylor of the Milwaukee Public Museum and the leading authority on the taxonomy of the genus *Isoetes* in the United States. As we waded through the mud on a scorching July day trying to discern quillworts from the look alike species in the genera *Eriocaulon, Lilaeopsis* and *Sagittaria*, Carl stopped and said-"How can you tell these things apart?" And that is the problem-- even for seasoned quillwort hunters. A few, very fallible, suggestions to help identify one of those grasslike plants as a quillwort are given below.

First, in the aquatic or wetland habitat where these plants grow, quillworts are the only plants with whorled,

grasslike leaves. (Granite outcrop species don't count!). This means that the leaves arise from the rootstock in a spiral. This is in contrast to the oft confused rushes that have leaves which slightly overlap at the base. Second, the base of the leaf has wing-like extensions (alae, see below). Third, some of the plants in the population will have at least some of the leaves twisted. Fourth, and this is the most subjective of all, the color of the leaves is a distinctive green slightly different in hue from grasses and rushes. Learning the search image takes effort and the easiest way to locate quillworts is by having the experience of locating them.

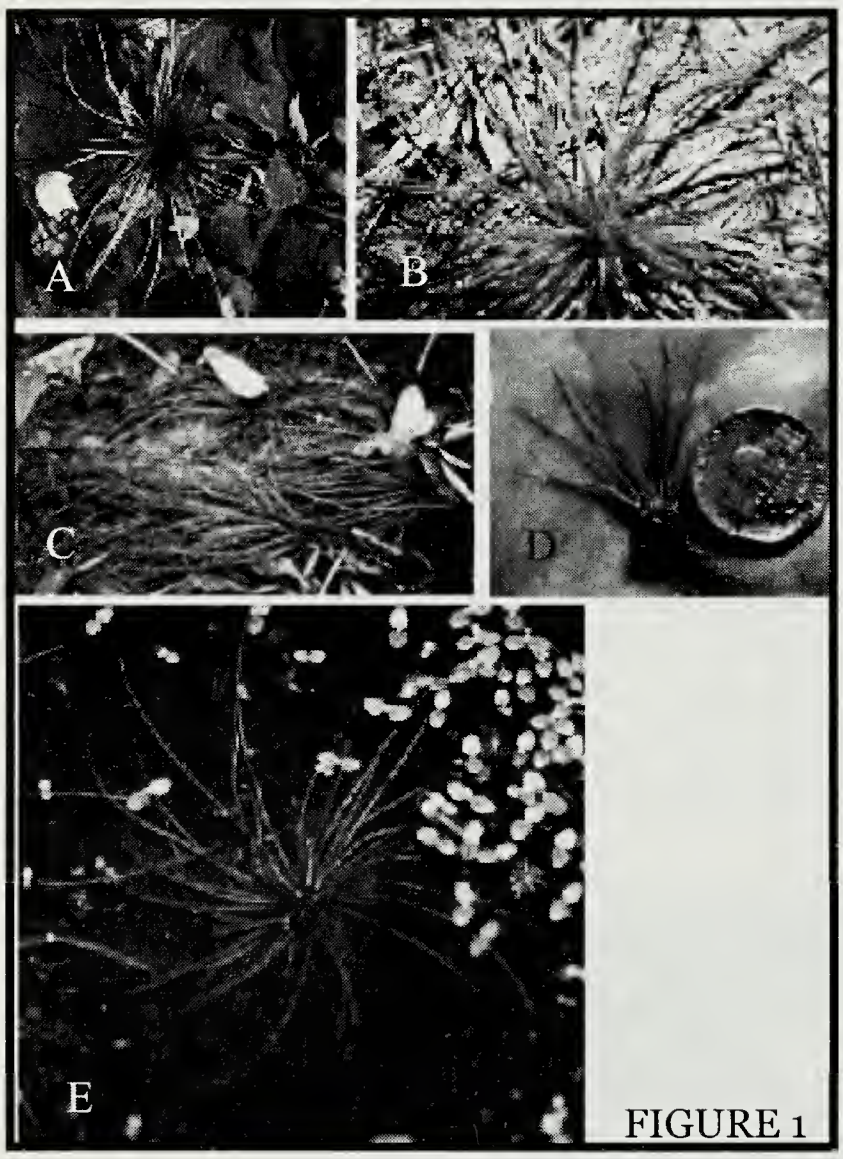


FIGURE 1

Here is a short introduction to quillworts starting with what we see first--the leaves.

Leaves or Sporophylls

Leaves usually taper from the bottom to the top and are seldom more than 1 cm broad. At the bottom, just above the attachment to the rootstock, the edges of the leaf flare to form a wing or ala (Latin for wing, plural alae). Alae are always present although of differing sizes in different plants.

Among aquatic plants in the Eastern United States, quillwort leaves are unique in having four air chambers.

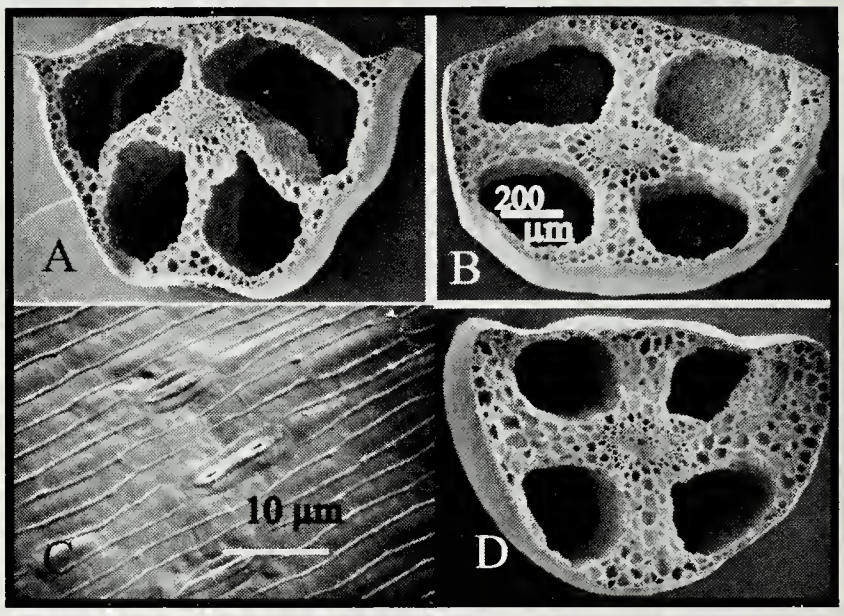


FIGURE 2

A, B, D At regular intervals along the leaves are diaphragms. Consisting of interlocking cells, these divisions of the leaves may control damage if the leaf is punctured. Most *Isoetes* species have leaves which are not terete, that is, round in cross-section, but are flat on the upper, or inner, surface. Another characteristic of many species is a twist or torque in the leaf. Other features of diagnostic value such as peripheral fibers, specialized strengthening cells in the corners of the leaves as well as the anatomy of the canals in the center of leaves are being studied for their taxonomic value.

Do quillwort leaves have stomata? This question was raised by Engelmann (1882) who reported several species lacking stomata. I have never seen a quillwort leaf without stomata. Often, they are only ten microns long. (One micron, or micrometer, is 0.000001 meter, or 0.000039 inch; abbreviated as Åm). Sometimes stomata are located only on one surface of the leaf. I think at least some reports of the absence of stomata is due to their being so small that they

are overlooked (FIGURE 2-C).

Quillwort leaves are actually spore bearing structures termed sporophylls although I will use the term leaf and sporophyll interchangeably. At the base of each sporophyll, at least during the growing season, a sporangium is found.

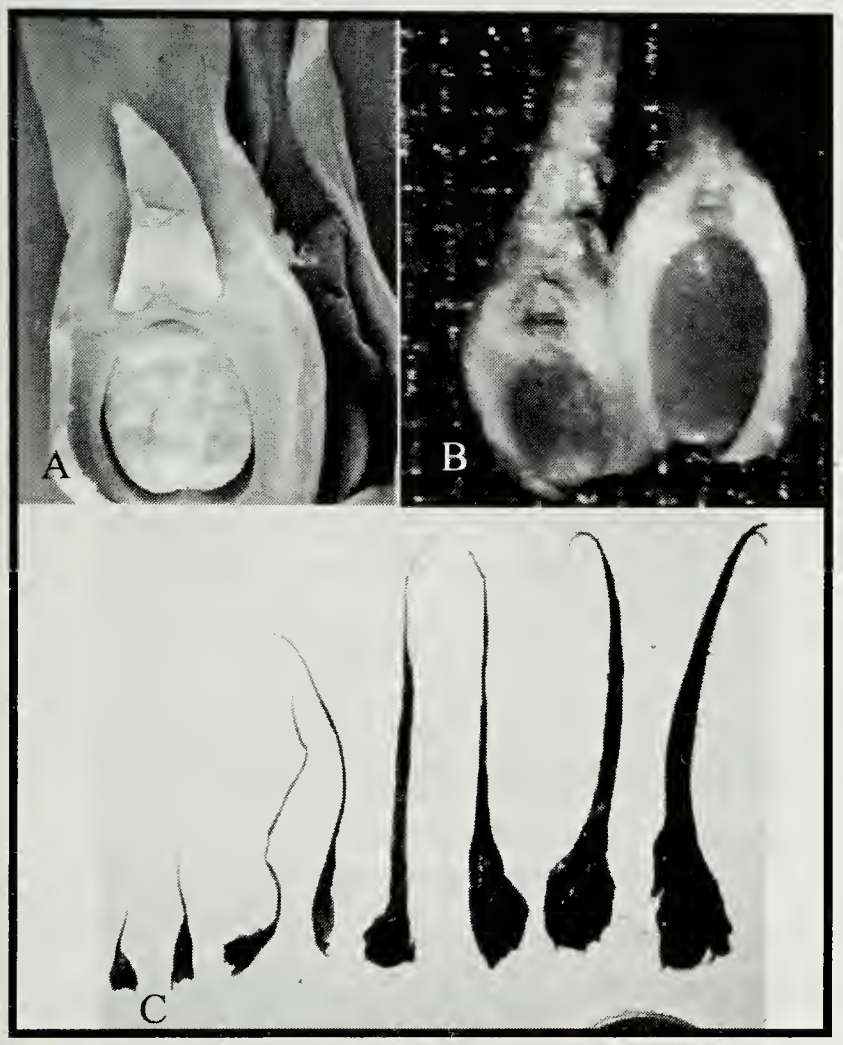


FIGURE 3

Located in a depression in the base of the sporophyll called the fovea (the Latin word for pit), the sporangium can develop either male spores, microspores; or female spores, megaspores. It appears that each plant can produce both microsporophylls and megasporophylls although one or the other may predominate at different times during the growing season giving the illusion of unisexual plants. Several intriguing features are associated with the sporangia.

The velum is an extension of the leaf tissue that covers all or part of the sporangium as in *I. melanospora*. Or, it may be missing entirely as in *I. flaccida*. Velum coverage is often a simple way to name a species so it is helpful to learn velum characters. Don't confuse the velum with the sporangial wall because they are overlapping structures. The sporangial wall is pigmented in some species. The pigmentation is usually present in the form of small flecks in the wall.

The ligule (Latin for tongue, in reference to its shape) is located just above the sporangium (FIGURE 3-A). This small flap of tissue arises from a base embedded in the leaf. The foliar part of the ligule usually disintegrates by the time the spores are mature in Georgia quillworts. Its function is unknown, although a diverse group of chemical compounds have been recorded from the ligule of a European species. In Georgia species, the ligule has disintegrated by the time spores are mature and the ligule base becomes darkened and slimy (due to secretions?). As with so many features of these plants, we remain ignorant of the function of the ligule base (sometimes called the cushion). (FIGURE 3-B). Recent investigations by Professor Jim Hickey at Miami University have revealed a suite of additional structures associated with the sporangium, the fovea, and the region of the ligule that vary among species and have taxonomic value.

Two specialized types of leaves are found in Georgia quillworts. Phyllopodia (singular, phyllopodium, Latin for base of the leaf) are hardened, darkened bases of sporophylls. After the softer part of the sporophyll decays, phyllopodia remain. These can be evident even when the plant is desiccated during the summer. A more specialized type of leaf is a scale.

Scales, highly specialized leaves reduced in size and lacking the structures described above, were thought to occur on only a few quillworts (FIGURE 3-C). Most of the scale-bearing plants were found on plants from other continents. In a survey of the southern species,

Rebecca Bray has found scales on most species. Like so many other structures in this genus, they have been overlooked. Apparently, scale production alternates with sporophyll production.

The Root of the Matter

I will use the term rootstock for this leaf-bearing organ because it is morphologically neutral. Corm is another term for the rootstock.

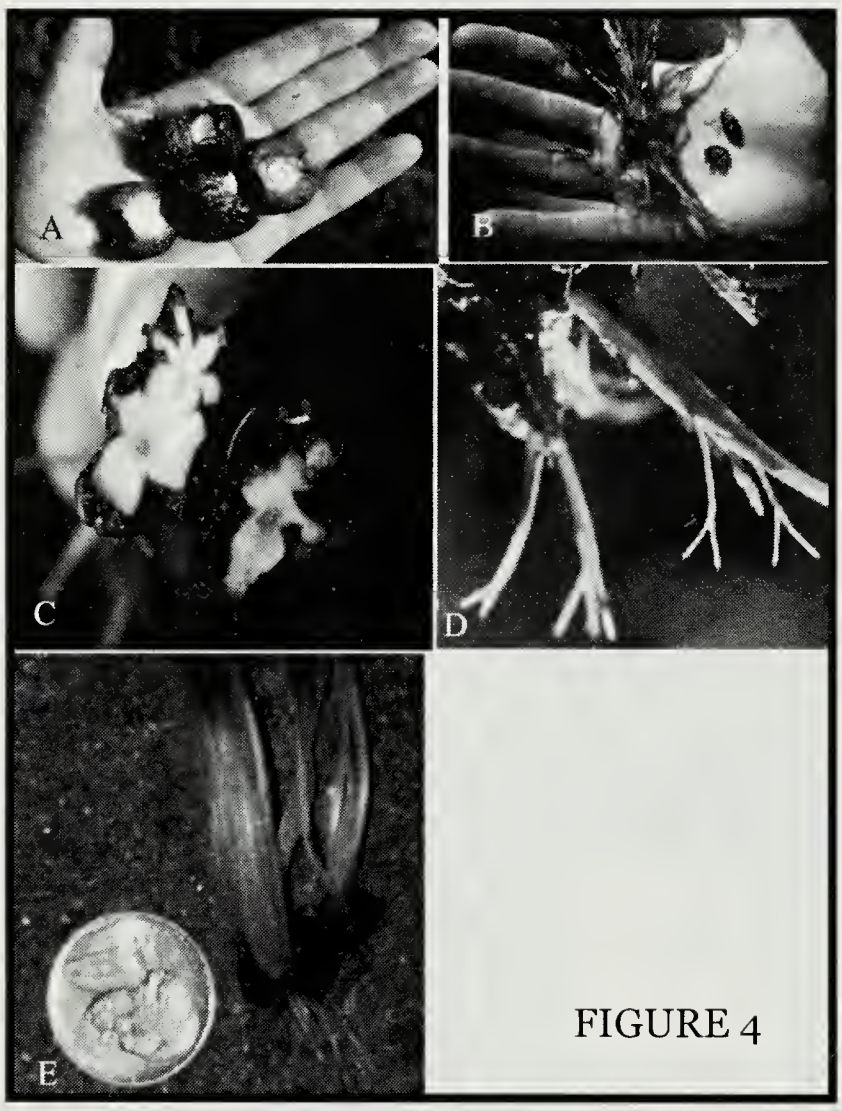


FIGURE 4

Sporophylls arise from a rootstock that is typically shaped like a disc but with notches on two sides, giving the appearance of the letter "H" with rounded edges (FIGURE 4-A). Shape and lobing of the rootstock varies among species and is often referred to in keys although I find it neither a reliable nor a useful character.

