This is the 106th
of NATURE MAGAZINE's
special educational inserts

THE MARSH

A Pageant of Natural History

By E. Laurence Palmer

Where land meets water, as in a marsh, the aquatic and the terrestrial patterns of life must be reconciled by those that make such areas their homes. Ecologists—those specialists in the interrelationships between living things and their environments—write about this great compromise in a language that is sometimes difficult for the non-professional to understand. But since it is the ecologists who are most familiar with the basic conflicts of marsh life, let us see if we cannot profit by some of their conclusions.

Here, we elect to recognize that, in a marsh, the predominant plant life is herbaceous, while that of a swamp is dominated by the woody plants. We cautiously reject bogs from consideration here, because in bogs there is but little decay of plant material; while in marshes the decay rate is high, with a corresponding abundance of animals that participate in reducing dead tissues to simpler forms—a function that provides material for the development of abundant new living tissue. Much as the gunner finds his best hunting along the borders where woodlands meet grasslands, or where dry lands meet wet lands, we should expect to find such areas good hunting for those whose interest lies in the study of living natural history.

The English poet Shelley made use of a marsh to depict the ultimate in ruin when he wrote: ". . . when London shall be a habitation of bitterns, when St. Paul and Westminster Abbey shall stand shapeless and nameless ruins in the midst of an unpeopled marsh. . . ." Apparently Shelley had never been in a boat or a blind to watch a busy marsh day begin or end, for certainly the average marsh is a populous area, zoologically speaking.

After you have finished reading this article, you may be able to see in a marsh not only beauty, but a great pageant of natural history displayed in its lands, waters, plants, and animals. You will better appreciate the serious human health problems associated with the damming of rivers like the Nile, and the serious conservation problems that may follow the promiscuous drainage of farm marshlands, as in our own Midwest.

A marsh is likely to be a difficult place in which to live, either for plant or animal life. In the heat of summer, humans seek the shade. During a windstorm, they seek shelter. From uncontrolled fire they seek a safe refuge. During floods they seek dry lands; and in drought, moisture. A marsh can be the playground for all such extreme conditions. How, then, does the life of the marsh meet high winds, fire, flood, and parching drought? As an example consider the cattail.

Notice how the cattails of the marsh yield to high winds, instead of resisting and being broken. What harm can the wind do to a plant like the cattail? When the sun is shining brightly, hold your hand, palm downward, in the sunshine. Is the back or the palm of your hand the warmer in this circumstance? Now turn your hand on edge, so that the sun strikes an edge rather than a flat side. How does this new position affect the amount of heat supplied to your hand? Remember that, in the morning and evening, the sun does not strike the earth as directly as it does at midday. Return, then, to your

Late spring fires, sweeping through winter-dried reeds and grasses, bring tragedy to animal life of the marsh.

cattail, and consider how this plant is so made that, through the lighted part of the day, it gets more heat when the sun is low, and less when it is high. Thus does the cattail escape the sun's most withering rays.

In spring or fall, fires may sometimes sweep the marshlands, particularly the cattail marshes. At such times the most valuable part of the cattail plant is likely to be buried under an inch or so of water or soggy trash. Can you imagine a safer place for the precious starch that is stored in this plant? If wind, fire, and burning sunlight cannot kill the cattail plant, what about drought? It takes a long drought to dry the blanket established by a mass of cattails, and even then there are roots that reach a level where moisture may still be found. A cattail marsh is a rather stable institution after it has become firmly established; and, once established, animal life depends on it for both food and shelter. Muskrats can hide in the swamps, and be certain of ample food under stands of cattail leaves that tower over beds of starch-laden underground structures. They are not only protected from hostile neighbors, but from fire as well—they have underground burrows in which to hide until danger has passed.

Perhaps the greatest tragedies for marsh-dwelling animals occur when late spring fires sweep their habitat. Marsh birds may have begun nesting activities, only to find that all is lost in a few minutes. There is probably no perfect place for any organism; if there were, that form of life well might overrun the earth.

Marshes may vary because of the chemical nature of their waters. There are salt marshes near the sea and near salt springs, alkali marshes near alkali exposures, and marshes whose waters are nearly pure—or at least relatively free from both salt and alkali. Where animal life remains in a marsh, we assume that it has adjusted to the chemical conditions prevailing in a given locality.

One of the most interesting phenomena connected with marshes is their tendency to build land. If you have the occasion to handle marsh plants, you may be impressed by the fact that many of them feel "slimy," and seem covered with a gelatinous coating. Such a coating may well be of plant origin, and may be composed of algae. The jelly-like covering tends to collect silt from the water, the silt eventually settling to the bottom to build more land. This may represent a substantial land-building contribution over the years, and may substantially reduce the area of open water in a marsh-surrounded pond or lake.

More effective in land building than the algae, perhaps, is the development by many marsh plants of horizontal underwater structures from which the erect parts of the plant arise. Cattails and bulrushes are particularly effective in this respect. They may build structures that resemble floating platforms on both edges of a waterway. Commonly, such platforms are thick enough and strong enough to support the weight of a man, so that in many extensive marshes one can walk all day in water up to the knees and never go deeper, unless an open stream should be encountered.

As far as humans are concerned, land-building may have its drawbacks, especially in the maintenance of open passages for boats. Such land-building accounts, however, for the relatively deep water to be found just off the channels that may penetrate marshes where streams enter them. Eventually, land development in marshes may become sufficiently advanced to allow human agricultural activities.

Dr. E. Laurence Palmer, for many years director of Nature Magazine's educational program, continues his special inserts in the pages of the combined magazines.

The dictionary tells us that a marsh is "a tract of wet or periodically inundated treeless land, usually characterized by grasses, cattails, or other monocotyledons." In our accompanying chart section there are nine representative plants of such an area. Of the two thallophytes, or plants that are not differentiated as to stems, leaves and roots, one is an alga and one is a fungus. A relatively common liverwort, and a moss that may or may not be considered a marsh plant—depending on your definition of the word "marsh"—represent the bryophytes. One pteridophyte, or representative of the fern division of plants, is listed. For the flowering plants, the cattail and the bulrush are suggested as being representative of plants of vertical pattern, while pond weed and cow lily are representative of the plants of horizontal plan. Only one of these four is a dicotyledon; so, in general, we recognize the dictionary's emphasis on the importance of monocotyledons.

