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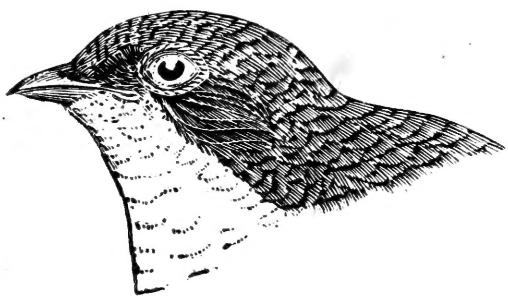
NATURE STUDY

IN

SCHOOLS

Conducted by C. J. MAYNARD



VOLUME I, 1899.

WEST NEWTON MASS.

C. J. MAYNARD.

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Vol. I FEBRUARY, 1899 No. 1

Snow Bunting

WEST NEWTON MASS.

C. J. MAYNARD

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NATURE STUDY IN SCHOOLS.

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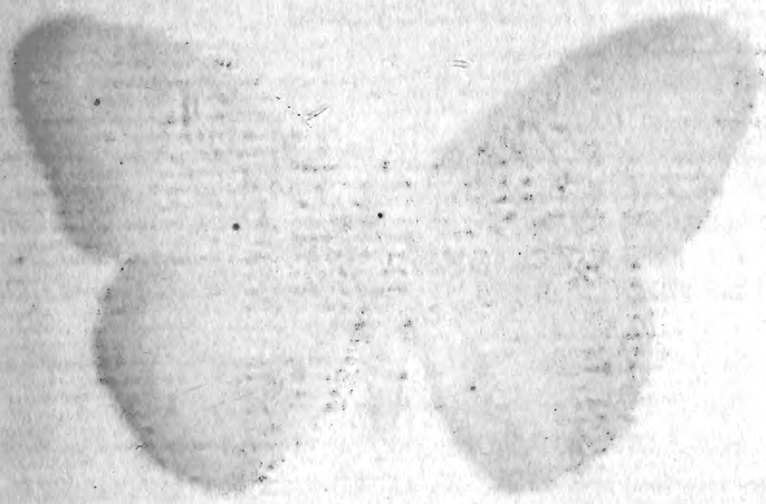
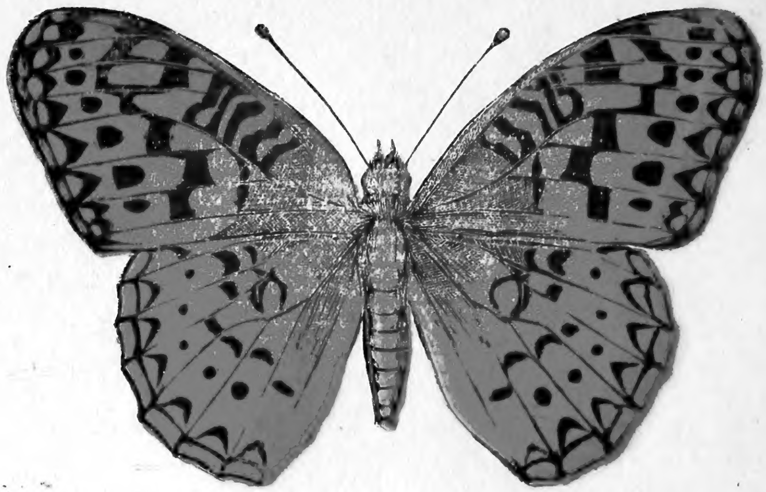


PLATE I.



EXPLANATION OF PLATE I.

Upper figure, Dark Silver-wing, Argynnis aphrodite, which does not hibernate.

Lower figure, Comma Butterfly, Grapta comma, which hibernates.

NATURE STUDY.

VOLUME I. FEBRUARY, 1899. NUMBER 1.

PROSPECTUS.

Although a number of Journals published in the United States in the interests of education, have for some years printed articles upon Nature Study, there has been, up to the present time, no periodical which has been devoted exclusively to this object.

With the rapidly growing interest in Nature Study, and the necessity of its introduction as a fundamental branch of education in our schools, a want has been felt by teachers and others interested in educational matters, for some guide to the practical teaching of Nature Study.

It is to meet this long felt want that the present publication has been organized.

General Plan.

The following is a general plan of the work.

There will be a series of articles on Systematic Zoology, seasonable articles upon birds, mammals and other animals, giving accounts of their habits, etc, such as can be observed by children, also upon trees and plants, as well as upon geology, rocks and minerals.

Another of the principal features will be practical lessons actually given by skilled teachers, in Nature Study, and the results acquired by their pupils. This series it is hoped will prove of great assistance to other teachers who are about to undertake nature work in their schools.

Many articles will be written especially for the Magazine, illustrated by original drawings and plates.

NATURE STUDY will be conducted by Mr. C. J. Maynard, the well known naturalist, who has not only had a wide experience in field work in many departments of Natural Science, but has given his attention for many years to the introduction of Nature Study in schools. Mr. Maynard is therefore particularly fitted for work of this kind.

Terms to Subscribers.

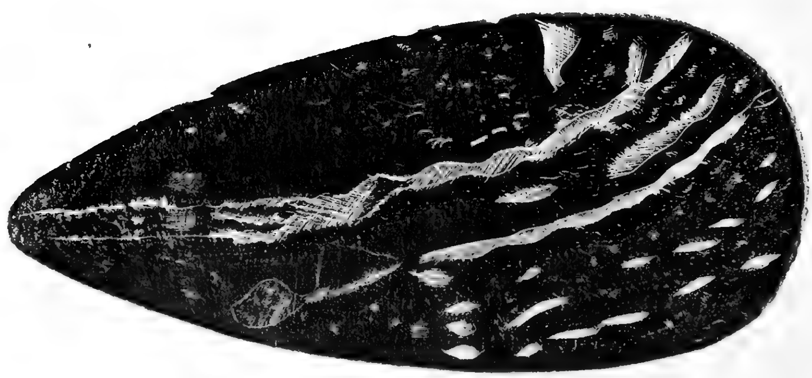
NATURE STUDY in Schools will be published monthly, at 10 cts. per copy or $1.00 per year, payable in advance.

Club Rates.

Children and others who wish to secure a copy of the magazine free, can do so by securing five subscribers for us. Send us $4.00 and we will send five copies of NATURE STUDY to five addresses, and for $10.00 we will send thirteen copies to as many addresses.

Send remittances, money orders or checks to C. J. MAYNARD, 447 Crafts Street, West Newton, Mass.

Figure 1.



Indian Stone Axe. See article.

WINTER BIRDS.

By

C. J. MAYNARD.

BLACK-CAPPED CHICKADEE.

Aside from the omnipresent English sparrow, one of the most common birds which we see in winter is the lively little black-capped chickadee. There are probably few birds better known than this species, partly because it is common, but more particularly because it is constantly reiterating its name. "Chick-a-dee-dee-dee" is the burden of the lay which we hear coming from woodland, field and orchard, as the busy little birds keep up a continual search for insects. Less often heard and much less well known, is a long drawn, somewhat plaintively given "cee-dee," a note which is often mistaken for that of the phoebe.

While it is well to remember that the phoebe, which is a species of flycatcher, is not found in the northern states in winter, it is better to learn the difference between the long drawn out "cee-dee" of the chickadee and the more emphatically given "phoe-be" of the flycatcher.

When heard together and contrasted, there is really very little resemblance between the two. The "cee-dee" is twice as long in duration as the "phoe-be". The note of the chickadee is rather indolently given, with a decided plaintive intonation, while the note of the phoebe is jerked out quickly and has a rather harsh intonation.

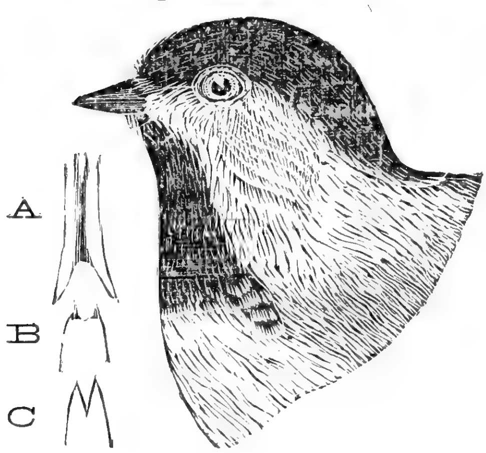
Aside from the notes mentioned, the chickadee has a low sweet song. This is, however, rarely heard.

Though the chickadee's "cee-dee" is indolently given, it is at wide variance with the habits of the bird. There are few more active little birds in this country than the chickadees, yet they are active without conveying the idea that they are fussy. They simply fly from twig to twig or from branch to branch, busily engaged in searching for insects, their larva or eggs, and one feels as he watches them that their work, although quickly done, is performed without undue haste, and is thoroughly accomplished.

The black cap and throat and gray bodies of the chickadee are well known distinguishing marks of the species. The Hudsonian chickades which is a very rare bird as far south as Massachusetts, but which is more common in northern New England, has a brown head and general brownish tint to the body.

The chickadees as a family have a general resemblance to the jays. Both have the same conical bill, with its nostrils concealed by feathers, and stout feet for clinging to branches and for holding food, while the birds eat it. There are also crested and crestless jays and chickadees. But there is one peculiarity in the internal structure of the chickadees which is not shared by the jays. That is the tongue; this organ in the jay is flat, horny, pointed and slightly cleft at the tip, while in the chickadee the tongue looks as if it had been cut off at the tip and four little tufts of bristles grafted into it(See figure 2, a.). These tufts of bristles no doubt aid the chickadee to gather the minute eggs of insects, etc. upon which the birds feed.

Figure 2.



Black-capped Chickadee.

Figure 3.

Golden-crowned Kinglet

The tongue of the newly hatched chickadee resembles that of a jay. (See figure 2, c, where I have given a cut of the tongue of a very young chickadee). As the bird grows older, the tongue gradually assumes the bristles, those in the center appearing first. (See figure 2, b, where I have given a cut of the tongue of an older chickadee).

There are many species of chickadees in the world and they are found scattered over the temperate portion of the northern hemisphere, some even being found in the arctic regions.

Can any bright boy or girl tell why the chickadee has its nostrils protected by feathers and where it builds its nest?

THE GOLDEN-CROWNED KINGLET.

Accompanying the chickadees, we frequently see a much smaller bird, which not only excells them in activity, but also has a very fussy way umping about with half open wings while it hastily examines cracks in the bark or crevices in the dead limbs of the tree on which it moves.

This is the golden-crowned kinglet. It is readily recognized by this active fussy habit, and its small size, olive back and grayish under parts. There are two yellowish white bands on the wings enclosing a dusky patch. The top of the head of the male has a bright orange patch, edged with yellow, which is in turn margined with black. In the female the orange is replaced by yellow.

The golden-crown kinglet is, with the exception of the ruby-throated humming bird, the smallest of our native birds, yet it spends the winter as far north as Massachusetts. It is a perfect marvel that such a little atom of flesh and blood does not freeze solid during cold nights when the thermometer indicates a temperature several degrees below zero. A piece of beef containing four cubic inches would become solid in twenty minutes if exposed to such a low temperature. The body of the kinglet does not contain one cubic inch of flesh yet it is rare that a living kinglet is ever frozen.

The blood circulates very rapidly in all birds, and thus their bodily temperature is high. Then the feathers with which the body is covered are, especially in birds which live in cold climates in winter, very thick, and form a perfect nonconductor of heat or cold, thus the cold is kept out and the heat in.

While with us the golden-crown has a little weak, squeaking chirp which cannot be heard at any great distance. This is the reason why it always accompanies the louder voiced chickadees, their constantly reiterated "chick-a-dees," keep all the flock together just as cattle or sheep follow the sound of a bell suspended from the neck of some older member of the herd.

The musical powers of the golden-crowned kinglet are not great; even in its northern summer home (it breeds in northern New England), its song is simple, consisting of a series of shrill chirps, terminating in a lisping warble.

The nest of the golden-crowned kinglet is a rather bulky structure when compared with the size of the tiny architect. It is rather spherical in form and is composed of moss and usually warmly lined with feathers. The eggs are from five to nine in number, about a half an inch long, white in color, spotted very finely with reddish brown.

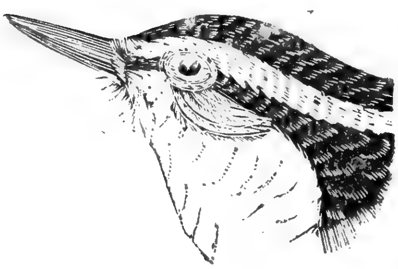
It may be well for those who are beginning to study birds, to remember that the closely allied ruby-crowned kinglet has never been known to occur in New England in winter. It is a spring and fall migrant, wintering in the extreme Southern States. The golden-crown winters from southern Maine and New Hampshire to northern Florida, but it is rare so far south as this, yet I have taken it there. Thus the winter range of both species overlaps a little in the south.

THE BROWN CREEPER.

This is a little brown bird about five inches long, with whitish markings on the back, white under parts, slender in form, with a long tail, that is stiffened somewhat as in the woodpeckers and, as in these birds, is pointed at the tips (See fig. 6). The bill of the brown creeper is also slender, long and somewhat curved, in order that it may more readily gather insects, their eggs and larva from the cracks of the bark.

The brown creepers alight near the base of a tree trunk, and climb up spirally, then after reaching the top, or near it, will fly down to the base, either of the same tree or one in the neighborhood, and again ascend in the same manner. The tail is held against the bark, and when the bird stops to gather an insect, it braces itself with this stiffened tail, much as do the woodpeckers, but it never backs down a tree as the woodpeckers do.

Figure 4.



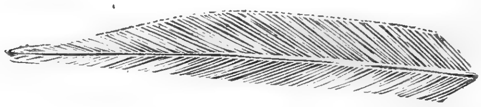
Red-bellied Nuthatch.

Figure 5.

Brown Creeper.

The only sound that the brown creepers utter in winter is a shrill chirp almost like a hiss. In summer they have a low musical song.

Figure 6.



Tail Feather of Brown Creeper.

Although a few of these birds remain to breed with us here in Massachusetts, the greater number go further north in summer. The nests are more frequently placed behind a loosened strip of bark which is hanging off a dead tree, than in any other place.

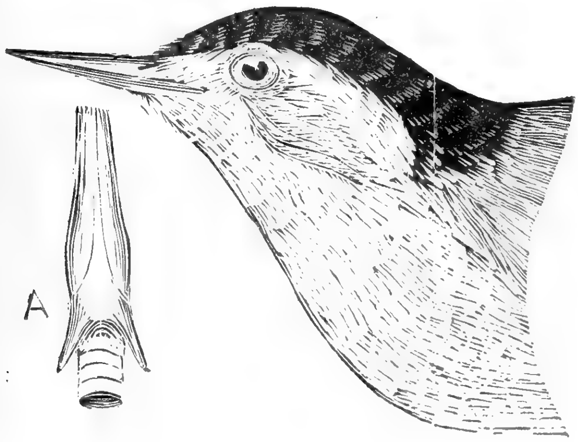
THE WHITE-BELLIED NUTHATCH.

The white-bellied nuthatch is the acrobat among birds. We have seen that the brown creepers climb the trunks of trees with as much agility as do the woodpeckers, but that they never descend by creeping downward. The nuthatches, however, not only descend tree trunks, but do so head first, and as these are the only birds with which I am acquainted, which do this, they well bear the name of acrobats. When coming down a tree trunk the bird will frequently pause and raise its head to look about and then presents a peculiar appearance, for its bill is thrown outward and upward. This habit of descending the tree head first is so characteristic of the nuthatches that they may be readily distinguished by it.

The white-bellied nuthatch is bluish above with a black head and nape, and white beneath. They may be found continually in the Northern States all winter. Sometimes at this season we find the red-bellied nuthatch, which is smaller and is red beneath, but otherwise has generally similar markings to the white-bellied.

Like the brown creepers, a few nuthatches remain in Massachusetts and southward to breed, but the greater portion go further north.

Figure 7.



White-bellied Nuthatch. A, tongue.

They nest in holes of trees which they often excavate for themselves. When sitting, the female nuthatch is so tame that she may be removed from the nest in the hand, then when released, will at once fly back again.

Nuthatches feed on insects, but will sometimes eat acorns and other nuts. In order to get at the contents of these nuts, they break them open by picking them as they hold them in one foot, that is they hatch them; hatch, being a word that is derived from the French hacher, which means to chop or hack, whence the name of the bird, nuthatch.

EXPERIMENTAL LESSONS.

LESSON ON STAR-FISH IN AN EIGHTH GRADE SCHOOL.

SOMERVILLE MASS.

By

M. Eva Warren.

I gave to my class, an Eighth Grade, a lesson upon the star-fish using dried specimens lent me by Mr. Maynard. The children had seen star-fishes among the rocks on the shore, and immediately became interested in learning about them. Each pupil was provided with a specimen and from this learned what he could. I did not give them a point which it was possible for them to find out for themselves. After they had carefully examined and made drawings of both sides, I supplied the remaining facts. They were delighted with the specimens of four, six, and seven rayed star-fishes which Mr. Maynard sent them.

Later in the week the children wrote what they could remember of the lesson and the following papers give an idea of their work.

That by Loena Snowman contains a large number of facts arranged in the best manner.

That by Thomas Dowd is a good example of a condensed style given in an original manner.

[Many other papers were excellent. There were thirty-four articles written, in eleven of which we find fifty or more facts recorded, the greatest number being sixty-two, (this article was by Helen A. Keach.) In ten articles were recorded between forty and fifty facts, and in twelve between thirty and forty; in one, the smallest number, twenty-four.

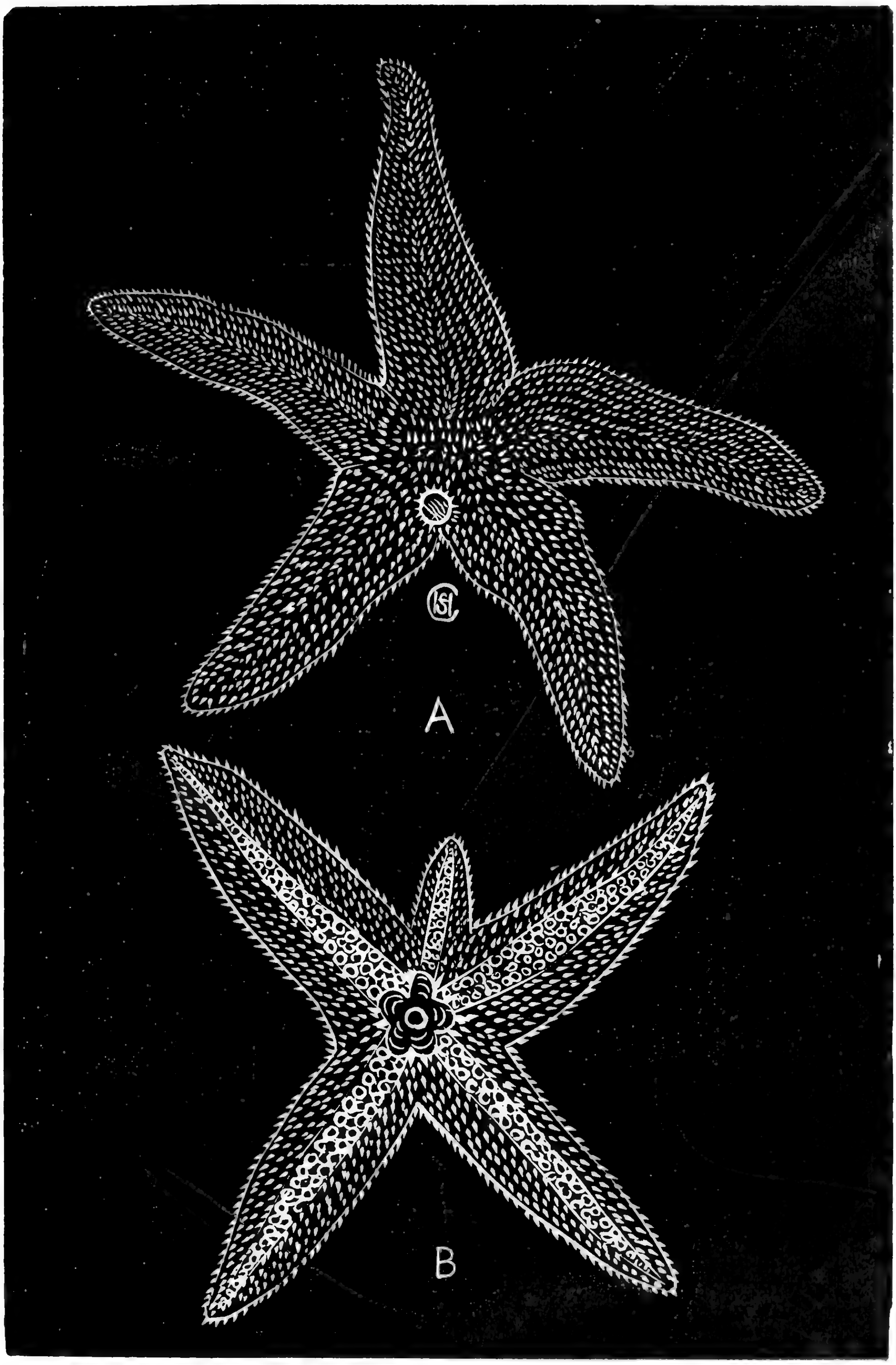
The drawings were on an average good, almost all showing that the pupils grasped the ideas which their teacher intended to convey to them, or that they saw for themselves. Ed.]

EXPLANATION OF PLATE II.

A Upper side of Star-fish by Harry S. Chandler.

B Lower side of a Star-fish with a new ray, by Harry H. Kelley.

PLATE II.



They were furnished with sketches of the water system, which they reproduced, and also of the spines with their accompanying snappers or pedicellariae. In the sketch there were two only of these, one on either side of the spine, hence many of the children thought this was their natural number, when of course there are several to each spine.

The best drawings were by Harry S. Chandler and Harry H. Kelley, and are reproduced on a separate plate.

The thinking questions which I put upon the board were as follows, all of which were correctly answered in most cases.

Is the starfish as a whole useful or injurious to mankind?

Is it beneficial in any degree?

Is a starfish likely to be eaten by a fish or any other marine animal?

The Star-fish, By Loena Snowman. Age 13.

The star-fish belongs to a family of Radiates, why they are called radiates is because they have a decided center with rays projecting from it. The star-fish gets its name star because it is the shape of a star with five rays.

Star-fishes are found all along the coast of North America, the farther north the smaller they are. In Maine some are small and their color is scarlet. In the Bahama Islands the starfishes are large. I have seen a black one that came from there.

The star-fishes do not always have five rays, some have four, and about one in every hundred has six rays, one in every thousand has seven rays, and to compare the eight rayed ones, there is usually one in every ten thousand. I have seen one with four rays, but there was one budding; I mean by budding a little new one is growing which will sometime be as large as the others.

The names of the rays are as I explain to you. You will find what is called a strainer on the upper surface. Hold the star-fish with the strainer toward you, the ray directly in front of you is the anterior, the one at the right is the right anterior, the one at the left is the left anterior. The others are the right and left prosterior.

The first thing you would notice on the star-fish's upper surface are spines. They cover the body, and on each side of the spines are a pair of snappers which keep the body clean. If some dirt should fall on the middle of the fish, the snappers would pass it from one to the other until it got to the edge and then it drops off. The star-fish has two skins and between the skins are stony plates, and the spines project up from these plates through the skin. The surface between the spines is covered with tentacles which have what is called the sixth sense with which they perceive a boat passing over them. If you put your hand in the water they perceive that, too.

At the end of each ray is an eye-speck, though they are so small that they cannot be called eyes. They are not of much use, and people think they cannot see much with them. They are surrounded by spines like the daisy is by petals. The nerves go around the body and a single nerve extends into the end of each ray to the eye-specks.

The star-fish breathes the air that is in the water. The water is taken in through the strainer and then it goes down the stone canal, so called because it always has sand in it. From the stone canal it goes into the water tube that passes around the body, then into each ray. When the star-fish wants to let the water out he lets it out through his feet.

Figure 8.

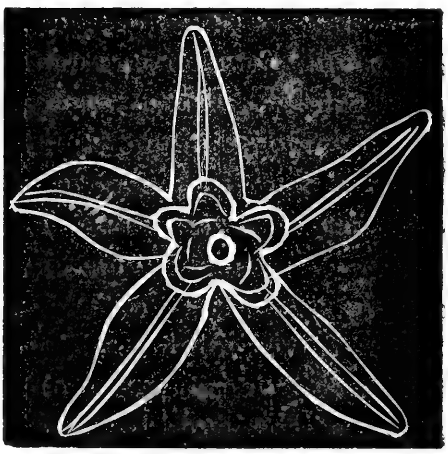
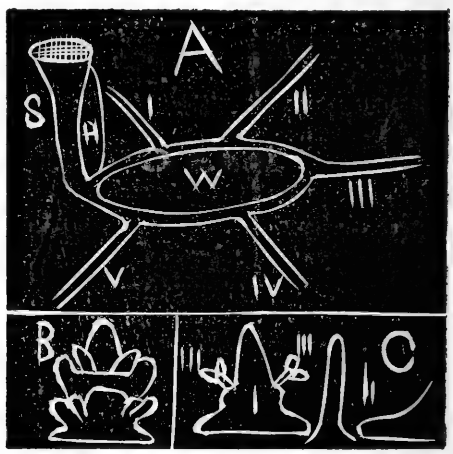


Diagram of lower side of star-fish, showing stomach protruding and position of mouth.

Figure 9.



A, water system of star-fish. S, strainer, H, heart, I, II, III, IV, V, rays, W, circle about mouth. B, young star-fish, C, spines I, spine, II, tentacles, III, snappers.

At the right of the stone canal is the heart. The blood vessels extend from the heart around the body, and lie beside of the water tube, and the air passes through the water tube from the water into the blood-vessels.

On the under surface of the rays are grooves; in the grooves are the feet. When they want to protect their feet, they draw them up into the grooves. It looks as if there were two rows of feet on each side of the grooves, but there is only one row arranged zig-zag. The feet have suction; when the fish wants to cling to a rock, she puts her feet on the rock and draws the water back into the bulbs at tops of the feet. This makes a vacuum. The mouth is on the under side, in the middle of the body and is protected by ten spines which can closè it.

The stomach is five-lobed shape, and extends a little into each ray. It is kept in shape by muscles which extend from each lobe toward the tip of the ray. When the star-fish wants to feed, it throws out its stomach and takes the nourishing food and then it takes the stomach into the body. It feeds mostly on oysters and dead fish.

The waste matter is thrown out through the mouth, and a little is thrown out through a small hole on the upper side. The eggs are dropped out of the mouth and the star-fish knows nothing more of them.

The star-fishes are useful in keeping the sea clear of dead fish, but they injure the oyster beds so men have to kill them.

Star-fish, By Thomas Dowd. Age, 13.

There are different species of the star-fish. There are the Bahama, the common, and the scarlet. They belong to the class of radiates. They live along the shores of North America, in Northern Maine, and the Bahama Islands. They live in shallow water.

The star-fish has five rays, but some have four, and one out of every thousand has six, and one out of every ten thousand has seven, and one out of every hundred thousand, eight. The ray opposite you is called the anterior, and the rays at the right and left of the anterior ray, are called the left and right anterior, and the upper two are called the left and right posterior.

The upper surface is covered with little spikes. The star-fish has two skins, and between the two skins are stony plates made of lime, and if any acid should fall on the back of the star-fish it would effervesce. The spines are of the same material as the plates. On each side of the spines are snappers. The spines protect the star-fish just as the thorns on a rose bush protect the rose.

The tentacles are the feelers. They can perceive when any one is near them. There is an eye-speck on every ray, and there are nerves running into these rays.

The star-fish breathes the air that is in the water. The heart is beside of the stone canal. In each ray are thin veins, or blood-vessels. On the under surface are the grooves, feet, and mouth.

On each side of the grooves are feet, which he can protect by pulling them under a covering made purposely for them. The mouth is sometimes protected by the little spikes. The stomach is five-lobed in shape.

The star-fish feeds on oysters and dead fish. The waste matter comes back to the stomach, and goes out through the mouth, and sometimes through a little hole in the back. The star-fish is useful in one way, and injurious in another way. It cleans the sea of dead fish, though it destroys many oyster beds.

LESSON ON THE STAR-FISH IN A KINDERGARTEN GRADE.

BEACHMONT, MASS.

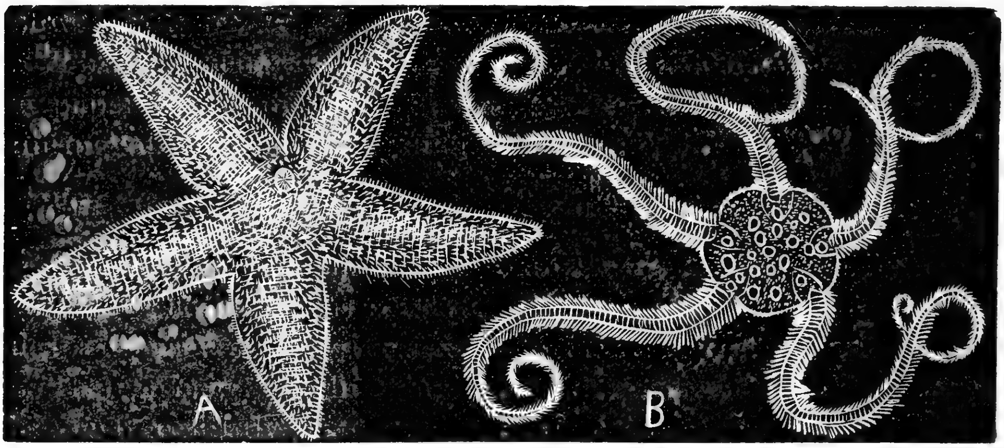
BY

LILLIAN A. YOUNG.

The children of the kindergarten are little ones of a seaside town, therefore they were all able to name the specimen of starfish which Mr. Maynard so kindly loaned me.

Almost every child had seen starfishes on the beach and each had stories to tell concerning many which they had found.

Figure 10. Figure 11.



A Common Star-fish. B Brittle Star-fish.

As I held the starfish before the class, I was told by one of the boys that it resembled a man. One ray stood erect like a head, two extended right and left like arms, while the remaining two extended almost vertically, making the legs. Many suggestions were made by the children in regard to its appearance and as to the habits of those which they had seen.

Those which they had seen on the beach were softer than the dried example I showed them, and some said that the starfish could curl up its arms.

The roughened upper surface of the specimen was likened to a corncob.

After all the suggestions had been made by the children, we studied the specimen in a simple way and learned the following facts.

It is like a fish because it lives in the sea; it is shaped like a star, consequently we give it the name of starfish.

The number of rays were noted and the eyes at the tips of the rays.

Beneath, rows of feet were discovered by which the starfish moves; these feet are provided with suckers which enables the fish to cling to objects, and some of the children said they stuck to rocks.

The mouth in the center, surrounded by spines was noticed, and oysters and mussels were mentioned as being the chief food.

The spines all over the upper surface were found to be protection against fish and other enemies. The respiratory organ was also noticed.

LESSON ON THE CHIMNEY SWIFT GIVEN TO AN EIGHTH GRADE CLASS.

SOMERVILLE MASS.

BY

M. Eva Warren.

I gave my class a lesson on the chimney swift using a skeleton and skin of the bird and a nest glued in position upon a board.

I also showed them sketches of the glands in the throat from which the glue is exuded, and of the tongue similar to those given below.

The class later wrote an exercise upon the lesson. The following paper is one of the set. One of the boys made a creditable painting of the objects used in the lesson.

The Chimney Swift, By Edward Douglas. Age, 13.

He is called a chimney swift because he always lives in a chimney, and because he moves his wings faster than any other bird. He is sometimes called a chimney swallow because he somewhat resembles the swallows.

The chimney swift lives in America. He is one of the latest birds to come, and goes early in the fall. When it leaves in the fall it goes to tropical countries.

Figure 12.