This rootstock has cambial activity. Unlike like almost all other ferns and ferns allies, the rootstock of quillworts produces new tissue year after year (we don't know how long individual plants live). This tissue is called secondary tissue. Each year as secondary growth is resumed, the outer layer of the rootstock is sloughed, producing an abscission cap (FIGURE 4-B). Like many other features of the *Isoetes* plant, abscission caps have not been documented for Georgia species but I expect to find them in all.

Roots arise from the notches in the rootstock. Most roots have forked tips. The rootstock of the Georgia endemic, *I. tegetiformans,* is unique and discussed later.

The Secret Sex Life of Quillworts

Georgia quillworts are furtive as well as shy. Accordingly, their sex lives require even more probing. Let's begin our discussion of sexual reproduction with the megaspore.

Megaspores

Megaspores are more or less globe shaped and range in diameter from 250-500 Åm. Generally, the larger spores are found in species with a higher chromosome number. By convention, the top (or proximal surface) of the spore is defined as the region where three crests are found. Envision four oranges, equally touching one another. The place where each orange touches another orange

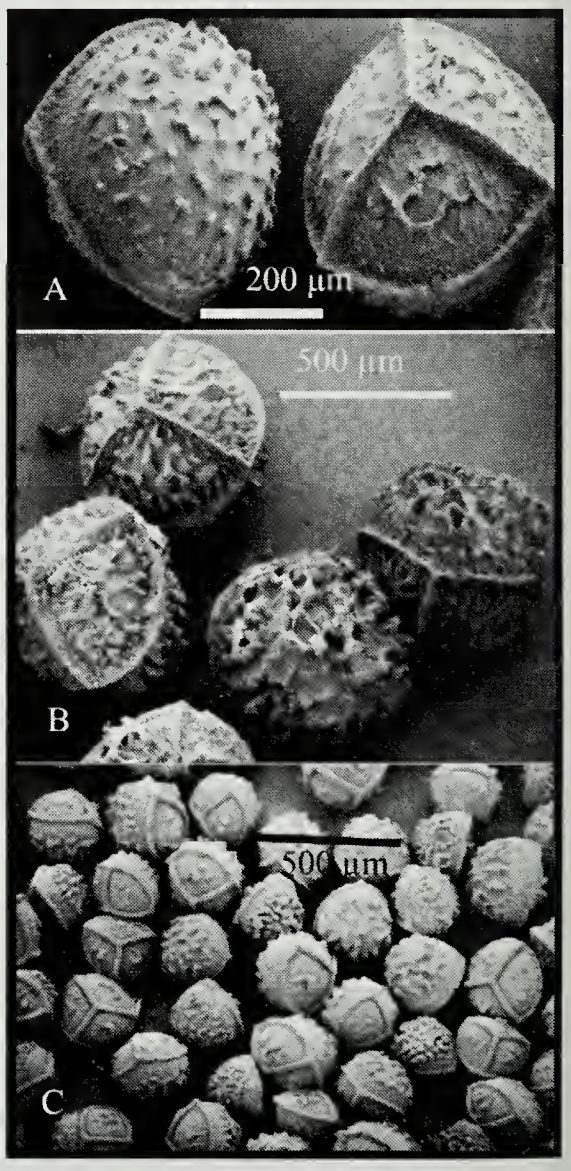


FIGURE 5

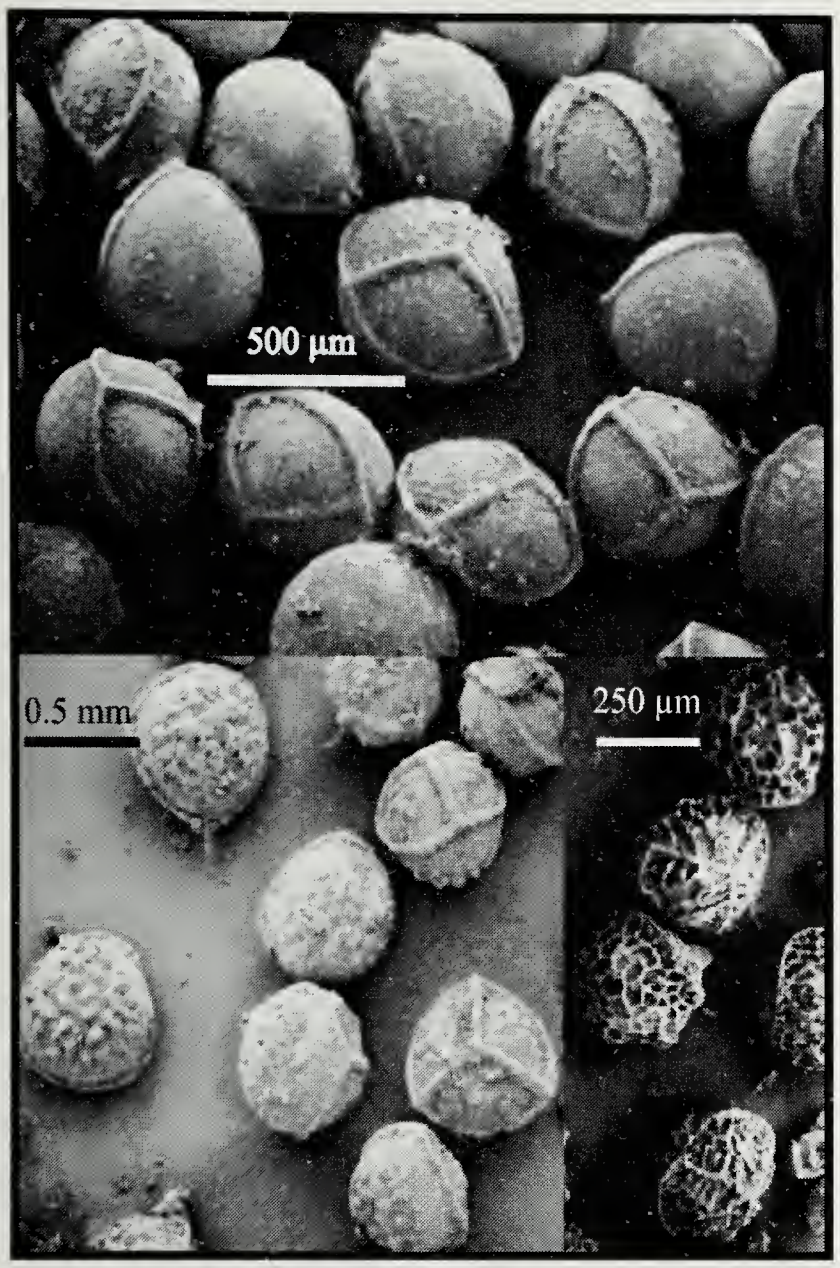


FIGURE 6

represents the triradiate ridges. At germination, the megaspore will split at the triradiate ridges. Triradiate ridges join another ridge, the equatorial ridge, that encircles the megaspore more or less in the middle. The distal (bottom) part of the megaspore lacks the triradiate ridges.

Megaspores exhibit a range of sizes and surface ornamentations. In true botanical fashion, a long list of terms is available to describe this ornamentation, sometimes referred to as sculpturing. Ornamentation may be found on the triradiate ridges (proximal ridges), equatorial ridge, and the distal surface. In some species there is a girdle, defined as the band just below the equatorial ridge, which can have features different from other regions of the megaspore. The girdle is especially well developed in tetraploids (see below). The type and density of ornamentation can vary on different parts of the same megaspore (see

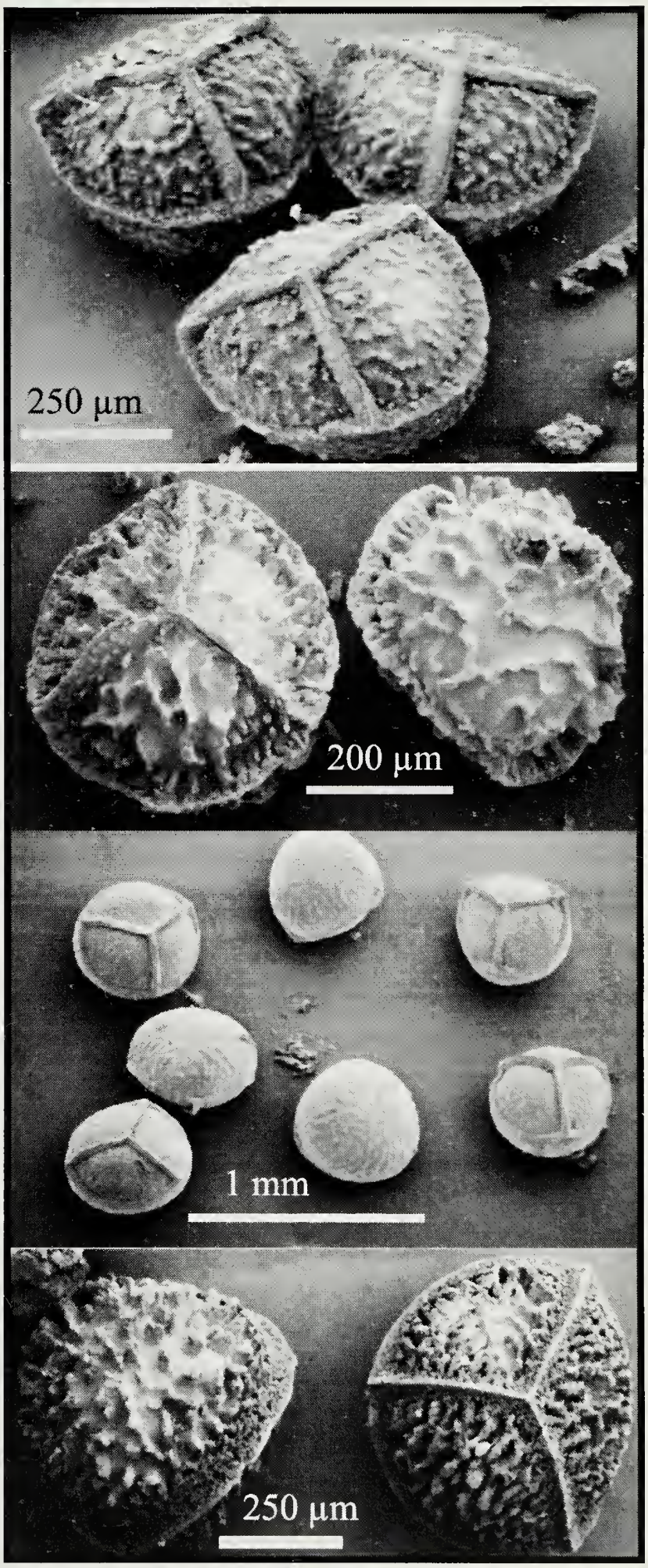


FIGURE 7

FIGURE 5-C, *I. flaccida*). In summary, surface ornamentation is one of the most important diagnostic features meaning that you need a mature megaspore to put a name on a quillwort if you are using a conventional key for identification.

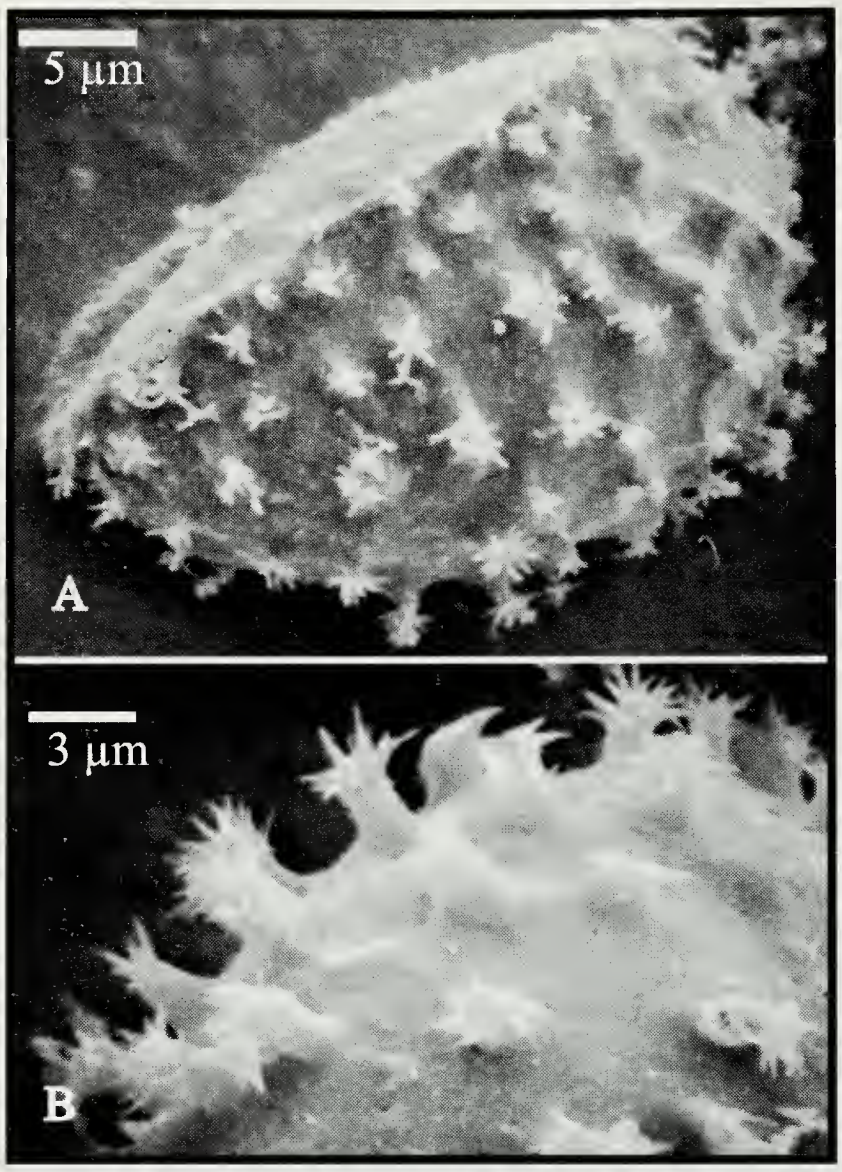


FIGURE 8

Microspores

In the meantime, the microspores are preparing for their mission. They are strikingly different from megaspores and usually one tenth their size.

If a megaspore is like an orange in shape, a microspore is like a single section of an orange. Microspores are poorly studied and little is known about the variability in their ornamentation. A helpful review of surface features of Southeastern quillworts is found in Boom (1979). Further study is necessary to see if microspores have taxonomic utility.

On a Rainy Night in Georgia . . .