While the cattails and bulrushes of a swamp are likely to be conspicuous, there may be other plants present that are of equal importance. The seasonal variation in the abundance of primitive marsh plants is great. At some times of the year, the alga *Nostoc* may become so abundant that it forces its attention on the most casual observer. This alga usually appears as masses of jelly that soon become silt-covered, and which look like semifloating mud balls. Other algae abound, and are conspicuous in their own ways as bright green, slimy threads like *Spirogyra;* delicate nets like *Hydrodictyon;* coarse-branching, somewhat slimy threads as in *Vaucheria;* or as the delicate, branching threads that are characteristic of *Cladophora.*

Many of these plants have been considered in detail in Number 69 of this series, or may be found figured and discussed in biology textbooks. Some of them seem to flourish best in polluted water, and are of some value in superficially indicating the presence of pollution. However, it is not always easy to determine whether the algae are responsible for the pollution, or the pollution responsible for the algae. Anyone who has explored a marsh has probably seen one or more dead fish floating in the water, and almost invariably such fish will seem covered with a fuzz, which is usually the fungus *Saprolegnia,* often known as "water mold."

The bryophytes, which include the liverworts and mosses, are rarely as conspicuous in marshlands as are the other groups. Forms like *Ricciocarpus* may be seen floating, closely crowded, on the water's surface; and the adjacent wet muds may support colonies of *Marchantia,* which may make an almost continuous green carpet close to the soil. The mosses do not ordinarily form a conspicuous portion of the marsh flora, although they may sometimes crowd the tops of floating logs. Sphagnum moss, although included here, is more typically a bog plant.

Among the pteridophytes—the division of plants that includes the ferns and their allies—there are marsh representatives in abundance. Our Number 104 dealt, for the most part, with this group. To that treatment we are adding the water-clover fern *Marsilea.* The peculiar sporocarps of this plant, which look like fruits but really are not, are frequently eaten by ducks. These plants play an important role in anchoring soft soil at the water edge, and in helping to build land.

As representatives of the flowering plants, or spermatophytes, we present the ubiquitous cattail, the historic bulrush, and the sometimes conspicuous, but diminutive, duckweed. From time immemorial, the flowering plants of marshes have supplied men with food, fuel, clothing, and shelter. In some parts of the world, the major means of transportation may be by boats made largely of cattails bound together and waterproofed. In many parts of the Old World, home-roofing is still of thatching, secured from the reed *Phragmites.* This same reed grows in abundance in many American marshes.

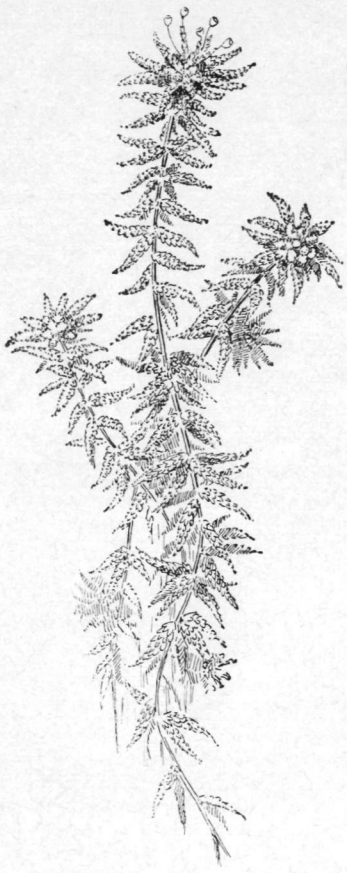
Marshes have supplied men with food in the form of wild rice, and flour from cattail tops, collected in season by beating the bent plant-tops, which release their contents into the bottom of a canoe. The arrowleaf group, so common about marsh edges, supplies man with underground parts known as Indian onion and duck-potato. The closely associated bur reed provides a superior food for muskrats and deer. Sweet flag, which is closely related to the duckweed discussed in the chart section, has pungent, aromatic rootstocks that are gathered, dried, and sold in drugstores, either ground or in their natural condition. It is used as a flavoring for food and candy, as a perfume in oils of various sorts, and sometimes even in soaps.

We must also consider the role of flowering plants in making marshes places of beauty. Some of these plants, like the calla lily and several orchids, are monocots, while others, like the water lily, are dicotyledons. Our American lotus, of the water lily family, is a thing of beauty, and in the South may be sufficiently abundant to provide a food source. Unfortunately, it has been found that the margins of its leaves provide excellent protection for transforming mosquitoes that may be future carriers of malaria. In China and in Egypt the lotus is grown extensively for food, and most of the lotuses produce beautiful flowers, acorn-sized seeds that taste like chestnuts, and tubers that, when properly prepared and baked, taste like sweet potatoes.

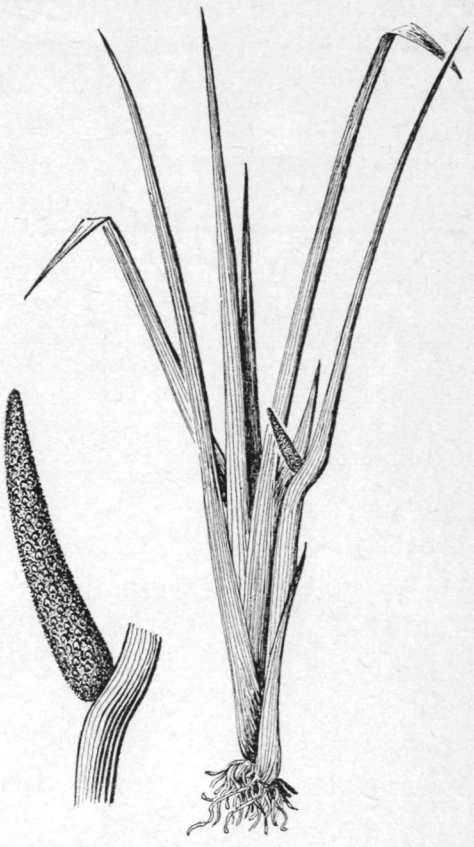
The animals of marshlands are of great importance in our picture of the marsh, and nine are listed in the chart section of this insert, each representing a major group. We have included the mallard duck as representative of the birds of such areas, and the muskrat as typical of the mammals; but of even greater interest might be representatives of the lower orders, like the protozoans that swarm unseen. Let us briefly review the role that marsh animals play in the health, comfort, and happiness of mankind.