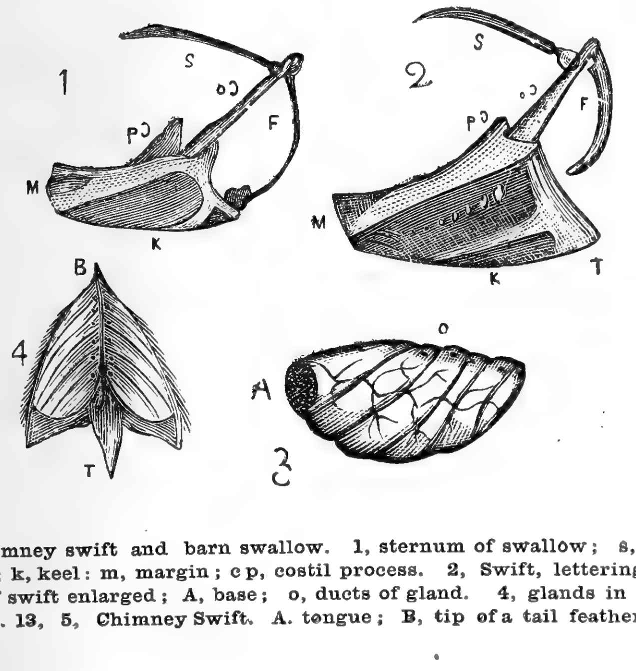


Figure 13.

Chimney swift and barn swallow. 1, sternum of swallow; s, scapula: c o, corocoids: F, furnicular; k, keel: m, margin; c p, costil process. 2, Swift, lettering the same as above. 3, salivary gland of swift enlarged; A, base; o, ducts of gland. 4, glands in position: T, tongue; B, bill.

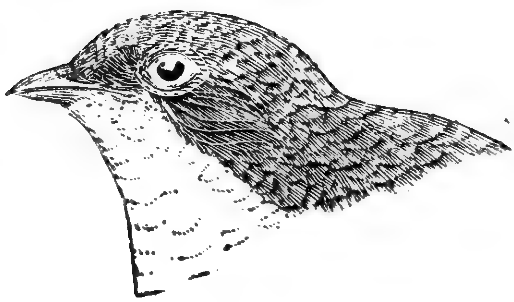
Fig. 13, 5, Chimney Swift. A. tongue; B, tip of a tail feather.

The color of its wings is almost black; the tail is of a dark brown; the bill is short and stubby, and its breast is of a light brown. The chimney swift is about four inches long, and its wings are about five inches long.

The feathers at the tail have midribs which are prolonged into sharp spikes. These spikes are useful in bracing him when in the chimney, as he cannot cling well with his feet, because they are not well developed. He sticks these spikes into the mortar and then he can hold himself there.

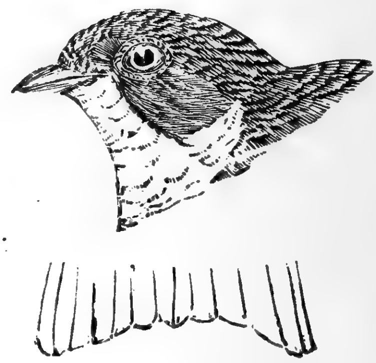
The wing is something like our arm, as it has three parts which correspond to our upper arm, forearm, and hand. The forearm has two bones in it, the same as ours. In flying, the bird does not use the arm movement, but uses the hand movement, therefore he moves his wings more swiftly than many other birds.

Figure 14.



Tree Swallow.

Figure 15.



Bank Swallow.

His nest is made inside of a chimney, shaped like a semicircle and tips downward. It is made of twigs and fastened together with glue. When the season comes round, the glands under the lower jaws begin to swell and in them is mucilage almost the same as you buy in the stores. The female then flies through the tops of trees, nips off a dead twig and then pouring this mucilage over it, sticks it to the side of the chimney. Then she sticks the next on to the one before it.

The use of these glands is to furnish this mucilage, and after the nesting season is over, these glands dry up and she uses them as pouches in which to carry insects that she may not be obliged to fly back to the nest each time.*

The eggs are pure white and are four in number.

The Chinese have a bird similar to ours, but it builds its nest of sea moss. The Chinese like this and eat the nests which the birds build on rocks.

The chimney swift has no song and only chatters as he flies.

In some of the old fashioned houses that have fireplaces, the birds often fly downward into the room, and when a fire is built the nests sometimes fall down into it. Many chimney swifts are caught in this way.

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* He should have said that the bird uses the cavity caused by the shrinking of the glands as a receptacle for insects.

SYSTEMATIC ZOOLOGY FOR TEACHERS.

BY

C. J. MAYNARD.

INTRODUCTORY.

It is a self-evident fact that children have to be taught to think. That is, aside from inherited thought, all the thoughts which children acquire, are derived from some source outside of their own minds.

Mind may be considered as potential or stored thought, which is the result of active thought. To make this matter plain, we may say that any decided impression which we receive through any of the senses, causes cellular action in a portion of the brain. By this action the thought becomes fixed, that is, the arrangement of cellular matter thus accomplished becomes permanent. This building up of various cellular tissues, storing thought, is what we mean by the acquisition of knowledge.

How is this acquisition accomplished?

Beginning with an infant we find that, aside from inherited thought or knowledge, to be spoken of hereafter, a very young child has no knowledge, and does not think. It must be taught to think. At first its eyes pass blankly over all objects, sounds make no impression on its brain, neither does it perceive odors; in fact no action of the senses produces any effect upon the brain.

In order to understand the beginning of the acquisition of knowledge in infants, it becomes necessary for me to explain what we mean by inherited thought, or instincts, as we term them. Inherited thoughts are the results of certain strong emotions transmitted from parent to child, that is, these transmitted emotions produce effects upon the brain of the infant which are similar to those pictured upon its brain by impressions derived through the senses. This is as true and as readily perceived, as is the inheritance of peculiarities of features, which characterize certain families. When these mental peculiarities are very pronounced, we call them mental traits and tastes, or family traits of character, or family tastes, and they often may be traced through many generations. All children may not possess strong family traits, but all do possess certain strong ancestral emotions which are common to all mankind, such as fear, maternal affection, attraction for bright colors etc. Many of these strong emotions have been inherited through long lines of ancestors, often far back into savage life.

Now what is thought? Thought is caused by an impression received through one of the senses which causes the vibration of some cells in which are recorded similar thoughts. But unless there is stored in the brain some associated thought to respond to a new impression, this new impression is not recorded. Hence we often hear and see without understanding.

These potential, or stored thoughts, may be inherited or derived from some source outside of the person in whose brain they have been recorded. In case of the infant, they at first are all inherited; hence we find that the first evidence we have of the infant exercising any thinking capacity, is when some object is presented to it which causes the cells of the inherited potential thought to vibrate. Thus a very young child sees a bright ball in motion, swung back and forth before its eyes, for example. The inherited bright color thought cells vibrate in response to this new impression, this vibration is extended to delicate nerve fibers and by them is carried to the retina of the eye, which is prepared to receive the new, but kindred impression. This new impression, or thought, is then in its turn recorded, but only as a very vague undeveloped thought. It is, however, a beginning: one thought in the vast vocabulary of potential thoughts which are to be stored in that individual mind throughout life.

Another movement of the ball, and still another thought, this time a little clearer, and better defined, for this time the thought just received, also assisted in the vibration. I have said that the thought was better defined, but the degree of advancement was infinitesimally small, yet the child has "begun to notice" as we say. Soon this noticing begins to give it a sense of pleasure, such as we all experience to a greater or less degree, when we see objects, or hear sounds, which are what we call pleasing. Then the infant reaches out for the ball. This gives a new kind of thought, and when it feels the ball, still another, and thus it goes on, but at first all of these impressions are associated with bright colors, and hence they are more quickly awakened by the sight of bright colors.

But as the child's education advances, for all this storing of potential thought, this mind building, is of course education, through thoughts associated with color-thoughts come other thoughts; of form and, as we have seen, through touch, of hardness etc. Thus after a time, the mind, by constant succession, acquires thoughts which are too remote from the color-thoughts for them to be awakened, or in other words, to cause the cells which represent them, to vibrate.

We have now arrived at a point, where new centers of potential thought-cells are being developed, but all are connected with previous thought-cells in some way, for, as I have said before, no new thought can be received, which does not in some way, awaken the vibration of some established thought cell. That thought-cell may be the result of inheritence, when it vibrates more feebly and requires a stronger combined sensation to excite it to action, or may be the result of recent acquisition, when it vibrates more strongly.

This being a fact, it becomes clear that children learn altogether by what we call comparison, that is, by the awakening of potential thought-cells through presenting to them new ideas which are similar to the thoughts which they have already acquired, or which have some association with them.

In acquiring new thoughts, which are in close association with potential thoughts the nerve vibration appears to be transmitted, not only to the sense organs, by which the new thought is recorded, but to other nerve fiber, and what we call a sense of pleasure, is given by these vibrations. Hence children learn more readily and are best pleased when closely connected subjects are presented to them, subjects which awaken at once, and fully, potential thought vibration. We have seen that thoughts derived from the sight of bright colors, are strongly inherited and that they are among the first to respond to the new thoughts derived from the admiration of bright colors. Thus we know that all children are fond of pictures which are brightly colored, simply because it gives them a sense of pleasure to derive new impressions which are closely connected with their strongest potential thoughts.

Knowing then that children learn most readily when closely connected ideas are presented to them, it would seem best to present all subjects which they are to study in as systematic a manner as possible.

What is true of children is also true, to a great degree, with older persons, and while publishing this series of papers on zoology for the use of teachers, I have constantly kept this idea in mind, and have endeavored to show the advancement of animal life, just as we find it in nature, in a closely connected series, from the one-celled-protozoa or first animals, up to man.

I have endeavored always to present the subject, just as I should like to see it taught, with one idea or thought leading into another, so that one series of stored thought cells will be always connected with another series.

The matter herein contained is intended for teachers, and also of course for pupils in normal schools. Teachers must thus, in a manner, use their judgment in presenting the subjects to their pupils according to the grade, but it is hoped that great benefit will be derived through a close study of the experimental lessons now being published in this magazine.

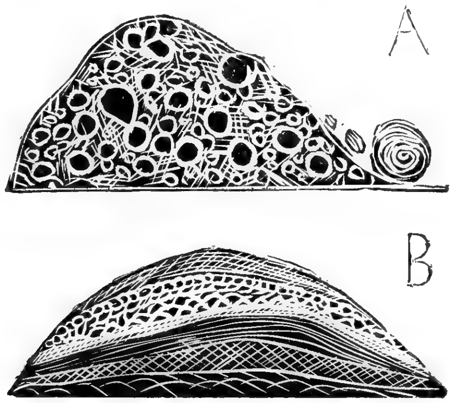
(TO BE CONTINUED.)

WINTER GEOLOGY.

By Wm. D. McPherson.

Winter geology is glacial geology. How could it well be otherwise? In spite of the cold, we can still observe the rounded outlines of the New England hills, as we spin along, in a sleigh, or take a brisk walk. Many hills were formed in the long glacial winter, and all were modified in form. How appropriate to study them at this season. There were doubtless always hills and valleys, from the time the first island appeared above the ocean, but the first hills were different than ours now. Most of the original rocky crust of the earth lies far below under our feet, and the hills we see daily are composed of a superficial deposit of sand, gravel, clay or boulders which have been

Figure 16.



A, moraine: B, kame.

piled up on the rocky crust of the earth by glacial action. The valleys and hollows have likewise been scooped out by the tremendous flowing action of huge masses of ice during the glacial age, which was ten thousand years ago, or longer.

A few hills in New England, called "out-crops", are composed of a part of the rocky crust, which protrudes up through the usual earth covering of sand or gravel. Prospect hill in Waltham is an example.

The great glacial ice cap that covered the Northern half of the United States, reached from the North Pole to a point covered by the city of Cincinnatti. Finally ,as the weather became warmer, and the ice cap began to melt away, immense rivers of water were let loose.

These sculptured out channels for themselves, many of which remain to this day. Our own Charles River, flowing into Boston Harbor, was one of these sub-glacial streams. At first it flowed under the ice, and afterwards when its channel was made, it still continued to drain the land.

The Mississippi was then ten times the size it is now. In going over the granite hills of New Hampshire, the ice sheet broke off fragments of rock of all sizes and rolled them along to the south, crumbling and crushing them often smoothing them into rounded pebbles. These pebbles, stones and boulders, with the sand and clay that was rolled and washed along with them, now form what we call gravel beds or pits, and every town has many of these gravel deposits, formed from material brought from the north.

The different markings and material left after the glacial period have received various names to distinguish them. Instead of lumping the material together simply as hills and valleys, we have a certain kind of hill known as a kame, and another as a moraine etc. Here are also kettle holes, boulders, drumlins, moulins, terraces, till, etc. etc., and for markings they have scorings, striae, grooves, etc.

Like running water, moving ice is a powerful agent in transporting rocks and earthy debris. This material is left on the path or at the termination of the glacier. Such a line of debris is called a moraine. When it forms along the edge of the ice, it is called a lateral moraine, and at the end of the glacier, a terminal moraine. Many moraines appear to have been moulded finally by the ice into what are called drumlins. Drumlins are abundant in the vicinity of Boston, and constitute nearly all the islands in Boston harbor, and on the main land, Beacon hill, Bunker hill and many others could be cited. While the glacial material piled up promiscously may be called a moraine, a hill that is built up more by water action, and has its material, generally sand or gravel, sorted and stratified, is known as a kame. Kames are also very abundant around Boston and all over New England. If one has the leisure to follow the Charles River along through Watertown, Newton, and Waltham, many instructive remains of glacial action will be seen along its banks, and as the river was probably at least a half mile wide in the glacial period the ground for this distance remains strewn with kames and other debris.

(Two good books on glacial geology are "Man and the Glacial Period" and "The Ice Age in North America," both by Wright, and obtainable in most all public libraries)

INSECTS IN WINTER.

THE YELLOW STRIPED LOCUST.

BY

HARRY H. WHALL.

To the casual observer there are very few, if any, insects to be found in winter. Yet if one knows where to look, they are sure to find plenty of material upon which to work, such as moths, butterflies, beetles, bugs, flies and many other insects which hibernate during the winter.

Any pleasant day when the sun is shining, take a walk into the fields, and on the sunny side of hills and knolls, if you will turn over the leaves and grass you will find the larva of locusts, and many other insects, also under rocks, stumps, and under bark of trees etc.

The yellow striped is one of the most common locusts, and here we might mention that, as there is more or less confusion regarding locusts, we will endeavor to rectify an error which is in use constantly by many people, that is, the word locust is applied to an insect in a very different order, the cicada, or harvest-fly. Then again the locust is called a grasshopper which is another error. The grasshopper is easily distinguished from the locust by the length of its antennae, which in the true grasshopper are one and a half times, and often twice as long as the body, while the antennae of the locust are about one half the length of the body.

The larva of the yellow striped locust is all that can be found now, and they are usually discovered on a warm sunny day, and you will find the young locusts quite frisky and hard to catch. The head of the locust is connected to the thorax by a thin skin which is easily broken, even the small blades of grass, if they slip between the armor-like plates, will often cut the tissues and result in the tragic death of the locust. The neck, which conneets the head and thorax, you will notice, is much longer than that of the fly, wasp, ants, etc., and this does not enable the locust to move its head a great deal. You have noticed when you catch a locust that it secretes a dark reddish brown fluid, which is produced by the salivary glands, you will also notice the young locust in winter, even in the warmest days, will not secrete this fluid when captured.

The eyes in the larva of young locusts differ from the eyes of the adult, which possesses compound eyes, while in the larva their place is taken by groups of simple eyes which, during the growth of the young locust increase in number, and finally unite to form the large many-faceted visual organs. The antennae, which are the appendages between the eyes, in the young locust are at first short and thick set, but as the insect undergoes its several changes, they gradually assume their perfect condition, that is more slender and much longer in proportion to the insect. That the antennae are organs of smell, taste, or used as eyes, is not at present known, although in some orders, say the mosquito, Meyer, often, by many experiments, proved that the antennae were organs of hearing, while the observations of Lubbock tend to show that the antennae of ants are organs of smell.

Experiments of Trouvelot, Packard, and others on butterflies, show that the antennae are organs of sight. A butterfly was caught its eyes covered with India ink, and was able to fly, but when the antennae were cut off, it was quite impossible for it to navigate or find its food.

(TO BE CONTINUED)

SINGULAR BELIEF AMONG THE BAHAMA CREOLES IN REGARD TO INDIAN STONE IMPLEMENTS FOUND ON THE ISLANDS.

BY

WM. D. MCPHERSON.

Fig. I in the present number is a fine illustration of an Indian axe. Mr. Maynard brought it from the island of Andros where it was found. The axe was made of green quartzite, a stone very rare for the Indians to use, and probably came either from Cuba or Hayti.

The present inhabitants of the Bahamas, the Creoles, believe that these axes and other stone implements which were used by the Indians, and which are occasionally found in the fields, formed the nucleus of either a meteor or of a flash of lightning. They call the stones thunderbolts, and consider that when kept in a house they afford it protection against a stroke of lightning.

See an account of this in a "Folk-lore among the West Indies" Contributions to Science, Vol. II, p. p. 1 to 23.

TREES IN WINTER.

BY

C. J. MAYNARD.

In winter, when many trees are destitute of leaves is a good time to study their forms, method of growth of the branches, twigs, and buds.

The following lesson is given in the form of questions, and is intended to set children to thinking about some of the common objects about them, and to aid in developing their reasoning powers. They are rather for children in from the sixth to the ninth grades, but may be modified, according to the teacher's judgement, to suit lower grades.

We shall be glad to receive articles from teachers by children who have answered these questions, and shall be pleased to print the best of these. This will serve as an incentive for children to do good work and will also aid other teachers.

In answering the questions, it is well either for the teacher to call attention to some typical tree of any of our common species, or for the child to find one, which may be convenient. It is best, however, to study a number of trees of the same species in order to select one which is typical in form and in habit of growth.

QUESTIONS.

1 What is the form?
2 How do the branches grow from the trunk?
3 Are they comparatively slender or stout?
4 Do the twigs grow upright or droop at their extremities?
5 Are the twigs numerous or scanty?
6 Is there any distinct difference in color between the trunk and the branches and twigs?
7 If so, what is this difference?
8 Can the yearly growth of the twigs be distinguished?
9 If so, how?
10 Are the latest growth of twigs different in color than older growths?
11 Are the buds large or small?
12 What is their form?
13 Are the scales which cover the buds plainly perceptible?
14 Are the terminal buds single?
15 What is the character of the bark when compared to that of other trees, rough or smooth?
16 Of what use is this tree?
17 Upon what kind of soil does this tree appear to thrive best?
Make a sketch of a twig with buds.

COMMENT AND CRITICISM.

"Nature Study has been shown to be useful as well as ornamental, practical as well as interesting, and is therefore sure to be as secure in the schools as penmanship. New York State has the honor of establishing the utility of this study. 'The Nixon bill,' as it is styled, provided for a state appropriation 'to promote the extension of agricultural knowledge,' and it was officially decided that this could be best done through Nature Study in the schools". (*Mr. Winship's Conversations in American Primary Teacher.*)

The agents in Boston for the sale of C. J. Maynard's books on birds and other scientific subjects, are Bradlee Whidden on Arch st. and W. B. Clark & Co. on the corner of Tremont and Park sts., under the Park st. church, and right opposite the sub-way entrance. Messrs. Dodd, Meade, & Co. Fifth ave., are the agents for the Maynard books in New York.

It gives us pleasure to refer to the announcement in this issue of the well known educational publishing house of D. C. Heath & Co. 110 Boylston street, Boston. Surely no teacher's list of books is complete, either in quality or variety, till Messrs. Heath & Co. have been consulted.

L. E. Knott, the well known dealer in physical and chemical apparatus, has lately enlarged his business by taking the entire building, in which before, he had two or three rooms on the second floor. This not only means success for him but much better facilities for teachers who are selecting apparatus. See his announcement.

It is exceedingly gratifying to one who understands the necessity of the introduction of Nature Study into our public schools, to note the many excellent articles upon these subjects which constantly appear in the several journals devoted to educational matters. In fact, it is doubtless largely due to these articles, that such rapid strides have been made in the last few years toward the introduction of these desirable studies into our schools.

It will be well, however, for the editors of these journals to exercise great care in selecting suitable authors to write articles upon Nature Study in order to prevent errors and misstatements.

It is painful for a scientist to note that such errors and misstatements do occasionally appear even in our best journals.

As an example of the truth of this statement, may be taken an article in a recent number of a well known educational journal. This article is entitled "Bird Talks" and in this particular number the junco or snow bird and downy woodpeckers are discussed. A very poor figure of the American redstart does duty for a "junco". Now as the redstart belongs to a wholly different family (the American warblers) than the junco, which is one of the great sparrow family, and bears not the slightest resemblance to the snowbird, any one at all familiar with birds will notice this error at a glance. While we think that it is far from a usual habit with snowbirds to feed with English sparrows, they may occasionally do so, and the author of the article may have seen them thus engaged, but we fear that there is some chance of misidentification, as the junco seen is described as having a "few dips of white on the end of his wing feathers." It is quite true that the junco has the outer tail feathers white, but there is never, in a normal specimen, any white on the tips of the wings.

Will any school boy who has seen a downy woodpecker, state whether the scarlet patch is on the top of the head as stated by our author, or elsewhere on the head?

We find it stated that the tongue of the downy woodpecker "can be thrust out several inches beyond the bill." Several inches must mean three, which is about the length of the body and neck of the downy woodpecker. As a matter of fact, by actual measurement, taken from a fresh specimen, now at hand, the tongue of the downy woodpecker can be protruded just a little over one inch and a quarter from the tip of the bill.

Nothing can be more obvious than the fact that it is not desirable for either publisher or reader of an educational journal, that such errors, of which the above are examples, be printed. No amount of fine writing will make up for such inaccuracies, for one of the first principles which should be taught in regard to scientific investigation, is care in recording facts.

It is well for teachers in working up science lessons for pupils, to use care in discriminating between what are given by scientists as probabilities only, and what are given as actual facts. In nine cases out of ten, a child does not remember that something is probably so, he remembers the main idea, and that is too often recorded as an established fact.

The third season of the bird classes, conducted by C. J. Maynard, has begun. Classes meet at the laboratory, 447 Crafts st., West Newton, twice a week, Wednesdays and Saturdays.

Ward's Natural Science Establishment.

The half page announcement of this old established firm should be consulted by our readers. The firm has the largest and best collection of rocks, minerals, fossils and animals to be found anywhere. Special attention is called to the Systematic Collections of this firm, illustrating in a progressive manner, the course of life from the lower to the higher animals. Write them for particulars and prices.

"Natural Science Readers."

We wish to call the attention of our readers to the advertisement of N. L. Wilson, found in another column of this journal; it will pay you to send to him for such specimens you may desire.

We will appreciate the mention of "Nature Study" by readers who have occasion to order of firms whose ads. appear in our columns.

We shall be glad to answer any questions upon scientific subjects which teachers and others may wish to ask.

Figure 17.

Bronze Grackle. Massachusetts.

BOOK NOTICES.

A New Bird Magazine — Bird Lore

We are pleased to note that the Macmillan Company are about to issue a new magazine devoted to the study and protection of birds. This is to be the origin of the Audubon Society. Although we have not seen a number of this magazine, we can with confidence assume its excellence, from the fact that Mr. Chapman, the well known author of the Hand Book of the Birds of Eastern North America is the editor. For particulars regarding this publication, which is called Bird Lore, we refer our readers to the advertisement which appears in this issue.

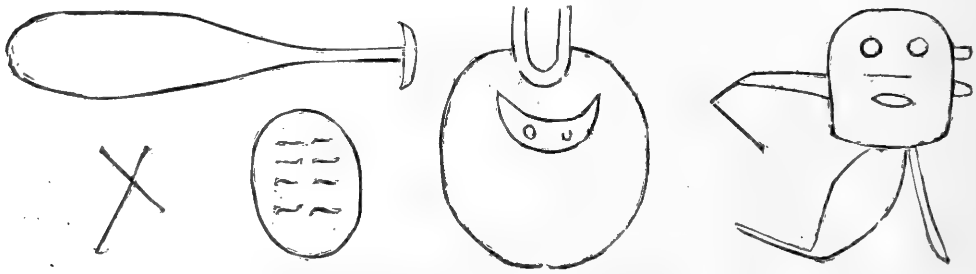
Since the above has been put into type we have received a copy of the first issue of Bird Lore. Its appearance and contents fully justify our anticipation of its excellence. We can cordially recommend it to teachers who are desirous of learning something of the birds. It is well illustrated with cuts made from excellent photographs of a number of species of birds.

Our Feathered Friends, by Elizabeth Grinnel and Joseph Grinnel. Boston, D. C. Heath & Co.

The above is the title of a very attractive looking little book, but unlike too many books, the beautiful covers are far from being the best part of it. This little volume is filled from begininng to end with exceedingly interesting stories of birds and their ways, all of which are quite true. We have read the book with care, and find no serious errors in it, and cordially recommend it to teachers, who wish a "bird reader" for their schools.

One of the best features in the book, and one which will recommend it to anyone who is interested in our feathered friends, are the photographs from life of the cedar bird and humming birds. The former named is very fine, but the latter named are rare gems worthy of the study of the professional ornithologist.

Figure 18.



Indian Inscriptions from cave on Rum Key, Bahamas.

Bird-Lore

An Illustrated Magazine Devoted to
The Study and Protection of Birds

EDITED BY FRANK M. CHAPMAN

OFFICIAL ORGAN OF THE AUDUBON SOCIETIES

Audubon Department Edited by Mabel Osgood Wright.

Nearly every prominent American writer on Birds out-of-doors will contribute to Bird Lore during the present year. The list includes John Burroughs, Dr. Henry van Dyke, Bradford Torrey, Olive Thorne Miller, Mabel Osgood Wright, Annie Trumbull Slosson, Florence A. Merriam, Edith M. Thomas, J. A. Allen, William Brewster, Henry Nehrling, Ernest Seton Thompson, and numerous other writers, known both for their powers of observation and description.

Contents of February Number

The unexpectedly large demand for the first number of Bird Lore renders it advisable to deliver the few remaining copies only to subscribers.

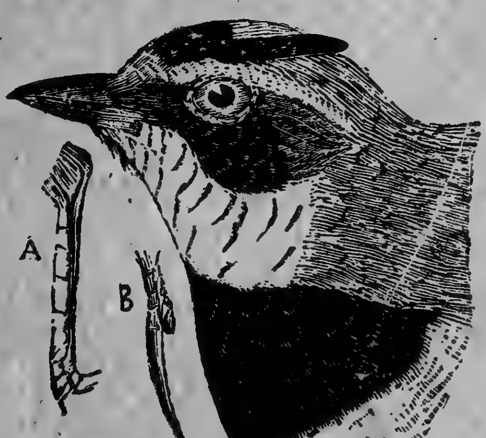
PRICE, ONE DOLLAR A YEAR

Subscriptions may be sent to
The Macmillan Company, 66 Fifth Avenue, New York City
or to the editor, at Englewood, New Jersey

NATURE STUDY IN SCHOOLS

Conducted by C. J. MAYNARD

Vol. I MARCH, 1899 No. 2



Shore Lark. A, tarsus; B, hind toe.

WEST NEWTON MASS.

C. J. MAYNARD

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NATURE STUDY IN SCHOOLS.

EDITED by *C. J. Maynard*. Published monthly.
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TERMS FOR ADVERTISEMENTS given upon application.

PLATE III.

EXPLANATION OF PLATE III.

Upper Figure, White-throated Sparrow.
Lower Figure, White-crowned Sparrow.

NATURE STUDY.

VOLUME I. MARCH, 1899. NUMBER 2

BIRDS OF EARLY SPRING.

BY

C. J. MAYNARD.

THE BRONZED GRACKLE.

Among the earliest birds to appear in Massachusetts from the south, if not the first, is the bronzed grackle, or, as it used to be called by the farmers of New England, (and in fact is still called) the crow blackbird.

In former days, when there were more farms in the vicinity of Boston than there are now, the crow blackbirds and the farmers were sworn enemies. The farmers declared, and possibly with good reason, that the crow blackbirds pulled up their young corn plants, thus thinning out their crops more than was necessary. In fact, it used to be a habit with the agriculturist to put two or three more kernels of corn in a hill than could grow to advantage, the extra ones being intended for the crows and crow blackbirds.

Looking back into the far away days of my childhood, this is one of the first birds that I remember, and it was on account of this very emnity which the farmers bore to them that the crow blackbirds became associated with my early recollections. One of the men employed by my father had shot four or five of them, and to please me, then a child of about three years of age, had given them to me to play with.

How well I remember the irridescent green and purple of the head, and bronze of the back! both distinguishing marks of this fine species. The long tail and generally trim form also attracted my attention.

Today, in the vicinity of Boston, the bronzed grackle no longer dreads the gun of the farmer's man. On the contrary, he struts with lordly ease over finely kept lawns, right beneath the windows of the residence of the owner, displaying his beautifully lustrous plumage, and uttering his somewhat rusty attempt at a song, all in perfect confidence that he is secure from harm.

The bronzed grackles now breed in pines and other evergreens, often in the yards of houses, but they have not quite learned to trust the boys (possibly with good reason) for they still place their nests high, on the very topmost branches, in some cases in trees that are fifty feet high. Here they build their large, rather clumsily constructed nests, which will contain from four to six pale, bluish-green eggs ,which are singularly marked with hieroglyphic-like figures in black and brown.

FIG. 18.

Bronzed Grackle, Massachusetts.

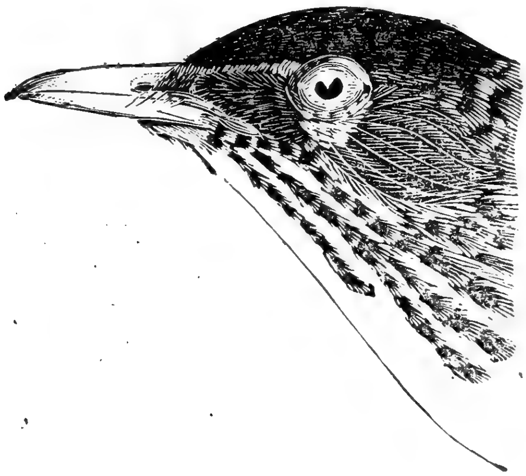
Success to the bronzed grackle! He has, like many another, out-lived persecution, whether just or unjust. Long may he live to dispute the grass of our lawns with the English sparrow.

The question I want to ask the children about the bronzed grackle is; in what form does he hold his tail as he flies?

THE ROBIN.

Next to the English sparrow, the most familiar of all our early spring birds is the robin. We call them early spring birds out of courtesy I presume, for although we see items in the newspapers every spring heralding the advent of the "first robin," the truth is, as many girls and boys know, that the robin is a constant resident in Massachusetts. That is, *some* robins remain all winter in the state. Of course the greater portion go south, and I have even heard the cheery chirp of the robin on Key West in winter, but the secret of the early coming of the robin, is, let us whisper to the newspaper men, that he has simply left his winter retreat, in some cedar swamp near by, and is out for a spring ramble.

FIG. 19.



Head of Robin.

Now about the nest of the robin; that is one of the most interesting parts of his history. How does he, or rather she, for the female does most of this part of the work, make such a structure? First, a platform of leaves, grass, and straw is made. On this is formed a cup-shaped structure of finer grass. Now the robin awaits a wet day, and we have plenty of these in April when the robin is building. Then the female brings mud in her bill, and plasters it all around the inside of the cup-shaped grass structure, pressing it outward and well into the grass with her breast, turning round and 'round in order that the inside may be properly formed.

A lining of grass is now furnished, and the eggs, usually four, as nearly every country boy and girl knows, are deposited on this comfortable bed.

It takes the robin about ten days to build the nest. It is allowed to dry three or four days. About five days longer are given to egg laying.

These hatch in from eleven to thirteen days. The young remain in the nest about two weeks before leaving it, nearly fully fledged, thus we have about six weeks between the laying of the first foundation of the home, and its final abandonment by the young.