Under the right conditions, the microspore germinates and produces four motile sperm. These require free water in order to swim to the egg. This is why quillworts must

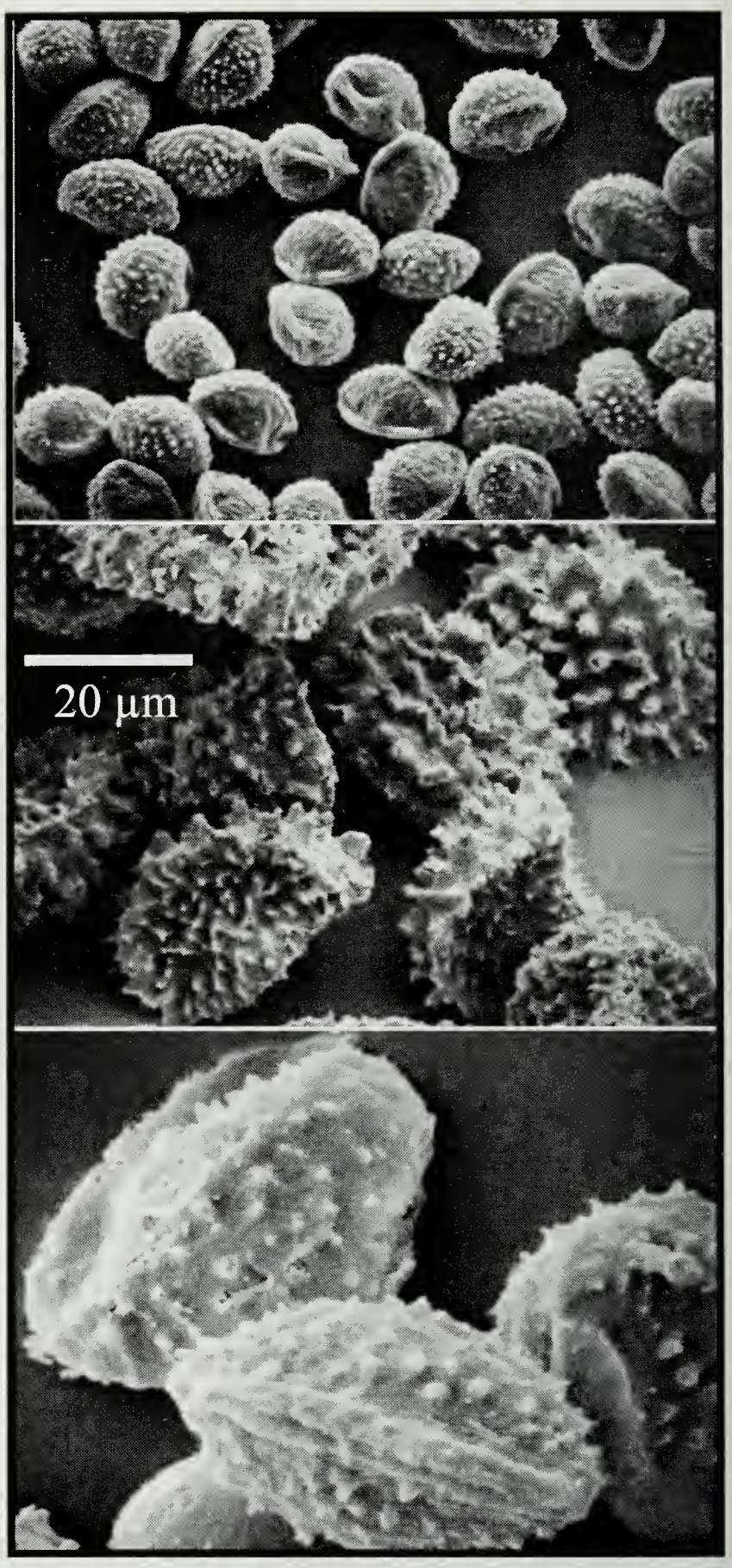


FIGURE 9

have water to reproduce.

Meanwhile, back at the megaspore changes are also taking place. The megaspore germinates, that is, cracks open to reveal the female sexual structure, the archegonium in which the egg is encased (FIGURE 10-A, B). Simpler than most archegonia, the top is composed of only four cells (FIGURE 10-C). The sperm swims down the short canal to the egg. After fertilization, the new *Isoetes* begins

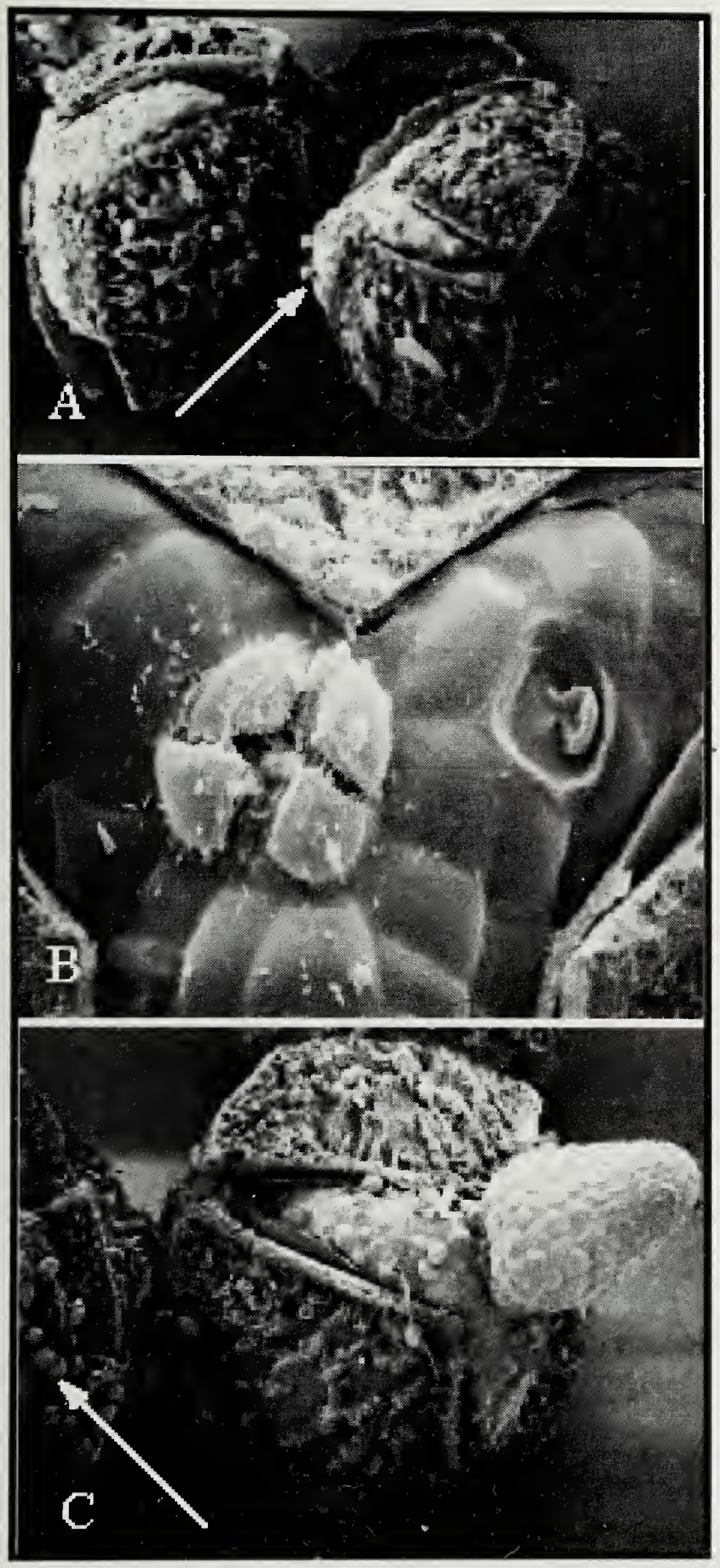


FIGURE 10

its development while still attached to the megaspore. This differs from typical ferns where the sexual stage is produced on a separate, free-living plant.

The first indication of a baby quillwort is the development of the sporeling within the archegonium (FIGURE 10-C). Little is known about how the quillwort separates from the spore and finds a new home. In ponds and still waters of streams, it is often possible to find aggregations of sporelings, suggesting that the sporeling stage may be important in the diaspore of the plant.

Asexual Reproduction

As recently as 1978 (Rury, 1978) vegetative reproduction in *Isoetes* was described as "rare," a misconception that persists. However, we are finding increasingly that asexual reproduction is likely to be important and widespread in quillworts. I have found that the most common means of asexual reproduction is the development of buds on the rootstock (FIGURES 4-C, E). As the rootstock grows, it branches and produces buds. These buds break off and become established in the substrate. It is not difficult to imagine how these plantlets might be distributed over a wide area under conditions of flooding and high water.

Speciation in Quillworts

While most wildflower enthusiasts will have little recourse to count the chromosomes of a quillwort to determine its affinities, chromosome number is important in understanding the relationships within the genus. Dr. Rebecca Bray has examined the chromosomes of every species of quillwort in the Southern United States and finds that all quillworts examined have a base number of 11. In other words, there are different numbers, or levels, of chromosomes in different species but always based on 11. The botanical shorthand for describing the number of chromosomes is $2n$=X, where 2 is the number of the chromosome complement (diploid, tetraploid, hexaploid), n is the base number (in Georgia 11) and X is the total number of chromosomes. Chromosome behavior is important in understanding the evolution and speciation of quillworts.

Quillworts exhibit a classic form of plant evolution found in other pteridophytes, most notably the spleenwort ferns, members of the

genus *Asplenium* and the log ferns, species of *Dryopteris*. This is known as reticulate evolution and involves a process called polyploidy. Unlike most animals, plants lack sex chromosomes so a doubling of the chromosome number is not lethal. Just the opposite doubling the number of chromosomes, polyploidization, confers an adaptive advantage on the plant by increasing the genetic material.

Few quillwort hybrids have been documented in Georgia but no doubt many will turn up with further studies. Let's use two species which occur in Georgia and the hybrid they frequently form everywhere but in the Peach State! (More on hybrids later).

For example, *Isoetes engelmannii* has a basic chromosome number of 22 ($2n$=22). That means that each cell in the adult plant received one set, 11 chromosomes, from each parent. *Isoetes hyemalis*, on the other hand, has 44 chromosomes ($2n$=44). Therefore, the sex cells of *I. hyemalis* will have 22 chromosomes (half of 44). If a sperm of *I. engelmannii* fertilizes an egg of *I. hyemalis,* a sporeling with 33 chromosomes will form. This hybrid will be sterile because 33 chromosomes can not pair to produce viable sex cells. This hybrid, known as *I. µbruntonii* Knepper and Musselman (the botanical convention for naming hybrids is to use the multiplication sign, µ, before the specific epithet to indicate that the name refers to a hybrid plant), will be sterile. But that is not the end of the story!

Through processes not fully understood, such hybrids are capable of producing sex cells through a failure in the process that reduces the number of chromosomes. If this happened in our example with *I. µbruntonii*, the sex cells would each have 33 chromosomes. If one of the *I. hyemalis* sperm (with its 33 chromosomes) were to fertilize an egg of *I. engelmannii* (which has 11 chromosomes), the new sporeling would have 44 chromosomes. It would be able to reproduce sexually. Also, the new genetic combinations could enable it to survive under conditions or in habitats where neither parent could.

Identifying Georgia Quillworts

Lots of luck! First of all, learn to recognize a quillwort. In many cases, most of us will have to be satisfied with just knowing the genus. There simply is no good way to easily distinguish among quillwort species. The morphology of the spore, discussed earlier, is the way most are determined. This is not much encouragement for the pteridophyte enthusiast who does not have ready access to an electron microscope, however!

In my experience, the best way to learn quillworts is to develop an attitude like theirs. Approach the whole matter of learning these diverse yet similar appearing plants with a spirit of humility. As a starter, learn those quillworts that have very specific habitat requirements. The granite outcrop species would fit here but retain your humility because there may be new species lurking in these oft visited sites!

Buy a 20X hand lens. This will enable you to examine the megaspores. (Microspores require very high magnification to see surface characters. Anyway, they have received much less study than megaspores). Features of the velum are helpful as is pigmentation of the wall of the sporangium.

Unfortunately, there is no single, good guide to the quillworts of Georgia. Nor can there be for several years because of the rapid rate we are being humbled by how much we don't know about these plants. While naming is important, enjoyment of quillworts and their fascinating life history does not require acquaintance on a first name basis.

Known (and Unknown!) Georgia Quillworts

As noted, there is not a single source for up to date information on the quillworts of Georgia (or anywhere else in the Southern United States). What I am presenting here are notes based on my studies. Detailed descriptions can be found in formal treatments of the species. County distribution data for many species, though out of date, can be found in Snyder and Bruce (1986) or in the treatment of the genus in the Flora North America (Taylor et al., 1993).

I am discussing species according to their ploidy levels. This is because the tetraploids ($2n$=44) may include plants that have the same name but are genetically distinct and evolutionarily divergent. Any understanding of the genus must be based on a thorough knowledge of the diploid taxa as it can be assumed that they form the basic evolutionary matrix for the development of polyploid species. Common names, when available, follow Taylor et al. (1994).

Diploids

Isoetes butleri Engelmann
Butler's Quillwort

This quillwort has a restricted range, being most common in the limestone region of central Tennessee and contiguous parts of Kentucky, Alabama and Georgia. I have seen *I. butleri* in Georgia only in the Chickamauga National Military Park, hidden among grasses. Finding this quillwort can be difficult! It is the most terrestrial of all the species we are discussing. In other words, it is not typically found submerged.

Isoetes butleri has the narrowest leaves of all the quillworts we are considering. It is also more evanescent than most other species, appearing with its pale green leaves and then drying only a few weeks later. Megaspores have modest ornamentation (FIGURE 7-A) in contrast to the microspores which are covered with a dense, distinct ornamentation (FIGURE 9-B).

I. engelmannii A. Braun
Engelmann's Quillwort

Named after George Engelmann, an eminent botanist who worked at the Missouri Botanical Garden in the 1800's, this quillwort is one of the most widespread in the Eastern United States. Leaves can be up to 1 m long and are usually dark green. Engelmann's quillwort is not as fussy about soils as Butler's quillwort so is found on both basic and acidic soils. Unlike Butler's quillwort, *I. engelmannii* is more aquatic, that is, it is more likely to be found in streams and ponds. When growing under water, Engelmann's quillwort, like all submersed quillworts, will remain green all winter.

According to Snyder and Bruce (1986), *I. engelmannii* occurs in 12 counties more or less throughout the state. Caution is needed, however, because some of the plants they included under this name may, in fact, be *I. appalachiana* which had not been described when their work was published (see below).

Megaspores are honeycombed and easily recognized although they can be confused with *I. appalachiana* (FIGURE 6-C). Engelmann's quillwort is assumed to be involved in the evolution of several southeastern species.

I. flaccida A. Braun
Florida Quillwort

Often forming large populations in springs and rivers in Florida, this species of *Isoetes* is restricted to Florida and a few counties in Georgia. Habitats vary. I have seen it blanketing stream bottoms as well as in roadside

ditches. Little distinguishes it vegetatively from other species except the long, flexuous leaves when it is growing in a stream. Emergent plants look like well, like any other quillwort.

This is where a hand lens is useful. The Florida quillwort completely lacks a velum. It is the only (known) quillwort in the eastern United States with this feature. Megaspores are also distinct (FIGURE 5-3).

I. melanopoda Gay and Durieu
Black-footed Quillwort

FIGURE 11

Both the scientific and Latin names refer to the blackened leaf bases (FIGURE 11) . Among quillworts, this is the only species which can be weedy. I have seen soy bean fields, abandoned for just one year, blanketed with *I. melanopoda* in Kentucky. In Georgia, this is rare quillwort recorded from only one county (Snyder and Bruce, 1986).

Black-footed quillwort is a variable species requiring additional research. It may consist of several taxa. Kerry Heafner, Miami University, is studying the systematics and evolution of this group. Megaspores from a Mississippi population are in FIGURE 6-A.

I. melanospora Engelmann
Black Spored Quillwort

The name refers to the color of the megaspores, which are especially dark when they are wet. Black spored quillwort looks like other quillworts except when young. As noted by Engelmann in the original description of the species (Engelmann, 1877), young plants of *I. melanospora* have a distichous arrangement of leaves. This means that the leaves are not whorled but are borne in a single plane (distichous means in two rows). Velum coverage is almost 100% of the sporangium although Matthews and Murdy (1969) found that velum coverage ranged from 30% to 100% in a population from Stone Mountain, the type locality.

A remarkable feature of the plant is its ability to resuscitate after drying out. According to Engelmann (1882): "A cake of them taken home with me began to sprout soon after being moistened, and, vegetating in the room through winter, fully developed in early summer, and afforded a fine opportunity for studying this curious little species . . ." *Isoetes tegetiformans* exhibits the same behavior.