It has long been recognized that there is a relationship between marshes and human health. Explorers have found that waterways are convenient highways into unknown territories, and early settlements have often been near such avenues of travel. However, men early recognized that there was an association between such waterways and human diseases, like malaria, which is carried

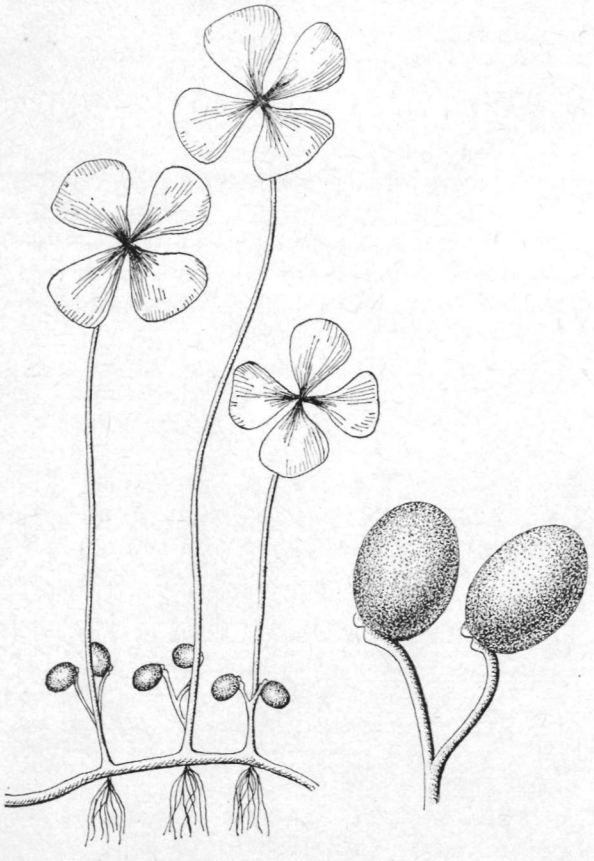
rbaceous plants, like the wild rice being harvested in illustration, *above*, distinguish the flora of marshes. Typical swamp, *below*, is dominated by the woody plants. The soil is saturated, but not wholly covered, with water.



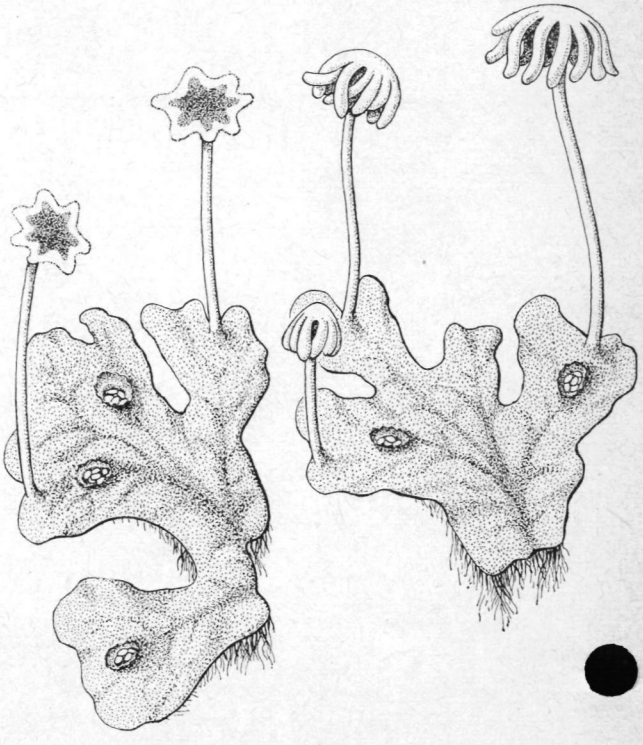
Sphagnum moss, *Sphagnum* sp.