My question in regard to the robin is; why do they put mud in their nests?

THE BLUEBIRD.

Our common bluebird is remarkable in several ways. It is usually placed by ornithologists in the great thrush family, but personally I consider that it should be separated from this family, and placed in one of its own, but grouped with an old word form, the Saxicolidae, or rock inhabiters.

My reasons for doing this are, first, that our bluebird and allied species differ in form and structure from the thrushes. The wings are longer in proportion to the body, the bill is proportionately shorter, the feet differently formed, the tarsus being more flattened than that of the thrushes, and the internal structure is different; the sternum of the bluebird is proportionately wider.

Second, as a group, the rock inhabiters have different habits from the thrushes.

Third, probably the most important reason of all, yet one which will not be so readily appreciated by ornithologists, who as a class are, I am sorry to say, not apt to give such matters sufficient thought, is, that the bluebirds belong to a far more ancient race than the thrushes. My reasons for this statement are based upon the following facts. Species in this group are not numerous, nor do they appear to be increasing. For example, we have three species only of bluebirds in America, and two so-called sub-species. In form, these three species are very similar, the differences between them being about wholly those due to color, or even shades of color. Individuals of the species do not appear to be very abundant anywhere in comparisons to members of the thrush family. New species and forms do not appear to be coming into existence, nor is there any great range of individual variation among the species. In short, the bluebirds are no longer a plastic race.

It is now a quite well established fact that species and groups among animals grow old and die, just as individuals do. That is, they have their seasons of youth, vigorous middle life and pass into the decrepitude of age. In youth, both species and forms often have to struggle for existence, and are then often not numerous as individuals, nor do they produce any species or forms, but this youth is indicated by a considerable amount of individual variation. In vigorous middle life species are often evolved rapidly by these groups and individual variation is great, although different in character from what it is in youth.

In the decrepitude of age, the groups, large and small, cease to be numerous as individuals, there is little individual variation and no species are evolved.

I believe that the bluebirds of North America have long passed the middle period of their existence, as a group, and that they are now in the decrepitude of age, for all of the conditions which indicate this, as seen by the foregoing, appear to be fulfilled.

Of course when we speak of the passing away of a group or species, we must consider this a very slow process, time must not be counted by years nor by centuries, but by decades and epochs. Thus, while we may look upon our bluebird as a representative of an ancient race, which has passed its vigorous stage of existence, in the common course of events, it will probably long be spared to gladden our fields and orchards with its cheery call.

I have given the above digression for the benefit of teachers and their pupils, for I feel that too little is known of such matters. We are apt to take too superficial views in teaching nature study in schools. We had better, perhaps, teach the facts in regard to the life history of one typical animal, than to attempt to teach about any animals in a superficial manner, for after all, it is the reasoning power of the pupil which we wish to awaken and develop, and this can be done in no better way than in nature study.

The bluebird is among the earliest to appear among our spring birds often being seen in Eastern Massachusetts during the last week in February, when the snow is still lingering in patches along the north sides of fences and walls, and in the wooded valleys.

I know of no more enlivening sound than the cheering whistle of the bluebird, for when this sound reaches the ear we may be sure that winter is in retreat towards the frozen north, and that genial spring has come. To be sure, this most fickle goddess may occasionally give way before the backward glance of winter, even allowing him to cover the earth with with his snowy mantle, but the bluebirds know that the sun rides high in the heavens, and that the snow will soon disappear before his rays. Spring soon asserts her sway, and early in the season the bluebirds begin to examine the natural cavities in apple trees, and those boxes put up for their use which are not occupied by the English sparrows.

There is most anxious research on the part of the female as to the condition of the cavity in which the nest is to be placed (it must be dry and sufficiently commodious to suit) and much wing fluttering and twittering on the part of the male, who accompanies her.

The domicle selected is completely furnished with a lining of fine grass, neatly arranged in the bottom of the hole, and on this bed the female deposits from four to six pale blue eggs. These are often laid in early May when the winds are often cold.

It cannot be said that the female bluebirds do not make every effort to keep their race exta nt, for they deposit from two to three litters of eggs in a season, and the fully fledged young may often be seen in June flying about in small flocks.

The whistle of the bluebird is not its true song. This is a call note. The true song is a kind of twittering warble, given as the bird is perched on the top of a fence, post, or in some similar elevated situation, uttered with fluttering wings.

In autumn, when the bluebirds gather in small flocks, they utter a shorter call note than in May, and this note is even given by the newly fledged young.

My question in regard to the bluebird is; why does it put its nest in a hole?

INSECTS IN WINTER.

BY

HARRY H. WHALL.

(CONTINUED)

THE YELLOW-STRIPED LOCUST.

The thorax is divided into three parts, the prothorax, the messothorax, and the metathorax. The prothroax, that next to the head, to which the first pair of legs are attached, partly covers the other parts of the thorax, acting as a shield, it being much harder. Then comes the messothorax which bears the second pair of legs and the wing coverts. Then following this is the metathorax which bears the long leaping legs and the wings. The prothorax moves freely, being apparently only connected with the middle segment, or mesothorax, by soft skin, while the messothorax and metathorax, the second and last segments, are quite hard to separate, and more as one body. The wings are membranous expansions which ore very different in aspect from the body walls, but by some authorities, are considered to be folds of the skin which have grown out from the tergal portion of their respective rings. In the young locusts they are mere pads, the veins are mostly hollow, although some of them contain tracheae. One peculiarity of this insect is the fact that its wings are reversed, that is to say the wing coverts are folded in under the wings, which as the insects reach maturity, gradually change about and the wing coverts, become hard and form a protection, to the true wings, which in turn become quite delicate.

The abdomen of the female is longer than that of the male. The first eight rings can be easily counted, but the ninth and tenth are fused together. On each side of the abdomen the skin is turned inward, forming a longitudinal fold which separates the upper part of the ring from the lower; just above this fold, on either side, are the breathing holes, or spiracles. Each spiracle is a slit-like opening surrounded by a horny ring, and is situated on the anterior portion of the segment.

FIG. 20.

Milbert's butterfly, Vanessa milberti. A butterfly which hibernates.

HIBERNATION OF ANIMALS.

BY

C. J. MAYNARD.

Although the term to hibernate, according to the dictionaries, is applied to animals which pass the winter in close quarters, whether they remain dormant or not, such is not the sense of the term usually understood by Zoologists.

The term hibernation should be applied only to such animals as pass the winter in a dormant (lethargic) state and without taking food. In many cases, probably always among vertebrates, there is a quantity of fat stored among the intestines and other internal organs. This fat furnishes nutrition for the animals during their long winter sleep.

Among the lower animals, few hibernate. Hydras, jelly-fishes and star-fishes retreat into deep water, but are more or less active all winter. Marine worms do not appear to hibernate, and while leaches and earth worms retreat below the reach of ice and frost, the former named, into the mud, and the latter, into the earth, I do not think they are wholly inactive.

Among mollusks, we find that land snails in the north pass the winter in a state of inaction which is true hibernation. The animals retreat within their shells and form two or three doors to the entrance, one behind the other. These doors are formed of a kind of mucus, secreted from glands in the head of the mollusk. I have found the land shells as far south as Southern Florida, thus hibernating, and in the West Indies they do the same thing.

Few, if any crustaceans, hibernate. Among the insects some beetles, butterflies, and bees hibernate, as will be seen upon consulting an article on another page upon this subject.

Among vertebrates, we find some fishes passing into deeper water, but it is highly probable that none hibernate.

The same is true of frogs, toads, and salamanders. None of these animals are as active as during warm weather, but I do not think that any of them hibernate.

All snakes, on the other hand, do hibernate in cold climates. There is an accumulation of fat about the intestines during autumn, upon which the snake subsists in winter. The animals crawl into some sheltered place like a heap of stones which extend some distance into the earth below frost, and then pass the winter in a dormant state.

If by chance a snake becomes frozen in its retreat, it probably dies. Such at least has been the fate of snakes that I have kept in confinement, when even slightly frozen. Turtles are more or less active.

Lizards and alligators hibernate in cold climates, the latter named lying buried in the mud.

No birds are known to hibernate, although swallows were once supposed to do so.

Some mammals hibernate. Among rodents we find that little animal with a reddish yellow back, and very long tail and hind legs, known as the jumping mouse, hibernating. The mouse burrows down into the earth below frost, and then makes a large, round nest of grass, pieces of fibrous bark, etc. In this nest it goes to sleep and remains in this state all winter. I once dug a jumping mouse out of a sand bank in winter. Upon removing the little animal from the nest, I at first thought it was dead, for it was quite motionless. Upon taking it into the house, however, it slowly awakened, becoming as active as in summer, but when placed in a cool room immediately returned to its dormant condition. In fact, if left to itself, it immediately tried to get into a cool place where it would curl itself up and become dormant.

The woodchuck accumulates fat in autumn, and entering its burrow before the ground freezes, stops up the entrance and hibernates all winter.

The chipmunk stores food in its burrow in autumn upon which it lives, and although it seldom comes out, is active all winter.

All of our other native squirrels are active all winter and during the cold weather, they may be often seen running about on the snow.

Rabbits are also active and the same is true of shrews and moles.

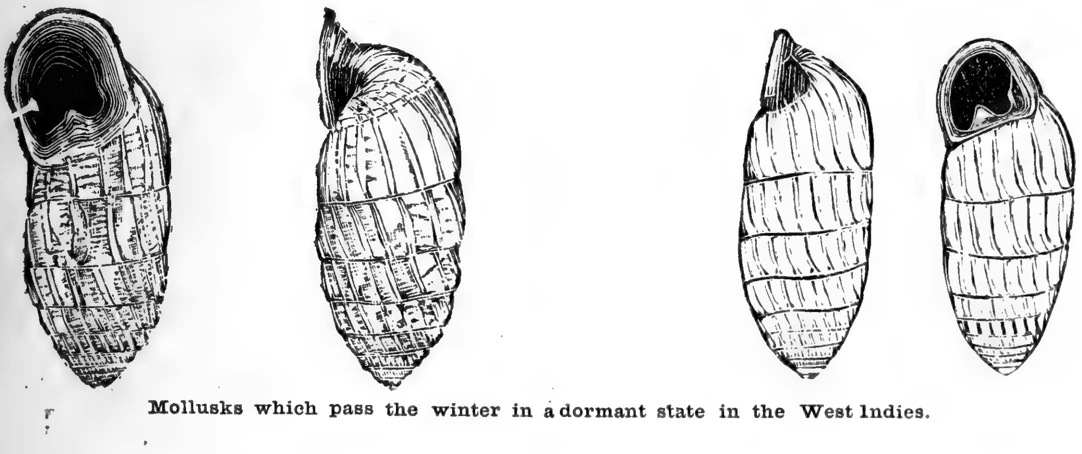
Bats, which were once thought to hibernate, are now believed by naturalists to migrate like birds to a warmer climate. They are continually active in Florida all winter excepting on very cold days.

Although skunks are inactive during very cold spells in winter, they never actually hibernate, for they leave their burrows when there is a thaw. Tame skunks which I have had, while they appeared very drowsy in very cold weather, could always be awakened by handling.

Among common mammals, bears are well known hibernators. They accumulate a vast quantity of fat in autumn, then enter some secure, sheltered place, as in rocky caves, and there pass the winter. Tame bears when kept in a cold place will also hibernate.

Raccoons, although closely allied to the bears, do not hibernate, but are not quite as active during extreme cold weather as on warm days.

FIG. 20a.



Mollusks which pass the winter in a dormant state in the West Indies.

EXPERIMENTAL LESSONS.

[NOTE. Teachers sending articles to be printed under this head, will greatly oblige if they will let us have them exactly as they are written by the pupils in their final copy, without change of language of any description.

We have three reasons for asking this; — first, in order that other teachers can judge of the quality of work done by their pupils, in comparison with the work of others, in the experimental lessons.

Second, that the pupils themselves may be benefited by seeing their articles printed verbatim, for errors in language become much more apparent when put into type than when written.

Third, because we think that much of the charm of the work done by children, lies in their method of expression, and this method should, we think, be encouraged, for it leads to an originality in writing which is certainly desirable.

We intended that this introduction to experimental lessons should have appeared in our first issue, accompanied by the statement that all of the children's work in that issue was printed verbatim, but it was overlooked until it was too late.]

LESSON ON A GRAY SQUIRREL IN A KINDERGARTEN GRADE.

BEACHMONT, MASS.

BY

LILLIAN A. YOUNG.

The children of the kindergarten were intensely interested in the lesson on the squirrel which I gave to them.

Stories about squirrels were told, songs were sung, and our talk continued for one hour, showing unusual interest for such young children.

The general impression, among the children, was that the squirrel lives in a hollow tree. One song, "Little Squirrel living there in the hollow tree," was quoted, and much surprise was manifested when they learned that our common gray squirrel generally builds a nest of twigs. His manner of gathering green twigs, and of making his nest was described to them.

The squirrel's resemblance to other common animals was noticed. As the horse had been our subject of study for the previous week, it was the first thought of the children to compare it with the squirrel. The life of "Black Beauty" and "Ginger" had been vividly described and it was decided that "Mr. Squirrel" must be like "Ginger" because he is apt to bite. One child said that the squirrel is like the horse because he has four feet; he does not make so much noise with his feet, for he is so much smaller and he wears no shoes.

It was also suggested that his face looks like a rat's, and that he has claws like a cat's. We found that the claws are used to aid the squirrel in clinging to the branches of the trees.

We carefully examined the specimen we had, and discussed its characteristics and its manner of living. Much interest was shown in discovering the reason for its bushy tail and its whiskers. I asked one of the children to walk on a crack of the floor. In doing this, the child's arms were naturally extended, and on being questioned as to the purpose of holding his arms in that position, he replied, "I will fall over if I don't."

I then explained that the squirrel's tail serves to balance him when on the branches of trees, and also acts as a parachute when he jumps.

To make the use of the whiskers more clear to the children, I asked a little girl to close her eyes and walk across the room. She held her hands before her as she walked, so that she might feel her way. We then learned that the squirrel's whiskers are his feelers, and are very necessary for him to measure the size of the holes in trees which he wishes to enter.

His ears are small so that they will not hinder him in entering holes.

The color of his eyes was questioned; his mouth and teeth were noticed. We found that he has four teeth in front; two on the upper jaw, and two on the lower. These teeth keep growing continually, therefore it is important that the squirrel should have a generous supply of nuts to gnaw. His back teeth were mentioned, also his manner of carrying nuts in his mouth.

Almost all the children had seen a squirrel in a cage, and had noticed his position when eating nuts. This position of the squirrel was compared, by one child, to that of a dog while gnawing a bone. The child said, "Mr. Squirrel sits up and holds his nut with his feet, but 'Biz' lays his bone on the ground and puts his paws on it to hold it."

I told the children that the squirrel barks like a tiny dog. It was amusing to hear them attempt various imitations.

Since the gray squirrel remains active all winter, we found that his fur coat is needed to keep him warm. One child thought that he resembles Santa Claus because he wears a gray fur coat.

Unfortunately for the children, there are no squirrels in the trees at Beachmont, but through stories, they have become greatly interested in a squirrel which is frequently seen near my home, and the stories about him are often repeated.

LESSON ON THE WHITE PINE IN AN EIGHTH GRADE SCHOOL.

BY

M. EVA WARREN.

I gave my class a lesson on the white pine, and later the children wrote an exercise upon this lesson. The following paper is one of the set.

THE WHITE PINE.

The pine tree is an evergreen. It is cone-shaped, the branches being longest at the bottom and growing shorter as they go to the top.

The roots are multiple roots. They grow very near the surface of the ground. That is why so many pine trees are blown over.

The trunk is large at the bottom and small at the top. The average height of the trunk is from seventy to one hundred and eighty feet, but it has been known to grow as high as Bunker Hill Monument. The trunk is very straight. They are the tallest trees we have. The trunk is used for making boards and masts of ships.

The branches are arranged in whorls. There are usually five in a whorl. Each whorl shows a year's growth. The bark is very smooth on young trees. It is a grayish color. Some of the lower branches do not get sun enough and they die and drop off.

The wood is white. There are little circles in the wood and each circle shows a year's growth. The wood is used for floors and inside finishing.

The leaves are green and are shaped like a triangular prism pointed at the top. One side is dark green and the other two are lighter green. One side rounds out, and the other two curve in. The light green sides have white lines running through them. If you look through a microscope they would look like a line of white dots. There are five leaves in a bunch and the bunches are arranged in spirals around the branch.

The cones are dark brown underneath and light brown on top. The light brown forms a triangle on the scale. The cone is large at the top and small at the bottom. It is made up of scales arranged in spirals. The scale is to protect the seed and the wing. The cone is found on the second year's growth back. The seed is to be blown round and make more trees. The wing is to help carry the seed, and to act as a little sail.

The little buds are green, and are found in whorls at the end of the branch with the largest in the middle.

LESSON ON CORAL IN NINTH GRADE, WILLIAMS SCHOOL. AUBURNDALE, MASS.

BY

JOHN O. GODFREY.

A lesson upon coral was given to the pupils of the ninth grade, Williams School, Auburndale. Average age of pupils, 14 years, 5 months.

Specimens were at hand, and the pupils were deeply interested in the lesson. Not a point was given which was possible for them to find out for themselves.

The next day the class made drawings, and wrote upon the lesson.

The following papers are from the set, and are as they came from the pupils.

CORAL, BY HARRY MABREY.

Coral is formed by little marine animals, called polyps. Some people call them insects, but they are much lower in the scale than insects are. Coral is the skeleton, the framework of the polyp. An island built of coral is a colony of these animals.

FIG. 21.

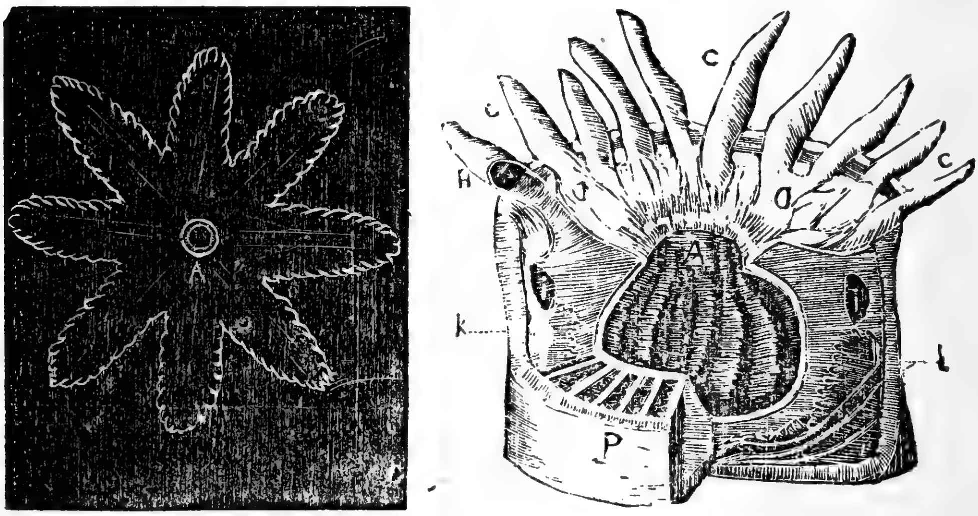


Fig. 1. Eight armed, fringed polyp of a gorgonia, Plexaura. Fig 2. Dissections of an anemone, essentially similar to a coral polyp; c c c, arms or tentacles; A, mouth, below which is the cavity of the stomach; D, body; B, opened tentacle, the arrow showing direction of water into the interspaces; k k, the water flowing from one to the other through the openings, i i.

A polyp is somewhat cylindrical in shape, with tentacles, or arms, radiating from the upper surface, as petals do from the centre of a flower. It has a mouth in the centre of the top.

The tentacles are used in breathing and gathering food. The food of the polyp is constantly floating about in the water. When anything eatable is floating near, he finds it out by a kind of sixth sense, a combination of all the other senses.

From each tentacle issues forth a number of fibers with rings on the end called lasso cells. Whenever these cells touch any living thing, it becomes paralyzed. The lasso draws it to the tentacle, which throws it into the mouth, from which it passes through a short gullet to the stomach.

Water passes in through the tips of the tentacles, carrying air with it, into a partition between the stomach and the next partition, which is divided into a great many cells. Each of these cells has a window on each side. As the water passes through these cells, it bathes them. It is discharged through the mouth, as are all substances which cannot be digested.

Sea water must consist of everything from which land is made up of, because the rivers flow through all kinds of soil, and carry a certain amount of it with them to the sea. Among the things thus collected is carbonate of lime, of which coral is made. The polyps collect this from the water and secrete it.

A great many years ago, a great glacier extended all over New England, and as far west as Cincinnati, Ohio. This glacier was about six thousand feet deep, as it did not quite cover Mt. Washington.

In the summer, when the glacier began to thaw, it naturally flowed to the place where the land was the lowest, the basin of the Mississippi. At this time the great river was about ten times as wide as it was formerly.

At any time the Mississippi carries a great amount of sediment with it to its mouth, but at this period it must have been very much greater.

When this sediment reached the Gulf of Mexico, it collected there at first, but the Gulf Stream soon began to wash this eastward until it collected at last where the Bahamas now are. The polyp will not live in water, deeper than one hundred and fifty feet.

The polyps grow in the form of a circle or ring, flat on top first. The mud kills the polyps, and as it kind of hollows in the middle, the mud collects there and the island reaches the water in the shape of a ring, the inner part of which is called a lagoon, and affords a safe harbor. The lagoon always has an opening.

The next thing to consider is the vegetation of the island. The first form which appears is the mangrove. In March a flower appears and soon forms into a fruit. The fruit takes over a year to mature. In May or June it drops off, when the sea is calm and floats to some land, where it takes root and grows. Next comes the cocoanut, and perhaps the birds drop some seeds. Some of these islands are inhabited. A striking instance of this kind of island is Whitsunday Island in the Pacific Ocean.

Coral, by Margaret L. Kingsbury.

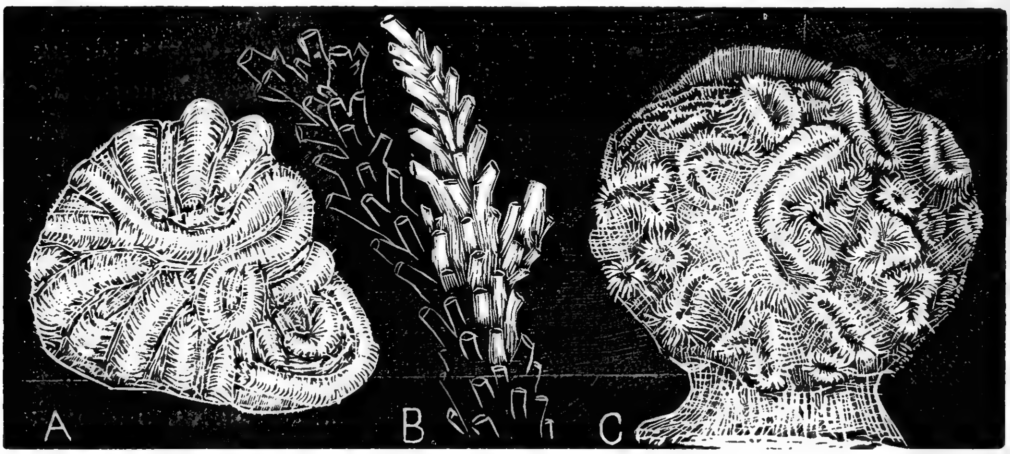
The coral is the bony frame of the coral polyp, and may be properly called the skeleton of the polyp.

The coral polyp is somewhat like a jelly-fish, but is very much smaller, sometimes not being larger than the head of a pin. The structure of the polyp consists of a cylindrical, or sack-like, membrane attached at the bottom, to some solid body, and inclosing a second sack, which forms the stomach.

At the top is an opening, or mouth, which is surrounded by thread-like organs, called tentacles. They are all hollow, and open into the body, which is also hollow.

The polyp gets its food by these tentacles in this manner; there are always things floating around the water which they can use for food. By the sixth sense they know when it comes within their reach, they then reach out a little feeler from the tentacle nearest the object, and in a sense paralyze it, grasp it and throw it into its mouth, from whence it passes into the stomach.

FIG. 22.



A, Erain Coral, B, Branching; E Elliptical.

It breathes by passing water into a cavity, next to the outer skin of its body, which is divided into partitions, all radiating from a common centre; the air which the water carries is passed from one little room to another and enables it to breathe.

The coral does not grow in water over one hundred and fifty feet deep.

The polyp is always taking in carbonate of lime, which passes through them, and goes to build up the skeleton to which they are fastened, and which grow until they reach the top of the water, when they die, for coral polyps cannot work out of water.

As the growth of coral becomes larger, the polyps on the outside become stronger than those inside, the latter ones die, and the coral sinks in the middle so much that when it reaches the surface, it is usually in the form of a broken ring, numerous channels affording entrance into the lagoon, such a group of islands is called an atoll.

The first tree that grows on this island is the mangrove: it takes a year to mature the fruit of this tree, which can only live where it can touch the sea water; the fruit then drops off, having formed little roots on it, and floats about on the water until it finds a place to grow in. As the island gets covered with these trees, the ones inland die, because they cannot be near the sea, and then birds drop seeds, and other trees start, among the first of which are the cocoanut trees.

NATURE LESSONS IN A THIRD GRADE, WILLIAMS SCHOOL.

AUBURNDALE, MASS.

BY

AMY H. BATEMAN.

This little story of the sponge was written a few days after the regular lesson, in which a little story of the sponge by Miss Laura Richards had been read to the class. It is partly a reproduction. Most of it is uncorrected.

In the stories of the pebble, which are uncorrected and original, I merely suggested that the class imagine that they were pebbles, and telling the story of their lives.

THE STORY OF A SPONGE, BY LESTER WALLING, AGE 8.

"Oh dear," said the sponge as it lay in the bath-tub.

"What is the matter?" said the bath-tub. "Has nurse squeezed you too hard?

"Well I have been squeezed a little harder than usual, but then I did not sigh for that," said the sponge.

"What is the matter, then?" said the bath-tub.

"I was only thinking of my old home," said the sponge.

"Your old home" said the bath-tub, "I thought this was your home."

"My home," said the sponge, was on a large rock on the coast of Syria. My mother laid five eggs some pink and some white.

When we are ready to come out a little fringe came on the outside of the egg.

"Then the mother knows that in a few days her babies will be out."

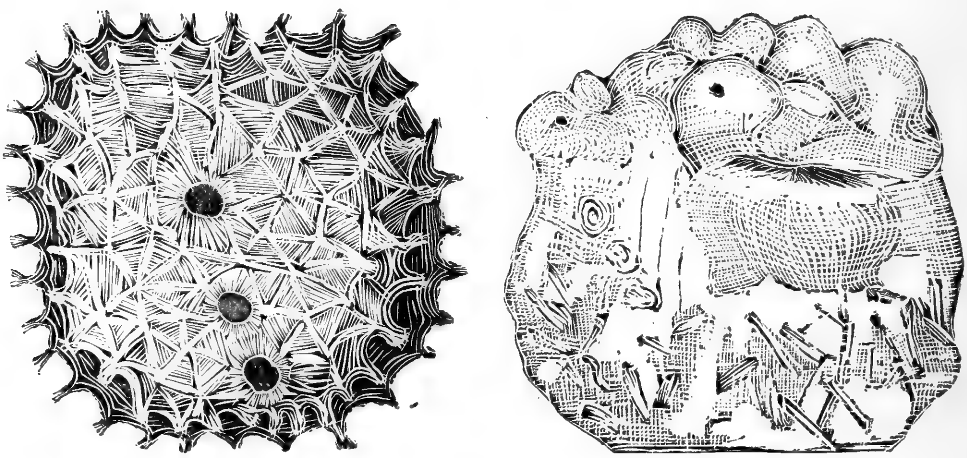
"At first when the baby sponges come out of their eggs they will not let their mothers out of sight, but when they are older they will swim away and she may never see them again," said the sponge.

I would sit on my rock and draw in the pleasant water through the small holes and let it go out through the larger ones," said the sponge.

I could not eat through all these holes for these were filled the earlier part of my life with a sort of jelly. I am nothing but a skeleton of a sponge.

I had a baby sponge who built his home on the shell of a crab.

Fig. 23.



Sponges. A, Loggerhead; B, Scarlet.

And as the crab was not a bad old fellow he often passed my home, and we often had pleasant talks together.

One day when the crab and I were talking together, we saw a large fish coming towards us. It had two long feelers coming out from its head with five claws at the end of each, and two more coming out from its body, though I have learned since that two of these feelers are called arms and the claws are fingers.

This fish had in her claws a thing that glittered.

When the crab and my son saw this big fish the crab ran off as fast as his legs could carry him."

"But," said the bath-tub, "if you were on your rock how did you get up here?"

"Wait," said the sponge, "and you shall know that.

For I was fastened to the rock and could not move."

This fish took his knife aud cut one by one my delicate fibers, the big fish put me into his bag and the fish took me on land and bleached me and put me into a box and nurse bought the box with myself in it, and that is how I came here."

THE STORY OF A PEBBLE, BY MIRIAM FULLER, AGE 7.

I was once a piece of a large rock by the side of a river.

There were some large cracks in the rock and the water ran into them.

When it was with winter the water froze, and as water when freezing grows larger the ice split the rock in two, and little pieces broke off and fell into the stream, and I was one of them. The stream carried me along a little way then threw me on the bank.

A great many years afterwards the stream changed its bed and took me on to the sea.

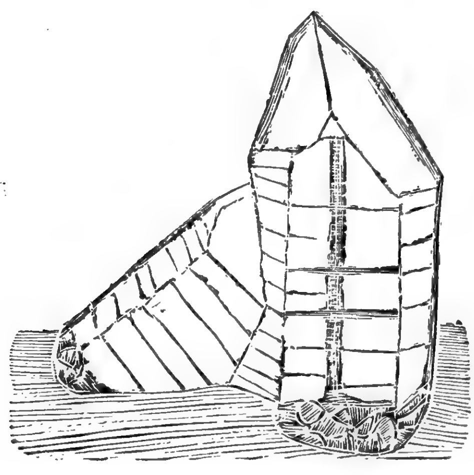
THE STORY OF A PEBBLE, BY CLEMENT NILES STANDISH, AGE, 8

A great many years ago I lived with my father and mother. One day a storm came and it washed against me and before I knew anything I was on the sand. I felt very rough but my brothers and sisters were smooth and I thought I would like to be smooth like them.

Years went by and I began to grow smaller and smaller. Then I felt of myself and I was smooth. I was washed ashore.

One day I was lying there a little girl picked me up and threw me into the water thinking that I was not pretty enough. In two or three days she came and picked me up again and took me home.

FIG. 23a.



Quartz crystal.

SYSTEMATIC ZOOLOGY FOR TEACHERS.

BY

C. J. MAYNARD.

(CONTINUED.)

CLASSIFICATION.

In order to teach intelligently any branch of nature study, especially in the animal and vegetable kingdoms, it first becomes necessary to understand the terminology of classification, or in other words, the names of the groups into which plants and animals are divided by systematists. It is also necessary to understand the relationship which each of these groups bears to the others.

TERMINOLOGY OF CLASSIFICATION.

The names of the various groups of plants and animals vary somewhat with various systematists, but the following names will be found sufficient to indicate any particular group, especially in the animal kingdom.

KINGDOM, ANIMAL.
BRANCH, METAZOA, MANY-CELLED.
PROVINCE, VERTEBRATES.
CLASS, BIRDS.
ORDER, SINGING PERCHERS.
FAMILY, THRUSHES.
GENUS, TRUE THRUSHES.
SPECIES, AUDUBON'S THRUSH.
SUB-SPECIES, HERMIT THRUSH.
INDIVIDUAL, A SINGLE HERMIT THRUSH.

RELATIONSHIP OF GROUPS.

In order to ascertain the relationship which one group bears to another, we will take some animal, a bird for example, and trace it through the series.