I. piedmontana (N.E. Pfeiffer) C. F. Reed
Piedmont Quillwort

What is Piedmont quillwort? Confusion exists over the name to be applied to the widespread quillwort of granite outcrops throughout the Southeast. I have included *I. piedmontana* as a diploid but Taylor et al. (1994), under the name *I. virginica* N. E. Pfeiffer, list it as both diploid and tetraploid. Here, I am treating *I. piedmontana* as distinct from *I. virginica*, Virginia quillwort, which is a tetraploid. Like all granite outcrop species, *I. piedmontana* has phyllopodia.

Snyder and Bruce (1984) call *I. piedmontana* "Most commonly found *Isoetes* in Georgia." In the more than 15 years since that book was published, it is likely that *I. boomii* now has that distinction.

I. tegetiformans Rury
Mat-forming Quillwort

The botanical community was astounded in 1978 when Phillip Rury published a description of this species (Rury, 1978) because the outcrops where it occurs had been visited by botanists for many years and because the new quillwort was so distinctive. It is the most unusual quillwort in North America! What makes this *Isoetes* unique are its distichous leaves, elongated rootstock, and dimorphic roots because all North American quillworts have whorled leaves, at least at maturity.

The elongate rootstock of mat-forming quillwort is strikingly different from other Georgia species. Long and narrow, it resembles a rhizome from which two kinds of roots arise. Those from the upper portion are thicker and twist like a corkscrew. Roots arising from the base of the rootstock are more typical of quillworts except they are not forked.

The resemblance of *I. tegetiformans* to *I. australis* S. Williams from Australia has apparently never been pointed out. In a study of quillworts of Western Australia Johnson (1984) shows several features in common with *I. tegetiformans*: elongate rootstock ("laterally elongated stock"), dimorphic roots (figured but

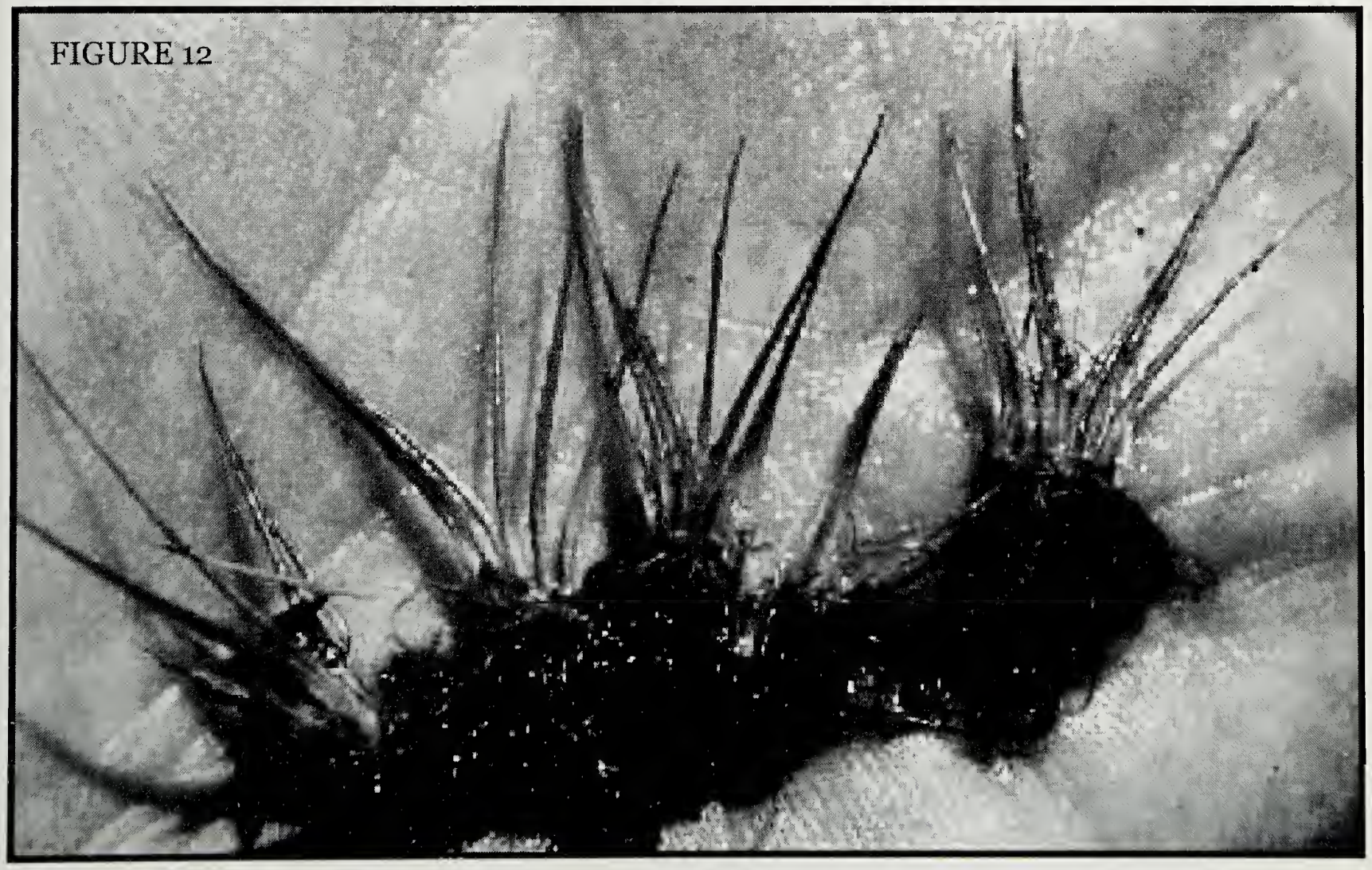


FIGURE 12

not described), and mat-forming ("... so closely massed that they form a green underwater sward"). However, unlike its Peach State relative, *I. australis* does not revive rapidly after being dehydrated; a period of four weeks in water is necessary for growth to resume.

Molecular techniques could provide a powerful tool to investigate the possible relationship between these similar-appearing but widely separated plants of granite outcrops. The putative hybrid involving *I. tegetiformans* is discussed below.

A species to look for in Georgia

I. valida (Englem.) Clute
Carolina Quillwort

Isoetes valida [=*I. caroliniana* (A. A. Eaton) Luebke] is not recorded from Georgia but is to be looked for in the Appalachian Mountains where it is widely distributed. Carolina quillwort often forms large populations of robust plants in mountain ponds or along streams. See FIGURE 4-A for a plant and FIGURE 7-B for megaspores of this wide ranging species.

Possible new species in the state

Altamaha Quillwort

Granite outcrops may support the best known flatrock plant communities but the Altamaha Grit (a coarse sandstone) outcrops are also diverse botanically. It is likely that the diminutive quillwort so abundant on some of the Altamaha grit outcrops, especially in the Broxton area, is a new species. We (Bray and Musselman) have found both diploid and tetraploid plants. The spores are difficult to place and the unusual asymmetry of the plant in the field make further investigation of this plant necessary to determine its taxonomic status. FIGURE 6-B illustrates megaspores.

Hancock Quillwort

A careful study of plants from an outcrop in Hancock County indicates strikingly different megaspore ornamentation. This difference is correlated with a different ploidy level. One plant is a diploid, the other is tetraploid. To further complicate matters, we have found a triplid ($2n$=33) at the same place! The proverbial further research is needed. FIGURE 6-B illustrates megaspores of the tetraploid.

"...lately so many forms have become known..."

Our story on Georgia quillworts would be almost over if I were writing as recently as ten years ago. Since that time, the number of species known in the state has almost doubled and the number of new populations discovered is probably more than one hundred.

Tetraploids

Until recently, no tetraploid quillworts were known from Georgia except *I. piedmontana*. But with the advent of extensive field work and laboratory studies during the past decade, numerous new species have been described, most of them tetraploids. A warning: any treatment of these tetraploids must remain tentative until more work has been done on their genetics. Caplen (2000) has shown that in the widespread *I. riparia*, parental genomes may vary. Put another way, one population of what is called *I. riparia* may be the product of parents A and B while another population may be the product of parents A and C. When a species might have more than one ancestor, the term paraphyletic is used. Without molecular studies, it is not known if some of the variable tetraploid (and maybe other ploidy levels) species are paraphyletic.

I. hyemalis D. F. Brunton and D. M. Britton
Winter Quillwort

The common name refers to the evergreen nature of this plant but only when submerged. As noted earlier, any quillwort that is submerged through the winter will be green.

Isoetes hyemalis often forms very large populations, sometimes with thousands of individuals. In some parts of the Southeast, like southeastern Virginia, *I. hyemalis* is the most common quillwort in ponded woodlands and along small streams. To date, one specimen is known from Georgia (Brunton and Britton, 1996) but I expect it to be found on a wider scale, especially in the Coastal Plain. Variability in this taxon and the possibility that it is paraphyletic (differing parents in differing populations) make another fertile area of research.

I. junciformis D. F. Brunton and D. M. Britton
Rush Leaf Quillwort

This is the newest member of the Georgia quillwort clan, found in only one locality in Tift County (Brunton and Britton, 1999). It bears a close resemblance to *I. virginica* (sensu Brunton et al. 1996) and may, in fact, be conspecific with it. The common name refers to its rush-like morphology, an apt name for this and several other quillwort species.

A tetraploid that should be looked for in Georgia

I. appalachiana D. F. Brunton and D. M. Britton
Appalachian Quillwort

The description of *I. appalachiana* only a few years ago indicates that this quillwort is widespread and should be looked for in Georgia (Brunton and Britton, 1997). Like so many other species, it looks like just another quillwort. Its range is extensive, from the Appalachians to northern Florida. Some of the quillwort specimens from Georgia might be this species. The megaspores bear a close resemblance to those of *I. engelmannii* which may be one of the parents.

Brunton and Britton (1997) suggest that *I. appalachiana* originated from *I. μaltonharvillii* Musselman and Bray, the sterile hybrid between *I. valida* and *I. engelmannii* (Musselman et al., 1995).

Hexaploids

I. boomii Luebke
Boom's Quillwort

The plot thickens! In addition to diploids, and tetraploids, the Georgia quillwort flora includes hexaploids, that is, plants with 66 chromosomes ($2n$=66). Less than a decade ago, Neil Luebke from the Milwaukee Public Museum, described two new hexaploid quillworts from Georgia, *I. boomii* (named for Brian Boom who contributed much to our understanding of southern quillworts) and *I. georgiana* (Luebke, 1992). At the time of publication, both plants were known from only one county each!

Based on work in our laboratory (Russell and Bray, unpublished) it seems likely that *I. georgiana* and *I. boomii* represent a single taxon. If this is true, which name should be used for this hexaploid? According to the rules of botanical nomenclature, the earliest published name takes priority. But since *I. boomii* and *I. georgiana* were published at the same time either name could be used. A "Georgia quillwort" had been described earlier. In 1882, Engelmann discussed *I. engelmannii* var. *georgiana* (Engelmann, 1882). To avoid confusion, therefore, the name *I. boomii* should be used if *I. georgiana* and *I. boomii* are treated as conspecific.

The megaspores of *I. boomii* have bold,

jagged ornamentation (FIGURE 5-B). Other than the megaspores, there is no simple way to distinguish this species. In a summer dry-down of streams, there may be no indication of the existence of the plant. Boom's quillwort (reported as *I. georgiana*) was documented from six counties (Brunton and Britton, 1996a). I have located it in three additional counties. Based on finding large populations (sometimes thousands of plants) along river systems, I believe many new populations will be located. I presume this is the most abundant quillwort in the state. Interestingly, it may be restricted entirely to Georgia!

Are Georgia Quillworts Promiscuous?

Scarcely. No hybrids have been reported from the state although Snyder and Bruce (1984) describe two hybrids based on the work of Brian Boom. One of the features of hybrid quillworts is the production of malformed and aborted spores, both megaspores and microspores (FIGURE 13). No such spores were reported in the putative hybrids in Snyder and Bruce (1984). What they may be reporting are extremes of variability within species.

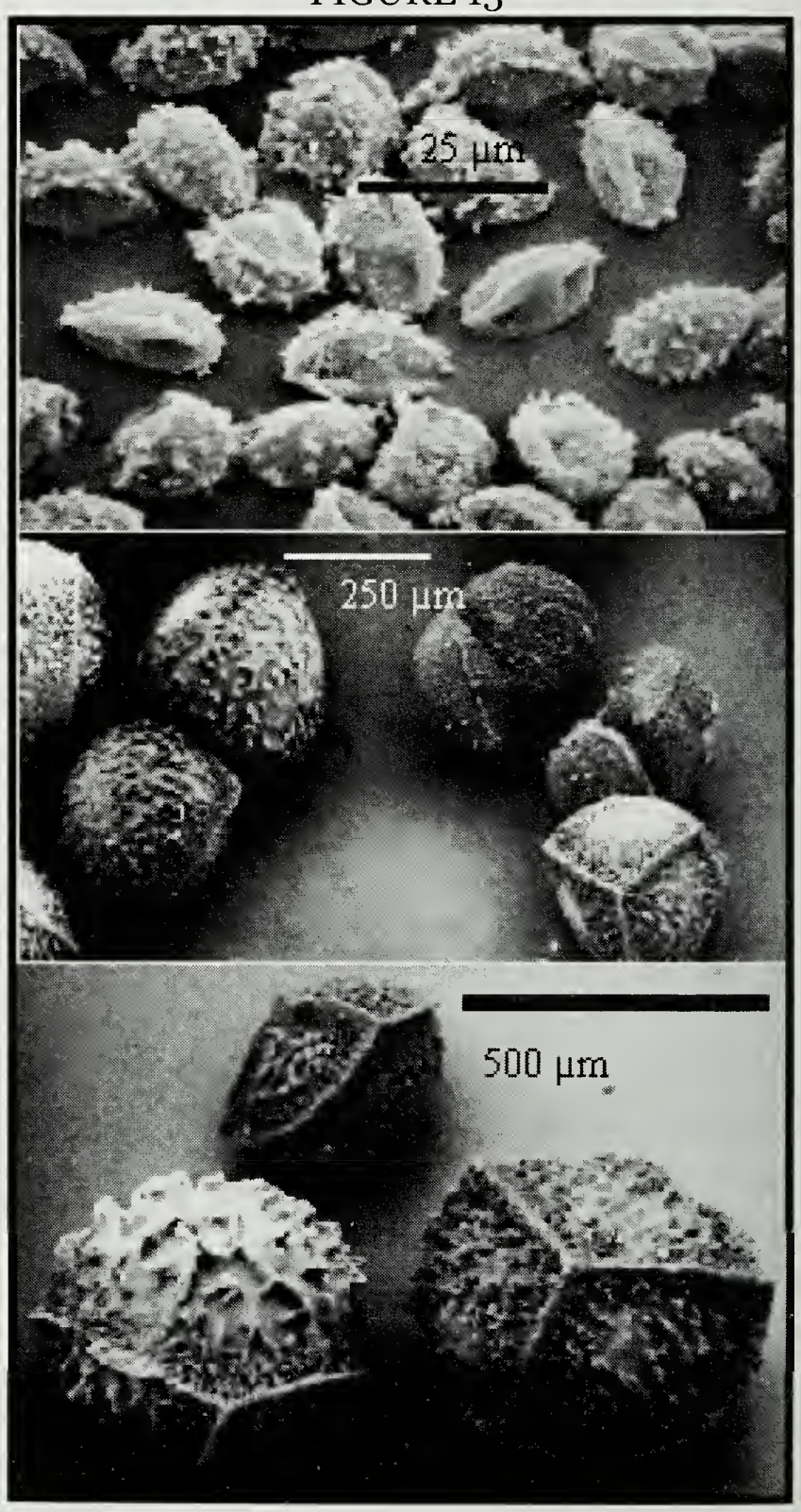
To date, 15 *Isoetes* hybrids have been reported for North America (Musselman et al., 1997). All of these involve either *I. engelmannii* or *I. echinospora*. The most exciting hybrid is in Georgia and involves the two granite outcrop species, *I. tegetiformans* and *I. piedmontana*. We intend to formally describe this taxon.