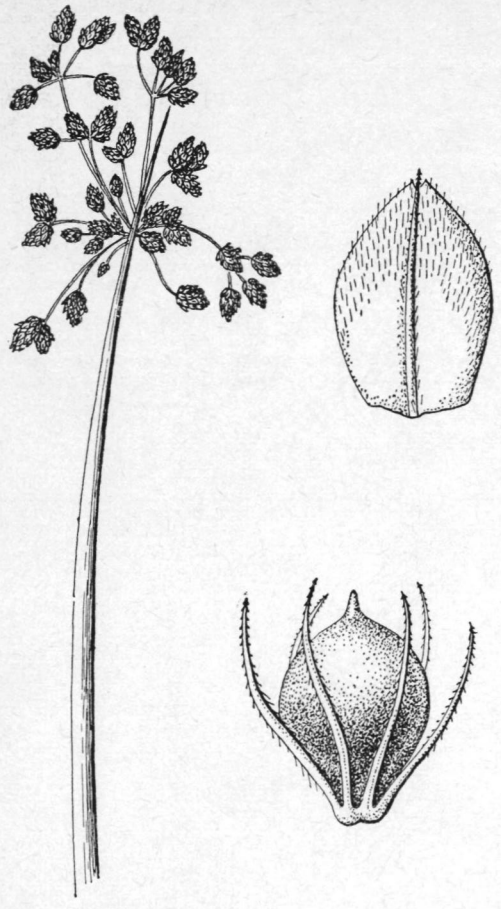
Sweet flag, *Acorus calamus*



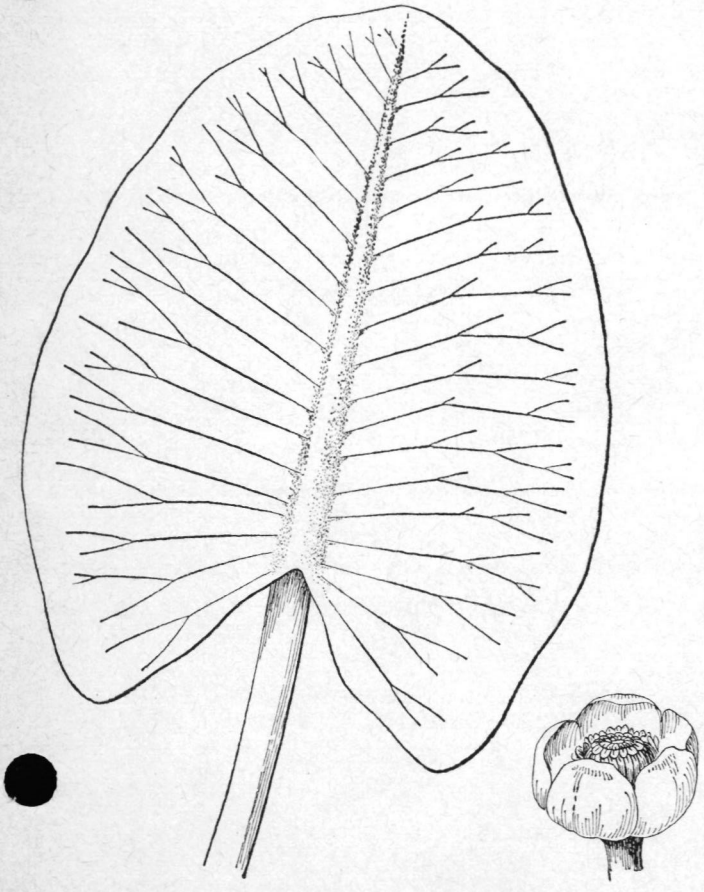
Marsilea, *Marsilea quadrifolia*



A liverwort, *Marchantia polymorpha*



The bulrush, *Scirpus validus*



Spatterdock, *Nuphar advena*

by insects that are part of a cycle depending on marshy conditions. At present, it is particularly important that we have some understanding of this relationship. All over the world we are damming streams to provide power, to irrigate deserts, to increase navigable waters, and to secure water for human consumption. In doing these things, however, we may be creating conditions that we cannot afford to ignore.

If the building of a dam on the Nile River increases marshy areas where human population is high, complications may arise. Such marshes are likely to support pond snails. In turn, the snails may be hosts to organisms that may infect men who wade in such marshes with schistosomiasis, a disease that not only deforms but makes it impossible for an infected person to live a productive life. The building of such dams thus may actually help to increase illness, poverty and misery, although intended, of course, to be of benefit to man.

THE shallow waters of marshlands may support mosquitoes and pond snails that can be disease carriers; but they may also support fishes that feed on such snails and insects. We must remember to protect some of these natural controls that are ordinarily present in a marsh.

Marshes are natural breeding grounds for many kinds of amphibians. Even the larvae of the tree toads that live much of their lives in treetops start life in marshy places. Swarms of salamanders invade the marshlands in spring to lay their eggs. A single spotted salamander may lay some two hundred eggs, the young from which may then spend up to three months in the marsh, feeding, in part, on smaller animals that may be undesirable from the human viewpoint. An individual bullfrog, on the other hand, may lay as many as 20,000 eggs, each of which can develop into a polliwog that will feed largely on the oozes and slimes of the marsh.

Marshes provide a favorable environment for many reptiles, too. Some of these, like snapping and painted turtles, spend much of their lives in such areas. They may destroy useful animal life like ducks, frogs, and fishes; but it is not commonly realized that more than fifty per cent of the turtle's food may be waterweeds, and that its appetite for carrion helps speed the destruction of dead animals whose bodies might otherwise be a potential source of danger to human health.

BIRD life of the marshes, is, of course, most plentiful; ducks, in particular, provide "sport" and food for many gunners, as well as satisfaction to bird watchers. Few birds of the marshes are undesirable from the human viewpoint, although marsh-inhabiting blackbirds may occasionally be charged with invading man's grain fields in great numbers.

It is doubtful if one could find a marshland that is not the home or range of birds, mammals, reptiles, amphibians, fish, and invertebrates of many kinds. The majority of this animal life is able to survive because of the shelter provided by marsh plants, and practically all of it is dependent on marsh plants as food, either directly or by way of the animals on which the individuals themselves feed. Basic, of course, is the fact that a marsh supplies exactly the right amount of water and soil and sunshine to keep this whole involved society—a pageant of natural history—functioning normally.

	THE SETTING	DESCRIPTION
POND SCUM *Spirogyra* sp.	Warm, shallow, stagnant waters form the habitat of many of the fresh-water algae. Of the blue-green group, both *Oscillatoria* and *Nostoc* thrive in the waters of marshlands. Here we consider the green alga *Spirogyra*, of the Family Zygnemaceae, and Order Zygnematales, Class Phycomycetes.	Other green algae, Class Chlorophyceae, are often abundant in marshes. There are oedogonium, water net, vaucheria, and chara, the latter found in waters high in lime. Pond scum looks like a mass of bright green, slimy strings, sometimes kept afloat by entangled air bubbles.
WATER MOLD *Saprolegnia* sp.	Water molds are often conspicuous in the polluted waters of marshes, particularly near centers of human population. A dead animal like a fish or cat may support the gray fuzz that generally characterizes this plant. Family Saprolegniaceae, Order Saprolegniales, Class Phycomycetes.	Most water molds are saprophytic, living on dead organic material, but some are parasitic. City folk are likely to see such mold on goldfish in aquariums that have not been kept clean. The plant body resembles a mass of threads, without cross-walls or color bodies.
RICCIOCARPUS *Ricciocarpus natans*	In marshes, conditions may be ideal for liverworts. Some, like *Marchantia,* are best known as earth plants; others, like *Ricciocarpus,* may float on the water. As representative of the liverworts, we name *Ricciocarpus,* Family Ricciaceae, Order Marchantiales, Class Hepaticae.	Common on marsh waters of many lands, including those of the eastern half of the United States. Appear like green triangles, separated or in rosettes, measuring to more than one inch across, with an abundance of thin scales beneath and branched and rebranched grooves above.
SPHAGNUM MOSS *Sphagnum* sp.	Relatively few mosses are to be found in typical marshes. However, sphagnum mosses grow in abundance in and near areas that might be considered marshes, and we elect to consider the moss *Sphagnum,* of the Family Sphagnaceae, the Order Sphagnales, and the Class Musci.	The choice of sphagnum as a marsh plant may be criticized, because the waters of marshes are free to circulate and change with every storm, while those of bogs do not. However, in marshlands, moss specialists are not overwhelmed with an abundance of their chosen study material.
MARSILEA, OR PEPPERWORT *Marsilea quadrifolia*	Marshlands support a number of ferns and fern allies. Horsetails, for example, may be abundant in some marshes. Here, however, we consider marsilea, sometimes called "waterclover fern," of the Family Marsileaceae, the Order Filicales, and the Division Pteridophyta.	Marsilea is a native of Europe and Asia that is firmly established in the United States. Most conspicuous are the erect "four-leaf clover" structures that arise from a horizontal body usually buried in the mud. The "clover-leaf" is about an inch across and of a clean green.
CATTAIL *Typha latifolia*	Strong winds that blow across marshes can do little damage to flexible, ribbon-like leaves of the cattail, and fires that sweep marshes cannot kill parts buried under mud and water. This plant is of the Family Typhaceae, the Order Pandanales, and Class Monocotyledoneae.	Success of the cattail system of survival is attested by the fact that it is found in abundance in temperate climates around the world. Cattails grow to 6 feet high, with leaves to 1 inch wide, which sheath the stem and are filled with large air cells. The horizontal rootstock branches.
BULRUSH *Scirpus validus*	Bulrushes meet the conditions of marshlands much as do the cattails, but pioneer farther into the water, sometimes being largely submerged without being destroyed. Bulrush is a sedge rather than a rush. It is of the Family Cyperaceae, Order Graminales, Class Monocotyledoneae.	There are at least 150 species found about the world, some of which grow in water and some on dry ground. *Scirpus validus* ranges from Newfoundland to Alaska, and south to California and Georgia. Stems may grow to more than eight feet high, from stout, horizontal, scaly rootstocks.
DUCKWEED *Spirodela polyrhiza*	In late summer marsh waters may be covered by floating duckweeds. Related plants include duckmeat, lesser duckweed and watermeal, all floating on water's surface. Duckweed has several rootlets; duckmeat and lesser duckweed, one. Family Lemnaceae, Order Arales, Class Monocotyledoneae.	*Spirodela* is widely distributed in the Old World, and into the tropics in America. The plant is an oval, floating body, bearing two or more rootlets beneath. It is to ⅛ inch long, dark green above and purple beneath. Four to fifteen nerves appear on the upper surface of the frond.
SPATTERDOCK, OR COW LILY *Nuphar advena*	Representing the dicotyledons in this discussion of the marshes is the spatterdock, or yellow water lily. As a rule, the monocots nearly monopolize marshlands. The spatterdock, cow lily, or yellow water lily is of the Family Nymphaceae, Order Ranunculales, Class Dicotyledoneae.	Found in waters and marshes and along slow streams from Labrador west to the Rocky Mountains, and south to Florida, Texas and Utah. Members of family widely distributed. Leaves are to 12-inch blades on petioles that may be more than a foot long. Rootstock may be 4 inches through.