Clearly, of the three Kingdoms which we have, the Bird belongs to the Animal. Hence there is no difficulty in deciding, for in most cases the differences are very wide. We thus place our Bird in this great division.

Next, to what Branch does it belong of the two, the one-celled or many-celled animals? There is still no difficulty in deciding, so we place it with many-celled.

Of Provinces we have several, but still as we know that the Bird has a back bone, we at once place our Bird with the Vertebrates.

Of the Classes in Vertebrates, Fishes, Batrachians Reptiles, Birds, and Mammals, we unhesitatingly place it among Birds.

Next comes Order. As there are over twenty Orders among Birds, we might be puzzled where to place our Bird, were it not for the fact that we find that it possesses two characters not shown by Birds in other Orders; namely, it has three toes in front and one behind, and the hind toe is level with the front toes. Thus it is a Percher, and we will suppose that by dissection, we learn that it has a complicated singing apparatus, so we do not hesitate to place it among the Singing Perchers.

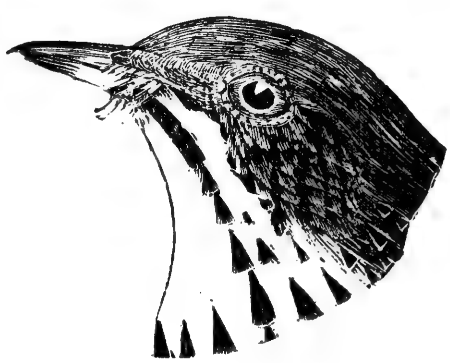
To ascertain to what Family it belonged, would require a little knowledge of ornithology, but its well proportioned form, and above all, the fact that its tarsus had one unbroken scale from the heel very near the toes, would lead us to consider it a Thrush.

Genus next. An American Thrush, brown or brownish above, with spotted breast, must belong to the True Thrushes.

Species. To determine to which Species of Thrush the Bird belonged, requires still more knowledge of ornithology, but if we examine it, we find that it is tawny above, with a reddish tail. When we come to consult the ornithologies, we find that this one of the Hermit Thrushes.

Sub-species. Further examination of the books, shows us that there are three forms of Hermit Thrush, differing from one another in comparatively

FIG. 24.



Head of Hermit Thrush.

minute particulars. Two of these are found in the West, and one has a very rufous tail (the Dwarf Hermit Thrush) and another, a rather dull rufous tail (Audubon's Hermit Thrush) while a third form, which occurs in the East is about intermediate between the two others in regard to the color on the tail. As we know, our Bird comes from the East, from New England, in fact, and as it answers to the description given of the third form, we readily decide that it is a Hermit Thrush.

Now if we could see a large number of these three forms of Hermit Thrushes together, taken from different localities, we would probably find that there were a number of these which presented intergrading phases of coloration, and which we could not exactly refer to any of the three forms. These would really be intergrading types, and where such intergrading specimens occur, we know that they indicate that the forms between which they are intermediates, have not become wholly separated from one another in the progress of evolution. Hence we call forms which still have these intergrading birds Sub-species.

Below Sub-species are Individuals. Our Hermit Thrush is an Individual, and is unlike any other Hermit Thrush, for there are no two Hermit Thrushes alike, any more than there are any two men or women who are exactly alike.

EVOLUTION IN NATURE.

We have seen that no two Hermit Thrushes are alike, and this is also true, to a greater or less extent, with all natural objects about us.

The rule then is, that nature never casts anything twice in the same mould. No two things are alike throughout the universe, not even two leaves on the same tree, nor two blades of grass in a wide prairie. No two grains of sand on the seashore, nor any two of the vast herds of antelope that roam the plains of Africa are alike. Similar to others, they may be but, differing in some particulars, minute though they be. Thus from atoms to mighty suns, individuality is the rule, all differ and all are constantly varying. The child is never, in any case, the exact counterpart of either parent, nor are children of the same parents exactly alike.

This individual variation, small though it may be, strikes the key note which vibrates through all of the universe, and is the undoubted origin of all the varied forms of animal and vegetable life.

Let one or more of the offspring of any one species of living organisms be placed under different surroundings from those of any form in which its parents lived, either climatic or otherwise, and the individualism usually increases, especially in its offspring, in the second generation, this variation is more pronounced, and in the third, still more, and so on, until at length this individual variation has become so great, that we are forced to consider the form, which has become separated from the parent stock, as a sub-species, and this, in turn, in progress of time, becomes a species.

Thus one species of animal, or plant, has become derived from another.

This is evolution, and this undoubted method of the derivation of species and higher groups, among living organism, is now recognized by nearly, or quite all, naturalists throughout the world.

GEOLOGY FOR SPRING.

GRANITE, SANDSTONE, AND LIMESTONE CONSIDERED.

BY

WM. D. MACPHERSON.

The beginner in any science is nearly always bewildered by the vast array of facts or specimens that science presents to him, but a teacher should always aim to show how really simple geology or zoology is when we get at the few fundamental facts. More definite knowledge later, as the study is pursued, brings us all the array of facts that first startled us.

Nothing is more confusing for a beginner in the study of geology, than to go through a first class museum and see ten thousand specimens of rocks of all colors and forms. He at once says, "I can never learn all that."

In the present article, for instruction sake, I intend to take just the other extreme, and tell my readers that there are only three kinds of rocks in the world, and all the great variety we see are modifications of these three. That's simple, surely.

You have all seen granite, slate, and marble. Well, there are innumerable kinds of granite, as many modifications of slate, and an endless variety of organic marble and rocks, so that is how the museum gets all its variety and numbers.

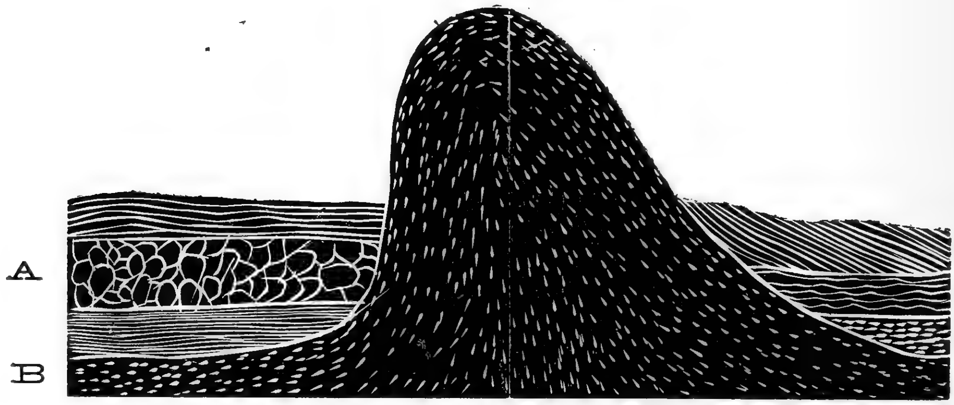
Any boy or girl of ten years, can find quite readily a chip of granite, a pieceof slate, and a piece of marble, and these three rocks will form our museum for the present. Instead of a hurried survey of a hundred rocks, we will learn a score of facts about these three rocks.

We consider granite here in a very broad and general sense. The student will later learn the importance of such rocks as gneiss, diorite, diabase, etc., which form so much of the earth's crust, in association with granite.

Starting from the granite crust of the earth, so to speak, it is quite easy to comprehend how other rocks were built up upon that. The first land that slowly rose from the primitive ocean, was granite, an erupted rock. As the barren rock towered above the sea, it was fiercely attacked by the wind and rain, and the powerful, grinding waves. Soon a part of the rock was ground to sand and mud, and then we had the second kind of rocks in the world, sandstone or slate, for sandstone is nothing but hardened and compressed sand of the seashore. While this grinding action was going on, there came to be corals and other lime secreting animals, out in deeper water. These little soft polyp animals had the power of extracting the lime or calcium (carbonate) that is in solution in the sea water, and making hard, limy skeletons of it.

These animals were so numerous that vast quantities of lime rock were thus built up. These three rocks, the granite, an erupted rock, the sandstone, an aqueous or stratified rock, and the limestone or marble, an organ-

FIG. 25.



A, Stratified rock; B, granite mountain from which the stratified rocks came.

ic rock, are the principal rocks, composing the earth's crust. All others may be considered as modifications of them. A good way to understand stratification is to fill a bottle half full of sand and pebbles, pour water in till the bottle is full, then close and shake violently. On resting, the pebbles at once sink to the bottom of the bottle, the larger grains of sand next, then the smaller grains, and lastly, the very fine sand and mud will settle. This happens at the seashore. At Crescent beach for example, we first walk down a banking of rocks and boulders, then we come to the pebbles on the beach, next, and nearer the water, we have sand, and out in deep water, mud.

Geologists are thus able to trace out ancient beaches, and if they find, for instance, some very fine grained slate, they conclude that it was formed in deep water. The famous trilobite slate quarries at Braintree, Mass. were thus formed in deep water, and are so ancient that they rest almost on the original granite rock, though of course they are considerably younger than the first granite.

(TO BE CONTINUED.)

BOOK NOTICES.

BIRD WORLD, A BIRD BOOK FOR CHILDREN, BY J. H STICKNEY., ASSISTED BY RALPH HOFFMAN, BOSTON, GINN & COMPANY, CLOTH, 214 PAGES.

This pleasantly written little book is intended as a bird reader for schools. The stories contained in it are well told, and will prove highly interesting to children. The facts are in the main correct, but we would suggest that the plaintive notes spoken of on page 5, in a foot note, were not those of the phoebe, whose oft reiterated call is energetically given, but those of the wood pewee, which are notably plaintive. We wish that the plate of the barn swallow, following page 84, had been omitted, pretty as it is, for it is misleading, as it represents these swallows as nesting beneath eaves of a building, which is the habit of a wholly different species, the eave swallow. The nesting habits of the barn swallow are correctly given on page 86, as inside a barn or other out building.

We fear that the oven bird will fail to meet our summer yellow bird, tanager, and oriole, in the West Indies in winter, as stated on page 147.

Nature study books for schools should, above all, be accurate, and a little attention to details would prevent misleading statements such as we have pointed out.

The story of the nesting of the yellow-throated vireo is delightfully told and is admirably calculated to arouse the interest of children in the protection of birds. In fact, the whole tone of the book is one which will foster the love of birds in children.

The colored figures of birds, and the many beautiful cuts will add much to the attractions of this book, and we should like to see it upon the desk of every second and third grade teacher. Stories selected from it and read to children will prove very instructive to them.

THE COLLECTOR, A HISTORICAL MAGAZINE FOR AUTOGRAPH AND HISTORICAL COLLECTORS, NEW YORK, WALTER R. BENJAMIN.

The March number of this magazine has been received. Among articles of interest to the historian is the continuation of the Diary of John Fitch, who was an officer in the American army during the Revolution. He was captured by the British on Long Island, and confined, with others, on a vessel, which was lying in Flat-bush Bay. This diary is exceedingly interesting, as illustrating the condition of prisoners of war in those days. The date of the resumption of the diary is September 8th, 1776, and continues each day until the 23rd of the month.

COMMENT AND CRITICISM.

In reading bird books, which are written in a popular style, we often find some particular species of bird spoken of as a "cousin" of some other closely allied species. For example, the jay is called a cousin of the crow, and the bluebird is spoken of as the cousin of the robin. A moment's reflection would show the author of such a book that no such relationship really exists between such birds, and that such statements, although possibly pleasing to children, are inaccurate.

We are frequently asked by teachers and others who are studing birds, where they can procure good field glasses. Mr. Andrew J. Lloyd, the optician, on Washington St., Boston, is a bird student and keeps a special line of field glasses, well adapted for the use of bird lessons.

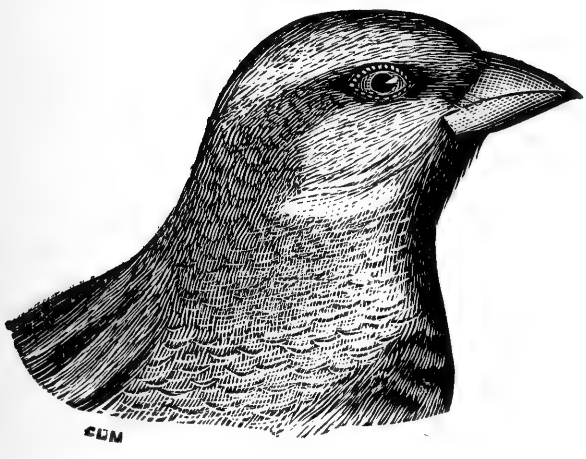
In view of the fact that the English sparrow has been a prominent object of comment in the daily papers of late, especially in the vicinity of Boston, we feel impelled to say a few words upon the subject.

While we do not advocate the extermination of any species of animal, we think that the sparrow in question should not be allowed to increase unduly. Some means should be devised to prevent its further multiplication.

No trained ornithologist, who has given the matter the proper amount of attention, thinks the English sparrow of any benefit to the agriculturist. In fact, the sparrow had an impartial trial by the Agricultural Department of the United States government a number of years ago, and was condemned by overwhelming testimony.

Over twenty years ago, we ventured to predict that the introduction of these sparrows would prove a mistake. It is a well known law in nature, that when any section of country is thoroughly occupied by any one species of animal, that other species having similar habits, will not venture to encroach upon this occupied territory. Thus it is, that the sparrows, being constant residents, have, not by force of aggressiveness, but by simpl possessing the ground, driven out those of our native species of birds, which nest in holes and boxes, such as the white-bellied swallow, purple martin, wren, and bluebird. This danger we foresaw, and it requires very little foresight today to see that this danger will increase with the increase of the sparrow. Apparently laudable sentiment, which is so loudly calling for the protection of the sparrow, is a mistake made by those who do not properly understand the true merits of the case. We say most emphatically, and in so doing, merely echo the opinions of every thinking ornithologist in America, that, if we care to keep those native birds, of which we have spoken above, with us, we must, at any cost, at least check the increase of the English sparrow.

FIG. 26.



Head of English Sparrow.

QUESTIONS AND ANSWERS.

To THE EDITOR OF NATURE STUDY.

At an ornithological lecture which I attended in Boston on Saturday, March 4, the lecturer told us that the tongue of the flicker is barbed, being adapted for impaling ants upon which he feeds.

This statement is contrary to what I have been taught. Is it true?

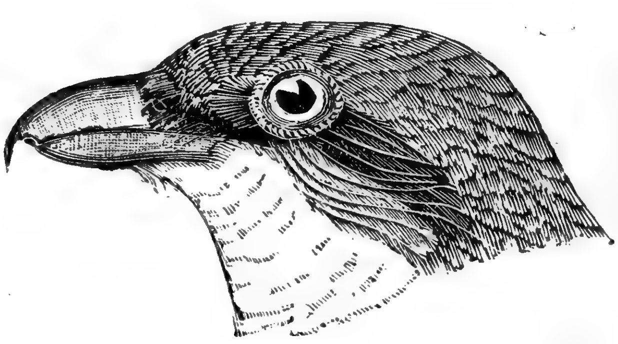
AN INTERESTED LISTENER.

The statement that the tongue of the flicker is barbed is not true in the sense which we usually understand the term when applied to the tongues of the woodpeckers. The tip of the tongue of this species is rounded and thus quite blunt, wholly precluding the power of impaling anything of the small size and hardness of an ant. To be sure, there are a few rudimentary barbs, or bristles, on the sides of the tongue near its termination, but these can be of little or no use to the woodpecker in feeding.

The ants which it eats in summer are really taken up on the terminal half of the tongue by the adhesiveness of a kind of mucilaginous coating with which the tongue is covered.

For further notes upon the tongue and methods of feeding of woodpeckers, we refer you to an article upon this subject in the April number of "Nature Study"

FIG. 27.



Head of Northern Shrike.

NATURE STUDY

IN SCHOOLS

Conducted by C. J. MAYNARD

Vol. I APRIL, 1899 No. 3

Head of Robin.

West Newton Mass.

C. J. Maynard

CONTENTS.

NATURE STUDY IN SCHOOLS.

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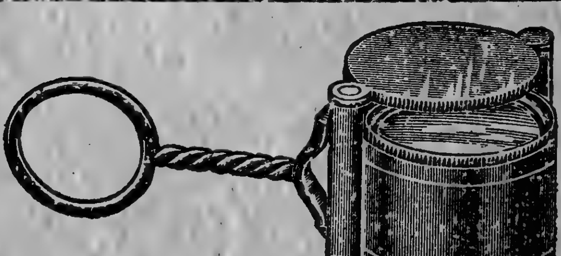


PLATE IV.

Rose-breasted Grosbeak.

NATURE STUDY.

VOLUME I. APRIL, 1899. NUMBER 3

THREE APRIL BIRDS.

BY

C. J. MAYNARD.

THE PHOEBE.

There are few birds more appropiately named than the phoebe. Clad as he is in a plain suit of olive brown, with his white breast slightly tinged with yellow, he would often quite escape observation, were it not for his energetically given and oft repeated cry of "phoebe," a decided accent being placed upon the last syllable.

This is a flycatcher, and thus belongs to the order of songless perchers. While we call the flycatchers "songless," we must, after all, consider the term as comparative, for there are few birds which do not make some attempt at a song, and among the flycatchers, the phoebe is no exception to the rule. But the "phoebe" is only their call notes, the true song is a low twitter, made by the bird during the breeding season. The male will fly to some favorite perch, flutter its wings, jerk its tail, and utter this rather feeble attempt at a song.

The phoebes come early, often during the first week in April, and haunt the barn yards. Soon they may be seen anxiously examining the interiors of open sheds with a view of selecting some convenient beam as a nesting site. Others prefer bridges or the sheltering bank of a stream. Overhanging ledges are favorite places with some, and I have even seen the nest attached to the upturned roots of prostrate trees.

Wherever the phoebe builds, should the nest remain undisturbed, either the same pair, or their descendants, are apt to return to the same spot year after year, to breed.

The nest is built early in May, and like the robin's, plentifully supplied with mud, and evidently for the same reason, but the mud is often covered with moss, and there is usually a lining of feathers. It is far from being as compact as that of the robin's, thus crumbling very easily.

The eggs are white, frequently unspotted, but sometimes finely dotted with reddish.

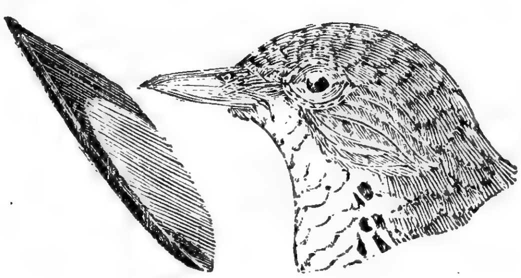
The phoebes migrate in September, and are then often accompanied by the wood pewees. At this season, the two species are quite difficult to distinguish, but if the fact that the phoebe has a wholly black bill, and the wood pewee a yellow under mandible, be known, there will be no difficulty in recognizing them. In spring, the plaintively given "pe-wee" of the wood pewee is in strong contrast with the more energetically given "phoebe" of the phoebe.

I will ask why the phoebe places its nest under shelter?

THE PINE WARBLER.

In the early days of April, when the sun shines warm upon the pine woods, and causes the fallen needles to give out a spicy, resinous odor, as a reminiscence of their birth place, when the heat is shimmering on the south side of fence rows, and there is a silence over all the woodlands, a silence rendered more intense by the faint murmur of the gentle south wind through the tops of the pines, suddenly, without warning, a low, musical trill comes to the ear. To the untrained ear, careless of the gems of melody, of which nature

FIG. 28.



Head and tail feather of Pine Warbler.

is so lavish, this quietly given song is meaningless, or even passes unheard To one, however, whose ear is awake to all of the melodies of the fields and woodlands, this gentle trill brings a feeling of gladness, for it is a true harbinger of spring, and gives promise of the coming summer.

This is the song of the pine warbler, and to many it closely resembles that of the chipping sparrow. There is some resemblance, but the warbler gives a much more musical song, with rather more volume to the notes: when heard side by side and contrasted, the wide difference between the two songs may be perceived at once. The song of the pine warbler is somewhat varied, but to attempt to give these variations here would tend only to confuse those who are learning bird songs. The results of my studies of the songs of this warbler, will be found in my Warblers of New England, now in press.

The appearance of the pine warbler corresponds well with its song, and with the yellowish pine needles among which it lives, for it is greenish yellow, darker above and lighter below, the female being considerably duller, in fact, frequently almost plain greenish gray.

The nest of this warbler is placed in its favorite pitch pine, well out on the end of a branch, often among the leaves. It is not unfrequently buil of pine needles. The eggs are laid early, often by the first of May and the young are thus the first of all our warblers to appear. A second litter of eggs is laid about the first of July. The pine warbler has a very wide breeding range, being found from Florida to New England, wherever the pitch pine, or allied species, grow.

My question in regard to the pine warbler is, why is it without conspicuous markings?

THE WHITE-BELLIED SWALLOW.

This bird is often a shining example of the one swallow which does not make a summer, for it frequently comes so early in April that it must wish itself back again to a warmer climate. I have no doubt, and even have proof of the fact, that these swallows do advance north during pleasant, warm weather, and return again during cold snaps. Why should not a bird which can cover the distance between Massachusetts and New Jersey in three or four hours, occasionally take a backward flight?

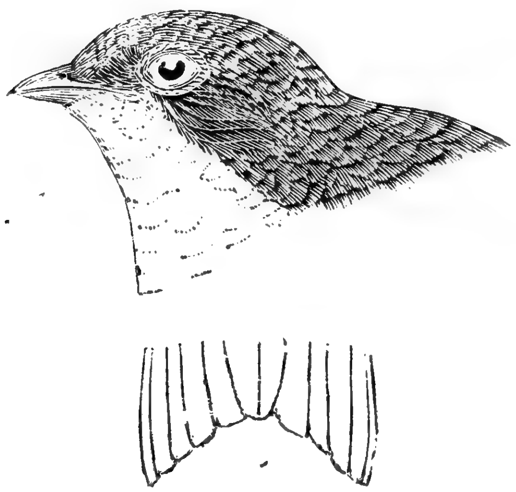
The steel blue back, white under parts, and slightly forked tail will serve to distinguish this beautiful swallow in spring.

The white-bellied swallows are sometimes called tree swallows from the habit which they have of nesting in holes of trees. They sometimes select a deserted hole of a woodpecker, or often a natural cavity in a tree in which to build. It makes very little difference to the swallow whether such a cavity be high or low, as long as it is of the right dimensions. The nest is made of grass and lined with feathers, and the eggs are pure white, unmarked.

The nests are often placed in holes about the eaves of buildings, or in boxes put up for the accomodation of birds. Such boxes are, however, in these days, too often occupied by the English sparrows, which, by being on hand, get in first, and thus possession is truly nine points of the law, but when the swallows do chance to obtain a foothold first, they can often hold their own in spite of the sparrows. I once watched a conflict between a pair of swallows and a lot of marauding sparrows. The swallows had found a cavity in the end of a partly decayed limb of an elm, which stood on the banks of Charles River, near a bridge. Here they were building a nest and had evidently taken possession before the sparrows became aware of the suitableness of the cavity as a nesting site.

It was instructive, as illustrating the sagacity of the swallows to watch their method of preventing the entry of the sparrows. The opening of the

FIG. 29.



Head and tail of White-bellied Swallow.

cavity was directly in the end of a broken branch, and unless a bird found a foothold by alighting in the cavity, it would not well cling anywhere. The way in which the swallows prevented the sparrows from entering was by simply blocking up the entrance by one of the pair sitting in the opening.

Several sparrows made frequent attempts to enter at irregular times, but were always foiled by this simple method, and the swallows found time to gather material and build when the sparrows got weary in their efforts. In fact, one or the other of the pair was thus nearly always at work.

I visited the place at intervals during the summer, and was satisfied that the swallows succeeded in rearing a brood of young in this well earned home.

The white-bellied swallows remain late in October in Massachusetts, often feeding at this time upon the berries of the wax myrtle, which are so common on our coast at this season, the waxy matter which surrounds the berry evidently furnishing them with nutriment.

They migrate leisurely southward, and I once followed them, and recorded their movements from Wood's Hole, Massachusetts, to Jacksonville, Florida. This is the only swallow which lives within the limits of Eastern North America in winter.

Can any one tell me why nearly, or all, swallows place their nests in sheltered situations?

EXPERIMENTAL LESSONS.

LESSON ON CORAL IN AN EIGHTH GRADE GLINES SCHOOL, SOMERVILLE, MASS.

BY

M. EVA WARREN.

My class were delighted the afternoon Mr. Maynard came to give them a lesson. He was no stranger to the children, for they knew it was he who had lent them so many interesting specimens.

Their last science lessons had been upon coral polyps, and the different species of coral; so Mr. Maynard continued the subject to reef building.

He first showed them a head of coral formed into the cup shape, which so well illustrates the development of an atoll. Then by careful questioning he led them to think out the development of the reefs, adding many interesting points including some personal experiences.

The following day I had a review of the lesson in the form of a recitation; later the children wrote and illustrated it.

Thinking that Mr. Maynard would be interested in the results, I sent the set of papers to him. The illustrations and the exercise given were selected by him.

[Although the method by which the lesson was given to Miss Warren's class was entirely new to the children, their papers show that they readily comprehended the ideas which were drawn out by the questions asked.

All of the papers were excellent. The greatest number of facts recorded by any one was one hundred and nineteen. This paper is printed below. The smallest number of facts was fifty-two.

Out of the twenty-eight papers, in three were recorded between sixty and seventy facts; in four, between seventy and eighty; in six, between eighty and ninety; in eight, between ninety and one hundred; and in six, over one hundred. The drawings were, in most cases, good, and in many papers, excellent, and as will be seen by reproductions given, in some cases above the average of children of their age.

In justice to the teacher of this class, we will state that she has had these children in charge from last September only, but since that time, although Miss Warren has had many difficulties to overcome, she has, through superior management, brought about a marked improvement in her class. In fact, we have seldom met with children who were capable of answering questions upon varied subjects so readily as are these children at the present time. Ed.]

Coral, by Merta Underhill.

Many persons make the great mistake of calling the little animal that builds the coral islands, the coral insect, for it does not in the least resemble an insect. The correct name is the coral polyp.

The coral which we see brought into our country from tropical countries, is not the coral animal as many people suppose it to be. It is the skeleton of the little polyp. This skeleton is formed inside the polyps, just as our bones are formed inside of us, Our bones are made of phosphate of lime and are not brittle, while the coral skeleton is made of carbonate of lime, and is very brittle.

The structure of the little polyp cell is just the same as that of the sea anemone. It consists of a trunk, or body shaped like cylinder. On the top of the body are rows of tentacles, which, when extended, form a crown. The number of rows differ according to the species. On the top of the trunk in the center, is an opening or hole, which is the mouth. This opens into the gullet, or a kind of throat, which leads into the stomach. The stomach is like a little bag and is in the center of the polyp.

When any little sea animal, which the coral polyp wishes to eat, comes within reach, the tentacles are extended to grasp it, and draw it into the mouth, down through the gullet into the stomach. If there is any part of the animal that the polyp does not care to eat, it is thrown back into the water through the mouth. The polyp has no intestine or any opening to pass off waste matter.

The tentacles do not look to be a very important part of the polyp, but they are most wonderful. They have little fine threads, called lasso threads, on them and at the end of these little threads is a cell. When the animal which the polyp wishes to eat comes within reach, the tentacles throw out these threads, and the poison which is contained in the cells affects the nervous system of the animal, causing paralysis. The animal is then drawn into the mouth by the tentacles, through the gullet into the stomach, and digested.

There is a space between the stomach and the outer walls of the polyp. This space is divided into little chambers by partitions, like the lobes of an orange. There is a little hole in the end of each tentacle, through which the water passes into the tentacle and flows through into one of these chambers, and as there is a little hole in each partition, the water flows through the hole and passes from one chamber to another. The water can come in or go out of any tentacle. The little polyp uses the oxygen in the water to help build up its system. This is the way he breathes for he has no heart or lungs.

The coral polyp produces its young in three different ways. The way I am going to tell you about first is by budding. The star-fish, when it loses a ray, buds another; so the polyp does the same thing when it produces its young. It buds a little bud on its side that develops into a little polyp, which does not leave the mother polyp but stays there. In some species the polyp divides itself down through the middle, making two perfect polyps where there was one before.

The last way, common to all species, is by laying eggs. The eggs are formed in one of the lowest chambers, and are thrown into the water through the tentacles, as the tentacles are the only opening, or passage, into the water, from the chambers. The little egg stays in the water until it is hatched.

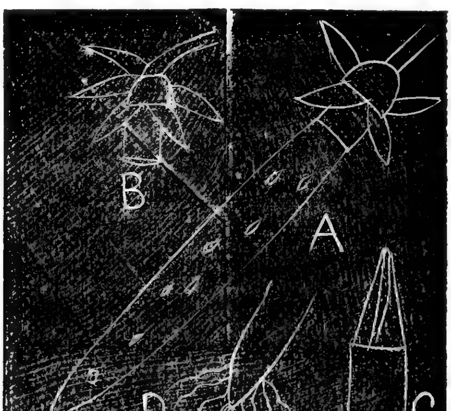
When it is hatched it is a round, soft body covered with little arms or legs called cilia, with which it can swim about very freely.

It swims about until it finds a suitable place to fasten itself. For, small as the polyp is, it knows it cannot thrive in water deeper than one hundred and fifty feet. It will fasten itself by suction to a rock, shell or a skeleton of a dead coral animal, and then begin to build a skeleton for itself.

It will bud or divide and so will start a new colony of coral polyps. Pretty soon the colony begins to take the shape of a head. The little polyps on the side grow much better than those on the top, as they can get more of the food. The polyps in the center grow weaker and smaller than those on the outside, causing the head to become flattened. Mud and debris now settle upon the head, killing the polyps beneath. As the polyps on the sides keep building up all the time, and the polyps in the middle die, the colony forms a cup shape. The side polyps build up and sidewise more and more, and the mud settles in the middle so the hollow cup grows larger and deeper. After many, many years, in this way the coral polyps reach the top of the water, making the coral island in the shape of a ring, called an atoll. An atoll in a perfect ring has never been found; there is always a break in it somewhere, and often more than one. The water inside of the atoll is called a lagoon, and as the water is very calm, it is an excellent harbor for ships during storms.