Granite outcrop hybrid

Isoetes piedmontana and *I. tegetiformans* grow together at only four known locations in Georgia (Patrick et al. 1995). *Isoetes tegetiformans* and *I. piedmontana* are restricted to shallow, flat-bottomed pools on granitic outcrops. *Isoetes tegetiformans* grows in shallower soil than *I. piedmontana* and often forms rather uniform mats in pools. *Isoetes piedmontana*, on the other hand, requires deeper soil and is more often found near the edges of pools where other plant species, such as *Andropogon* and *Juncus*, have invaded. The hybrid is found in the transition zone where both species can grow.

The outcrop hybrid is unique among all described hybrids in that it is recognizable from vegetative morphology alone. The rootstock is distinctive, usually horseshoe-shaped, bearing roots that are forked. A few individuals have smaller lobes but have more than the normal two lobes, each separated by a basal groove. Roots are bifurcated and non-coiled.

FIGURE 13



In a study of *I. melanospora, I. piedmontana,* and *I. tegetiformans* using electrophoresis, Van De Ganachte (1996) detected putative hybrids between *I. piedmontana* and *I. tegetiformans* in a population from Hancock County, Georgia. Of the 17 plants sampled from that population, seven expressed combinations of alleles unique to both *I. piedmontana* and *I. tegetiformans.*

The outcrop hybrid is the first involving either parent and the first hybrid involving a granite outcrop species. Interestingly, the results of van der Ganachte's work (1996) indicate a closer relationship between *I. melanospora,* another federally endangered granite outcrop endemic, and *I. tegetiformans* than between *I. tegetiformans* and *I. piedmontana.* No hybrids between *I. tegetiformans* and *I. melanospora* are known, perhaps because they do not grow together.

Growing Quillworts

Despite very specific habitats, we have been able to grow all Georgia species. Our technique is very simple. Place the plants in a cut off plastic drink bottle with sand in the bottom. Water with tap water. We have maintained some of our plants this way for many years.

Quillworts can also be grown outside. However, if they are left in plastic containers they will be killed if temperatures remain below freezing for several days. Quillworts planted in the soil are not affected this way.

". . .until thirty or forty years ago very few specimens were collected, . . .

but the genus has attracted so much attention . . ."

In summary, more quillworts are now known in Georgia than five years ago and the number is certain to increase. By way of review, it may be interesting to recount how our knowledge of Georgia quillworts has grown.

1884 (Engelmann, 1884)
- *Isoetes engelmannii*
- *I. melanospora*

1922 (Pfeiffer, 1922)
- *I. engelmannii*
- *I. melanospora*
- *I. piedmontana*
  (as *I. virginica* var. *piedmontana*)

1986 (Snyder and Bruce, 1986)
- *I. butleri*
- *I. engelmannii*
- *I. flaccida*
- *I. melanopoda*
- *I. melanospora*
- *I. piedmontana*
- *I. tegetiformans*

2001 (This paper)
- *I. boomii*
- *I. butleri*
- *I. engelmannii*
- *I. flaccida*
- *I. hyemalis*
- *I. junciformis*
- *I. melanopoda*
- *I. melanospora*
- *I. piedmontana*
- *I. tegetiformans*

In addition to these ten species, botanists should be on the lookout for the following which are known from contiguous states: *I. appalachiana, I. microvela* (Brunton and Britton, 1998) and *I. valida.* But what is really needed is continued, careful field work to find out just how rich the Georgia quillwort flora is.

Acknowledgments

Imbibing the humility of these plants, I proclaim the quillworters a fine group to work with. Thanks to the leader of the sporangia, Captain Carl Taylor for all his encouragement.

One of the reasons we have learned so much about quillworts in the past decade is because Captain Carl has gone out of his way to encourage anyone to look at the curious quillworts. Thanks to the person who knows the plants of the granite outcrops best

Jim Allison for his care for these fragile systems. Thanks to Frankie Snow in like manner for his love and concern for the Broxton outcrops. Who knows *Isoetes* chromosomes better than Rebecca Bray, she knows and grows these plants. Carl and Rebecca have read and commented on drafts of this paper and I thank them. However, hyperbole and other errors are solely mine.

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Notes on the photos

(unless indicated, all by the author)

FIGURE ONE

Representative quillworts. A-*I. valida*, Bland County, Virginia. Several of the leaves exhibit twisting.. B-*I. butleri*, Edmonson County, Kentucky. Leaves in this species have a distinct groove on the upper surface of the leaf. C-*I. boomii*, Colquitt County, Georgia. The spiral arrangement in this quillwort has been obscured by flooding. D-*I. tegetiformans*. Greene County. This quillwort is unique in lacking whorled leaves at all stages of its life. E-*I. piedmontana*, Hancock County, Georgia. The spiral arrangement of leaves is evident here

FIGURE TWO

Cross section of leaves of *Isoetes*. The four chambers are evident in each. A-Granite outcrop hybrid, Greene County, Georgia. B- *I. "piedmontana"*, Hancock County, Georgia. C-*I. engelmannii*, live plant supplied by Jim Allison. Stomata from C- D. *I. piedmontana*, Franklin County, North Carolina.

FIGURE THREE

Sporophylls of quillworts. A-*I. hyemalis*, Dinwiddie County, Virginia. The well developed ligule is evident above the immature sporangia. Although this species has a velum it is not yet developed in this very young leaf. Note the heart shaped base of the ligule. The region between this and the sporangium is termed the sela. B-*I. echinospora*, Lake Joseph, Ontario, Canada. Megasporophyll left; microsporophyll right. The ligule has decayed in both. C-*I. piedmontana*, Franklin County, North Carolina showing a continuum from phyllopodia (far left) to scales (far right). The upper edge of a nickel for a scale is evident lower right.

FIGURE FOUR

Roostocks. A-*I. valida*, Giles County, Virginia. This species has large rootstocks. Note the notches. B-*I. louisianensis*, Perry County, Mississippi. As the rootstock grows, the corky outer layer of the tip of the rootstock, termed the abscission cap, is sloughed. Most species of quillworts have abscission caps although this feature has not been recorded. C-*I. hyemalis*, Chesterfield County, Virginia showing the

Continues on Page 40

Some Native Orchids of the Southeastern United States

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The orchid family, *Orchidaceae* (Greek *orchis* "testis" which refers to the appearance of the tuber, and *aceae* the specified ending for a family name), consists of three subfamilies. One occurs in southeastern Asia and has about fifteen species in two or three genera. The other two subfamilies, *Cypripedioideae* Hatch and *Orchidoideae* Dressler & Dodson, are widely distributed and both are well represented in the southeastern United States where one or more species is in bloom from early spring until fall.

Members of the subfamily *Cypripedioideae* (named for the genus *Cypripedium* and *oideae*, the specified ending for a subfamily) have an inflated lip, two separate lateral anthers, and granular viscid pollen; they are known as the lady's slippers. All other southeastern orchids are members of the subfamily *Orchidoideae* (named for the genus *Orchis* L.); they have a lip that is variously modified (but not inflated), a single anther, and pollen grains that cohere to form compact masses called pollinia.

Subfamily *Cypripedioideae*

Showy members of the *Cypripedioideae*, which number over 110 species, are distributed nearly worldwide, but are absent from Africa, Australia and southernmost South America. Today, they are known in English-speaking lands as lady's slippers because of the resemblance of the inflated lip of the flower to an imaginary slipper. In America, they were found it woods inhabited by Indians and became known as moccasin flowers.

In 1753, Linnaeus described the genus *Cypripedium* (Greek *kypris*, Latinized *Cypris*, goddess of love and beauty who was supposed to have been born on Cyprus and Latin *pes* "foot" or Greek *pedilon* "slipper"). The yellow lady's slipper was known in 16th century Europe as *Calceolus marianus* (*Marienschuh*). Linnaeus based his description of the genus *Cypripedium* on this species which he named *C. calceolus* (Latin *calceolus*, "a little shoe") as the type. Thus he invented the generic name and retained the old generic name as the specific epithet.

Of eleven species of *Cypripedium* present in North America, one is confined to Mexico. Efforts to propagate members of the genus have been mostly unsuccessful. Seeds rarely germinate; those that do may reach the leaf state, but do not bloom. Only rarely do transplanted mature plants survive.

The pink lady's slipper, *C. acaule* Aiton (Greek *a*, "without," Latin *caulis*, "stem", refers to the leafless flower stem that arises between a pair of basal leaves). The solitary pink flowers (Figure 1) appear from April in the south to

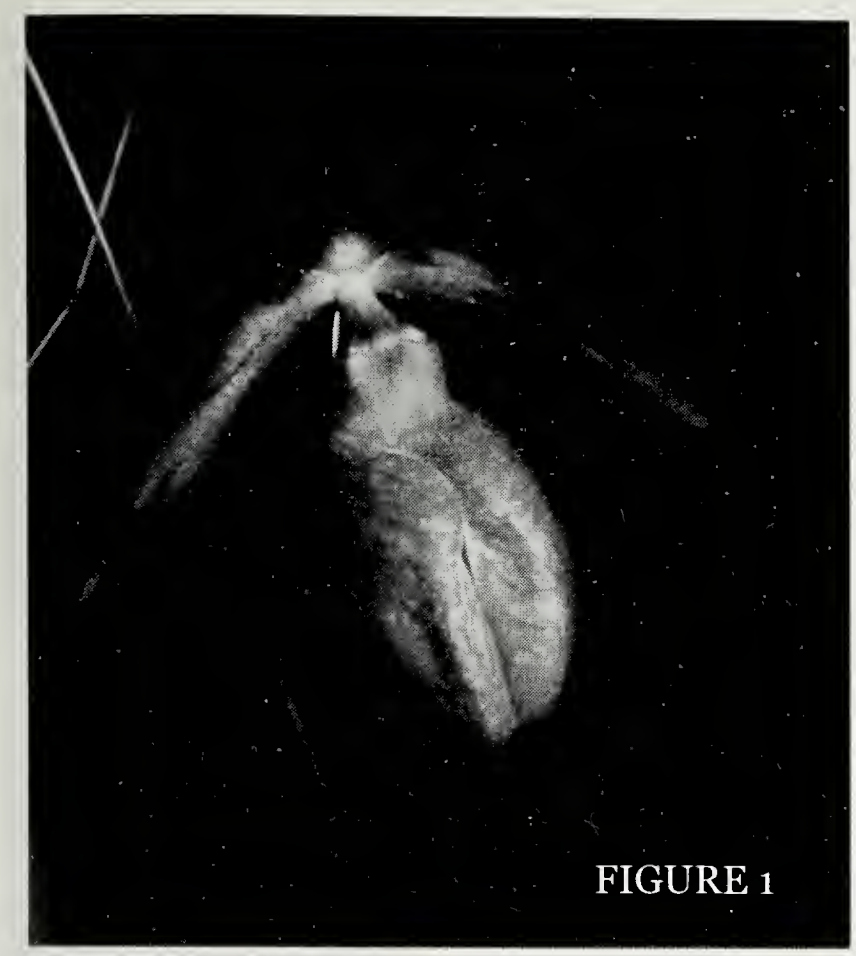


FIGURE 1

August in the north. Plants occur in high, dry woods as well as in bogs from Great Slave Lake in a broad arc to Newfoundland and south along the Appalachians to northern Georgia and Alabama. Large colonies may form Albino plants may be present in the northeastern part of its range.

The yellow lady's slipper, *C. calceolus* L. var. *pubescens* (Willdenow), has one or two large, showy, yellow flowers (Figure 2) at the top of a stem which bears three to five leaves (Figure 3). The species ranges from Newfoundland to Texas, exclusive of the coastal plain, north to North Dakota, west through Canada to Alaska and Oregon, and down the Rocky Mountains to New Mexico. The typical variety is the only *Cypripedium* found in

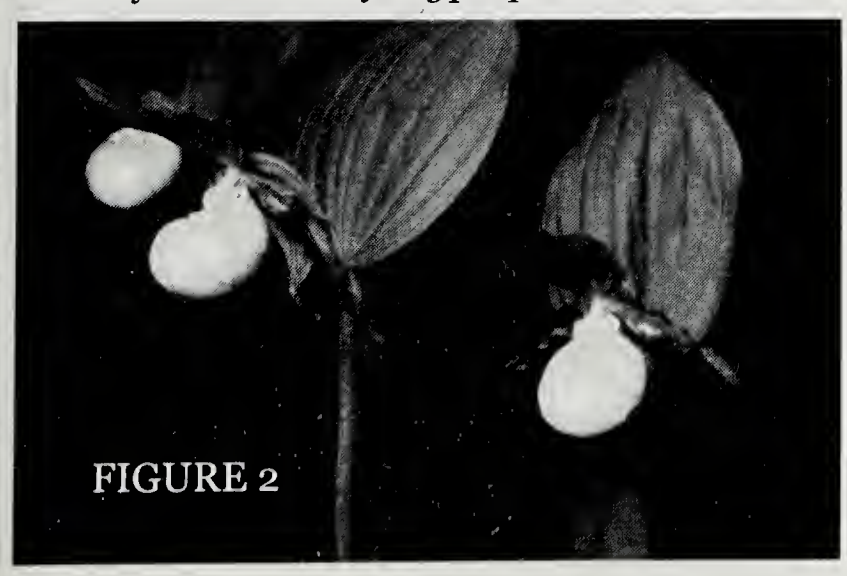


FIGURE 2

Europe exclusive of Russia.

FIGURE 3

[Editor's note: Recent work (Sheviak 1994, 1995, 1996a, 1996b; Doherty 1997) on new world yellow lady slippers has led to a change in nomenclature with this summary now being generally accepted:

Cypripedium calceolus L. is the old world yellow lady's slipper.

The new world plant has been elevated to species level as *Cypripedium parviflorum* Salisbury with three varieties:

C. p. var. *parviflorum*, the southern small lady's slipper of the eastern United States, with medium sized flowers with petals nearly or entirely uniformly dark brown. It occupies the driest habitats.

C. p. var. *makasin* (Farwell) Sheviak, the northern small yellow lady's slipper, very similar flowers to above, but nearly always has blotches of green-yellow near the base of the petals. It occupies much wetter areas, often in black, mucky soil.

C. p. var. *pubescens* (Willdenow) Knight, the large yellow lady's slipper, which some segregate as a separate species to *C. pubescens* Willdenow. Usually much larger flowers than the other two varieties, but it shows great variation in size and color, ranging from pure yellow to yellow-green and green-brown.

Another lady's slipper, *C. kentuckiense* C.F. Reed was featured in *Tipularia* 2000, p.17]

Subfamily *Orchidoideae*

This subfamily includes all North American orchis except the lady's slippers, from which they differ by lacking the inflated labellum and by having a single anther with pollen grains that adhere together in compact masses.

The genus Spiranthes **L.C. Richard**

(Greek *speria*, "coil" and *anthes*, "flower", in reference to the coiled spike of flowers) consists of over three hundred widely diversified species. They occur mainly in nearly all of the tropical and temperate zones of the New World, but a few occur in the Old World. Commonly known as ladies' tresses, the many highly variable species are difficult to identify; identification is compounded by the fact that hybridization occurs.

Giant ladies' tresses, *S. praecox* Walter (Latin, *praecox*, "precocious", refers to the early season in which the species appears) has a slender to stout green stem with up to forty

FIGURE 4

white flowers (Figure 4) that form a spike from 20 to over 60 cm long. Some spikes are coiled gently (Figure 5); others are so tightly coiled that only four flowers are require for the spike to make a revolution.