FOOD	REPRODUCTION	GENERAL IMPORTANCE
Spirogyra manufactures its own food by using light, water and carbon dioxide, the water and carbon dioxide entering into the composition of the ultimate products—sugars and starches. Oxygen is freed, and the entangled bubbles found in masses of *Spirogyra* may actually be free oxygen.	*Spirogyra* increases by growth and division of strings of cells and the cells themselves. There may also be a sexual reproduction in which contents of cells in parallel strings join to make single cells. This may be induced by a change of ratio between the volume of water and its surface area.	*Spirogyra* may be a serious pollutant of fresh water in marshes, although it may produce a basic food for some marsh animals. Algae may clog drains controlling marshlands, and may restrict the movements of fishes and other animals living in marshland waters.
Water mold gets its food wholly from other plants and from animals, the threads penetrating the tissues of the host and extracting the needed nourishment. Some members of the genus are serious menaces to crops, often attacking the growing roots and finally destroying the plant.	Reproduction in water mold is by division of the plant body. Also, the ends of some threads may produce hosts of microscopic swimming spores that become freed, swim about, and develop new threads on suitable sites. A sexual method of reproduction also is known.	*Saprolegnia* is both a blessing and a curse. It serves to destroy wastes that might otherwise persist. It also serves, unfortunately, as a menace, particularly in fish hatcheries and in some crops. In aquariums it may be controlled by addition of salt to water.
Compact floating mats may cut off light under water to limit the growth of certain plants there. May serve as food for ducks and other plant-eating animals of the environment. Are to be found almost wholly in the warmer summer seasons, vanishing with the onset of cooler weather.	Reproduction is by growth and division of the rosettes of triangles. The floating form reproduces by means of spore-bearing capsules in April, the spores of which develop into plants that are sexual. The spore-case stage of *Ricciocarpus* is, however, asexual.	This species is sometimes known as the purple-fringed riccia, because of the abundant scales underneath. It has been described as looking like duckweed, but this is far-fetched. It is likely to be confused only with those plants that are most closely related to it.
Mosses do not ordinarily enter into the diets of many animals, and their prosperity is dictated more by chemistry than by systematic zoology, since the associated animals use the moss more as a cover than as food. It may be interesting to note the sparsity of mosses in the marsh environment.	Mosses, including the sphagnum mosses, are usually most conspicuous in the sexual, or gametophyte, stage. In many mosses, this stage is characterized by stemmed structures supporting spore capsules. In the sphagnum mosses, the supporting stems are either conspicuously short or absent altogether.	Sphagnum mosses are valuable as retainers of water, and are widely used to pack commercial shipments of plants. The peat of commerce, used as a fuel in many parts of the world, is derived from dead sphagnums that, although compacted, have not reached the stage of complete decay.
Plant parts of marsilea are eaten by ducks, and to some extent by fishes. The plants are relatively free from injury by insects and fungi. The fruiting bodies are hard and dry, and serve to tide the plants over times of unfavorable conditions. These fruiting bodies, or sporocarps, are remarkably hardy.	Reproduction is primarily by division of the vegetative parts, particularly those buried in mud. The sporocarps are parts of the sporophyte, and may produce large or small spores. The larger develop into the female, and the smaller into the male stages, which then unite to form the plant.	Water-clover fern may serve as a valuable anchor in holding soft muds intact against the action of currents, waves, and the actions of animals. It provides good shelter for a number of marshland animals—muskrats, for example—and helps build up marsh bottom.
Cattails have few natural enemies abundant enough to do serious damage, in spite of their storage of rich, starchy food underground. Waterfowl lack the strength to harvest cattail wealth, and soft mud bogs down such animals as might adjust to grazing on cattail roots.	Cattails reproduce by their spreading, horizontal underwater rootstocks, which are perennial and persist in holding territory once occupied. They also bear spikes, the lower portion yielding fruits, and the upper portion stamens that produce the necessary pollen.	Leaves are used by man in making rush-bottom furniture, in calking barrel staves, in manufacture of insulating material. Fluffy fruits are used in pillows and blankets. Starchy rootstocks are a good emergency survival food; young fruiting stalks are sometimes eaten as "Cossack asparagus."
Bulrushes provide food and shelter for many forms of wildlife, both bird and mammal. Muskrats and ducks are often largely dependent on these plants for survival. Most land mammals cannot pursue them in marshy areas, and a patch of bulrushes provides a superior hiding place for lesser life.	Major reproduction is by persistent branching of horizontal rootstocks. Also, nutlets are borne in the branching, fruiting portions of plant. These nutlets may be egg-shaped, black, to nearly .1-inch long, somewhat flattened on one side, are hardy, and are often found in considerable abundance.	Bulrushes provided concealment for the infant Moses, according to the Bible. They are superior builders of land, while the fleshy rootstocks are eaten raw, bruised, boiled, or made into flour. The young shoots or stem bases may provide man with a source of food during an emergency.
Duckweed may affect the ecology of underwater areas by cutting off light, but may also serve to keep water temperatures down. Ducks swim through masses of the plants, gorging themselves, while muskrats may also feed on this plant of the marshland.	Reproduction is largely by division and growth of the floating plant body. It is seldom found in flower. Ovary borne under plant yields two seeds in a round, wing-margined fruit, which is not likely to be found. Anthers of stamens are two-celled, but are also hard to find.	Duckweeds may be found in places similar to those occupied by *Riccia* and its relatives. Duckweeds, however, fill a definite role in the economy of the water surface between the stems of marsh plants in the late summer season. The name properly associates chief food function.
Deer, moose, beaver and porcupines feed on raw, sweet rootstocks. Ducks eat seeds, and men roast them for food. The yellow flowers are commonly crowded with insects and the leaves may show insect injury; but in spite of such predation, the plants may appear to be quite thrifty.	Flowers are to 3½″ in diameter, like flattened globes, with six sepals. Petals are fleshy, and less than ½″ long. Flowers appear yellow, with a purplish cast outside. Fruit is to 2″ long and 1″ thick, with many seeds inside. Stamens are numerous, as in the water lily, and are in five to seven rows.	Some western Indians have used the seeds to make a flour for bread. If the seeds are to be stored, they must not be allowed to dry, or viability is lost. The stout rootstocks are ideal for anchoring a shoreline along stream or marsh, where wind or wave action causes severe erosion.