The coral island has now no earth or vegetation on it, but the mangrove, a certain kind of tree, can thrive here without earth, as it grows in

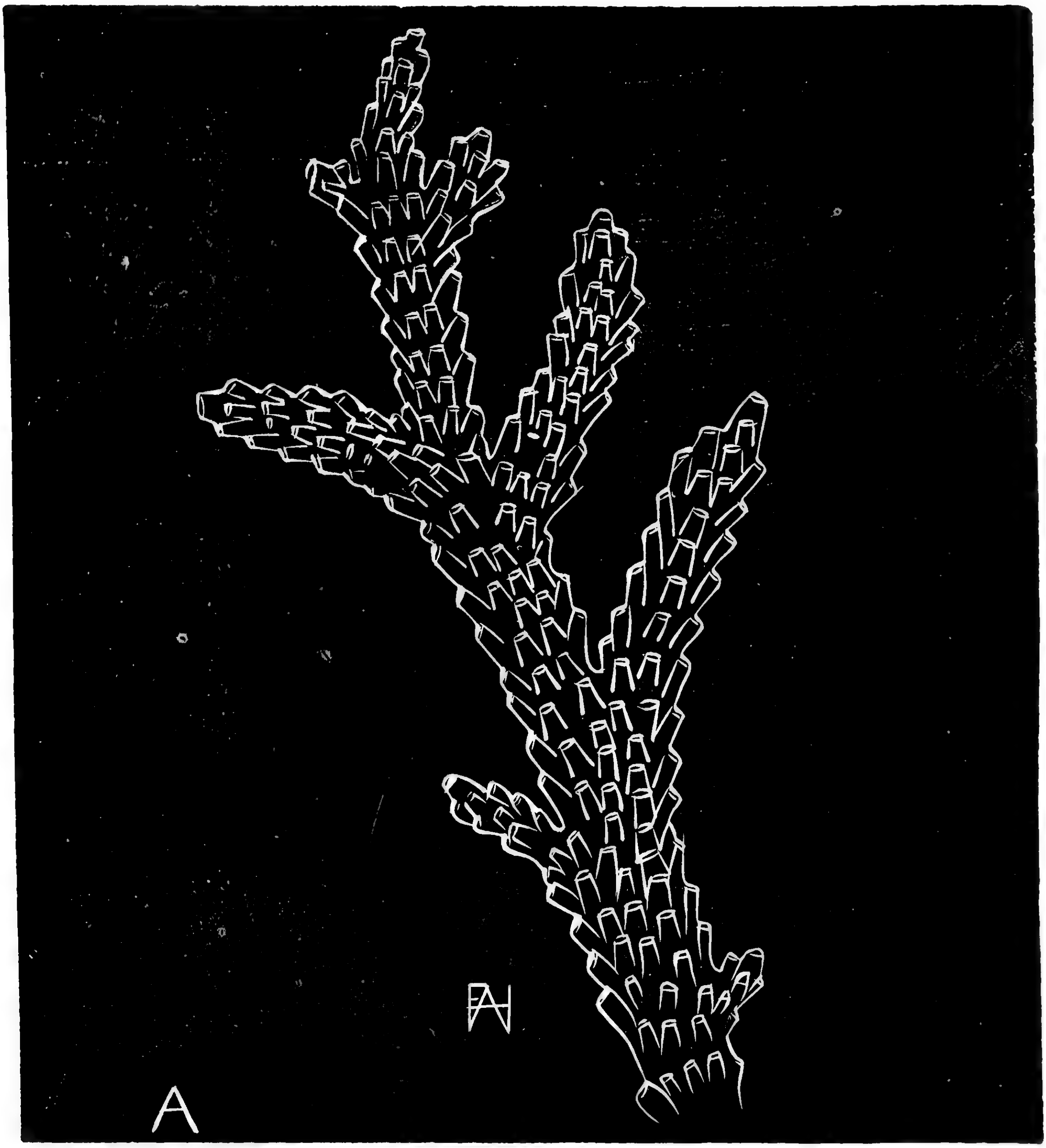
FIG. 30.

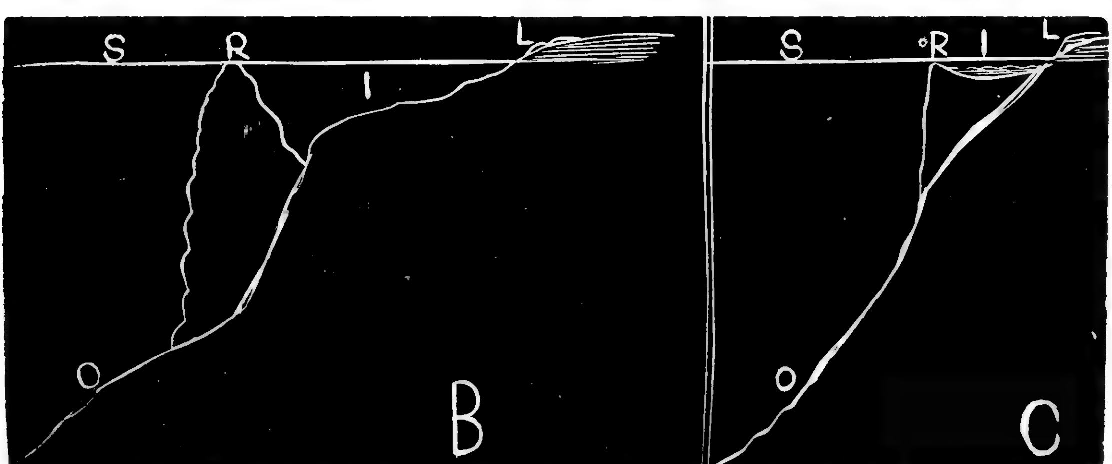


Mangrove fruit, by Beatrice Hodges. A, entire fruit; B, base; C, folded leaves; D, rootlets.

salt water. In the spring, the mangrove buds, and later on, these buds project a long cigar-shaped fruit. As the fruit gets ripe, this cigar-shaped part drops into the water. There are little leaves on the top of this and some roots on the bottom. Before the long part dropped off, the leaves were folded in the cup-shaped bud. As the heavy part of the bud or fruit is in the lower part of this cigar-shaped part, it floats with the leaves up. As it is in the spring the water is calm and the bud floats along very smoothly.

PLATE V.





EXPLANATION OF PLATE V.

A, Branching Coral, drawn by Florence A. Hatch, Glines School, Somerville, Mass. B, Barrier Reef; C, Fringing Reef, by Eliot H. Robinson, Williams School, Auburndale. Mass. S, Sea level; R, reef; L, land; I, lagoon; o. ocean bottom.

The tide naturally carries it on to one of these coral islands. Here it fastens itself by the roots very strongly and grows very rapidly.

Its branches send out aerial roots, so called because they live in the air. These aerial roots send out roots called buttress roots which clasp the rocks and hold the tree in place. The mangrove is so strongly held by the roots that the wind and storms cannot blow it down or break it. Soon the tree has spread itself over the entire island.

As the mangrove, in order to live, requires its roots to be submerged in saltwater twice a day, those in the center, which the tide does not reach, die. They decay and form earth.

The cocoanut tree now comes to take its place. The cocoanut thrives best when its roots are washed in salt water once a day. As the sea-weed, waste matter, and debris are brought in by the tide they get lodged in the grove of roots of the mangrove, and so decay and make more earth. As more cocoanuts and mangroves die and decay and new ones grow again the island becomes fertile and ready for inhabitants.

FIG. 31.

Mangrove, by Edward J. Fuller.

Now I will try to explain how the Bahama Islands were formed. Years ago in the glacial period, the Mississippi was ten times as wide as it now is. If there were ten times as much water coming to the mouth then, there must necessarily have been ten times as much mud. Now the mud settles at the mouth and forms a delta; then it flowed too fast to drop the mud at the mouth. The Gulf Stream, which then flowed through the Straits of Florida and straight across the Atlantic Ocean, took it up and carried it to the Straits of Florida. Here the Gulf Stream broadened and the mud was dropped. When the embankment of rock, mud and debris was within one hundred and fifty feet of the surface, the coral polyps began to build on it, and in time the Bahamas were formed.

Florida was not there at all many years before the formation of the Bahamas. There was a volcanic mountain near Florida underneath the water. This mountain had an eruption and threw up earth, part of where Florida is. After this eruption the water was no deeper than one hundred and fifty feet, so the little coral polyps built on it. Florida is partly a volcanic and partly a coral peninsula.

"So the little coral workers,
By their slow but constant motion,
Have built up pretty islands
In the distant dark-blue ocean;

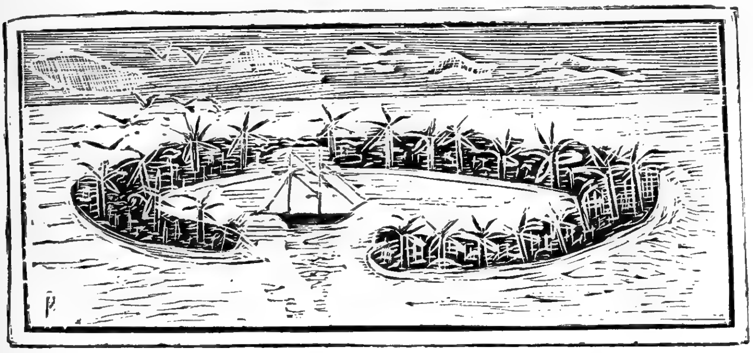
And the noblest undertakings
Man's wisdom hath conceived,
By oft repeated efforts
Have been patiently achieved."

The water inside the lagoon is calm and quiet, so that the more delicate and pretty species of coral grow on the innerside of the atoll, or next to the lagoon. These kinds of coral are branching, forking, rose, and tooth coral. The coral on the outside of the reef is more compact and strong, as it has to stand the strong ocean waves. These species are the head, plate, and brain coral. The Bahamas are formed mostly of head, plate, and fan coral.

The little coral animals keep on building until there are several little atolls and lagoons inside the large one, and as the polyps keep on building, the lagoon in time fills up, and it becomes a solid coral island with a few lakes and ponds.

There are other kinds of reefs beside atolls. One is the barrier reef. Barrier reefs are formed where the shore slopes suddenly and steeply down into the water, and then is level for a ways, and then slopes suddenly and steeply again. It is where the land is about to slope the second time that the coral polyp builds. The coral polyp will build until he reaches the surface, and so forms a coral reef five miles or more from the main land with a lagoon between. There is a barrier reef off the southern coast of Florida, from the islands of Tortugas to Cape Florida. This is one hundred and seventy-five miles long, and is the only coral reef in the United States.

FIG. 32.



Atoll, by Evelyn Pascal.

There is another one off the north-east coast of Australia, which is the largest and greatest one in the world. It is a thousand miles long and higher than Bunker Hill Monument, built in the midst of a rough sea, where no work of man could stand the high, strong, ruinous waves. The Egyptian pyramids and the great wall of China seem like playthings beside it.

There is another kind of reef still, the fringing reef. It is formed where the land gradually slopes under the water. The little polyp builds on this slope at a place one hundred and fifty feet from the surface of the water. It builds up against the land and reaches the surface, so forming a fringe of coral on the land. The only fringing reef of much importance is the Molasses Reef off the island of Inagua, near Cuba.

The coral polyp has a good influence on commerce, as the lagoons of the atolls form safe and excellent harbors for ships. It is also a hinderance as many vessels run upon the coral reefs and are wrecked.

The Bahamas, which were made by the little coral polyp, have turned the Gulf Stream from its natural course, straight across the Atlantic Ocean, up along our Atlantic coast, thus making the climate of the Middle Atlantic and New England States a great deal warmer.

This change in the Gulf Stream causes the mild climate in the British Isles and in Western Europe. So we see that had it not been for the coral polyp, France and England would have a climate like that of wintry, ice-bound Laborador.

LESSON ON THE ROBIN IN A KINDERGARTEN GRADE, BEACHMONT, MASS.

BY

LILLIAN A. YOUNG.

The robin was my subject for one of our talks on early springtime, since that bird is one of the heralds of warmer weather.

To introduce the subject, each one in the kindergarten mentioned some change in nature that had taken place since mid-winter. Many things told us of our approaching springtime: Jack Frost and the north wind are not such frequent visitors; the sun comes to us earlier in the morning and stays later at night; the leaf buds are swollen and a bluebird was seen. Pussy willows and poplar catkins had been found and with much delight we had watched some alder buds "shake out their powd'ry curls."

A few days prior to this talk, a moth that had been sleeping in the schoolroom all winter, crept from his cocoon. The interest of the little ones had been greatly aroused by the coming to life of this moth, for in the previous fall a cabbage worm had made his chrysalis in the kindergarten, and we were eagerly awaiting his awakening. The chrysalis was examined, but no signs of life were yet visible.

My assistant had seen true harbingers of spring—robins. She told me that many robins had sought the shelter of spruce trees which were near her home. We were all anxious to know what these robins did all day long and just how they looked, consequently many questions were poured forth, some of which were quite amusing.

Finally when the skin of a robin was shown to the class, I could see a look of disappointment on the face of almost every child, and I heard one exclaim, "That is not a red breast."

They had expected to see quite a bright red breast, and the dull chestnut color of the female bird, which I held before them, did not meet these expectations. All declared, however, that they had seen "redder robins" than the one which I had.

To illustrate the talk, I had the skin of a mother bird and that of a young one, a nest and eggs.

First we compared the "dress of the baby," as the children called it, with that of the mother bird. We found that the baby bird had a white throat, while that of the mother was streaked with black. The breast of baby was spotted with black, while the mother's breast was chestnut. The markings on the back of the young bird were also noticed. The large feet, small wings, and short tail were readily observed by all.

Much interest was shown when I mentioned the change of dress of the baby bird, which in the fall of the year moults and acquires a dress like that of its parent. The feeding of the young birds by the parents aroused the sympathy of the children, and led them to think of their own mother's care.

The mouth of the baby bird was examined and the tough skin at the base noticed. We found that this skin serves as a protection against the bill of the mother bird when she feeds her young. It is possible that the mother bird might strike the mouth of the baby with her bill, but no injury could come to the little one, since the skin is so tough, and not at all sensitive to the touch. The egg-tooth was mentioned as being required by the young bird in order to break the shell.

The nest was next shown to the children. The manner of building was described. The gathering and placing of the straw by the birds, the waiting for a rainy day so that mud might be found, the plastering of the nest with the mud, so that the babies should have a warm home, all brought more strongly to the minds of the children a mother's thoughtfulness and care.

Froebel attached much importance to the sympathetic study of nature in the kindergarten. In order to give a clear expression of his thoughts, I quote the following paragraph from one of his Mother-plays.

"Through the play of The Bird's Nest, mother, you take a few short steps upon one of the paths which lead toward this goal, viz. the path which starting from sympathy with nature, runs through study of nature to comprehension of the force, laws, and inner meaning of nature. You are incited to enter upon this path by your feeling that a prophetic sense of the inner connectedness of nature stirs and dreams in your child's heart. You also feel that there is no single object in nature which has more power to lift his dreaming presentiment into working consciousness than a bird's nest."

It his hoped that our children reaped a benefit from this lesson, and that their interest in nature was awakened.

LESSON ON COMPARISON OF ANIMALS IN A SECOND GRADE, CARR SCHOOL,

SOMERVILLE, MASS.

BY

ALMENA J. MANSIR.

Mr Maynard kindly gave to my class a talk on the comparison of animals.

On the next day I had the class write the following exercise. To aid them in this I put a few suggestive questions on the board.

This paper from Bertha Hahner I considered among the best, although there were other good papers.

ANIMALS, BY BERTHA HAHNER.

A cat has four legs.

A squirrel has four legs.

A monkey has two arms and two legs.

A bird has two wings and two legs.

A fish does not have legs.

A fish has fins. The fins are placed two at his head and two at his side, and one at his tail, and the two at his head are like the cat's front legs, and the two fins at his side are like the cat's back legs.

The fish swims mostly with his back fin.

The cat is covered with fur.

The monkey is covered with fur.

The squirrel is covered with fur, while the fish is covered with scales.

Animals breathe air, fishes breathe air too. They breathe the air what comes in with the water. The water goes back through the gills.

LESSON ON CORAL IN A NINTH GRADE, WILLIAMS SCHOOL, AUBURNDALE, MASS.

BY

JOHN O. GODFREY.

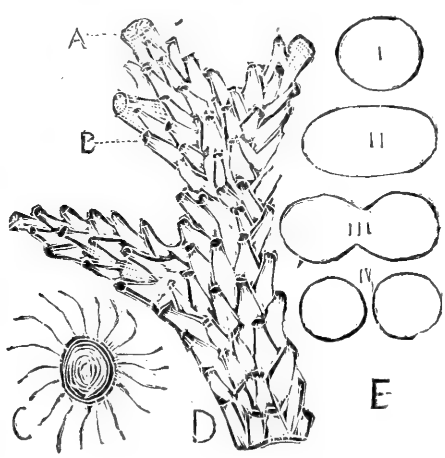
[In regard to the lessons given to the pupils of Mr. Godfrey's school, we desire to say, that, although the pupils have had instructions in science, the method in which the lessons on coral etc. were given, was wholly new to them. The information which was given them, the pupils themselves thought out through a series of questions which were asked.]

CORAL, BY JOHN F. NORTON.

"Full fathom five thy father lies;
Of his bones are coral made." SHAKSPERE.

The coral polyp forms its kind in three ways. 1. Buds. There is a mother bud at the top of the branching coral, which sends out smaller

FIG. 33.



D, Branch coral. A, mother polyp cell; B, bud cell; E, polyp division; I, single polyp; II, polyp elongating; III, partly divided: IV, wholly divided: by Marion Jewett. C, young coral polyp, by Alice Cunningham.

buds around it. 2. By division. The polyp, when first hatched, is very nearly round, as figure 33, I. After a time it gets forced into form II. Still a little more time and we find it like figure III. It then wholly separates like IV. 3. By eggs. All polyps produce eggs and out of these eggs comes a little animal. These little animals float about in the water, and so coral spreads. The force of the waves also moves the coral, but only to a limited degree.

In building, coral is arranged in three classes; reef building, lagoon filling, and barrier building coral. Solid heavy coral grows on reefs and barriers, as it has to withstand the great force of the waves, while the frail coral fills lagoons. Coral has its largest growth as well as man. The largest growth of the coral is about ten feet in diameter.

On land sloping gradually deeper into the ocean, the coral usually begins its building about one hundred and fifty feet down from the water line. The tendency of the coral is to grow outward, but the force of the waves is so great that it pushes it towards the land, and therefore it grows up almost vertical. Where the land slopes gradually there is a wide lagoon. If the land goes suddenly down into the water the coral starts at about the usual depth, but there is only a narrow lagoon between the shore and the coral reef. These reefs are called barrier reefs. The coral polyp makes no effort to build these reefs.

The only barrier reef in the United States, before the Cuban War, extends from Cape Florida, an island just off the southern point of Florida, to the Dry Tortugas. This barrier is one hundred and seventy-five miles long, and ships drawing only a little water, not more than twenty-five feet, can sail between the barrier and the islands, with a heavy sea beyond it, and be in perfect safety. The largest barrier reef in the world is off the coast of Australia and is over one thousand miles long.

The reefs which come close to the land are called fringing reefs. There are many kinds of coral, four of which are brain, branching, rose, and fan coral. Some corals grow quite rapidly, and others grow very slowly.

Best Answers to Questions, by Austin Early.

The three questions asked were;

1. Is the coral polyp beneficial or injurious to man and how?

2. Has the coral polyp had any influence upon the climate of the world; if so, in what way?

3. Has the coral polyp had any influence upon commerce; if so, in what way?

1. The coral polyp has been beneficial to man in many ways. It has made safe harbors, where man could not even pretend to. It has served the purpose of a break-water in many places. Made land for man to live on.

And at last, manifested what one of the very minutest creatures in creation can make, something to withstand the force of waves, and the wear and tear of ages, a reef. But it has also been injurious to man, the most serious result being the sinking of so many ships.

2. The coral polyp has had a great influence on the climate of the world, in the case of the Gulf Stream. This stream starts at the Gulf of Mexico and, if its course were unobstructed, would go straight across the ocean and hit Africa. This would probably make the coast much warmer than it is. But instead of this, it goes straight a little distance and then strikes against the Bahamas, which are simply coral islands, and is turned in a north-east direction. It crosses the ocean and goes along by England, and around the Scandinavian Peninsula. The stream is composed of hot or warm water, and this is what makes Hammerfest as warm as New York, though it is much farther north.

3. The coral polyp has had influence upon commerce. It has made good harbors. It has been bought and sold.

SYSTEMATIC ZOOLOGY FOR TEACHERS.

BY

C. J. MAYNARD.

(CONTINUED.)

THE ANIMAL KINGDOM.

Although it is easy in most cases, to tell the difference between vegetables and animals, for example, between a butterfly and the plant upon which it alights, there are some forms of life which are so simple that no method has yet been discovered by which they may be distinguished as plants or animals.

The Bacteria, for example, are about as often claimed by zoologists as by botanists, and certain plant-like forms exhibit flagellate movements. These also possess an "eye spot" so called, which is quite sensitive to the light. Other similar forms also occur that so evidently exhibit characters which are possessed by both plants and animals, that we must consider that they live on the border line between the two, and belong to neither one nor the other.

Soms naturalists go as far as to place these plant animals, as they are called, in a separate kingdom by themselves, but as this makes two border lines, where there is probably none, it is far better for us to consider these peculiar forms are intergrading species between the animal and vegetable kingdom.

Here occurs an opportunity to impress upon the pupil's mind, the importance of the fact that there are no hard and fast lines in nature, but that all living organisms have at one time, through the operation of the change produced by evolution, intergraded, and that the communicating links between groups from species upward, are often to be found living at the present time.

THE PRINCIPAL DIFFERENCES BETWEEN PLANTS AND ANIMALS.

Animals move voluntarily in response to certain interior irritable fibers, known in higher groups as nerve fiber. Plants move voluntarily, if at all, probably without response to any inner irritation.

Animals inhale oxygen, exhale carbon dioxide, while most plants reverse this process, and inhale carbon dioxide, and exhale oxygen, but mushrooms behave at animals do, and exhale carbon dioxide. Among plants, however, it is difficult to understand the stimulating cause of the movements of the mimosa, venus fly traps etc.

Animals reach their maximum size comparatively early in life, when they cease to grow, while plants contrive to increase in size as long as they live. Exceptions to this rule may, however, be found in most fishes and in some reptiles.

The presence of cellulose in plants and its absence in animsls, is one of the best defined differences between the groups, but cellulose is absent in some of the mushrooms and allied forms of plants.

INSECTS.

BY

HARRY H. WHALL.

THE SILVER COMMA.

(Plate 1, lower figure, Vol. I, No. 1.)

The silver comma, which is quite abundant in summer, is one of the butterflies which passes the winter with us, not flying about, but sleeping in some sheltered place such as under stumps and leaves. In one case I can remember of finding an old water bucket, with one stave broken in, in some bushes along the side of an old road, so I thought I would see what might be in it, and upon raising it, what was my surprise to find not only a wasp's nest, and a cocoon of one of our smaller moths, but also a butterfly clinging to the bottom. This, however, was not the above named comma, but the mourning butterfly, Vanessa antiopa.

I saw an article in one of the daily papers some time ago, which amused Mr. Maynard and myself quite a little. This I quote below.

"It was a warm day in February, in fact people were tempted to go out of doors without an overcoat, so warm was the day that the writer sat at an open window reading when in through the window fluttered a little butterfly. What could it mean? Was it some bad omen? Where did it come from? It could not live through the severe storms and cold weather. It must be some forewarner of ill luck. What was to be done? Should she let it go or allow it to remain? She got some sugar and water placed a little in a spoon, and to her surprise it unrolled its tongue and began to feed. She kept it in her room for some time and fed it every day, but one day when she arose and looked at her little friend it lay upon its side, and never ate again."

Now you see if they had studied natural history in schools at the time the writer attended, she would have known how it was that a butterfly should appear so suddenly at that season of the year.

It seems strange, but it is true, nevertheless, that different insects will live out of doors when it is extremely cold, and if brought into the house where it is warm, will live only a few days.

THE BROWN-TAIL MOTH.

(Euproctis chrysorrhoea.)

The brown-tail moth, with which they are having so much trouble in Cambridge, Somerville, Malden, and other adjoining districts, is one probably with which you are all familiar, that has the small nest at the tip end of the branches, which the Mass. Board of Agriculture are busily engaged in collecting during the winter months.

These small nests do not contain moths, as many suppose, but small caterpillars which hibernate during the winter, and are so destructive to the trees in the spring and early summer.

The moths are on the wing during the month of July. The males are usually pure white on the wings, but are tinged with brown along the body. The females are of the same color as the males, but have a large tuft of brown hairs at the tip of the abdomen, from which they take the name of brown-tail moth.

The female deposits from two to three hundred eggs on the under sides of the leaves near the tips of the branches. The moths use this tuft of brown hair at the end of the abdomen to cover the eggs, which hatch about the middle of August. The young caterpillars then begin to feed, at first beneath a web which they spin about the leaf, on which the eggs are deposited, and when the fleshy part of the leaf is eaten, another is drawn into the web, and so on till cold weather. They then strengthen their web by adding several layers of silk to the nest, and thus pass the winter.

As soon as the buds start on the trees in the spring, the young caterpillars emerge from the silken nests and commence feeding. Later they feed upon the blossoms, although most of the damage being done to the foliage.

The caterpillars, which measure from one to one and one-half inches in length, and are of a dark brown color, finely mottled with orange, and covered with long, reddish-brown hairs, having along the upper side of the body two rows of large, dense tufts of white hairs, and on top of both the tenth and eleventh segments there is a small bright red tubercle, feed until about the middle of June, when they enclose themselves in cocoons, usually placed at the tips of the branches. These cocoons are frequently found in great numbers, massed together in sheltered spots along fences, walls, and many other places.

These moths, unlike the female Gypsy moth, can fly, and therefore are more easily spread. Any high wind, when the moths are flying, is liable to carry and spread them many miles.

GEOLOGY.

BY

Wm. D. Macpherson.

DIFFERENT VARIETIES OF GRANITE.

Last month we discussed the three very important rocks, granite, sandstone, and limestone, giving our reasons for doing so. Before departing finally from them, to learn of other geological questions, let us spend a while investigating the constituents of the three rocks which we considered before only in a general way. While sandstone is simply sand of the seashore compressed into big cakes, and limestone is only lime rock or calcium carbonate, granite, on the other hand, is a good deal like mince pie and has four principal constituents, mixed in as though with a spoon, showing little angular junks all through it. Each little junk, moreover, has its own peculiar chemical composition, so that while a piece of marble is nothing more than calcium carbonate, crystallized, granite has at least eight, and often more, elements in it, and they are combined in a complex manner. These four constituents of granite are quartz, feldspar, hornblende, and mica, and all but quartz vary in composition according to what rock they are in.

Quartz is a very important compound in granite rocks. The conventional granite, and also gneiss and syenite, are profusely speckled all through with these glassy grains, which are white and without cleavage. There are also many ledges of pure quartz. I knew a farmer once who thought he had a marble quarry on his farm and was surprised when I explained to him chemically that it was only quartz. Quartz is an oxide of silica, which is one of the non-metallic elements, and when not subjected to pressure, as most rocks are, makes beautiful hexagonal crystals. Quartz is nearly colorless, but may take on almost any hue if impurities are in it, these colors, as smoky quartz, rose quartz, etc. being very beautiful sometimes. It will scratch glass, showing that it is quite hard, and it is one of the few rocks that refuses to be melted or dissolved in the strongest acid. Quartz is the hardest of the constituents that we have under consideration to-day.

Hornblende (amphibole) is the black, or greenish black mineral that we see in the granite, being just the opposite in color to the snow white quartz, but shining with the same glassy lustre. Occasionally the biotite form of mica would have the same dark color in the same rocks with the hornblende, but the mica is in little thin sheets, while the hornblende is not. All these little fine black specks of hornblende that we see in the granite, are composed of silica, alumina, magnesia, lime, iron oxide and soda.

So it is quite complicated in its makeup, though hornblende itself is only a subordinate part of the granite. Occasionally we see a mass of hornblende by itself and it makes a handsome mineral.

MICA is that peculiar mineral that separates so easily into thin sheets. As children, we saw it in stove doors and often wondered why it was not used for window panes also. A mass of mica has the form of a crystal before it is split up into sheets. There are two principal varieties, muscovite, generally in light colors, and made up largely of silica, and biotite, a darker colored mica, containing more iron and magnesia and less silica. Each of these micas forms a strongly marked family by itself, muscovite being an acidic mica and biotite, a basic mica. The basic rocks have a preponderance of the dark, heavy minerals like iron etc., while the acidic rocks have mainly silica, potash, etc. Aside from stoves, mica of late years, is largely used as an insulator by electricians, and they generally choose the light colored variety, probably because it has less iron in it.

FELDSPAR. This constituent of granite is quite easily distinguished from the other three. It is generally of a pink or flesh color, though may be red, brown or greenish. It is softer than quartz and may be scratched and cut by quartz and it also has a cleavage, while quartz has not. Its color is not so glassy or vitreous, either. Though the little feldspathic junks in granite look innocent enough, feldspar is really the name of a family of minerals and they are very important in geology, composing a great part of the earth's crust. Five principal varieties of feldspar are now recognized. They all have sixty or more per cent of silica, together with several other minerals, and are hence called silicates.

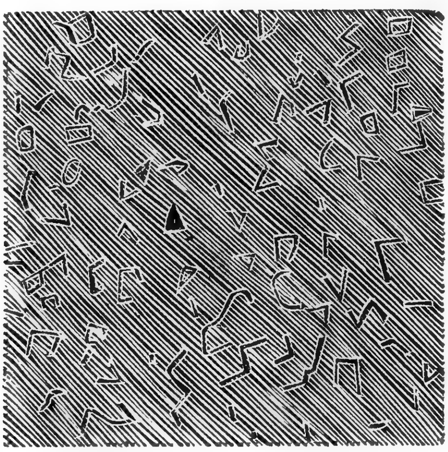
Orthoclase is a silicate of aluminum and potassium and is called a potash feldspar.

Albite is a silicate of aluminum and sodium and is called a soda feldspar.

Oligoclase in like manner is a soda-lime feldspar, and Labradorite is a lime-soda, the last one having more lime than soda, and the one before it, more soda than lime. On account of containing so much potash, soda and lime, the feldspars are easily destroyed or disintegrated by the weather, when exposed to the rain, frost and sun, hence it is not so durable as quartz. Orthoclase, the first one given above is the most common feldspar, and the one that our readers would be most apt to see, Commercially, feldspar is used in large quantities all over the world in the manufacture of crockery and china ware. The product of the decomposition of feldspar is Kaolin or common clay, a silicate of aluminum, which is made into bricks and tiles. The aluminum is also extracted, or separated from the silica, and made into sheet metal. While most metals have to be mined out of the solid rock, at great depths, aluminum, one of the most beautiful and useful of all metals is found on every hillside, roadside and by-way about us, in the clay over which we walk.

Here is a very brief list of some granites, just to give an idea of the variety that is possible.
Binary granite. Composed of quartz and feldspar. White in color.
Binary hornblende granite. Composed of feldspar and hornblende.
Binary micaceous granite. Composed of feldspar and mica.
Syenite granite. Composed of feldspar, mica, and hornblende.
Quartzose granite, Composed of quartz, feldspar, and mica, in fine grains.
Quartzose granite (coarse) Composed of quartz, feldspar and mica.
Red granite (fine) Composed of quartz, red feldspar and hornblende.
Red granite (coarse) Composed of quartz, red feldspar and hornblende.
Quartenary granite. Composed of quartz, feldspar, mica and hornblende.
Iron granite. Composed of the usual material, but much stained with iron.
Decomposing granite. Composed of the usual materials, but disintergrating through the decomposition of the feldspar.
Graphic granite contains hornblende that has assumed irregular forms, many of which resemble the letters of some ancient alphabets. See fig. 34.

FIG. 34.



Graphic Granite.

It is easy to see that if we have these four constituents in the rock at once we have, for instance, quartenary granite. If nature withholds one or two of these ingredients, we have a different kind of granite. So also, if the particles be fine or coarse, or irregularly distributed in the mass, we have a decidedly different appearance, although the composition of the rock is the same. Thus it is possible to have several specimens of rock arranged along a museum shelf, all differing from one another in appearance, but having the same chemical composition. Granite for building purposes should not contain too much iron, or at least the iron should be so combined that it will not readily oxidize and look dingy.

BOOK NOTICES.

THE ANNUAL REPORT OF THE SMITHSONIAN INSTITUTION.

The annual report of the Smithsonian Institution for 1896 has just come to hand. This is a volume of over eleven hundred pages and contains several papers of great interest.

The first 348 pages are taken up by a very valuable paper upon Prehistoric Art as manifested by Prehistoric Man, by Thomas Wilson.

Art is defined in the beginning as an expression of the human emotions, either by sound in music, poetry, and the drama, or in painting, sculpture, engraving, architecture, and the dance.

There are three kinds of art; fine, decorative, and industrial.

The earliest manifestations of human art consisted of flint clippings, and belong to the Paleolithic Period of the Stone Age. The people who made these lived way back in the Quartenary Geological Period, and hence earlier than the present geeological period.

"The man of this time has passed for a savage, and he doubtless was one. He had no tribal organizations, no sociology, no be ef in a future state, no religion; he did not bury his dead, he erected no monuments, he built no houses; he was a hunter and fisher, he had no local habitation, dwelt in no villages. * * * * Yet he occupied in the Solutreen Epoch the highest rank as a flint clipper, and in the Madelainien Epoch the highest place as an engraver on bone and ivory. His materials were the bones, horns, and tusks of the animals he killed. His tools, or implements, were sharply worked points or gravers of flint."