The species inhabits swamps, bogs, pocosins and wet savannas of the coastal plain from New Jersey south to Florida and west to

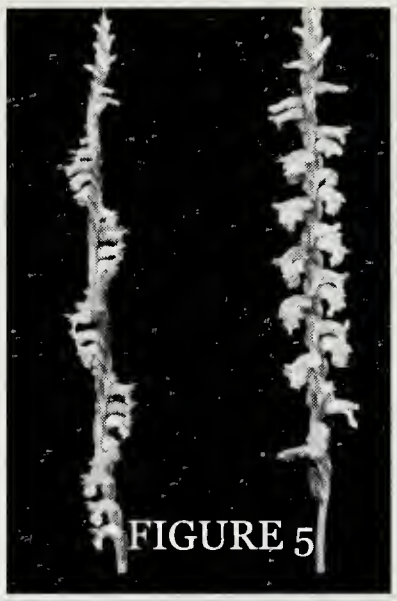


FIGURE 5

east Texas. Flowering advances north with the season from February in the south to June in the north.

Nodding lady's tresses, *S. cernua* L. (Latin *cernus* "inclined forward", in reference to the nodding position of the flower) has up to 60 flowers arranged in a single strong coil on a stout stem (Figure 6). The twist sometimes produces a disorderly arrangement so that neither rank nor spiral is discernible. Petals are white with a greenish-yellow center. Flowers are produced from September to November. This species typically occurs in colonies in a variety of wet habitats such as marshy fields, wet meadow, wet woodland, and roadside ditches from Maine to northern Florida and west to North Dakota and mid-Texas.

FIGURE 6

The genus Goodyera **R. Brown**

(Named for John Goodyer, a seventeenth century English botanist) has a worldwide distribution. It is represented by about 25 species, of which four occur in temperate and boreal North America where they are commonly known as rattlesnake plantains. The word plantain originated from Latin *planta*, meaning sole of the foot and, as applied here, refers to the broad, flat leaves. The reticulated markings on the leaves reminded early settlers of snake bites. Roots arise at intervals from creeping rhizomes and at these points arise a rosette of evergreen leaves with a flowering stem at the center; compact colonies may develop (Figure 7).


FIGURE 7

Downy rattlesnake plantain, *G. pubescens* Willdenow (Latin *pubescens* "growing hair" or "downy" refers to the densely pubescent inflorescence). The inflorescence consists of a densely flowered spike with up to 80 flowers tightly packed in intersecting spirals (Figure 8). The sepals are white with a greenish central vein, with the dorsal sepal over the column. Petals are white, the lip short, blunt, recurved and white. Flowers are produced from May to October in dry or damp woodlands from southern Maine to South Carolina and west to Minnesota and Arkansas. The species is common in the Appalachians, including north Georgia.


FIGURE 8

The genus Galearis **Rafinesque**


FIGURE 9

(Latin *galea* "helmet" or "hoot" over the column by the convergent sepals and petals). The genus includes the show orchid, *G. spectabilis* of eastern United States (originally assigned to the genus *Orchis* L.) and a species in eastern Asia. The flowers are arranged in a loose raceme.

Galearis spectabilis L. (Latin *spectabilis* "remarkable" or "notable", from *spectere* "to look at carefully" in reference to the show flowers) the showy orchis. This is a common woodland species of eastern forests and one of the earliest wildflowers to appear. Up to 15 flowers are produced in a loose terminal raceme on a fluted stem. The plants flower from April in the south to July in the north. The species is distributed from Maine south to Georgia and west to Minnesota and Arkansas.

Flower parts of delicate pink or mauve color contrast with the snowy-white labellum (Figure 9) which is drawn out behind into a conspicuous club-shaped spur. The entire flower may be either white or rich red-lilac color.

The genus Plantanthera **L.C. Richard**

(Greek *platys* "wide or broad" and *anthers* "anther") is a genus of about 200 species of terrestrial orchids from both hemispheres. Free petals and dorsal sepals form a helmet over the column; the lateral sepals are spreading. The labellum may be entire, divided or fringed to varying degrees; its base forms a spur of varying lengths.

Platanthera ciliaris L. (Latin *cilium*, equivalent to Greek *blepharis* "eyelashes", referring to the finely fringed lip), the yellow fringed orchid. The plant produces a terminal raceme with 30 - 60 orange flower (Figure 10) on a 60 - 90


FIGURE 10

cm stem from June in the north to September in the south.

The oblong labellum is about one centimeter long with an abundantly fringed margin that adds another centimeter, and with a slender, curled basal spur that is 2.5 - 3.5 cm

FIGURE 11

long (Figure 11). The large raceme is one of the most conspicuous late summer flowers in bogs, fields, woods and well-drained Appalachian slopes in either full sun or partial shade. The plant ranges from southern New Hampshire west to Michigan and south to central Florida and eastern Texas.

Platanthera blephariglottis Willdenow var. *conspicua* Nash (Greek *blepharon* "eyelid" and *glotta* "tongue", hence, a tongue like and eyelid; Latin *conspicuous*, "striking"), the large white fringed orchid. This species produces a densely to loosely many flowered raceme with 30 - 50 white flowers (figure 12) from June in the north to October in Florida. The variety occupies wet meadows along with *P. ciliaris*, which it closely resembles except for its color. Its large brilliant white racemes are truly conspicuous from New Jersey south in the coastal plain and piedmont to east Texas, excluding southern Florida. The variety conspicua is taller, has racemes twice as long and twice as broad, and its spurs are twice as long as the more northern variety.

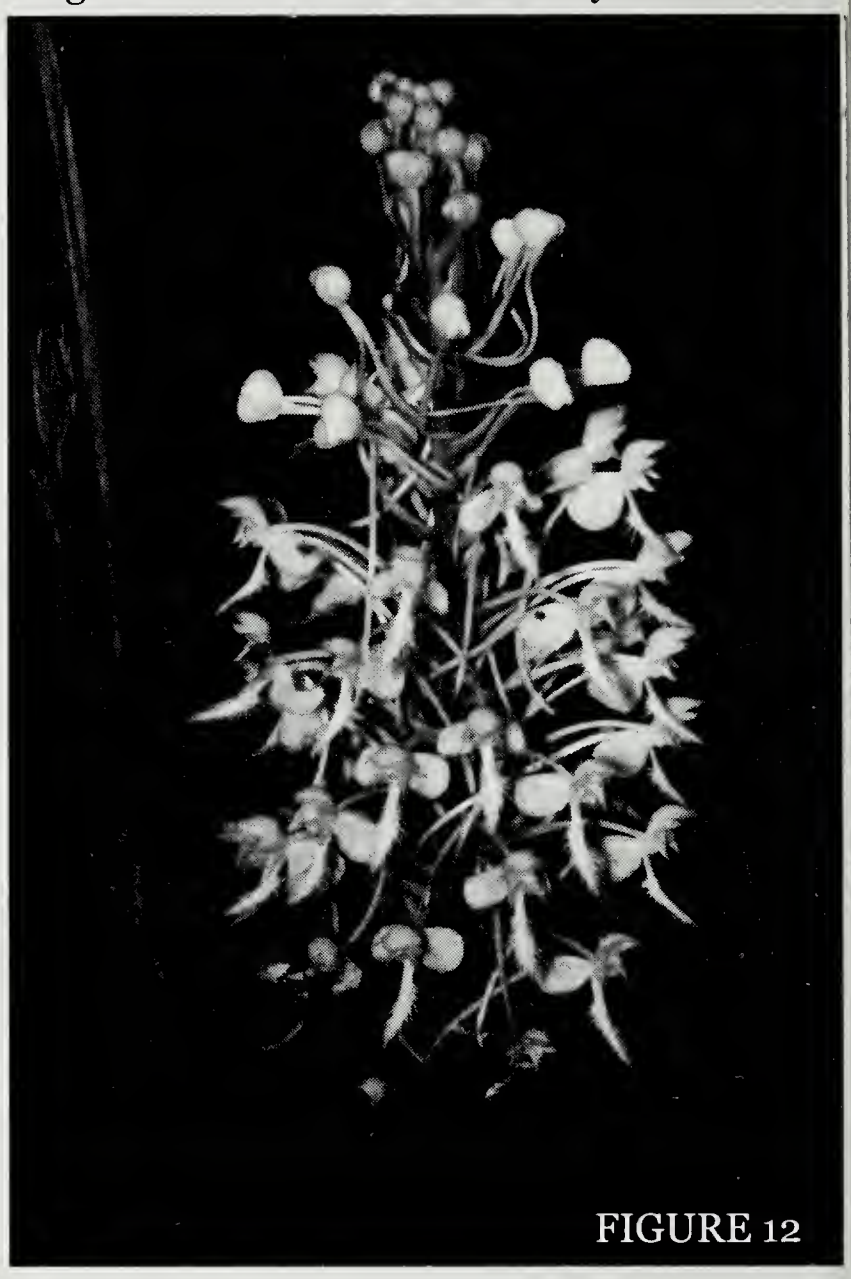


FIGURE 12

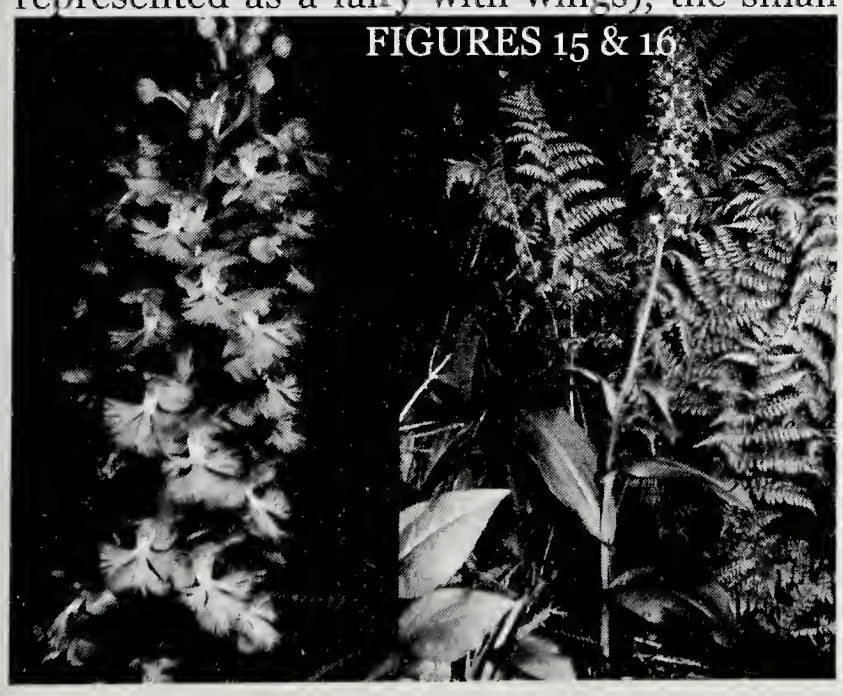
[Editor's Note: *P. integrilabia* (Correll) Luer, monkeyface or white fringeless orchid was featured in *Tipularia* Spring 1990 p.24 and 1994, p.7 and is known from about eight locations in Georgia, the location mentioned in previous Tipularia articles now being exptirpated.]

Platanthera cristata Michaux (Latin *cristatus* "crested" as the comb of a cock), the crested fringed orchid. *P. cristata* has a densely to loosely many flowered terminal raceme with


FIGURES 13 & 14

up to 80 small, bright orange flowers (Figure 13 & 14) that are produced from late June in the north to early September in the south. It inhabits low moist meadows and damp pine woods from Connecticut to Tennessee and south to central Florida and east Texas. It frequently occurs with P. ciliaris but differs from it in that its racemes are narrower and proportionally longer, its flowers are less than half the size, its petals are fringed around the entire edge instead of just at their tip, its lip curls as short fringe upward instead of downward, its spurs are small and inconspicuous, and its color is usually deeper orange that of *P. ciliaris*. The two species occur together, but *P. cristata* is less abundant and blooms earlier that *P. ciliaris*. There are no hybrids.

Platanthera psycodes L. (from ancient Greek *Psyche*, mythological lover of Cupid and represented as a fairy with wings), the small purple fringed orchid. Deep purple flowers (a snow-white albino form is not uncommon) in a dense raceme with the flowers in a tight cylinder (Figure 15) are produced from June to August. It inhabits damp meadows and pastures, edges of sunny bogs, in dense growths of ferns (Figure 16), damp woods, and rocky beds of mountain streams. It ranges from Newfoundland south along the Appalachians and west to Minnesota and Iowa; disjunct colonies occur in Missouri and Iowa.


FIGURES 15 & 16

Platanthera integra Nuttall (Latin *integer* "whole or entire", referring to the fringeless lip to distinguish it from the fringed-lip species), the yellow fringeless orchid. This species produces a cylindrical, densely many-flowered terminal raceme with 30 - 60 bright lemon-yellow flowers (Figure 17). It bloom from July to September in wet meadow and pineland from New Jersey south to mid-Florida and west to Tennessee and east Texas. It differs from *P. cristata* and *P. ciliaris* with which it occurs, in that the edge of the lip has rounded scallops instead of being fringed, and the raceme is conical and lemon-yellow in contrast to the pyradmidal orange-yellow racemes of the fringed species. There are no hybrids.


FIGURE 17

Platanthera nivea Nuttal (Latin *niveus* "snowy" or "white as snow"), the snowy orchid. This species produces a cylindrical, densely many-flowered terminal raceme with 20 - 50 snow-white, nonresupinate flowers (that is, they do not rotate during development, the lip is uppermost) with a slender straight spur


FIGURE 18

(Figure 18). Flowering occurs from late May and June in Florida to September ;in the northern part of its range. It inhabits open bogs and sunny, wet meadow from New Jersey south through Florida and west to Missouri and east Texas.

The genus Habenaria **Willdenow**

(Latin *habena* "rein" referring to the rein-like spur and rein-like appendages of the petals and lip), is an essentially tropical or subtropical genus in both hemispheres. An erect leafy or branched stem that arises from a fleshy tuber, characteristic of the genus, terminates in a raceme of relatively small flowers.

Habenaria repens Nuttall (*repa*, botanically speaking "to creep", Latin dictionary "sudden" or "unexpected"), the water slipper orchid. This plant produces a densely flowered terminal raceme with up to 50 tiny, spindly flowers (Figure 19) from April until frost. A subaquatic species, it grows in wet situations, whether in full sunlight or in deep shade. In woodland pools and swamps it may grow into large floating mats. The stem is leafy up to the flowers. This species grows in a narrow strip of coastal plain from North Carolina down to and including all of Florida, then west to Texas and down eastern Mexico and all the reminder of Central America and northern border of South America, then up the island chain into Cuba. There is a disjunct population in Peru.


FIGURE 19

[Editor's Note: *Habenaria quinqueseta* (Michaux) Eaton, Michaux's orchid, occurs in scattered locations of Georgia's outer coastal plain and at Broxton Rocks in Coffee County.]

The genus Pogonia **Jussieu**

(Greek *pogon* "beard" referring to the bearded crest of the lip typical of species comprising the genus). The genus consists of two or three species of terrestrial orchids scattered in both hemispheres. The single species indigenous to North America is very similar to a species in China and Japan.

Pogonia ophioglossoides L. (Greek *ophis* "snake", *glossa* "tongue" and *eidos* "resembling", hence "resembling the tongue of a snake", but actually referring to the plants resemblance to the adder's tongue fern, *Ophioglossum* L., with its solitary leaf), the rose pogonia. This species produces one to three pink to white terminal flowers that last for several days. The lip is pink with a dark red, deeply fringed margin on the spatulate apex (Figure 20). Flowers are produced from March in Florida to August in the north. The species occurs in wet meadows and sphagnum bogs from Labrador to Florida and west to Minnesota and east Texas. Its roots grow superficially so the plant cannot tolerate drought.