	THE SETTING	DESCRIPTION
LEECH *Placobdella parasitica*	Turtles found in marshes are commonly hosts to leeches that attach themselves to the soft under parts of the animals as parasites. From among the invertebrate animals of marshes, we choose this leech of the Family Glossiphoniidae, Order Rhynchobdellae, Class Hirudinea.	This leech is free-living during the breeding season, but is otherwise found clinging most commonly to the legs of snapping turtles. This is the largest species in the genus, to over 2″ long, dark greenish-brown, variously spotted and striped with yellow and orange.
DISC POND SNAIL *Helisoma trivolvis*	Marshlands are both a blessing and a curse, and mollusks contribute to making them so. Involved are both univalves, like snails, and bivalves, like clams and mussels. Of the univalves, the disc pond snail is of the Family Planorbidae, the Order Pulmonata, and Class Gastropoda.	Pond snails, for the most part, live in waters from 1 inch to 6 feet deep, and have shells to nearly 3 inches long. They are most abundant in waters having a *p*H above 7.0, and more species are to be found in large bodies of water than in small. The shell of this snail is a flat coil.
CRAYFISH *Cambarus bartoni*	Marshes rich in decaying plant material and with soft bottoms provide homes for many crustaceans. Freshwater shrimps and water sowbugs revel in abundant food, and serve as food for others. Abundant also may be the crayfish, of Family Astacidae, Order Decapoda, Class Crustacea.	Of some 70 species of *Cambarus, C. bartoni* is from streams east of the Mississippi. *Cambarus* has 17 pairs of gills, while Pacific Slope genus, *Astacus,* has 18 pairs. There are about 100 species in all. Length is up to 5 inches, with 2 large front claws and 4 pairs of walking legs.
MOSQUITO *Culex pipiens*	Man's establishments near marshes have sometimes failed because of insect populations. Abundant are mayflies, dragonflies, water bugs, water beetles, caddis flies, and many others; but representative is the mosquito, of the Family Culicidae, the Order Diptera, and Class Insecta.	*Culex pipiens,* the house mosquito, is common wherever there is stagnant fresh water, but it is most abundant in marshes. Female is to 1/6″ long, proboscis slender, brown, dark-tipped. Abdomen is black, with bluish to bronze reflection. The hind legs, at rest, are held upwards.
CARP *Cyprinus carpio*	Warm, shallow, fresh waters lying over oozes with abundant decaying plant material and aquatic invertebrates are "heaven" for many fishes. Minnows are important here, including the immigrant large carp, of the Family Cyprinidae, Order Cypriniformes, and Class Teleostomi.	World-wide, carp are among the commonest fishes invading the waters of marshlands for living and breeding. Native to Asia and Europe, they are widely established in American waters. They are coarse-scaled or scaleless, dark brown to yellow or golden, with 4 barbels near mouth.
VERMILLION-SPOTTED NEWT *Diemictylus viridescens*	Marshes are the habitat of many amphibians, including frogs, toads, and salamanders, particularly during breeding seasons. The bullfrogs and green frogs may pass entire lives there. Representative is vermillion-spotted newt, Family Salamandridae, Order Caudata, and Class Amphibia.	Eastern newts, *Diemictylus* sp., and Pacific newts, *Taricha* sp., populate marshy areas from coast to coast. *D. viridescens* may be to 4″ long. Adult is brown and black, with yellow beneath, black and red spots, finned tail. Land form, immature, is mostly pale red, lacks tail fin.
SNAPPING TURTLE *Chelydra serpentina*	Shallow waters, deep muds, and abundant animal life provide ideal habitat for turtles such as the soft-shelled, musk, mud, spotted, painted, and diamond-backed. Highly representative among these is the snapping turtle, Family Chelydridae, Order Testudinata, Class Reptilia.	Snapping turtles range eastern North America, east of Rockies, from southern Canada south. Length, to more than 3 feet. Upper shell, 1 foot; lower, to 8″ long. Under parts poorly protected. Weight up to 86 pounds, while that of related alligator snapper to more than 200 pounds.
MALLARD DUCK *Anas platyrhynchos*	Many marshes are created by man to supply breeding grounds for valuable bird species. Representative birds include ducks, some geese, rails, coots, and many others. Among most representative of marsh birds is the mallard, Family Anatidae, Order Anseriformes, and Class Aves.	Mallards and close relatives are probably commonest of all ducks, being found nearly world-wide where habitat exists. Length to 28″, including a 4½″ tail. Wingspread to 40″. Drakes commonly with green heads and white collar, with a purple breast and gray under parts. Flesh superior as food.
MUSKRAT *Ondatra zibethicus*	By draining, flooding, and cultivating, man makes or destroys more marshland than any other mammal. Representative mammals are beavers, mink, otters, nutria, rats, and mice. Also typical may be the muskrat, of the Family Cricetidae, Order Rodentia, Class Mammalia.	Muskrats range most of North America north of Mexico. Adults weigh to 3 pounds, are 25″ long, with 10″ scaly tail. Except for tail, has heavy, fine pelt. Fur is sold as Hudson seal, Russian otter, red seal. Flesh is excellent and often is included in dishes in which chicken or terrapin forms the basis.