The first flint clippings are found in what is sometimes known as the Cave Bear Period and occur beneath the gravelly deposit of the River Marne. All this illustrates the great antiquity of man, and is so highly instructive that we wish we could quote further from Mr. Wilson's work, but lack of space will not permit us to give further notice of this highly interesting and valuable paper. Other papers of value in this volume are Chess and Playing Cards, by Stewart Culin, Biblical Antiquities by Cyrus Adler and I. M. Casanowicz, and the Lamp of the Eskimo by Walter Hough.

The April number of BIRD LORE contains some gems of photographs, among which are that of the Least Bittern, which is one of the best photographs of bird life that we have ever seen, and that of a Bird in the Hand. Bird Lore is truly an ideal ornithological magazine.

COMMENT AND CRITICISM.

On March twenty-fifth, there was a large flight of robins in Newtonville, Mass., in fact the largest flight which we have seen for years. We saw hundreds of specimens during a walk of less than a mile. In this vicinity were a number of hawthorne bushes, or small trees, which were loaded with berries, and upon this fruit, which was in a softened and partly dried condition from the effects of repeated freezings, the robins were feeding. This abundance of these berries in this immediate neighborhood, was evidently the cause of the accumulation of this bird, for three days later, in going over the same ground, we saw two or three robins only, while the trees were completely stripped of berries.

It is worthy of note that the robins seen on the first day were nearly all males and in very bright plumage, showing that they were fully adult birds. We examined scores, with a glass, and nearly every one had the clear bright breast, black head, and yellow bill, characteristics of the fully matured male robin.

It is gratifying to note that most, if not all, of our State Normal Schools regard nature study as a fundamental branch of education. This will have a vital influence upon the introduction of nature study into schools throughout the State where it is not now taught, for the pupils who graduate from the Normal Schools in the future will feel the necessity of teaching nature study, and upon obtaining positions will doubtless do what they can to advance this branch of education. While we feel sure that school superintendents are fully awake to the idea that nature study is of great benefit to pupils in all grades of schools, they do not always see their way clear to its successful introduction. This is partly due to the lack of good science teachers, and partly to the fact that there is, at present, no established method of study along these lines. To remedy these defects, we would suggest that superintendents employ a special science teacher to regulate these matters. Such teachers should, however, be trained for the service and bear a certificate from a state board of examiners, showing that they are competent to fill the position.

We will appreciate the mention of "Nature Study" by readers who have occasion to order of firms whose ads. appear in our columns.

We shall be glad to answer any questions upon scientific subjects which teachers and others may wish to ask.

NATURE STUDY

IN

SCHOOLS

Conducted by C. J. MAYNARD

Vol. I MAY, 1899 No. 4

Head of Cat Bird.

WEST NEWTON MASS.

C. J. MAYNARD

CONTENTS.

NATURE STUDY IN SCHOOLS.

Edited by *C. J. Maynard*. Published monthly.

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PLATE VI.

Yellow Swallow-tail.

NATURE STUDY.

VOLUME I. MAY, 1899. NUMBER 4

AMERICAN WARBLERS.

BY

C. J. MAYNARD.

I know of no more appropriate subject for May than to give some account of our American warblers, and to indicate, as far as possible, some method of identifying the species.

As a beginning I will say that the members of this large and important family of birds are restricted in distribution to the continent of America and adjacent islands, thus these feathered gems belong to us exclusively, and it is particularly fitting that American students should know something of them.

FIG. 35.

No. 1.

Members of this family may be briefly characterized as follows. Small birds, less than six inches long. The elongated flight primaries are nine. The tail feathers are twelve. The colors of the species are conspicuous and showy, yellow, black, and white, appearing in patches and streakings, while others are prominently marked with orange, salmon etc.

The food of the warblers consists largely of insects, but a few species eat berries, and some of the tropical warblers vary their diet by devouring small lizards.

All of our northern warblers are migratory, with the exception of a single species, the yellow-rump, which is mainly migratory, but a few remain as far north as Massachusetts all winter.

The following may be considered as a synopsis of all the warblers which occur in Eastern North America, excepting possibly a straggler or two and two or three recently discovered sub-species. The arrangement of the groups is by color, and is thus purely artificial.

The large type indicates the color groups, and then follows the species. The localities given indicate the breeding range, but this may be somewhat extended by stragglers, in some cases southward along mountain ranges.

The dates given are the the approximate beginning of the spring and fall migrations. In spring each species is apt to be about ten days in passing a given locality, in fall, often, but not always a longer time.

It is, of course, understood that the name warbler is ommitted after the name of the species.

The wag-tailed thrushes and the chats are purposely excluded from this list, as I do not consider them as belonging to the warbler family. The numbers under the cuts indicate those used for the species in this list.

FIG. 36.

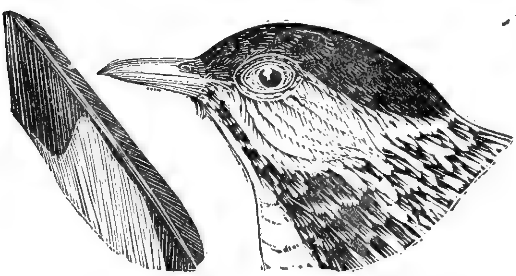

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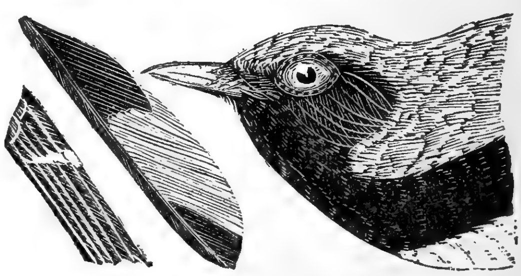
FIG. 37.



3.

Black and white in streaks Wing bands and tail spots white.

1. Streaked all over. No ashy above. Crown divided by white line. Female paler. Woodlands. Va., northward. Apr. 20, Sept. 15. BLACK AND WHITE WARBLER.

2. Streaked above on breast and sides. Crown, undivided by a white line. Ashy above. Female and autumnal male greenish. Wing bands, greenish, tail, spots and under tail coverts, white in this stage. Open country and woodlands. Northern Me., northward. May 15, Oct. BLACK POLL.

Black, white, and bluish in masses. Tail spots white White beneath.

3. Throat, upper breast and sides, black. Back, bluish. No wing bands, but a spot at base of primaries, white. Female, dull grayish green above. Wing spot as in male. Swampy woodlands. Northern N. E. to Labrador. May 10, Sept. 10. BLACK-THROATED BLUE.

FIG. 38.

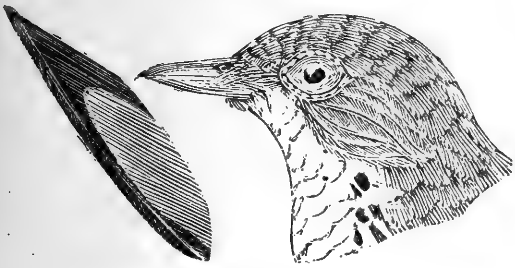
2. Female.

Black, white, and yellow in streaks and spots. White beneath, ashy above. Wing bands and tail spots, white in 4, 5. 6. Female duller.

4. Streaked with black on back, breast, and sides. Yellow patch on crown, rump, and either side of breast. Sides of head black. Northern U. S. northward. Woodlands. Apr. 15, Oct. YELLOW-RUMP.

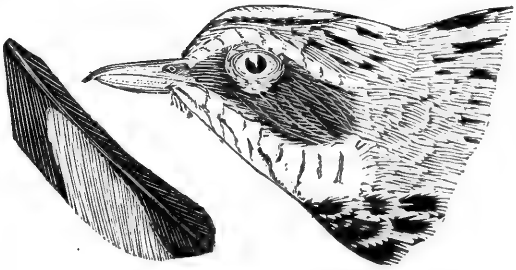
5. Similar to No. 4, but with throat yellow, no black on sides of head, less streakings above. Western U. S. Accidental in Mass. and Penn. AUDUBON'S.

FIG. 39.



23.

FIG. 40.

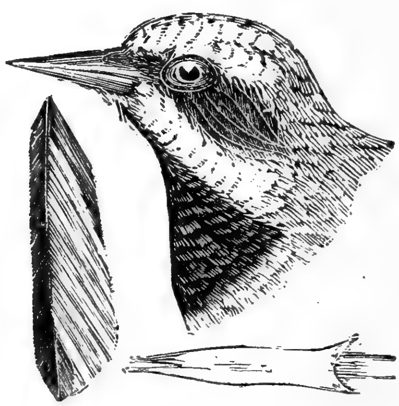


4.

6. Throat yellow. Streaks on sides and spot on sides of head, black. No streaks above. Woodlands. Resident from Va. southward, Rare as far north as Mass. YELLOW-THROATED.

7. Cheeks and throat, black. Crown and wing bands, yellow. No streaks above or below. Female, with throat dull blackish. Swampy wood-

FIG. 41.



7.

lands. S. C. to Mass. May 1, Sept. 1. GOLDEN-WINGED.

8. Similar to No. 7, but with a narrow black line through eye, and throat white. Va. to southern N. E. and rarely to Mass. May 1, Sept. 1. BREWSTER'S

Black above; yellow, or yellowish beneath, streaked with black. Wing bands and tail spots, white. Females dull.

9. Heavily streaked beneath. Bluish crown. Yellow rump. Woodlands. Northern N. E. to Hudson Bay. May 10, Sept. 1. BLACK AND YELLOW.

10. Narrowly streaked beneath. Black crown. Yellow rump. Back tinged with greenish. Chestnut cheeks. Woodlands and orchards. Northern N. E. northward. May 10, Sept. 1. CAPE MAY.

11. Throat, upper breast, line over eye, and middle of crown, orange. Back streaked with white. Woodlands. Northern N. E. to Labrador. May 10, Sept. 1. BLACKBURNIAN.

Greenish above. Yellow beneath. No wing bands nor streakings, excepting Nos. 14, 15. Females duller.

12. Chestnut crown patch. No tail spots. Edges of woodlands. Mass. northward. May 1, Sept. 1. NASHVILLE.

13. Orange crown patch. No tail spots. Swampy woodlands. Penn. southward. Chiefly resident. ORANGE-CROWNED.

14. Yellow crown patch. Narrow black line through eye. Tail spots and wing bands, white. Scrubby woodlands. Southern N. E., southward. May 1, Sept. 1. Blue-winged.

15. Similar to No. 14, but with throat black. Very rare. Southern Conn. and N. J. Lawrence's.

16. Crown patch black in front, ashy behind. Throat and upper breast black. Tail spots white. Scrubby woodlands. Southern Atlantic States. Bachman's.

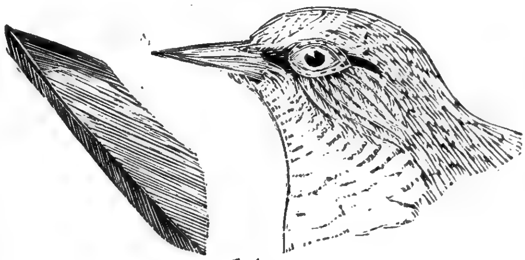
17. Crown patch black. No tail spots. Edges of woodlands and thickets. North of U. S. May 10, Sept. 1. Wilson's Black-cap.

18. Yellow cheeks and forehead. Black hood extending around crown and throat. White tail spots. Swampy thickets. Southern N. E., southward. May 10, Sept. 10. Hooded.

Fig. 42.

12.

Fig. 43.



14.

Fig. 44.

13.

19. Head, all around, throat, and upper breast, ashy, mixed with black. Eyelids, white. No tail spots in Nos. 19, 20, 21, 22. Wings, short. Females without black or ashy markings. Thickets. Northern Me., northward. May 10, Sept. 1. Mourning.

20. Similar to No. 19, but with long wings and white eyelids. In autumn, and females plain greenish, lighter beneath. Rare in spring; common in autumn. Swampy thickets. May 10, Sept. 1. Connecticut.

21. Throat and upper breast more yellow than remaining parts beneath Face and cheeks with black mask. Female without mask. Wings short. Swampy thickets. Ga. to Northern N. E. May 1, Sept. 15. Maryland Yellow Throat.

22. Similar to No. 21, with mask broader and yellow beneath, more extended backward. Swampy thickets. Ga. and Fla. resident. Florida Yellow-throat.

23. Slightly tinged with dusky in streaks beneath. Wing bands and tail spots, white. Pitch pine woods. Eastern U. S. Apr. 15, Sept. 15. Pine.

24. Crown tinged with grayish. Forehead and sides of head, black. Swampy thickets. Fla. to Southern N. E. May 1, Sept. 1. KENTUCKY.

Greenish above. Yellow, or yellowish beneath, streaked.

25. Yellow cheeks. Black on throat and in streaks on sides. Wing bands and tail spots, white. White pine woods. May 1, Sept. 1. BLACK-THROATED GREEN.

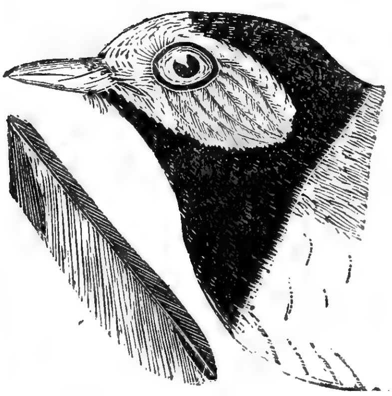
26. Similar to No. 25, but with black cheek patches and crown, and more yellow beneath. Western N. E. Accidental in Penn. TOWNSEND'S.

27. Tinged with brownish on back. Chestnut crown and streakings on sides. Wing bands and tail spots white. Has the habit of raising and lowering its tail. Thickets and margins of woodlands. Northern Me., northward. Apr. 15, Sept. 1. YELLOW RED-POLL.

28. Similar to No. 27, but with yellow of under parts confined to throat, chest, and under tail coverts. Northern interior of U. S., northward, rare in N. E. during migrations. WESTERN YELLOW RED-POLL.

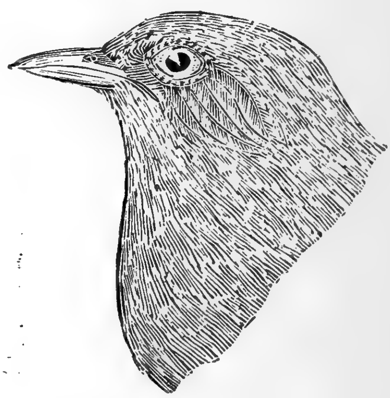
29. Narrow streaks on sides of head and beneath, black. Chestnut

FIG. 45.



18.

FIG. 46.



20.

spots in middle of back. Wing bands, yellowish, tail spots, white. Scrubby woodlands and brushy fields. Fla. to Mass. May 1, Sept. 1. PRAIRIE.

30. Yellow crown patch. Reddish streaks beneath, on sides and throat. Wing bands and tail spots, yellow. Open country, often about dwellings. Very abundant. N. A., numerously distributed. May 1, Sept. 1. YELLOW.

Greenish, ashy or bluish above, white beneath.

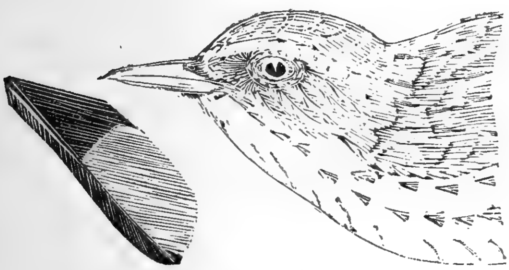
31. Crown, ashy. Greenish above. No streakings nor wing bands. Tail spots slight. Woodlands and orchards. Northern N. E., northward. May 10, Sept. 1. Rare in Eastern Mass. TENNESSEE.

32. Crown yellow. Black line over eye, streaks on sides, chestnut. Wing bands yellowish. Tail spots white. Scrubby swamp lands. Northern

N. J. northward to Southern Canada. May 1, Sept. 1. CHESTNUT-SIDED.

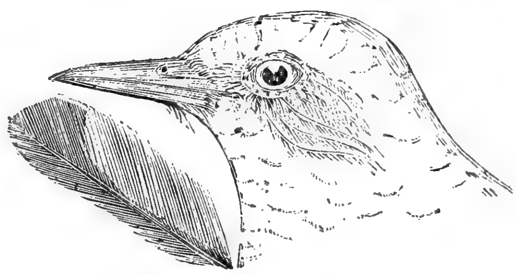
33. Ashy above, black streaked. Bay (chestnut) crown, throat, and sides. Wing bands and tail spots white. Female and autumnal male like those of Black-poll, but often showing traces of bay on sides, and the under tail coverts are buff, not white. Woodlands. Northern N. E. northward. May

FIG. 47.



27

FIG. 48.



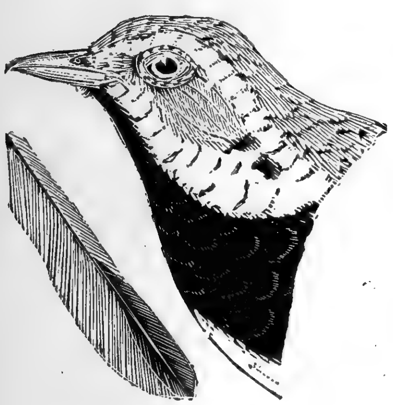
33

15, Sept. 1. BAY-BREASTED.

34. Bright blue above, slightly streaked with black, sometimes with a blue band across breast, and always with streakings along sides. Wing bands and tail spots white. Woodlands. W. Va., north-west to Minn. May 1, Sept. 1. CERULEAN.

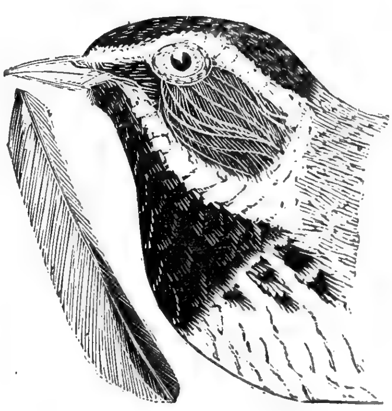
Bluish above, yellow beneath. Females duller.

FIG. 49.



25.

FIG. 50.



26.

35. Black necklace of spots across breast, streaks on forehead, and marks on sides of head. No wing bands nor tail spots. Swampy woodlands. Northern N. E. northward. May 10, Sept. 1. CANADIAN.

36. Black on sides of head, streaks on sides and back, in female across breast. Rather dull yellow beneath. Wing bands grayish. Tail spots, white.

Scrubby woodlands. Fla., S. C., Ohio, Mich. Very rare in migrations, probably breeding in Minn. and northward. May 1. KIRTLAND'S

37. Greenish patch in middle of back. Yellow on throat and upper breast, crossed by a band of bluish, over which is a tinge of burnt sienna, which often extends along sides. Woodlands. Eastern U. S., locally distributed. May 1, Sept. 1. PARULA, or BLUE YELLOW-BACK.

Orange throughout. No wing bands. Tail spots, white Females duller.

38. Dull orange on back, slaty on wings and tail. Swampy woodlands. Eastern U. S. from Va. and Southern Mich., southward. Casual in N. E. May 1, Sept. 1. PROTHONOTARY.

Black above, and on head and neck all around, with conspicuous patches of salmon. Female duller.

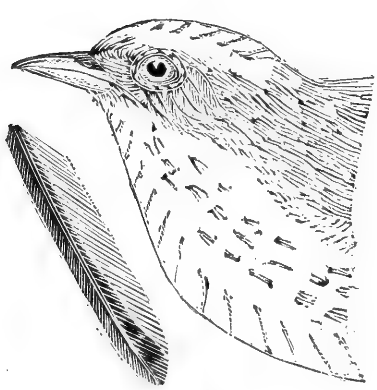
39. Salmon patch on wings, sides, and sides of tail. Female, greenish, with salmon replaced by yellow. Woodlands. Middle U. S., northward. May 1, Sept. 1. AMERICAN REDSTART.

Plain brownish above. Buff beneath. No wing bands nor tail spots.

40. Crown, plain brownish red, without central stripe. Distinct light stripe over eye. Swamps. South-eastern U. S. May 1, Sept. 1. SWAINSON'S.

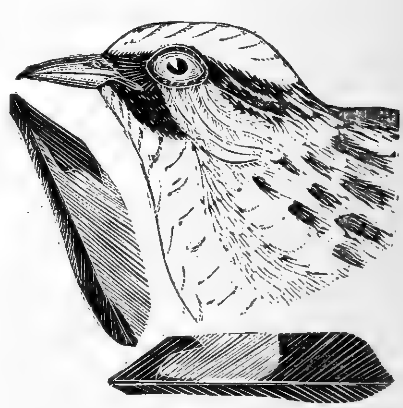
41. Crown with two broad stripes of dull black. Woodlands. Eastern U. S., Southern N. E. southward. May 1, Sept. 1. WORM EATING.

FIG. 51.



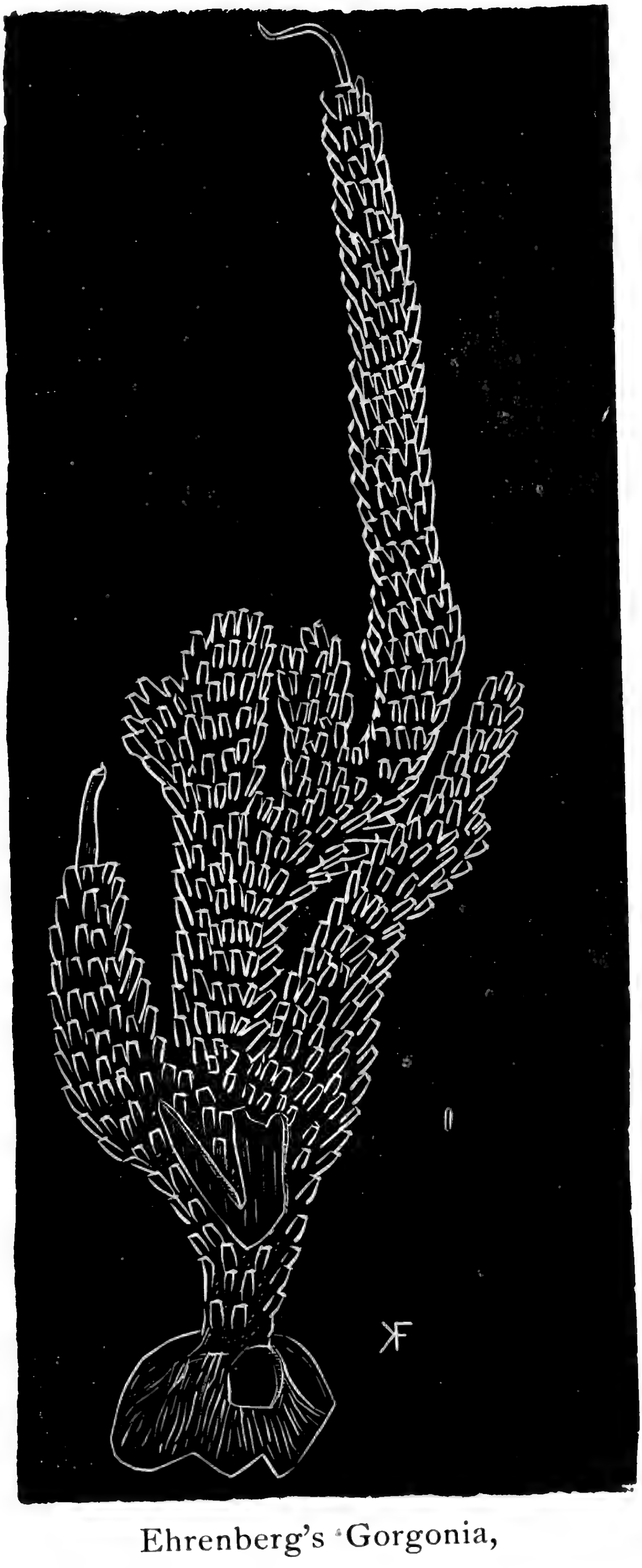
30.

FIG. 52.



32.

PLATE VII.



Ehrenberg's Gorgonia,

By Frank Kemp.

EXPERIMENTAL LESSONS.

LESSON ON BIRDS IN A SIXTH GRADE, WILLIAMS SCHOOL, AUBURNDALE, MASS.

BY

HARRIET B. SPOONER.

This paper, uncorrected, is the result of a half hour's lesson given by Mr. Maynard to my pupils.

In the lesson, a fish, squirrel, robin, song sparrow, and vesper sparrow were used.

This was the first time the pupils had ever been called upon to take notes.

[Articles worthy of notice were by Ethel Wyeth, Marion Chamberlin, Gladys Underwood, Elsie Purdey, and Edward D. Kendall. The question, why does the vesper sparrow build its nest in an open field? was answered correctly by Lizzie Long, as follows. ED.]

The reason why the vesper sparrow builds his nest in the open field where the stubble grows, is because he is about the same color as the stubble and is not noticed much.

SOME NATIVE BIRDS, BY RUTH STRONGMAN.

I have found by comparing a fish, a squirrel, and a bird that they all three have some protection. The fish has scales to protect him; the squirrel hair or fur to protect him; and the bird feathers to protect him. A fish needs scales to keep him from hurting himself as he runs against rocks and such things. A squirrel needs fur to keep out the cold, as he stays north all winter. A bird needs feathers to keep out the cold, and so that he can fly easily.

The male robin has a dark gray back, a jet-black head, orange-brown breast, and an orange-yellow bill. The female robin has a lighter gray back and head than the male robin, a gray-brown breast, and a gray bill. The female robin does not attract as much attention when she is on the nest as she would if she were brighter colored.

The robins build their nests quite early in the spring. They are usually built in the crotch of a tree, or hidden by twigs and leaves. First the female bird, for she builds the nest almost entirely herself, lays a foundation of stubble and makes that into a cupshape, then she puts in some mud, this she pats with her breast, turning around and around in order to keep it cup-shape. She lays from two to five eggs at a time, they usually lay four.

The song sparrow has a chestnut-brown back, a grayish-white breast, with a dark spot under the throat. They are distinguished by this spot from the other sparrows. The song sparrow builds two or three nests in a season. The first one is built in the field because there it will be sheltered from the cold wind, for he builds very early in the season. The second nest is built in the hedges where it will be shaded, and where people will not see it. He always makes a very loose one, usually of sticks, grass and horse hair.

The vesper sparrow is lighter colored than the song sparrow and has no spot on his breast, but has two white tail feathers. He builds in the stubble fields.

LESSON ON THE ELM IN WINTER IN A NINTH GRADE, HIGHLAND SCHOOL, SOMERVILLE, MASS.

BY

MABEL A. JEPSON.

The following paper is one of a set written by the pupils in answer to questions upon trees in winter published in the February number of Nature Study, page 22. The questions were written upon the board by the teacher, and were, in almost all cases, correctly answered.

ELM TREE, BY ETHEL NUTE, AGE 14.

The form of the elm tree is straight, and branching or feathery at the top. The branches grow upwards and outwards, or in acute-angles from the trunk. The elm is very tall and slender. The twigs droop at their extremities and they are very numerous.

There is a difference in color between the trunk, branches, and twigs. The twigs are lighter in color than the trunk or branches. The yearly growth of the twigs can be distinguished because of their color; and there are rings on the twigs which show how old they are.

The latest growth of the twig is different in color from the older growth.

The buds are large, are oval shape, and are covered with scales, so that the birds cannot find the buds. The scales which cover the buds are not very plain. The terminal buds, or leaf buds at the end of the twigs, are single and pointed. The elm tree bark is rough and in grooves.

The elm tree is used for a shade. The white and black elm are used for medicinal purposes. The elm wood, when acid is put with it, looks like mahogany. The city of New Haven is called City of Elms. The elm thrives best on sandy soil. The Washington Elm is so called because Washington took command of the Continental Army under it in July, 1775. James Russell Lowell's home is called Elmwood because there are so many elms in the yard. The elm tree lives to be very old.

AN OUTLINE FOR ANIMAL STUDY

BY

JOSEPHINE H. CARR.

SALEM, MASS.

M. ALICE WARREN, INSTRUCTOR.

The following paper is one selected from a set of outlines prepared by the class to illustrate the plan of conducting one or more exercises in animal study suited to pupils of a third grade.

KINDS. How many of you like dogs? How many different kinds do you know? Name some of the breeds found in different parts of the world.

USES. For what purposes are dogs used? For what do the Eskimos use their dogs? What kind do they have? What kind of dog is kept in the mountains of Switzerland? For what are they used? In what countries are dogs kept by shepherds? What do they do? What kinds are used for hunting? For watching and guarding? For rescuing drowning persons?

SIZE. What is the largest kind of dog you have ever seen? What is the smallest?

HEAD. What is the shape of the dog's head? Is it shaped anything like the human head? What does this show concerning his intelligence?

EYES. What can you tell about the eyes of the dog? What is the shape of the pupil? How does it contract? Compare this with the way in which the cat's pupil contracts. What is the color of the dog's eyes? Are they bright in the night like the cat's eye?

NOSE. What kinds of dog have very long noses? Describe the nose of the greyhound. What has the dog around his nose and mouth? What is their use?

MOUTH. What kind of dogs have a long upper lip? What kind of tongue does the dog have? How does it differ from the cat's tongue? Describe the teeth.

EARS. Describe your dog's ears. What kind have very long ears? What kind have very short ears? What do dogs do when listening? Do all dogs turn their ears? Name other animals which turn their ears to hear. Can we turn our's? How then do we hear sounds coming from different directions so well? What do you see inside the dog's ears? What is their use?

LEGS. Describe the dog's legs. How many parts have the fore legs? The hind legs? How do the dog's legs compare with number and position of parts? Which pair corresponds to our arms? How many toes has the dog on his hind feet? On his fore feet? Has the cat the same number on each pair of feet? How are the toes shaped? For what are they adapted? How many claws has the dog on each pair of feet? What is their position? Can they be withdrawn like the cat's? What dogs are very fast runners?

HAIR. Describe the hair of different dogs. What kinds have very long hair? What kinds have curly hair? What kinds have bushy tails? What kinds have short, slender tails?

RELATED ANIMALS. What wild animals are much like the dog? Where are they found? In what ways do they differ from our dogs?

CHARACTERISTICS. Are dogs intelligent? Tell some stories proving this. What can they be taught to do? Tell some stories showing how faithful they often are. What do you know of the bravery of some dogs?

LESSON ON GORGONIAS IN AN EIGHTH GRADE, GLINES SCHOOL, SOMERVILLE, MASS.

BY

M. EVA WARREN.

GORGONIAS, BY LOUISE LATONA.

There are many places in the ocean, especially in the tropics, where the water is very transparent, and one can see the wonderful plants and animals growing in the ocean-bed fifty feet below the surface, as plainly as you can look from your window and view your flower garden. Indeed, these beautiful places are called gardens.

A sea-garden is generally found in a swiftly-flowing tide-way between two islands. One commonly visited by tourists is near the Bahama Islands outside the harbor of Nassau. Persons sometimes visit this garden by moonlight when one could not perceive when the row-boat, as it was lowered, suspended in air or floated on the water, except by the splashing of the water as the boat strikes it.

Sometimes people go out in a small boat and take a water-glass, which is a piece of common window glass fastened in the bottom of a box. A large piece of glass is sometimes inserted in the bottom of the boat, and as the glass acts as a lens when it rests on the water, the beautiful things in the sea are magnified and seem to be close at hand, instead of many feet below the eye.

The person who first discovered this beautiful coral named it gorgonia probably remembering the old fairy story of mythology. The story tells of three sisters, called the Gorgons, who had snakes for hair. So this structure, with its long, curling branches is called gorgonia from its resemblance to the Gorgon's snaky locks.

Gorgonias grow so fast to the rocks or shells in the sea that they cannot be pulled up by the hand without either breaking the gorgonia or overthrowing the person. So naturalists who gather them, take a hammer with which to strike at the base and break off the piece of rock to which it is clinging.

The most beautiful gorgonia is the sea-feather, which reminds one of an ostrich plume. This grows in swiftly-flowing currents of the sea, as it bends easily and will not break.

The rock gorgonia is about the color of the coral island to which it clings. This species often spreads over large portions of ground.