FIGURE 20

The genus Cleistes **L.C. Richard**

(Greek *kleistos* "closed", referring to the closed floral parts of the earlier described species). Many members of this genus were formerly included in the genus *Pogonia*. The genus now included about 25 species of terrestrial orchids confined to the Western hemisphere, mostly in wet areas in South America, but one species ranges north to New Jersey. Members of the genus have an erect stem with a solitary leaf and one to three flowers

with petals close together.

Cleistes divaricata L. (Latin *divaricata* "spread", referring to the widely spread sepals, in contrast to the genus named for its floral parts), the spreading pogonia. The three magenta pink to white petals from a tube-like terminal, solitary, large flower (Figure 21). The lip is indistinctly 3-lobed, 50 x 25 mm, strongly veined with purple on yellow-green; its margins are scalloped with a deep rose apex. The species flowers from April to June in damp grassy meadows from New Jersey south to upper Florida and west to West Virginia.


FIGURE 21

The genus Triphora **Nuttal**

(Greek *tri* "three-fold" and *phoros* "bearing", in reference to the small number of flowers, often three, or to the three crests on the three-lobed lip). Of about a dozen terrestrial woodland species found in the Western Hemisphere, five are found in the United States, but only one north of Florida.

Four, if not all, species of *Triphora* exhibit mass flowering with is triggered by a drop of a few degrees in average nighttime temperature. Buds develop continually, but then cease at a certain state; less mature buds continue to develop. When triggered, all sufficiently mature buds of a give colony open simultaneously. This is repeated until all buds have opened.

Triphora trianthophora Swartz (Greek *tri* "three-fold", *anthos* "flower" and *phoros* "bearing", in reference to a common number of flowers in the inflorescence at one time—one in bud, one in flower and one fading), the nodding pogonia. This species has one to six flowers borne on pedicels that arise from axils of the leaves. Petals are white to rose, some sepals and petals are tinged with pink or veined or suffuses with purple and green (Figure 22). The labellum is white with three papular crests of green. Flowers are produced from July to November from Maine to mid-Florida and west to Iowa and east Texas.


FIGURE 22

The genus Calopogon **R. Brown**

(Greek *kalos* "beautiful" and *pogon* "beard", in reference to the bristles that resemble anthers on the lip). The genus consists of four species, all of which occur in eastern North America, with three small species confined to the southeastern coastal plain. The inflorescence is a terminal raceme of nonresupinate flowers of various shades of pink on a stalk that arises at the ground. Sepals and petals are free and widely-spreading. The labellum, which has a patch of yellow hairs or bristles, stands erect over the column.

Calopogon tuberosus L. (Latin *tuberosus*, in reference to the tuberous corm of the species), grass pink, the largest of the four species. The terminal raceme consists of 3 - 25 successively opening flowers on a stalk that arises at or below the surface of the ground. Flowers are pink to white, the lip is


FIGURE 22

obscurely 3-lobed, and the disc has numerous clavellate bristles with free yellow tips reduced toward the apex to orange, then white with nodules (Figure 23). Grass pink is common to locally abundant in bogs and damp pinelands from Newfoundland south to Cuba and the Bahamas and west to Manitoba and Texas. It flowers from March in southern Florida to August in the north.


FIGURE 24

Calopogon pallidus Chapman (Latin *pallidus* "deficient on color" or "pale"), pale grass pink. The terminal loosely flowered raceme has up to 12 nonresupinate flowers that are sometimes deep rose, but mostly pink or white. The slender middle sepal is up to 15 mm long, lateral sepals are markedly reflected white the tree petals seem to reach forward (Figure 24). The flowers are only slightly smaller than those of *C. tuberosus*. Pale grass pink blooms from March to July in synchrony with *C. tuberosus* in a given locality. The flowering period extends over several weeks; flowers open successively up the stem. The species inhabits marshy meadows and pineland of the coastal plain from Virginia through Florida and west to Alabama.

Calopogon barbatus Walter (Latin *barbatus* "beset with long stiff hairs", "bearded"), bearded grass pink. The inflorescence is a compact terminal raceme on an erect stem up to 40 cm tall with up to five nonresupinate, light pink flowers (Figure 25), but darker and lighter forms occur. Flowers open in quick succession or nearly simultaneously. The middle sepal is 15 - 16 mm long; lateral sepals are not reflected. The lip is uppermost and obscurely 3-lobed; the disc has a cluster of bright orange club-shaped hairs, reduced to nodules toward the apex. *C. barbatus* flowers from February through May in pitcher plant bogs, damp meadows and open pinelands of the coastal plain from North Carolina through all except the south tip of Florida and west to Mississippi.


FIGURE 25

The genus Epidendrum **L.**

(Greek *epi* "on" and *dendron* "tree", in reference to the fact that the plants described were found growing on trees). The genus is represented by seven epiphytic species in southernmost United States and by 600 tropical and subtropical species, mostly in South America. Some species are terrestrial. Flowers are small to medium and not showy.

Epidendrum conopseum R. Brown (Greek *conops* "gnat"), the green fly orchid. This is the only epiphytic orchid north of Florida. It was collected by Bartram in his travels and described by Brown in 1813. Up to 18 yellowish green flowers (Figure 26), which are sometimes suffused with purple, terminate the 10 - 15 cm long stem as a loosely flowered raceme. Flowers are produced in autumn and winter and sporadically throughout the year. This species grows on large limbs of deciduous trees where

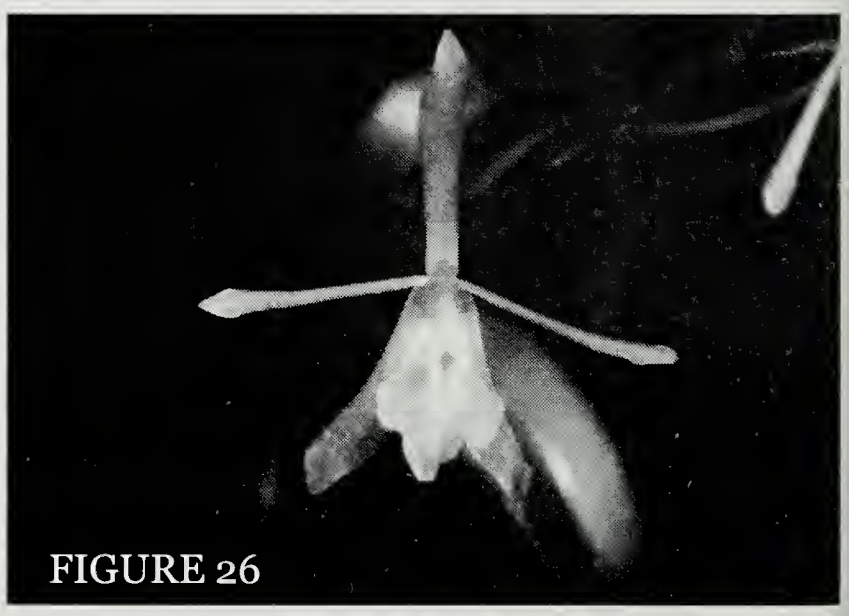


FIGURE 26

very large colonies may develop in company with resurrection fern, *Polypodium polypodioides* L, as well as on most soil banks. It occurs on the coastal plain from North Carolina south to lower Florida and west to Louisiana. Disjunct populations occur in central Mexico.

The genus Corallorhiza **Haller**

(Greek *korallion* "coral" and *rhizo* "root", in reference to the coral-like appearance of the branching underground rhizome), the coral-root orchids. This genus is composed of ten saprophytic species that are native to North and Central America; six of these are native to the United States, and three of the six are found in the southeast.

Members of this genus are not totally without chlorophyll or chlorophyll-like substances. Erect green to purple flowers stems are produced from fragile, multibranched, warty rhizomes that live symbiotically with fungi and multiply until maturity.

Flower stems are produced in a favorable season. Additional stems may be produced the following year or the rootstock may lie dormant for one or more years. During dormancy of a given rhizome, flowering will occur from other long-dormant rhizomes or from rhizomes that are products of previous crops of seeds.

Corallorhiza wisteriana Conrad (named in honor of Charles J. Wister, an American botanist who first collected the species in Pennsylvania), spring coral root. A terminal raceme of 5 - 25 small flowers is produced by a stem that arises at or below the surface of the ground. Sepals and petals are green to yellow, suffused and mottled with purple or red-brown; they converge over the lip. The lip is white spotted with pink or purple (Figure 27), the disc has a pair of small lamellae.

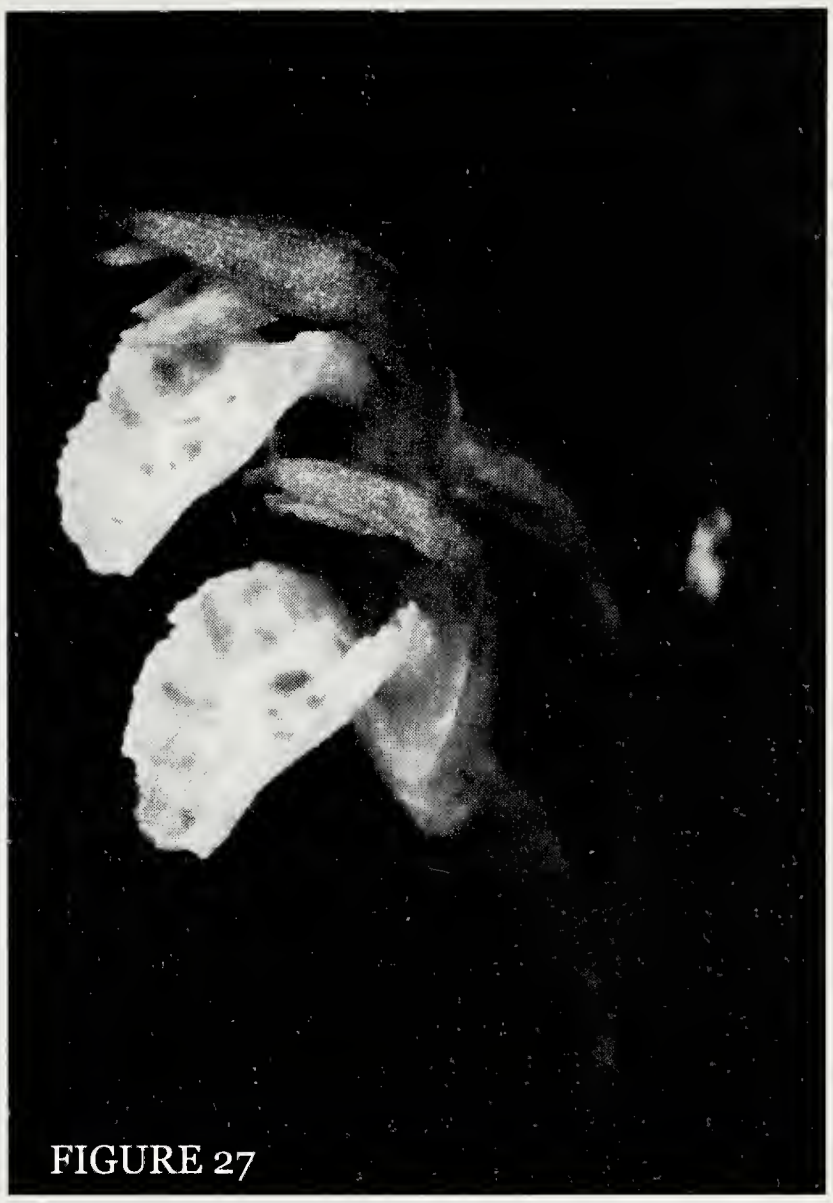


FIGURE 27

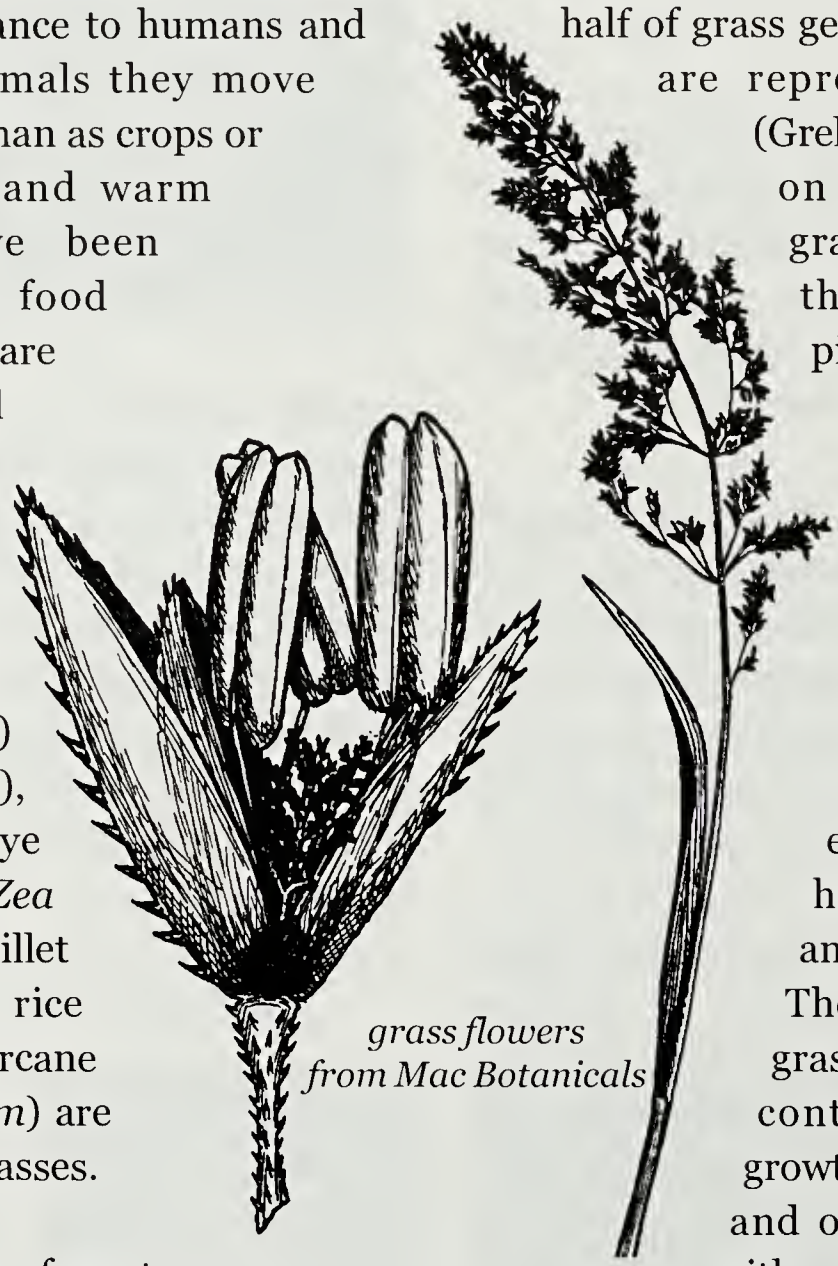
This is rare woodland species that is found in swamp forests, rich ravines and northern slopes in several widely scattered localities from Pennsylvania south to lower Florida and west to east Kansas and east Texas. In favorable years, small groups of brown to purple flowering stems are produced as early as December in Florida, from early February to early March in southeast Georgia, in April and May in North Carolina, and it August farther north.

All photos are by the author.