FOOD	REPRODUCTION	GENERAL IMPORTANCE
Leeches feed primarily by sucking the blood of the host after piercing the skin. They are primarily external parasites, unlike the flukes, hairworms, and hookworms of closely related classes and order, all of which may be found in the marsh type of habitat in some development stage.	Individuals bear both sex organs, but two individuals reciprocate in the breeding act. No egg cocoon is formed in this species, the young remaining attached to the parent animal. Are easily carried over wide territories, attached to feet of ducks or in water as parasites attached to fishes.	Important members of the Phylum Protozoa are to be found in freshwater marshes. On these two pages, we have chosen one representative each of the Mollusca, Arthropoda, and Insecta; and one fish, one amphibian, one reptile, one bird, and one mammal as typical of marsh life.
Pond snails feed largely on oozes and plant wastes of waterways, using a rasp in the mouth to prepare food. They are eaten freely by fish and other aquatic animals. Schistosomiasis, a disease of man, is caused by a parasite of a pond snail closely related to and resembling *Helisoma trivolvis*.	Both sexes are represented in an individual disc pond snail, with mating reciprocal between two individuals. Eggs, laid in small jelly masses, hatch in from two to three weeks into snails whose shells are at first left-handed, with opening to left when spire is pointing upward.	On a world-wide basis, probably the most important role of pond snails is in connection with parasites that affect domestic animals and man. Schistosomiasis, involving pond snails, may debilitate whole populations and make them ineffective, especially where men free wastes in water.
General scavengers, feeding on both plant and animal matter, living or dead. Some live in turret-topped burrows, others among stones or in debris. With growth may shed outer shell and expand during the "soft-shell" period. The crayfish is able to regenerate lost limbs. Is prey for fish, mammals.	About 2 years from egg to egg. May breed through the year. Female carries to 200 eggs under her body for about 2 months, eggs hatching 2½ months after mating. Larvae may be free of mother after 3 months. May be reared in captivity, largely for use of fishermen as bait.	Management for profit consists primarily in controlling water supply, keeping enemies away from the animals, and providing needed food supplies. May be pests in hatcheries, or where fish eggs are available. Valuable as laboratory animals. Some 330 tons are harvested annually.
Male house mosquitoes feed largely on plant juices, and do not bite animals. Females feed on the blood of animals, including man, and are active day or night, feeding mostly in dim light of morning or evening. Greatest enemies probably are drought and the poison sprays of man's civilization.	Sexes may be brought together in part by sounds produced by female. Eggs are laid in rafts of 100-300, which hatch in 1-5 days. Larval period lasts from 1 to 2 weeks, and pupal stage a few days, during which time the pupa may be easily killed by an oil film on water of habitat.	Mosquitoes and their larvae may serve as food for fishes, or for other insects. Control is by draining of breeding sites, spraying of areas involved with oils and poisons, screening of houses and spraying of their interiors, or, in an emergency, by the ancient but effective method of swatting.
Carp feed on decaying organic matter or on plants or small animals found in mud. They are largely scavengers, but also destroy fish nests and young. Their reproductive capacity makes it difficult to control their numbers, and they pre-empt territory more valuable for other species of fishes.	Eggs are laid in early summer in shallow waters with no nest, no parental care. Eggs may number two million per female, hatch in 5-13 days, and young may reach maturity at 2-3 years. Have been known to live over 47 years. Can survive salinity up to 10 per cent for a short time.	Ordinarily a most unwelcome fish, but one that is now considered of some sporting value if taken on light tackle. Food value of the flesh is low, but may be of value in a crisis, since the fish are usually easily taken on a hook and line with nothing more elaborate than plain bread dough as a bait.
Newts on land feed almost wholly on small invertebrates. Adults in water may feed on eggs of fish and frogs, on mosquito larvae, tadpoles of frogs, toads, and salamanders. In destroying many aquatic insects, like mosquitoes, salamanders may prove themselves highly useful to mankind.	Adults mate in shallow water in spring. Fertilized eggs deposited separately on submerged water plants, a single female laying to more than a hundred eggs. Eggs hatch in 20-35 days into gilled larvae, which may live in water to 3 months, absorb gills, and then take to land for from 1 to 3 years.	Serve as food for fish and other animals of the habitat, but more importantly as enemies of eggs and young of other animals their size. May be particularly destructive in hatcheries. The land form is known as the "red eft," seen commonly on woodland paths after a summer rain.
Snappers feed mostly on animal matter like fish, ducks, and carrion. Are essentially scavengers. Pond may support two snappers per acre. May wander over a wide territory. Chief enemies of snapping turtle are man and the elements, although skunks may also destroy many turtle eggs.	Males may fight for mate. Breeds April-November. Eggs laid May-October, in two or more clutches of to 80 eggs that are white, parchment-covered, 1¼" spheres. Nest ashore in dry earth or sand, usually within 75 feet of water. Young hatch in 81 or more days, take to water promptly.	Dangerous predator of habitat, particularly to raisers of ducks, fish, frogs, and other marsh animals. May concentrate in numbers during hibernation. With floats attached to shells, have been used to locate drowned persons. Commercially captured in wire-cage baited traps.
Feed mostly on plant material, including grain and vegetation, but also destroy great numbers of mosquito larvae. Domestic mallard is of same species as wild mallard. Enemies include fire, epidemic diseases, starvation, and over-hunting, as well as natural animal predation.	Nest is usually built near water, commonly on ground, fairly well hidden. Eggs, gray-green to brown, 6 to 13, with nest sometimes shared by two females. Incubation 26-28 days, by female only. Duckling downy, yellow, and able to swim soon after hatching. May be domesticated easily.	Most valuable game bird, but becomes domesticated too easily to satisfy average gunner, who might as well go hunting in poultry yard. Abundance of mallards and ease of harvest helps sell hunting licenses, thus building up financial resources of state conservation departments.
Muskrats feed largely on plants. Using wastes, they build mounds that, when frozen, provide protection from enemies like wolves, dogs, coyotes. Enemies also include mink, some snakes, hawks, owls, human trappers. Fires may be calamitous. Active day or night, winter or summer.	Muskrats are polygamous, and may bear 4-11 young, 19-42 days after mating, and may have to 3 litters a year. Can safely remain submerged to 12 minutes. Good marsh management, including intelligent harvest, may have a beneficial effect on a muskrat population. Do not flourish in captivity.	Muskrats have been considered as the most valuable fur resource in the country. They are generally harvested by the most inhumane of means, but their role in human economy may be taken over by the nutria or by synthetic furs. Can cause damage to earthen dams, some farm crops.