Another is the Briareum which is without the horny axle, and so grows in calm water, for the carbonate of lime of which it is wholly composed, being pure lime, is very brittle. It is named Briareum from the hundred-armed giant, Briareus, because the polyp of this species has many arms.

All other gorgonias may be classed as those having the horny axle, the most familiar being the sea-fan. This species grows in surf where the water is rough. As nature provides protection for all things, so she has joined together these little arms that they may withstand the surf the better, just as children when they go in bathing, join their hands and fear to separate them lest the tide should bear them away.

All gorgonias, except Briareum, are composed of two kinds of lime, phosphate and carbonate. The inner part, or axle, is composed of phosphate of lime, and therefore bends easily. The outer covering is carbonate of lime, and is easily crumbled in the fingers.

The wave of agitation in the ocean averages about forty feet, but in a hurricane the agitation is much deeper. During storms, the gorgonias are torn up by the waves and are washed onto the shores of the coral islands, where they form long windrows, sometimes two feet high and six or eight feet wide.

When the rain falls it dissolves the outer covering of carbonate of lime, and so the horny axle of phosphate of lime is left bare. It is the carbonate of lime which makes the gorgonia heavy, so when this has been washed away the light phosphate axle is left, which being too light to withstand the wind is soon blown over the land. The next rain dissolves the phosphate of lime which trickles down into the openings of the coral rock.

This has an attraction for the carbonate of lime, of which the coral rock is composed, and they unite, forming a hard, rocky substance.

Bones are ground and used as fertilizers, so this rock consisting of the same materials as bone, is used in the same way, and ships are sent from all parts of the world to get it.

The red gorgonia, used in jewelry and commonly called coral, is found only in the Mediterranean Sea.

The gorgonias growing near the Bahamas are valuable only as fertilizer, for the red species has never been found there. The Bahama government has offered ten thousand dollars to the first person who finds this variety growing within its limits.

LESSON ON BIOLOGY IN A NINTH GRADE, WILLIAMS SCHOOL, AUBURNDALE, MASS.

BY

JOHN O. GODFREY.

BIOLOGY, BY MARGARAT L. KINGSBURY.

Natural science is divided into biology and geology. Geology treats of inanimate things, and biology, as the science of life, treats of animate things. Biology is then divided into botany and zoology, while the latter also includes physiology. These are the chief divisions, although there are many others.

It is very hard to draw the line between plants and animals. Some German scientists have, therefore, formed a third class, but these objects are generally called plant-animals, and are usually very minute.

Animals are divided into two groups, one-celled, or protozoa, and many-celled, or metazoa. The one-celled hold a very low place in animal life.

Chalk is made of lime, and all lime-stone is of organic origin. It is built up by the little animal, very much as the polyp builds up the coral. The little animal that makes it is one of the protozoa. It once lived in the sea and gathered lime, in much the same way that coral polyps do. Marble is crystallized lime-stone.

The first land which appeared was formed mostly of lime-stone. It was at first level, but hills, mountains, and valleys were soon formed by volcanos.

This land was near the place where the St. Lawrence river now is. Land appeared later near Colorado, these lands were called Laurentian. Land soon, however, appeared in Europe, which was also formed of lime-stone. It is now covered with about 90,000 ft. of solid rock.

The animal which formed these lime-stone islands is still found in the Bahamas.

Protoplasm is the base of life, and is made of proteids which contain six elements, oxygen, hydrogen, nitrogen, sulphur, carbon, and phosphorus. There are always five, and often six; when there are five, phosphorus is left out.

Oxygen is remarkable for its combining powers. Iron rust is really the combining of oxygen and iron. Hydrogen always remains in molecules. Nitrogen is very mild, and combines with few things. The other three are remarkable for existence in one or more conditions.

The amoeba is lowest in animal life, consisting of little more than a jelly. It is a protozoa, and has inside of its body the nucleolus, and inside of that the nulicore. When it wishes to move, it thrusts out a foot and flows into it. It has a contracting cell, something like a heart.

Propagation is carried on by dividing; the division begins in the nucleus, and the amoeba cuts itself into two pieces. It is, to speak, immortal; it never dies unless killed by something unusual.

The white blood corpuscles resemble the amoeba.

NOTES ON THE TONGUE AND DIGESTIVE ORGANS OF THE FLICKER.

BY

C. J. MAYNARD.

The object of the present communication is to illustrate the modification undergone by the common flicker, or golden-winged woodpecker, on account of its food.

Many species of woodpeckers feed upon what are known as boring grubs, which are usually the larvae of several species of beetles. These live in the trunks and branches of trees in holes which they excavate for themselves.

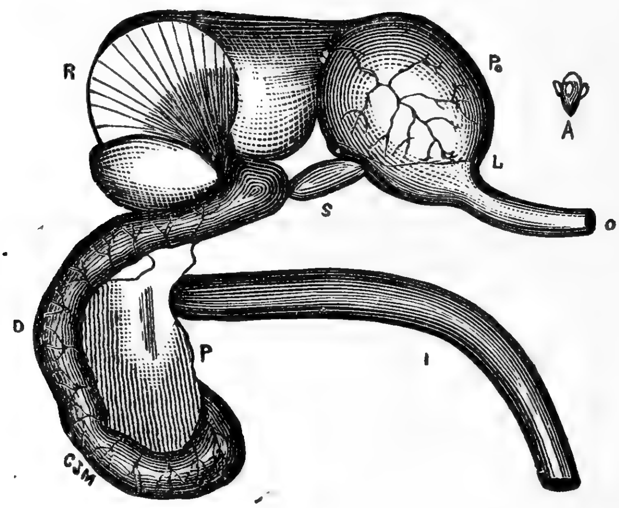
The woodpeckers, which feed upon them, are provided with a strong bill terminated with a chisel-like tip. These birds are further provided with a tongue extensible to a considerable degree, but which is furnished with a sharp barbed tip, with which the grubs are impaled.

In fig. 54 A is given the tip of the bill of one of the larger woodpeckers. And at B, the tongue of the common downy woodpecker considerably enlarged, showing the barbed tongue with its sharp tip. See D.

In the flicker we find that the bill is not straight, but curved, and that its tip is not as chisel-shaped as in many of the other species. See fig. 54, C. The termination of the tongue is also greatly modified in the flicker. It is not sharp, nor is it provided with other than a few rudimentary bristles. Thus this woodpecker is incapable of impaling insects.

We find, however, that the flicker, for that portion of the year when

FIG. 53.



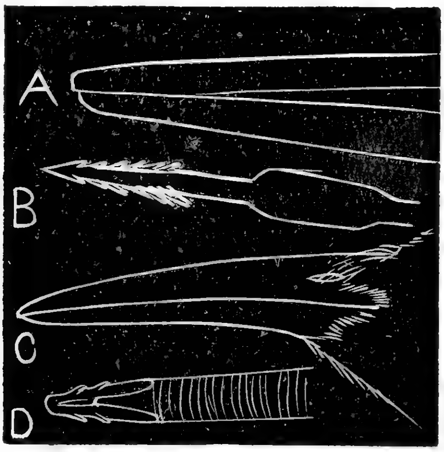
Stomach etc. of flicker. A, single compound gland; o, gullet; L, entrance to proventriculus; Po proventriculus; s, spleen; R, stomach; D. duodenum; P, pancreas; I, intestines.

ants are active, feeds largely upon them. The way in which it catches these insects is peculiar. If we examine the tongue of the flicker we will find that it is fleshy for a greater portion of its length, and that this soft part is covered with an adhesive substance. This is supplied to the tongue from the ducts of two glands, which lie along the sides of the lower jaw and which open just under the tongue.

The flicker takes his stand by the side of an ant hill, or on it, and with this adhesive coating to his tongue, gathers the ants as they run about him.

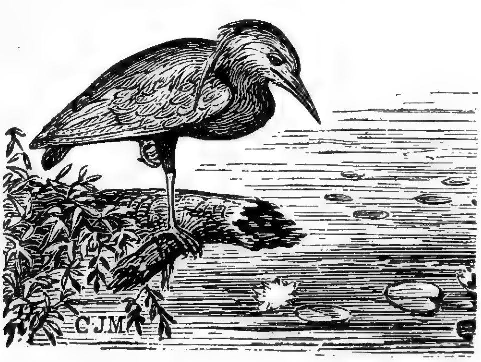
Not only is the tongue of the flicker modified to catch ants, but the stomach is also modified to digest them. Those who have chanced to taste of ants know that they are very acid, and further study shows that this is formic acid. Now in order to digest insects, which contain such a large percentage of formic acid, the proventriculus, or first stomach of the flicker, has become greatly enlarged, while the grinding, or muscular, sometimes known as the gizzard, is very small. This large first stomach serves two purposes, first, in retaining the ants till they are thoroughly mixed with the digestive fluid which exudes from glands with which the walls of this stomach are provided, second, the digestive surface is increased. The glands themselves are not only numerous, but each gland is furnished with small projections arranged around

FIG. 54.



A, bill of Yucatan ivory-billed woodpecker; B, tongue of downy woodpecker, enlarged; C. bill of flicker; D, tongue of same.

a central gland. This may be understood by referring to fig. 53, A, where is given an enlarged view of a single gland. The stomachs and other digestive organs, figured with it, are life size and the parts are explained beneath the cut. Stomach and tongue of other species of woodpecker will be figured in a forthcoming number of Nature Study.



SYSTEMATIC ZOOLOGY FOR TEACHERS.

BY

C. J. Maynard.

BRANCH PROTOZOA.

Single-celled Animals.

In this group the single cell is the chief character. That is, as far as our knowledge now extends, all the animals contained in this group are of a simple primitive structure, consisting of what appears to be a single cell. This cell usually, however, contains organs, but these are of an exceedingly simple character. Propagation is by division, perhaps after conjugation with another protozoa of the same species, never by eggs.

Most of these animals are so minute that they are quite invisible without the aid of a microscope, although some living forms are large enough to be seen by the naked eye, some being a quarter of an inch in diameter, while a nnmber of fossil forms were much larger than this.

It may be well for the teacher to note that this single cell in zoology and botany are, in a great measure, equivalent to the atom in chemistry, or the molecule in physics.

CLASSIFICATION OF PROTOZOA.

The following classification gives an idea of the principal groups in this branch with description of some typical forms, all of which illustrate some point of advancement over the lowest, or most primitive form

PROVINCE MONERA.

The most simple forms of all animal life are placed in this group. They are simple drops of jelly without any apparent nucleus or contractile vesicle, but some of them are very brightly colored. They have no fixed form, but they are constantly changing by thrusting out long, slender portions of their jelly-like protoplasmic structures with which they secure food in a manner quite similar to that explained under the head of amoeba on a following page. Propagation is by fission.

PROVINCE RHIZOPODA.

ROOT-FOOTED ANIMALS.

Many forms of this group are also naked drops of jelly-like protoplasm, but differ from the monera in having a nucleus and a contracting vesicle. Some members of the province are, however, covered with a calcareous shell by which they are protected.

ORDER FORAMINIFERA.

Animal either naked or provided with a shelly covering of carbonate of lime.

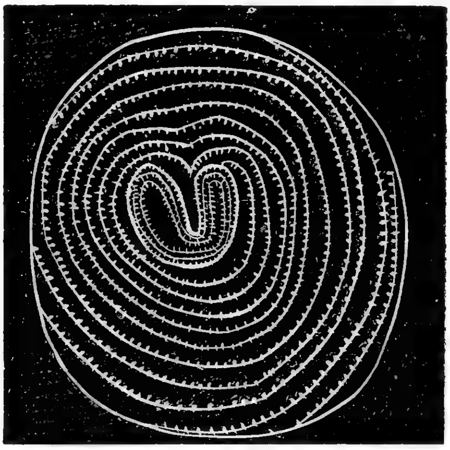
Foraminifera. These animals are covered with a calcareous shell, which is pierced with holes, and from these are thrust out and withdrawn jelly-like arms, known as pseudopodia. With these, food is captured, and the animal also moves by their aid.

The foraminifera are inhabitants of the water, and are found in all oceans, excepting, possibly the Polar seas. Small as they are, many being microscopic in size, although others, as will be seen, exceed a quarter of an inch in diameter, these animals play a very important part in the economy of nature. They do the first work of collecting the organic matter contained in sea water, converting it into living substances. (It is noteworthy that this organic matter is returned to the sea water as fast as it is withdrawn by vegetable life in the form of the sea weeds). The foraminifera also imbibe lime from sea water, of which they form their shells. They are then in turn eaten by animals higher in the scale of life. These animals are often provided with lime shells as in the mollusks, sea urchins etc., or with a stony base as in corals, and these calcareous deposits are finally, to a great extent, converted into lime stones, which form the greater portion of islands in tropical seas.

Then when we look back into the past history of the world, and examine the calcareous deposits of the Secondary and Tertiary Epochs, we find that the chalk beds are almost wholly formed of the remains of foraminifera themselves, as are also the so-called Nummulitic limestones of which the Egyptian pyramids are made. There is also a strong reason for believingthat the older limestones also have had a similar origin. Indeed, far back among the oldest Archaic rocks, among the Serpentine limestones of that first land which was pushed up from the bed of the primitive ocean, the Canadian Laurentian, we find that the earliest remains of animal life yet discovered, the Eozoön canadense, was a foraminifera.

It is singular that while many higher and larger forms of animal life have passed away leaving their fossil remains or some distant living relatives only to tell of their former existence, some of the most primitive, minute and simple forms of life should remain represented by species which are closely

Fig. 55.



Bahama Foraminifera greatly enlarged.

allied in form and method of living to those which were in existence uncounted ages ago.

Some of the most easily accessible of the shell bearing foraminifera now living can be found in the shallow waters of the Bahama islands. One form, bright reddish purple in color, the ruby foraminifera, occurs clinging in rounded masses to the base of coral. Another, which is typical in form, occurs free, as flattened disks of varying forms, but in the adult state very nearly round. This disk is perforated by a rather regular set of minute holes through which the animal thrusts its jelly-like arms. See fig. 55. This is the Bahama foraminifera (Orbitulina adunca) and is greedily eaten by two or three species of echinoderm.

Shells of different species of foraminifera are exceedingly variable in form, some being globular, some globular with other globes attached to them, forming grape-like clusters. A common form is a shell with chambers, not unlike that of the chambered nautilus.

LIMESTONE.

BY

WM. D. MCPHERSON.

We now come to the second kind of rock, limestone ; while we find granite composed of hard minerals of two, three, or four kinds, we find that pure limestone is composed of a single kind, namely carbonate of lime and this is always quite soft. While it may be true that some silica or quartz, which is found in granite may have been taken up by plants and re-deposited again, we cannot consider granite as being of organic origin.

On the other hand, it is probable that all of the limestone in the world has at one time or another passed through the bodies of animals. Thus it is of true organic origin, and is very often the true store house of fossils.

Although pure limestone is thus made of one single kind of mineral substance, there are various kinds of limestones. These may be divided into two groups, sedimentary, which are the more recent, and chrystaline, which are the more ancient.

We speak of recent limestone, and while it must be understood that the term is comparative, and that some fossiliferous limestones were formed long ages ago, it is also true that limestone is being formed to-day. If we gather ooze from deep ocean beds, we will find that it is made up of numerous minute shells, which are called foraminifera, and the animals which formed them are living to-day. If we let a quantity of this ooze dry, it forms a kind of soft, gray, chalky rock, which is wholly limestone or chalk.

In fact, the chalk beds of Europe were all principally formed of the minute shells of these small foraminifera that lived in ocean beds of ages passed, but which have since dried up. Chalk, then, is the softest kind of limestone. Coquina is another which is composed of shells, corals and their fragments, ground and broken into pieces of varying size by the action of the waves. Florida is made up largely by an underlying state of coquina limestone.

Aeolian limestone is made up of coral, shells etc. These are broken at first into coarse pieces by the action of the waves, especially during hurricanes and afterwards ground finer by being dashed back and forth repeatedly on the ocean beaches by the powerful waves. When these pieces get fine enough, to form a sand, they are blown by the winds into the interior of the land, and accumulating in quantities, become cemented together through moisture and pressure and thus form aeolian limestone, that is, limestone made by Aeoleus, the god of the winds. The Bahama Islands are largely made of this kind of limestone.

Fossiliferous limestone is wholly only ancient coquina formed ages ago, and oolitic limestone only ancient aeolian limestone.

Crystalline limestones are usually called marbles, and some of the finer kinds resemble sugar in the fineness of their grains. The crystalline structure can be easily seen by the aid of a magnifying glass. The veins and colors of other kinds in marble are caused by the staining of iron or other metals and minerals.

Sometimes other minerals mix with limestone in quantities enough to produce rocks. One of the most common kinds, and one of the most useful, is phosphate rock, composed of carbonate and phosphate of lime; the latter being usually the remains of animal life. This kind of rock is used as a fertilizer. Clay mixes also with limestone, also quartz to some extent, dolomite, forming dolomitic limestone, and serpentine, forming what is known as green marble or serpentine limestone.

Nearly all the great caves of the world, like Mammoth Cave in Kentucky, are in limestone rock. Though quite a hard and durable stone if kept dry, limestone readily yields to water action. If an earthquake or other earth movement makes fissures through this rock over a wide area of country, the water on the surface of the earth gets in and washes away and dissolves out the marble, and oftentimes we have an underground river. Under favorable circumstances this river continually widens till we have a great cave. With granite, the case is different. Fissures are just as often made, but no cave results. The water flows in, but instead of dissolving away the rock to any great extent, all the sediments and salts in solution in the water settle into the fissure or crevice, and we have what is known as a vein. Thus we see that lime rock, the fissure under water action constantly becomes larger, while in granite and the harder rocks, the same fissure becomes filled with other minerals, firmly cementing the fracture together again.

With sixteen original members, a society has been organized under the name of the Maynard Chapter of the Newton Natural History Society. A constitution and by-laws have been framed and the year's work planned. The purpose of the society is to follow a systematic course of work to obtain a deeper insight into nature study. New members are desired.

THOMAS FITZPATRICK, Sec.

BOOK NOTICES.

THE COMMON TOAD, BY DR. C. F. HODGE. OLIVER B. WOOD, WORCESTER, MASS.

"Biology is defined as 'the science of living things in the widest sense.' Thus the biology of any animal is a knowledge of its whole life story, its activities, all its relation to food supply, to enemies that feed upon it, its relation to mankind and to human interests. It is not zoology, not botany, not anatomy, not physiology. It includes and is greater than all these, and when this science is complete for any animal, it will tell us just what part it plays in the economy of nature, the whole work which the species does in the world.

We need this word, biology, in elementary school work, and there should be associated with it no suggestion of the introduction of a new study into the curriculum. It is simply an easy word to designate the 'nature study' of living things, and it is the writer's opinion that this wider study should largely supplant the more technical and special science in our schools. This larger view must inspire life-long interests. These should be developed at the earliest practicable moment, and will thus form the well-spring of interest and energy for more special work later on in the child's course."

The above is a portion of a very pertinent introduction to Dr. Hodge's valuable pamphlet upon the biology of the common toad, in which the author lays special stress upon teaching children to observe the life history of animals. The common toad is given as an easily accessible example.

The paper opens with a synopsis of the species of most of our northern frogs and toads, and then proceeds to give a general account of the habits of the common toad, beginning with the laying of the eggs, and ending with an account of the toad in its adult state.

Methods of keeping and hatching the eggs, of rearing tadpols, and of keeping the young and adult toads are given.

This truly and thoroughly practical paper, which is written in a simple manner for the use of those who have had no scientific training, we should like to see in the hands of every teacher in the country.

We also desire to call attention to the prizes which Dr. Hodge offers for the best articles upon original observations made by school children upon the habits of toads.

Those desiring to secure a copy of Dr. Hodge's pamphlet can do so by sending five cts. to the publisher, Oliver B. Wood, 50 Foster st. Worcester, Mass.

North American Fauna, No. 14. United States Department of Agriculture.

Contains the natural history of the Tres Marias Islands, Mexico.

These islands are situated about 65 miles west of San Blas, Mexico, and are thus south-east of Cape St. Lucas and a considerable distance from it. Soundings show that there is no deep ocean channel between these islands and Mexico, thus they are true continental islands.

The group consists of four islands, San Juanita, Maria Madre, Maria Magdalena, Maria Cleopa. The largest, Maria Madre, is about 8 by 15 miles and rises over 2000 feet above the sea, in fact, all the islands, excepting San Juanita, which is flat, are mountainous, rising in successive slopes from the coast to the center. They are evidently of volcanic origin. The fauna and flora appear to indicate that these islands were at no distant geological period one island, but also that this was separated from the neighboring coast of Mexico of which it once formed a part.

The general account of the islands, of which the above is an abstract, is by E. W. Nelson, who has also written the reports on mammals and birds both of which are extremely interesting and valuable contributions to science. One of the most noteworthy features in Mr. Nelson's account of the birds and mammals of these islands is their extreme tameness. The birds were not molested in any way by the inhabitants, and consequently were unsuspicious often allowing members of the expedition to walk within a few feet of them. We have had occasion before to refer to the tameness of birds in localities where they are undisturbed. Even in Jamaica, an island which is thickly populated, the birds are exceedingly tame. Surely this is a reproach to us, and in it we can read a lesson that should teach us wisdom in regard to treating our own birds in such a manner that they will have confidence in us.

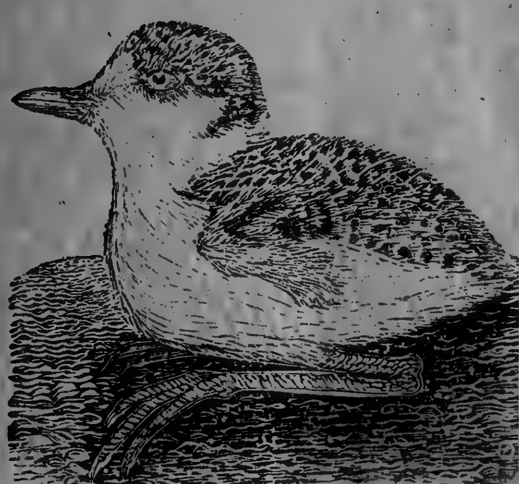
Other papers of value are embraced in this report, completing, as far as is known, the natural history of the Tres Marias Islands.

The Collecter for April and May contains some exceedingly interesting, historical sketches, one of which is of some of the noted men of Cambridge in early colonial times. Walter B. Benjamin, publisher, N. Y. City.

NATURE STUDY IN SCHOOLS

Conducted by C. J. MAYNARD

Vol. I JUNE-JULY, 1899 Nos. 5-6



Young Wilson's Plover.

WEST NEWTON MASS.

C. J. MAYNARD

CONTENTS.

NATURE STUDY IN SCHOOLS.

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Tube Sponge, Bahamas.

NATURE STUDY.

VOLUME I. JUNE – JULY, 1899. NUMBERS 5 – 6

THE SWALLOWS OF EASTERN NORTH AMERICA.

BY

C. J. MAYNARD.

The swallows, as a family, are so well known that I scarcely need give their characteristics. Their gliding flight and the graceful aerial evolutions that they execute with the long wings, which are especially adapted for this purpose, serve at once to distinguish the swallows from all other land birds.

To be sure the chimney swift, sometimes erroneously called the chimney swallow, often has a gliding flight, but as will be seen upon reading an article upon this subject in the February number of Nature Study, the swift flies with its primaries, or hand, while the swallows use the whole arm or entire wing. That is, the swift moves the tip of the wing in a quick, fluttering manner, while the swallow gives a longer, more graceful movement. Although both swallow and swift have short, triangular beaks, and wide gapes to aid in catching insects when in swift motion, there is no relationship between the two groups of birds. The swallows are singing perchers modified for rapid flight, while the swifts are derived from some widely different ancestors. In passing, I will say that the swifts and humming-birds are related, but not very closely. The form of the tail and coloration is so different in our swallows that they may readily be distinguished as given in the accompanying figures and descriptions

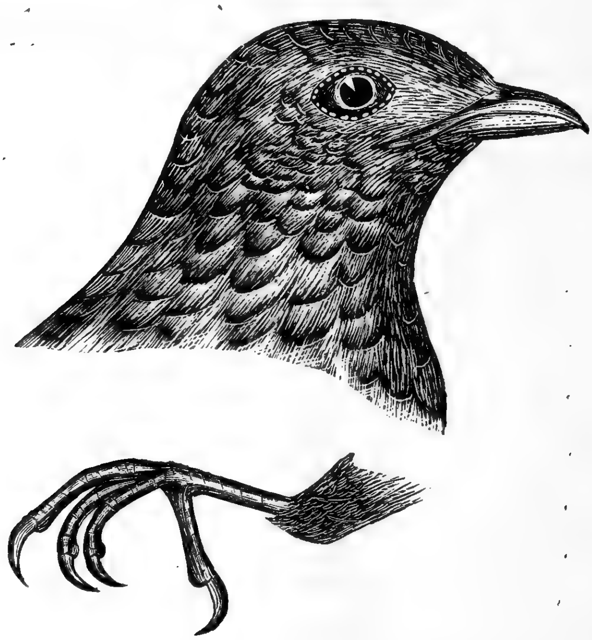
PURPLE MARTIN.

Size, large, over eight inches long. Tail, moderately forked. Color, uniform, dark steely blue throughout. Female similar, but grayish beneath. May 1 to Sept. 15. Temperate North America.

Flight, rather heavy. Song, loud, clear detached notes, frequently uttered as the birds fly high in the air. Eggs, white, unspotted.

The purple martins breed, I think now, almost universally in bird houses erected for their accomodation, but which are too frequently occupied by

FIG. 56.



Head and foot of adult Purple Martin.

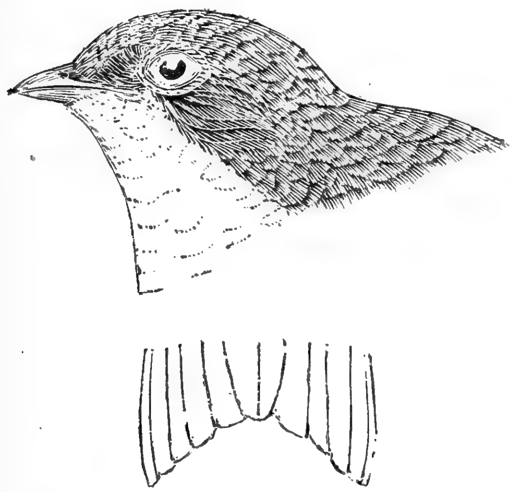
English sparrows. In fact, the sparrows have driven the martins completely away from some sections which they have occupied for years. On May 6, when, with members of my class at Concord, Mass., we observed a bird house which, being three stories high, had quite a number of apartments, all of which were occupied by English sparrows, excepting one hole of two in the attic, in which sat a male purple martin, evidently guarding this last foothold in the house which must once been wholly occupied by martins.

WHITE-BELLIED SWALLOW.

Size, medium, six inches long. Tail, slightly forked. Color, above, lustrous, greenish blue ; beneath, pure white. Female, duller above and ashy beneath. Very young birds are dusky brown throughout, and then have a more or less distinct band of smoky brown across the breast. Apr. 15 to Sept. 15.

Flight, quite graceful and light. Song, a low, short twitter. Nests, placed in bird boxes, in holes about buildings, in deserted holes of woodpeckers, and in natural cavities of trees, or in holes excavated by the birds in partly decayed trees. Eggs, white, unspotted.

FIG. 57.



Head and tail of adult male White-bellied Swallow.

The white-bellied swallow deposits three eggs during the first week in June ; the young leave the nests early in July ; after that they congregate on sea shore in vast flocks.

This is the only swallow which remains any where in the United States in winter, being abundant in Florida all that season.

BAHAMA SWALLOW.

Size, medium, about six inches long. Tail, deeply forked, with outer feathers slightly narrowed. Above, velvety green, becoming lustrous blue on lower back, rump, tail, and wings. Beneath, pure white. Female similar, but duller.

Flight, quite graceful and easy. Song, a low, chirping, musical warble. Nests, placed in holes about the eaves of buildings. Eggs, unknown.

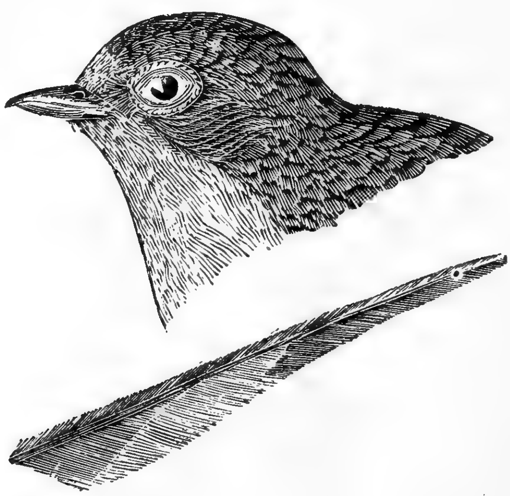
I give the above account of this beautiful and rare swallow, inasmuch as I have twice seen it in Florida, where it has also been actually taken, thus completing the account of the swallows of Eastern North America.

BARN SWALLOW.

Size, medium, about seven inches long. Tail, deeply forked, with the terminal portion of the outer feathers much narrowed.

Above, dark steely blue. Forehead and upper part of breast, chestnut. Female, similar, but duller. Breeds throughout United States, May 1 to Sept. 1.

FIG. 58.



Head and tail feather of adult male Barn Swallow.

Flight, exceedingly graceful and easy. Song, consisting of twitterings and a continuous bubbling melody

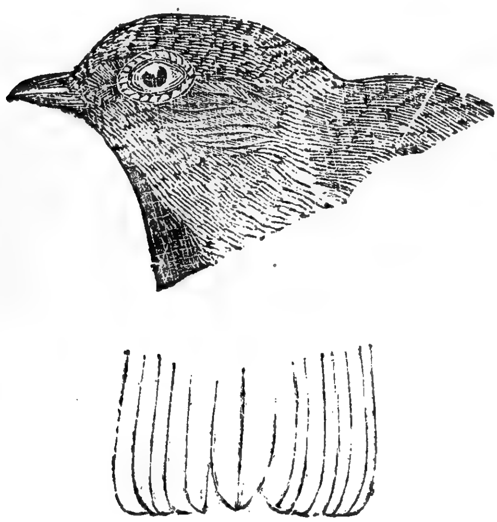
Nests placed inside barns and other out buildings, composed of mud, in which is mixed straw, etc., lined with feathers

CLIFF SWALLOW.

Size, medium, about six inches long. Dark steel blue above, somewhat streaked with lighter on the back. There is a buff lunette on forehead and the rump is chestnut. Beneath, whitish. Throat, chestnut, enclosing a dark spot. Breast and under tail coverts ,pale chestnut. May 1 to Sept. 1, United States.

Flight, heavy and less graceful than that of the barn or white-bellied swallows. Song, a rather harsh, short warble.

FIG. 59.



Head and tail of adult Cliff Swallow.

Nests, placed beneath the overhanging eaves of buildings, goured-shaped, composed of mud, lined with a little grass, etc. Eggs, white, spotted with reddish brown and lilac.

The cliff swallows nest in colonies, usually beneath eaves, but occasionally under cliffs. On account of this habit of building together in communities, they are rather local in distribution, especially as few farmers like to have their buildings decorated with a row of the rather awkward looking nests, and frequently destroy them as fast as the bird builds them until finally the locality is abandoned.

BANK SWALLOW.

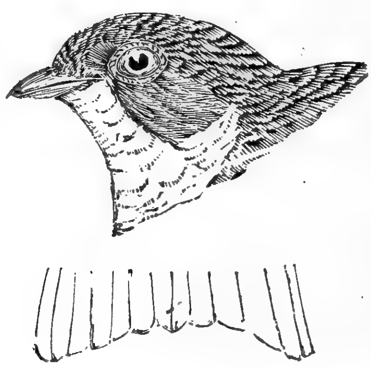
Size, small, about four and one-half inches long. Tail, slightly forked. Color, above, mouse brown; beneath, white, with a band of mouse brown crossing the breast. Female similar. May 20 to Sept. 2. Middle U. S. northward to the barren grounds.