A Primer on the Grasses of the Georgia Piedmont

Elaine Nash

Grasses are the world's most important plants. Of the fifteen major crops that stand between us and starvation, ten are grasses. The saying that "All flesh is grass" is true at least where man is concerned. Grasses are the primary food source for humans as well as for domestic and wild grazing animals. Because of their economic importance to humans and our domesticated animals they move around the earth with man as crops or weeds. Annual cool and warm season grasses have been exploited for human food while perennial grasses are exploited for animal forage. Some of the annual cool-season grasses that stand between us and starvation are—wheat (*Triticum aestivum*) barley (*Hordeum* spp.), oats (*Avena sativa*), rye (*Secale cereale*). Corn (*Zea mays*), *sorghum* spp., millet (*Panicum miliaceum*), rice (*Oryza sativa*) and sugarcane (*Saccharum officinarum*) are annual warm-season grasses.



grass flowers from Mac Botanicals

Native grasses are of great ecological significance. The grass family, *Poaceae*, is made up of 600 genera and more than 9000 species, the third largest flowering plant family after Orchidacae and Asteraceae on this earth (Darke). Grasses grow on every continent and are part of all major biomes of the terrestrial world. Most grasses are sun loving and are the dominant plants of most open habitats, and except for the bamboos, are relatively scarce in dense forests. Hitchcock (Manual of Grasses of the United States) numbered the grasses in the continental United States at 185 genera and 1518 species. About half of grass genera found in the nation are represented in the South (Grelen). This article will focus on native southeastern grasses, particularly those that are common in the piedmont.

Grasses are adapted physiologically as colonizers and are able to thrive under a wide array of challenging habitat conditions. Their fibrous roots are extremely efficient at holding and building soil and withstanding drought. The low-growing points of grasses allow them to sustain continual damage to top growth by grazing animals, fire, and other destructive events without serious damage. While humankind has destroyed vast stable tracts of grasslands, as the North American prairie, we have simultaneously created a huge amount of disturbed open space favorable to the grass family. Native grasses provide food and shelter to many birds and animals with significant

support to the bottom of the food chain especially insect populations. They are adapted to local soil and climate conditions, requiring much less input of water and energy than introduced grasses. Many are quite beautiful and are finally gaining recognition for looks as well as function.

Few people—even those passionately interested in the natural world—take the trouble to learn the names of grasses. Misconceptions about grasses abound. "They have no flowers" or "they all look alike" one hears. These statements are not true. The flowers are small so it is difficult to see the necessary characteristics without a hand lens. Grass leaves display an infinite range of the color green, everything from a muted chartreuse to a striking blue green. A different terminology has been developed for grasses that does not apply to other flowers and is not exactly self-explanatory. Alas, there is no good, modern identification manual for North American grasses despite their importance.

For the common grasses, both native and introduced that are all around us, technical identification methods are not necessary to begin with. A 10X hand lens is useful. Any area in your yard that is an edge, wooded or not totally dominated by a monoculture of turf grass is a good place to begin the education process about grasses or look-alike plants. It is important to observe those grasses you wish to identify for a full season of growth from green-up to seed set and to observe whether they green up in the spring or fall, which means not mowing that area until dormancy occurs. One doesn't notice glumes, lemmas and paleas (the technical terms for parts of the grass flower). Rather the obvious characteristics are observed—general shape, color, texture, and habitat and landscape patterns.

Then begins a sorting process. Is this plant a grass or a grass-look-alike? Is it a cool or warm season grass? It is a native or introduced? Is it an annual or perennial? Is it a bunch grass or rhizomatous? Is it growing in sun or shade? Is there a rosette, which changes through the year? Is it decumbent with stems that root at the nodes or is it erect? As you answer these questions, you move closer to getting to the genus, which should be your goal if your grass knowledge is limited. Most native grasses don't naturally occur in a monoculture but in a mixture of grasses and forbs and, in the Georgia piedmont, a mixture of cool and warm season species also. Many of the grasses used in monocultures like pastures, lawns and golf courses are "improved" introduced species maintained by enormous inputs of energy and water and are an artifact of humans. Most "improved" cool season species were imported from Europe and warm season "improved" species are of African or Asian origin.

Two books are useful at this stage. "Grasses, An Identification Guide" by Lauren Brown and "Weeds of Southern Turfgrasses" Cooperative Extension Service, The Georgia College of Agricultural and Environmental Sciences, Athens. Both are in paperback and together will cost about $20.00.

A first step is to distinguish between the grasslike plants. The following comes from Lauren Brown's excellent small book:

"The grasses and allies are all members of the great group of flowering plants called the Monocotyledons. The members of this group are alike in having one seed leaf, parallel-veined leaves (with few exceptions), and stems in which vascular bundles are scattered in the pith. Among the monocotyledons, members of three families of plants have a "grasslike" appearance and may be confused. These are the grasses (*Poaceae* or in some books the *Gramineae*), the sedges (*Cyperaceae*), and the rushes (*Juncaceae*). A little study of the following key and pictures will show how to

separate them quickly and surely."

1a Flowers with stiff, greenish or brownish, 6 parted perianth (calyx & corolla); stamens 6 or 3; fruit a many-seeded capsule; leaves usually wiry & round in cross section .... RUSH FAMILY (Juncaceae)

1b Flowers without evident calyx or corolla, gathered into short scaly clusters (spikelets); stamens 3; fruit with a single seed 2

2a Leaves in 2 vertical rows or ranks; leaf sheaths usually split, with overlapping edges; stems usually round in cross section & hollow between the joints; each flower of spikelet contained between 2 bracts, the lemma & palea ..... GRASS FAMILY (Gramineae)

2b Leaves in 3 vertical rows or ranks; leaf sheaths tubular, not split; stems often triangular in cross section & solid between joints; each flower of the spikelet in the axil of a single bract, the glume .... SEDGE FAMILY (Cyperaceae)

[key from Brown]

The next major sort to be mastered is whether the grasses under consideration are cool or warm season plants. Native grasses differ in temperature requirements for growth. Because of this difference, they are placed in two groups—cool-season or warm-season. The southeast has an abundance of both with many cool season grasses growing in partial to full shade. Cool season grasses are physiologically adapted to lower temperatures and begin their growth cycle in late fall or early winter when sun is available and the leaves are off the trees. The minimum daily temperature for active growth is 40-45 degrees. There are always warm periods during southern winters and these periods are exploited. Their most rapid growth period is from late March into May when they flower and set seed.

Warm season grasses, especially perennials, begin greening up when the minimum daily temperature is 60-65 degrees and after 90 degree days arrive, put on major growth. These bunch grasses put down an awesome root system and generally those plants capable of producing the greatest top growth are capable of producing the greatest root growth. There is recent interest in converting fescue (*Festuca arundinacea*) pastures to native grasses because of their superior drought tolerance and nutritional forage quality. Indian grass (*Sorghastrum nutans*), big bluestem (*Andropogon gerardii*), switch grass (*Panicum virgatum*), and eastern gama grass (*Tripsacum dactyloides*) are big, bold, robust grasses with leaves reaching four feet and seed heads up to six feet with the first three best known as


orchard grass

members of Midwestern tall grass prairies. In southeastern meadows they are mixed in with many small to medium sized grasses and forbs creating a different visual impact. Horticultural varieties of little bluestem (*Schizachyrium scoparium*), Indian, and switch grass have been introduced. Landscape designers have recognized the visual impact of broomsedge's (*Andropogon virginicus*) copper color and the movement, texture and light gathering qualities other natives add to the winter landscape.

Studying grasses with a knowledgeable human is the fastest way to develop your skills. Also growing them from seed makes it much easier to recognize field characteristics in all stages of development. Eventually a key is needed; "How to Know the Grasses," Third Edition by Richard W. Pohl, is suggested. Radford's "Vascular Flora of the Carolinas" can be used if you know the grass "language". The descriptions in Hitchcock's "Manual of the Grasses of the United States" are very useful. Jim Allison's workshops, in the field or UGA herbarium, are not to be missed opportunities.

Locations to study grasses, beside your own yard, are big power line easements that haven't been converted to pastures, the power line at the State Botanical Garden in Athens from the Oconee River to the gate at the top of the hill, smaller service and power lines on state parks and natural areas and roadsides that are

not sprayed with herbicides. Have fun identifying the other plants that like to grow with grasses. Additional reading about grasses, particularly restoration projects, can be found in "Land and Water" The Magazine of Natural Resource Management and Restoration, Native Plants Journal and Ecological Restoration.

Many thanks to Hugh and Carol Nourse for the grass photographs.

NATIVE GRASSES

COOL SEASON

All the following species are perennial & tufted or bunch grasses unless otherwise noted.

Name	light	moisture	Comments
Agrostis hyemalis Ticklegrass	Open	Dry/Mesic.	Common roadside grass with mauve inflorescence
Danthonia sericea Downy oat grass	Open/shade	Dry/Mesic	These would make good erosion control & roadway grasses
Danthonia spicata Poverty oat grass	Open/Shade	Dry/Mesic	
Elymus canadensis Canada wild rye	30% Shade	Mesic/Wet	Grow best in association with other grasses
Elymus virginicus Virginia wild rye	Shade	Mesic/Wet	Grow best in association with other grasses
Glyceria striata Mannagrass	Open	Hydric	Wetland grass; rhizomatous
Hordeum pusillum Little barley	Open	Mesic/Dry	Another good erosion control grass; annual
Poa cuspitata	Part Shade	Mesic/Wet	Floodplain grass
Stipa avencea Black seeded Needlegrass	Part Shade	Dry/Mesic	Grass of dry oak-hickory ridges & rocky slopes

WARM SEASON

Name	light	moisture	Comments
Andropogon gerardii big bluestem	Open/Sun	Dry/Mesic	Most valuable forage grasses Skips the piedmont
A. glomeratus bushy bluestem	Open/Sun	Mesic/Wet	Grows in soils too wet for upland species
A. *tenarius* split beard bluestem	Open Sun	Dry/Mesic	Dry site upland species.
A. virginicus broomsedge	Open/Sun	Mesic	Common in Piedmont
Aristidia spp. three-awn grass	Open/Sun	Dry	Annuals & perennials
Chasmanthium latifolia riveroats	Part shade/ Shade	Mesic	Begins growth early Riparian grass
C. laxum slender spikegrass	Part shade/ Shade	Mesic	Floodplain & woods grass.
C. sessiliflorum long-leaf spikegrass	Part shade/ Shade	Mesic	Most common woodland grass
Dichanthelium spp.	Open/Sun	Dry-Mesic	Look for winter rosette; vernal & autumnal foliage
Eragrostis capillaris lacegrass	Open/Sun	Dry-Mesic	Pinkish seedhead; annual.
Eragrostis spectabilis purple lovegrass	Open/Sun	Dry	Short grass; beautiful, purple inflorescence
Muhlenbergia capillaris rocky	Open/Sun hair awn muhly	Dry	Beautiful piedmont variety found near outcrops & sites
Panicum anceps beaked panicum	Open/Sun	Dry-Mesic	More nutritious than bluestems; fills *P. virgatum* niche in Piedmont; rhizomatous.

Panicum rigidulum red-top panic grass	Open/Sun	Hydric	Rhizomatous wetland plant
Panicum virgatum switchgrass	Open/Sun	Mesic-Wet	Awesome roots.
Paspalum laeve field paspalum	Open/Sun	Mesic-Wet	considered weedy
Paspalum seteceum thin paspalum	Open/Sun	Mesic-Dry	considered weedy
Saccharum alopecuroides silver plume grass	Open/ Part Shade	Mesic	Good ornamental
S. *contortus* bent awn plume grass	Open/ Part Shade	Mesic	Both plume grasses are edge plants.
Schizachyrium scoparium little bluestem	Open/Sun	Dry	Short foliage, dry sites
Sorghastrum nutans yellow Indian grass	Open/Sun	Mesic	Somewhat rhizomatous
Tridens flavus purpletop	Open/Sun	Mesic-Dry	Very common
Tripsacum dactyloides Eastern gama grass	Open/Sun	Mesic-Wet	Good ditch grass; high nutrient forage.

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plume grass

poverty oat grass

Quillworts, Continued from Page 19

lobesof the rootstock which break off to form new plants. D-*I. valida*, Conecuh County, Alabama showing the typical forked roots. E-*I. hyemalis* Putnam County, Florida. Numerous growing tips are evident on this single rootstock. Each of these has the potential to form a new plant

FIGURE FIVE

Representative megaspores. A-*I. piedmontana*, Hancock County, Georgia. B-*I. boomii*, Colquitt County, Georgia. C-*I. flaccida*, Putnam County, Florida.

FIGURE SIX

Representative megaspores. A-*I. melanopoda*, Pearl River County, Mississippi. B-*I. "altamaha"*. Washington County, Georgia. C-*I. engelmannii*, Southampton County, Virginia.

FIGURE SEVEN

Representative megaspores. A-*I. butleri*, Edmonson County, Kentucky. B-*I. valida*, Giles County, Virginia. C-*I. tegetiformans*, Greene County, Georgia. D-*I. hyemalis*, Dinwiddie County, Virginia.

FIGURE EIGHT

Microspores of *I. tegetiformans,* Hancock County, Georgia. The delicate ornamentation types on these microspores have not previously been reported.

FIGURE NINE

Representative microspores. A- *I. flaccida*, Putnam County, Florida. B-*I. butleri*, Edmonson County, Kentucky. C-*I. boomii*, Laurens County, Georgia.

FIGURE TEN

Aspects of the life cycle of *Isoetes*. These photographs are of *I. hyemalis*..A-Germinating spores. The spore on the right has two archegonia with protruding neck cells (at arrow). B-Detail of the four-celled archegonium, a distinctive feature of quillworts. C-Young sporeling with developing leaf. At lower left, arrow indicates microspores attached to wall of megaspore.

FIGURE ELEVEN

I. melanopoda, Culpepper County, Virginia with evident darkened base. This is the basis of the specific epithet meaning "black footed."

FIGURE TWELVE

A-The remarkable *I. tegetiformans* with its elongated rootstock. Notice how small the plants are no wonder it was overlooked!

FIGURE THIRTEEN

Irregular spores of the granite outcrop hybrid, Greene County. A-microspores. B and C-megaspores. Note the variation in size and ornamentation of both microspores and megaspores, typical of hybrids.

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Some of us have to choose a Steve Bowlingism for either or both them: the Henry Higgins *by golly I think I've got it*!—hardly; the Scarlet O'Hara *tomorrow's another day*—someday I'll learn the grasses; or the Rhett Butler: *frankly my dear, I don't give a damn!* After reading this issue's bookend articles, I hope you might have a bit of Henry and a lot of Scarlett!

Sturgis McKeever, Professor Emeritus of the Biology Department of Georgia Southern University in Statesboro has provided us with a primer on what many consider the queen of wildflowers, the orchids. It forms the centerpiece of this issue so we may provide you with his wonderful color photographs of orchids. They remain unnamed in color, for they are all included in his article illustrated in black and white photos. See how many of them you can name without referring to the article!

So why the fuss about orchids? Any who has botanized with me know I consider *orchidophilia* a dread, terminal and expensive disease. I know of no cure, everyone who has it dies with it, and spends much money on it! Why do so many passions rise with orchids and not with quillworts or grasses? Yes they are spectacular, but as you read and learn about quillworts and grasses here, they can be as well! The vocabulary of orchids is no less daunting than quillworts or grasses. When is the last time you brought up *pollinia*, *labellum*, or *resupinate* in dinner panter? So why do otherwise sane botanizers feign at *lemmas*, *awns* and *paleas*?

After browsing this issue, we hope all will have a greater appreciation for quillworts and grasses. I know I've made a Scarlett category for the first and the last! Now the question is, when is that tomorrow????

Scott Ranger
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The cover photo is of the snorklewort and black spored quillwort pool atop Arabia Mountain in DeKalb County, taken by Scott Ranger. The orchid photos on the back cover are by Sturgis McKeever, and the orchard grass by Hugh and Carol Nourse.

orchard grass

spotted coral root

nodding ladie's tresses