nature IN THE SCHOOL

IT IS HARDER, sometimes, to keep youngsters out of marshes than it is to keep them in schoolrooms. This is an observation that applies with as much force to youngsters who are just beginning their school lives as it does to those about to finish high school. But it must be admitted that marshes are most interesting places, particularly at the time of year when school is about to close. At that time, a marsh is fascinating in what may be heard, seen, smelled, tasted and felt.

Now, the frog choruses are at their height. The peeper orchestra, which commenced almost as soon as the water was free of ice, has begun to wane, it is true. Wood frogs may also have become quiet, but the tree toads will likely continue on into summer—although not in chorus proportions. A few bullfrogs, and certainly a number of green frogs, will add to the sounds that may be heard in the marsh.

At this time of year the school might make a study of the frog sounds that are to be heard in some nearby marsh. At least two valuable recordings of frog and toad sounds have been made in this country, recordings that will be found most useful in identifying the various sounds. A class may decide it would like to locate such animals, using the available professional recordings; or it might decide to make its own recordings of marsh sounds with a portable sound recorder.

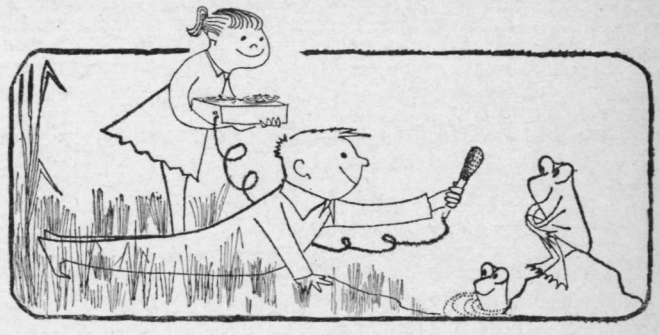
OTHER youngsters might be interested in collecting the egg masses left in the marshes by various species of frogs and toads. Should this be done, it is important that "wholesale" collections of such egg masses be discouraged as leading to unnecessary destruction of future highly useful animals. An explanation of the reason for this tempering of enthusiasm may be effective as a general lesson in conservation.

If a few egg masses of frogs, toads, or salamanders are brought into the classroom and kept in an aquarium, youngsters may derive from them a notion of events that take place in a marsh. One such egg cluster might be broken up, and a few of the eggs placed in an aquarium whose sides and bottom have been thoroughly cleaned, and in which the sticks and stones have been cleaned of all their oozes.

After a few days it may be observed that the polliwogs in a clean aquarium are not so prosperous as those in an ooze-supplied aquarium. From this fact the youngsters may draw some conclusion as to the role played by oozes and slimes in the general economy of the marsh. Many tadpoles, in their earliest stages, will remain suspended on the sides of the aquarium, rather than resting on the bottom or among the water plants, and such individuals may be observed feeding on the ooze of the aquarium wall.

Two aquariums of approximately the same size may be stocked with clusters of frog or toad eggs so that nearly equal numbers of tadpoles will develop in each. For the purpose, two-quart fruit jars may equally well be used. If an adult newt or other aquatic salamander that is normally an inhabitant of the marsh be added to one of the jars, it will be observed how nature takes care of surplus populations. The salamander may sometimes be seen resting on a mass of frog eggs, waiting for the tadpoles—and a salamander's meal—to emerge. Some pupil might like to find out whether the salamander's reaction would be the same for its own eggs. Such an observation may suggest to the students how natural control is accomplished, and also the reason why it is necessary for frogs and toads to lay so many eggs. If the egg-laying habits of the newt are observed, it may be found that these animals lay their eggs singly, as do the peepers that lay their eggs early in the season.

It is not likely that school will be in session when



the bullfrogs and green frogs lay their great sheets of floating egg masses. The tadpoles of these frogs may require two full summers of development in the north before they can transform into the adult frog form. Under such circumstances, it may be obvious why, in order that a species may survive, such frogs must lay as many as 20,000 eggs, as compared with the hundred or so laid by frogs whose larval development-time is shorter. Frogs, either as tadpoles or adults, are relished by many of the inhabitants of the marsh. Through observation and reading, a class should note the affinity of fish, reptiles, birds, and mammals for a good meal of "frog," no matter what the stage of development of the unfortunate amphibians may be!

THE class lesson in frog study might lead to a better understanding of conservation problems if it followed the life history of the frog or the toad beyond the scope of aquarium study. For example, frogs may migrate, and if a student should be riding in an automobile on a rainy night, he might see these animals migrating in great numbers. He might notice that barriers like railroad or highway embankments may sometimes interfere with such frog migrations.

In the past, great numbers of frogs were captured by simply directing them, during migration, into convenient enclosures by means of barriers. So successful was this practice that it became necessary for a number of states to make it illegal.

For our marsh-life example in this article we have used the well-known frog; but we might well have used almost any of the other marsh dwellers. Further exploration of the marsh is sure to reveal a rich variety of animal life, a better understanding of which will be most rewarding to the young naturalist.