Flight, rather easy. Song, a low twitter. Eggs, white, unspotted.

Nests, placed in holes found in sand banks by the birds. This little swallow, although by far more abundant than the cliff swallow, is rather local in distribution, being restricted to the neighborhood of the sand banks in which it builds, and all the way from a few pairs to a thousand may be found congregated together. They occur everywhere, but seem to prefer the coast.

One of the most singular breeding places for the bank swallow, that I ever saw, was a lonely islet, one of the Magdalen group, called Shagg Rock,

FIG. 60.



Head and tail of adult Bank Swallow.

which, although near one of the larger islands, is situated more than a hundred miles from the mainland. The rock rose abruptly from the water to the height of ninety feet, but the top was covered with soil, portions of which overhung the water, thus affording the swallows a fine opportunity to build.

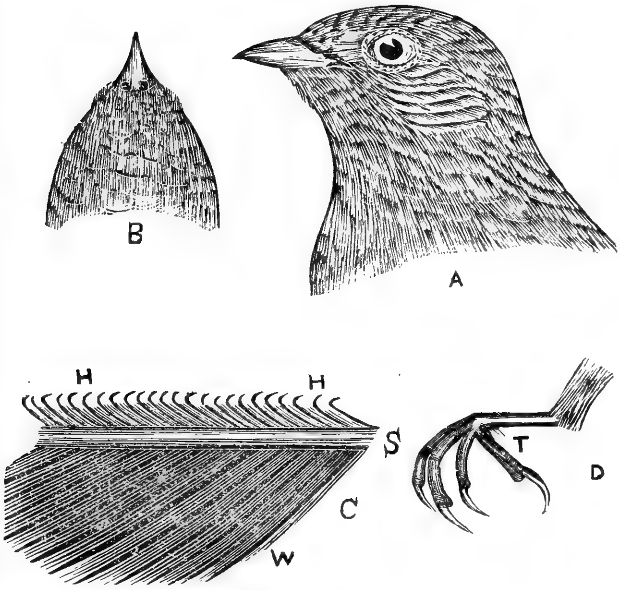
The rocky face of the cliff was inhabited by cormorants; hundreds of terns that were breeding on the upper surface, hovered confusedly about and filled the air with their harsh, continuous cries, but amid all the discord the soft twitter of the bank swallows could be heard as they flew quietly about their strangely chosen home.

The bank swallow excavates its burrow with its feet and bill, and although these members are comparatively small and weak, as in most of the swallows, the birds manage to perform their work quite rapidly, often penetrating a bank to the depth of three or four feet in a few days. The bank swallow has a little tuft of feathers at the base of the hind toe, see fig. 61, D, T.

ROUGH-WINGED SWALLOW.

Size, rather small, a little larger the bank swallow, or about five and one-half inches long, Tail, slightly forked. Color, above, uniform smoky brown, beneath, white, with throat, neck, and sides, pale brown. The outer webs of the outer pair of primaries are provided with hooks which curve forward, giving the wing a rough appearance, whence the name of the swallow. See Fig. 61, C, H, H. May 1 to Sept. 1. Southern Conn., southward and westward in the U. S.

FIG. 61.



Rough-winged Swallow. A. head; B, upper mandible; C, portion of outer feather of wing enlarged S, shaft of feather; w, web; H, H, hooks; D, foot of Bank Swallow; T, tuft of feathers.

Flight, rather heavy and fluttering. Song, a low, twittering warble. Eggs, white, unspotted.

The nests of the rough-winged swallows, as far as my experience with the species extends, are placed in deserted kingfishers' holes, or in those of the bank swallow made the previous year. Sometimes a cavity in a stone bridge pier is chosen, or a hole beneath the eaves of a building, but I think that the rough-wing rarely excavates a hole for itself.

The following is a synopsis of our swallows arranged according to form of the tail, color, flight and size so that they may be recognized when on the wing.

Tail, most deeply forked. Flight, most graceful. Beneath, reddish. Size, medium. BARN SWALLOW.

Tail, a little less deeply forked. Flight, graceful. Beneath, white. Size, medium. BAHAMA SWALLOW.

Tail, moderately forked. Flight, heavy. Beneath, dark colored. Size, large. PURPLE MARTIN.

Tail, quite slightly forked. Flight, rather easy. White beneath. Size, medium. WHITE-BELLIED SWALLOW.

Tail, very slightly forked. Flight, quite light and easy. Beneath, white, with dark band across breast. Size, small. BANK SWALLOW,

Tail, very slightly forked. Flight, rather heavy and slow. Beneath, white, with throat and neck brown. Size, rather small. ROUGH-WINGED SWALLOW.

Tail, square, not forked. Flight, heavy and slow. Beneath, reddish, with dark spot on throat. Rump, chestnut. Size, medium. EAVE SWALLOW.

EXPERIMENTAL LESSONS.

LESSON ON SPONGES IN A NINTH GRADE, WILLIAMS SCHOOL, AUBURNDALE, MASS.

BY

JOHN O. GODFREY.

SPONGES, BY ANNA LOWE.

The fibers in the sponge are woven closely together. They all grow into one another, and are one continuous line all the way through the sponge. The fibers are hollow in the interior, and if we were small enough to get inside of these fibers we could travel all through the sponge.

The flesh of a sponge grows first so that it can produce the fibers and every thing that is necessary for the sponge is produced by this flesh. The fibers are composed of horn, and sponge flesh is constantly adding horny matter to these fibers, so that old sponges become thicker than younger ones, and they cannot be as tightly squeezed as the old ones. When the lining membranes of the fibers come together, they run into each other. Salt water sponges put into fresh water will be killed.

Some people say that sponges are planted. When this is done, the sponge grows from the side which is not cut. When long sponges are growing, they are apt to be broken off, so then they will not grow upward any more, but will grow from the sides.

Some sponges are made up of one of the hardest minerals we have. The spiculigenous and horny sponges constitute one group. Others are made up of spicules of carbonate of lime. One gathers silica from the sea, and does not gather carbonate of lime. The other does not gather silica, but gathers carbonate of lime.

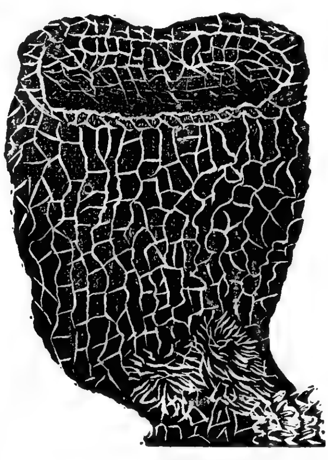
There lived, many years ago, a man by the name of Pliny, who used to write books. He was not very wise, and after reading other people's books, would write what he remembered of them. He was a Roman, and lived in Pompeii. When this city was destroyed, Pliny's father was killed, but he managed to escape. Pliny said that sponges were animals, because when they were touched they would shrink away.

Not long after this, people began to think that they were vegetables, but it has been decided that they were animals, because they have muscle and nerve cells. Some plants shrink.

FIG. 62.

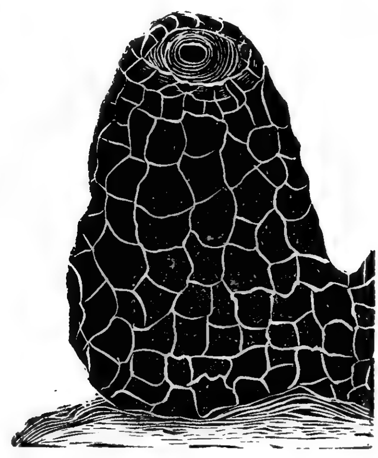
Green Cup Sponge. A, part of B, life size.

FIG. 63.



Giant Cup Sponge.

FIG. 64.



Net Sponge.

On an island off Key West there is a plant called the sensitive plant. It grows very straight, and the leaves of the plant stand up very prettily. If we were walking by these plants and should happen to touch the leaves, they would begin to droop. After having passed them all, by looking back we could see the path which we had taken by these drooping leaves hanging down.

The sense by which sponges perceive is called the sixth sense, which we first studied about in the gorgonias. Some sponges depend upon rocks, and spread all over them. These sponges have no fibres, but are classed with the horny sponges.

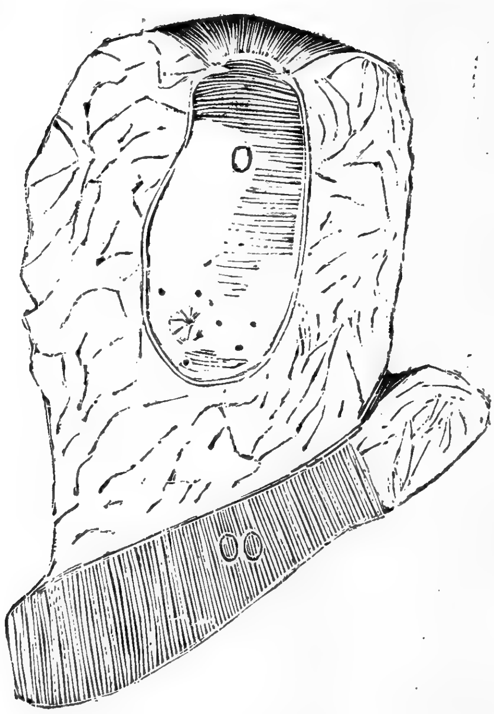
Fresh water sponges are found in ditches, where generally there is little current. Their color is usually brown or green, and they are irregular in form. Limy sponges grow in shallow salt water. Sponges that grow in salt water have various shapes.

The color of sponges differ. The scarlet sponge is a different color when dead than when growing. Some sponges are deep orange in color, and this color is very common. All sponges which are used for the bath-tub and other common things are shiny black when growing. Blue is the rarest color that a sponge has, and green is a rare color also.

SPONGE GATHERING, BY MARTHA G. HASKELL.

Many men make it their business to gather sponges. They are generally sent out by merchants, who in reality make by far the greatest profit, although they provision the ship, pay the men's wages, and provide all the

FIG. 65.



Section of small Tube Sponge, life size. Which grew from a larger cylinder, a portion of which is given at o, o. Allen's Harbor. May, 1893.

neccessary implements, consisting of a rude deep-sea glass and a sponge-hook A sponge-hook is merely a pole with two prongs on the end, an inch or two apart. With it, a skilful man can capture many sponges in one day. The merchants send out a comparatively large vessel, with five or six small boats for the spongers, as the men who engage in this business are called.

They engage as many men as they need, generally two to each boat, a man to stay aboard the vessel and take care of her, and a boy to "lend a hand" wherever needed. For the first week the men are away sponging, so let us follow them and see how they do it.

One man manages the boat and skulls her as nearly over a sponge bank as possible, while the man in the bow watches intently through his glass (mentioned above) until he sees the variety of sponge he wishes to secure, then giving the signal to stop, he raises his sponge-hook (on a rod 30 or 40 ft. long) and letting it slip through his hand he allows the prongs to rest on the bottom ahead of the sponge, then all that is needed is a quick jerk when the sponge is dislodged from its home and becomes the prey of the man who drops it unheedingly into the bottom of the boat and continues his task.

When we pause to think of the muscular exertion and the quick eye needed to perform this task, we may well wonder at the ability of man to perform it. Even the man who is managing the boat has no easy time, for he must keep the boat steady, with the wind paying her head off and the tide threatening to swing her round, and all with one oar.

When, at the end of the week the vessels return with their load, the sponges are put into a sponge- crawl (a closed in place, made of net work, and in the middle of a swift current) and left there while the boats go off for another week.

When they return, the sponges left in the crawl have, by the action of the water, had their flesh washed off, they are then put on palm leaves in the sun to dry while the spongers place their second batch in the crawl, and again go after more. When they return, the now dry sponges are strung on strings, made of palm-leaf fibre, and then are ready to be sold.

When the second and third batch are treated in the same manner, the sponges are taken to the sponge market and put into the ship's bin (each ship having her own bin) and after a little while are auctioned off. When bought, they are sent all over the world, and who knows but what we may have one treated by the very men that I have told about.

LESSON ON THE STAR-FISH IN A SIXTH GRADE, WILLIAMS SCHOOL, AUBURNDALE, MASS.

BY

Harriet B. Spooner.

Mr. Maynard, with one specimen for class inspection, gave a half hour lesson to the pupils of grade VI, Williams School. From notes, taken while he was teaching, the pupils produced these papers which are first draft.

Star-fish, by Ruth Strongman.

The star-fish has two sides, the upper side and the under side, the upper side being covered with spines. These spines protect the star-fish from any harm. A star-fish commonly has five rays. These rays are so ealled because they radiate from a center.

On the star-fish there are many little feelers. On the under side of the rays there is a hollow running to the tip of each ray. Along the edges of these hollows are some little holes. These holes run parallel with the rays. They are not opposite one from another, but are alternate. They appear opposite when the star-fish is dead.

The mouth of the star-fish is in the center of the under side where the rays join. The star-fish has the power, when he wants something to eat, to throw his stomach out of his mouth and fill it with water. When he has taken out what he wants he throws the rest away. His stomach is composed of five lobes, one to each ray. These lobes are not always regular, but are very often irregular. There is an opening in the stomach where the part the star-fish does not want is thrown out.

Between the two rays that are the farthest apart up toward the center is a little spot. When the star-fish is alive, the strainer, as this spot is called, is red, but when he is dead the strainer is creamy-white. This strainer is exactly the same as a sieve, it keeps all, except the water, out. The water goes in at the strainer through a tube, into another, which is called the ring tube, from this there goes one to each ray, a ray tube. There are many little bulb-like things along each ray. These bulbs are called suckers because they suck the food up. There is a bulb and below that a tube. When the star-fish wishes to suck something up, he squeezes the bulb, and when he lets go the water comes up. The ray tube enters this just where the bulb and the tube join. A little way down the tube there is a valve which the star-fish can close if he wants to take the water in through the strainer.

The star-fish feeds on oysters, insects, dead fish, and dead crabs. The star-fishes destroy bushels of oysters every year. Probably when a star-fish wishes to catch an oyster, he throws out a fluid which stupifies or poisons the victim. If the oyster is small, a star-fish can put the shell and all into his stomach, but when it is a large oyster the star-fish sucks out the flesh.

The star-fish is not the only enemy of the oyster. Another enemy is a bird about the same size as a hen with a long, flat, red bill. This bird is called the oyster catcher, and he knows that when the tide goes out, all the oysters gape. So when the tide has gone out the oyster catcher goes and puts his bill into a certain muscle, and thus the oyster is unable to close his shell.

LESSON ON FROGS IN AN EIGHTH GRADE, GLINES SCHOOL, SOMERVILLE, MASS.

BY

M. EVA WARREN.

FROGS, BY ISABELLA COPLAND.

Frogs belong to the Batrachian order, which includes frogs, toads, and salamanders. Many people mistake the salamanders for lizards, but there are no lizards in New England.

All the members of this order lay their eggs in the water. Frogs' eggs are laid on the edges of ponds, around sticks near or on the surface of the water, because there it is warmer and the eggs are more liable to hatch. When frogs' eggs are first laid, you can easily distinguish the dark spot where the tadpole will form; the white circle above this, which is the yoke, and the albumen corresponding to the white of the egg, which surrounds both. When the eggs have been in water a short time, the albumen soaks water, swells, and becomes like a mass of gelatine. If a very cold snap comes, of course the eggs are spoiled, and the whole mass turns greenish in color.

When the tadpoles come out, they eat first this gelatine, and then fresh water plants. The tadpoles have three gills on each side of the head with which to breathe, a long tail which enables them to swim, a small mouth, and horny jaws. The blood passes into the gills, and is purified by the oxygen in the water, then as the tadpoles grow older, the gills are taken in through the slits on either side of the head, and the water passes in through the mouth, and through an opening on the left side. It is now breathing like a fish. In a little while the two upper gills on each side become absorbed, while the third becomes changed to form the lungs.

A tadpole has a very long intestine and a small stomach, but when it becomes a fully developed frog, it has a large stomach and a small intestine. A tadpole has a long intestine, because it feeds on vegetable matter, and this is true of all vegetable eating animals. But when it is a frog it has a large stomach, because it feeds on animal matter.

The hind legs of a frog are first seen as a bud on either side of the tail. They gradually develop until fully formed in the same way that a star-fish buds a ray. The front legs are first seen as little bunches on the sides of the head. They are perfectly formed inside of the skin, and then the tadpole pushes out one and then the other. A tadpole has a small mouth, but you can see a dark line extending from either side of the mouth, which plainly shows where the large mouth of the frog is to be. When the tadpole has all of its legs it rests awhile and absorbs its tail. The flesh and bone in the tail furnishes nourishment for the frog during this process. Then the mouth widens and teeth form on the upper jaw, and the animal is a frog, which will live upon animal instead of vegetable matter. This change is as great as if a cow should change from eating grass, and eat small animals.

The frog's tongue is hinged to the front part of the lower jaw. When a frog wishes to catch an insect, it throws the tongue forward on the hinge, and catches the insect by means of sticky matter at its tip, which is forked and by letting the tongue spring back into place, the insect is thrown into the frog's throat.

The difference between the eyes of the tadpole and those of the frog, is that the eyes on a tadpole are very small, while the frog's eyes stand out from the head and can be seen very easily. The frogs, as well as some other animals, have a third eyelid which is transparent, and comes over the eye while in water, to keep the eye from harm. The ears are two circular membranes which are on either side of the head and below the eyes. The frog has very keen sight and very sharp hearing.

The frogs moult in water, the old skin coming off in strips and looking like a film as it is left in water. The frog stores up fat on either side of the intestine to serve as food during the winter. Then they go down to the pond where they are, and hide under rocks or anything that will protect them during the winter. There they stay, and when springs comes again, they come out and lay their eggs. After the breeding season, the frogs usually come on land.

The frog has four toes on his fore feet, and five on his hind ones which are all webbed. A frog swims with his hind legs only, using a double stroke, while the fore legs are held close to the sides. Frogs come to the surface of the water to breathe the air outside, and we often see them resting in the water with their nostrils just above the surface.

The female frog is larger than the male. Frogs sometimes live from twenty to twenty-five years. In the spring the male frog does all the singing.

LESSON ON TOADS IN AN EIGHTH GRADE, GLINES SCHOOL, SOMERVILLE, MASS.

BY

M. Eva Warren.

Toads, by George L. Thurlow.

The toad, one of the most interesting and useful animals, breeds in the water. The eggs are laid in two strings, which if extended, would reach a distance of ninety feet, which contain from eight to ten thousand eggs. The eggs are not all hatched, however. If they were, the country would be swarming with toads which would be as bad as the plague of Egypt.

Fishes eat many of the eggs and the frogs and toads eat others, so that they are exposed to many dangers.

The tadpole when hatched, has a round head and a small tail. Its development is about the same as the development of a frog tadpole.

The differences between the frog and toad are mainly these; while the skin of a frog is smooth and even, that of the toad is very rough and is covered with warts. The frog gets over the ground by taking long jumps, while the toad either walks or takes short hops. The reason for this is that the frog has long hind legs while the toad has short ones.

You have quite likely seen toads hopping and lying in the dusty street. The reason for this I will explain to you. The toad has just moulted and is in the street to get his new suit dusty so that he will not be conspicuous. (In this way he doesn't resemble people very much.) This is the manner in which the toad moults. His skin cracks up and down the center of his back. With his two front legs he draws it off over his head in the same manner as you would draw off your sweater. Then with first one front and then the other he takes the skin off each front leg, and finally, sitting on the ground, he pulls off first the skin on one hind leg and then the other.

The color of the toad is a ground color, making it hard to distinguish him from the ground. Celia Thaxter, the noted writer, was very fond of the sea. So she built a house on an island and went there to reside. She was fond of flowers and tried to have a garden, but the grubs were so numerous that every new attempt was followed with failure. Finally she sent to a friend to send her some toads. A box came one day and she opened it expecting to see a great many, when to her surprise she saw only three sorry looking toads on top of what appeared to be a solid bank of earth. She sent for her gardener to turn the hose on to the box, when to her surprise ninety toads jumped out. What had appeared to be a bank of earth was really the toads packed like sardines. This shows that even an educated person can be deceived by the color of the toads, they so nearly resemble the earth. The food of the toad consists of grubs, insects, and earthworms.

The toad has a forked tongue which is fastened to the front part of the lower jaw, thus the tip or forked portion points down the throat. When the toad sees a fly he sends out his tongue, and catches the fly on the tip, which is covered with a sticky substance. Then it goes back into his mouth.

If the toad gets hot he blows up his skin just like a pneumatic tire and thus keeps himself very comfortable. When we study into animals, we find that nearly all have some weapon with which to defend themselves. The toad's weapon is a white fluid which comes out of his skin after hav-been plagued or irritated. This fluid makes the raw flesh very sore, but this fluid will not cause warts as many people suppose.

The toad is very useful in the garden and field. They eat the different things that harm the garden and thus insure you against an eaten crop if you cultivate their friendship by not hitting and maltreating them. Prof. Riley, a famous naturalist, said that $400,000,000 worth of property were destroyed yearly by grubs, insects, and so forth. The toad is very useful in prevent-this large destruction of insects.

Toads are bringing to-day twenty-five cts. apiece in England. And if they are worth 25 cts. in England, they are surely worth protection in America.

LESSON ON THE STAR-FISH IN A SECOND GRADE, CARR SCHOOL, SOMERVILLE, MASS.

BY

ALMENA J. MANSIR.

The pupils were much pleased with the star-fishes shown to them and were delighted to write a story about them

These papers were written without the aid of questions as in some of the previous exercises. The more difficult words were taken in the spelling lesson on the same morning.

It is called a star-fish because it looks like a star. It lives in salt water, the upper side is up when it is in the water. The star-fish is covered with spines; it is covered with spines to protect it or so the fishes won't eat it.

I see the mouth in the middle, and five furrows, one on each ray; it has five rays. The star-fish eats oysters. When he eats the oyster he gets on top of the oyster and throws a poison out of his mouth that kills the oyster, then he throws the stomach out of his mouth and eats the oyster, then he takes his stomach in. His eyes are on the end of each ray. The star-fish has five eyes, because when he curves four rays in, he can see with the other one.

AN EXERCISE ON THE CLAM, STATE NORMAL SCHOOL, SALEM, MASS.

BY

Mercy Jane Davis.

M. Alice Warren, Instructor.

We will suppose that the children of a fourth or fifth grade, under the direction of a teacher, have seen and studied the parts of the clam This article is intended to suggest a way by which the facts may be more firmly fixed in their minds.

I know you are ready at any time to hear a story. This is to be a true one. It is about a curious little animal. Let me describe it briefly, and see if you can tell me its name.

This little animal is very soft and delicate, so it has a house to live in. This house is made of two shells. Within the walls of its home it feels very safe. To protect the little creature still more, the house is sunk deep in the dark mud along the shore. Here the animal stays until some one finds it. It may be taken to the fish-dealer's with many others just like it. Perhaps your father sometimes stops to buy some of these little animals. They are taken to your home and cooked for you to eat. I thought some one could tell me their name. Yes, they are called clams. Did you ever think about the life of a clam?

We have already spoken of the house in which the little fellow lives. Let us examine these shells more closely. Do you see the curving lines on the outside? The clam's house is just large enough to cover its body. When the clam was very small, its house was very small. As the clam grew, in order that it might still be protected, its house grew also. Each line shows what was once the edge of the shell. The spaces between the lines on the shells show the different periods of growth. You will notice that one end of the house is more rounded than the other. This end is downward. You can easily see how this rounded part keeps the shell from sinking too deeply into the mud.

You know how water wears away the rocks against which it washes. Sometimes it wears away shells and makes them crumble. Sea-water sometimes even dissolves them, leaving only a fine powder. It would not do for the clam's house to crumble away, so the outside of it is covered with a thin skin. In this way it is protected from the rude action of the sea-water. Suppose we look within the shells. First, we must force them apart. This is not easily done. We find that they are fastened quite firmly together by two muscles, for the clam needs to be well protected. We must cut these muscles to see the interior of the house. Just look at the inner walls of our clam's house! How smooth and polished! How much prettier than the outside! Perhaps here is a lesson for us. We do not find all the pretty things until we ourselves hunt for them. What seems rough at first sight, may be found to have some beauty after all. What makes the inside look so much more shiny and pearly than the outside? The body of the clam is too delicate to come in contact with the hard shell. It is therefore surrounded by a smooth, thin mantle. The edges of the mantle are thickened. They may be seen between the edges of the shells when they are in their natural position around the clam. The smooth, pearly surface is made by the mantle.

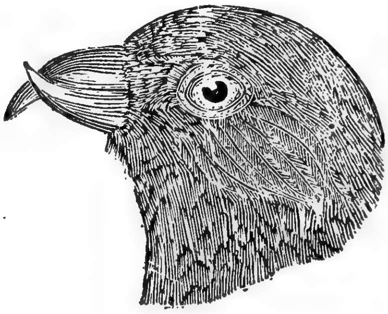
We have learned a few facts about the house of the clam. Now let us try to learn something about the little friend who lives in this shell house. The first thing that we see is the wrinkled, black portion which extends beyond the shell. This is called the siphon. Do you find two openings in the end of the siphon? They are surrounded by ray-like projections. These openings are the mouths of tubes which extend into the clam's body. Later on, we will tell you about their use. Let us remove one of the shells as we did before from the other clam. We can now see all of the clam. I can imagine your saying, "What a queer body the clam has! It has no head! It has no legs!" But let us see what we can find. The four thin, delicate bodies which float upward as we put the clam into a dish of water are the gills. These have the same use in their bodies as our lungs have in our bodies. The clam cannot breathe the oxygen from the free air as we do. It breathes oxygen from the air which is in the water. The water containing the air passes through the large opening which we saw in the siphon, into a tube, through which it enters the body. It then passes over the gills, and around the body, and out through the smaller opening in the siphon. In this way the clam gets the oxygen that it needs.

It must have food as well as oxygen. If we look carefully, we shall find near the end opposite the siphon, three or four slender projections. These surround an opening. This opening is the mouth. The food of the clam consists of particles of animal and vegetable matter found in the water which comes in through the siphon. The small projections surrounding the mouth help to draw in the food particles. The food passes into the stomach and intestine, the soft portion of the clam's body. The material which is not digested is carried out through the small siphon. There are tiny blood-vessels in the different parts of the body. The blood is not red like ours, but colorless, much like water. It is sent along by the beating of a small heart. Nourishment is absorbed from the stomach and intestines, and is carried by the blood to other parts of the body.

Near the mouth of the clam you will find its one foot. This seems a queer place for a foot, does it not? It can be thrust out through an opening in the mantle. The clam does not need to move about much, but by means of this foot it can have a little motion. Because the foot can be thrust out and drawn in, we know that the clam must have muscles. You remember that we found that the shells are held together by muscles.

The clam is very sensitive to touch. If the siphon be touched, it will at once be drawn into the shell. If the shells are partly open and we touch them, they will be drawn tightly together, probably for greater protection. Clams are found along the shores of bodies of salt water. As the tide comes in, fresh sea-water is brought across the mud. Thus the clam, having its siphon projecting upward, gets fresh oxygen and fresh food. The clam is certainly a very interesting animal. At first it does not seem that there can be so much active work going on within such a small body. In the study of the clam, we see that the smaller animals have been as carefully and thoughtfully provided for as the larger ones.

Figure 67



Head of Red Cross Bill.

SWALLOWS.

BY

C. J. MAYNARD.

I stood on Cayman's lonely isle,
  On which the tropic sunbeams pour;
Where the wild waves of the Caribbean
  Roll in thunder on the shore.

When from o'er the deep blue ocean
  Northward bound from southern climes,
Came the swallows, softly twittering,
  Reminding me of other times.

Gone is all the tropic splendor,
  Vanished is island, sea, and sky;
For now I stand upon a hill-side
  O'er which the west winds softly sigh.

Stand within the wide barn portals
  Of my old New England home,
List'ning to the swallows twittering,
  As on rushing wings they come.

And instead of spicy odors,
  Now I smell the new-mown hay,
Lately piled upon the scaffolds
  In the deep and spacious bay.

Summer sunshine falls in patches
  Through the branches of the trees:
While just beyond are pastures broad,
  Where many cattle graze at ease.

Up the lane and on the hill-side
  Overlooking meadows wide,
Where grows th' grass in deep luxuriance,
  In which both rail and bittern hide;

Winding brook and leafy woodland,
  Where with lingering steps I stray,
Thinking of the many mysteries
  Found in childhood's happy day.

Over all this pleasant landscape
  Twittering swallows come and go,
Darting onward through the sunlight,
  Sweeping over hedges low.

Alas! this is a vision only;
  For around me palm trees stand,
While the wild waves of the Caribbean
  Roll in thunder on the strand.

CAYMAN BRAC, APRIL, 1888.

SEDIMENTARY OR STRATIFIED ROCKS

(MECHANICALLY FORMED)

BY

WM. D. MACPHERSON.

As we have mentioned before, there are, roughly speaking, only two kinds of rocks, first, the eruptive, or igneous, which were the first rocks when the earth cooled from a red hot mass, and second, the sedimentary rocks which have been formed either from ground up fragments of the lower igneous rock, or from organic remains. Plants have left us vast beds of peat lignite, coal, etc., and animals, the great mountain ranges of limestone. Coal, and limestone are stratified rocks that have accumulated upon the lower igneous rock bed. They were largely in the form of sediment deposited in regular layers and then hardened, hence sedimentary. These sedimentary rocks are classed as chemically formed, while the sedimentary stratified rocks that we are to speak of to-day are formed simply mechanically. These are the slates, formed from fine mud, the sandstones, formed from sand, and the conglomerates, from gravel. There is thus a regular series of rocks made from the finest clay or mud, to the coarsest of gravel. These have the least value of any rocks in a mineral sense. As a general thing, they contain no minerals in sufficient quantities to pay for the working. They are sometimes penetrated, or split up, by veins which have valuable mineral deposits, so that miners see a good deal of slate and conglomerate, without actually getting much mineral matter from them.

Slates and sandstones, however, are quite often rich in fossils, which give the past history of animal life on the earth. The particular kind of fossils a piece of slate holds, always determines the relative age of the slate' for every age of the earth has had its own animals. The lower slates and sandstones, for instance in the Cambrian Age, had low forms of animal life, and as the ages went on, and new rocks were piled up, different animals appeared, and the old ones, with a few exceptions, died out. From the Cambrian to the present age, animals have increased not only in size, but in intelligence and complexity of structure. In the Reptillian Age, and in some instances since then, many animal forms have been vastly larger than any we have now, but the size and quality of the brain has doubtless increased steadily and without a break from the dawn of life to the present time.

Let us see how slates are made, and the fossils accumulate. We have previously told briefly in Nature Study, how the process was. When the earth had first cooled from a red hot mass, and was covered with water, there doubtless could have been little or no mud or sand for slate or sandstone, till huge masses of rock had been pushed up out of the ocean by volcanic or geologic action. Then the waves and elements began to grind the mountain of rock into powder, and all this powder, or rock dust, gradually settled under water. In fact, by the action of the wind or rain, everything on land gradually reaches the ocean, and vice versa, all the mud along the ocean that we see at low tide, comes from the land. When animals, like crabs, star-fishes, and worms that crawl about on the bottom of the ocean, die, their remains settle down into the soft mud, and before they decay, perfect impressions of themselves are made, which endure for ages. The mud becomes hardened into slate, and the skeletons and shells previously buried in it so many years ago, are to-day scarcely less realistic and beautiful than when they breathed and lived. So simple, yet so wonderful is the story of a fossil. To the geologist the sedimentary rocks are highly interesting, while to the hard, practical man of the world, the chemically formed sedimentary rocks, like marble and coal, and the eruptives, with their commercial values, are of the first importance.

SYSTEMATIC ZOOLOGY FOR TEACHERS.

BY

C. J. Maynard.

ORDER LOBOSA.

Amoebae.

The minute animals which form this group of the root-footed animals are often unprotected by shelly or other covering, but a large number of species are provided with coverings which they secrete themselves, or which are made of grains of sand, portions of diatoms or spicules. Amoebae live in both salt and fresh water, also in damp earth.

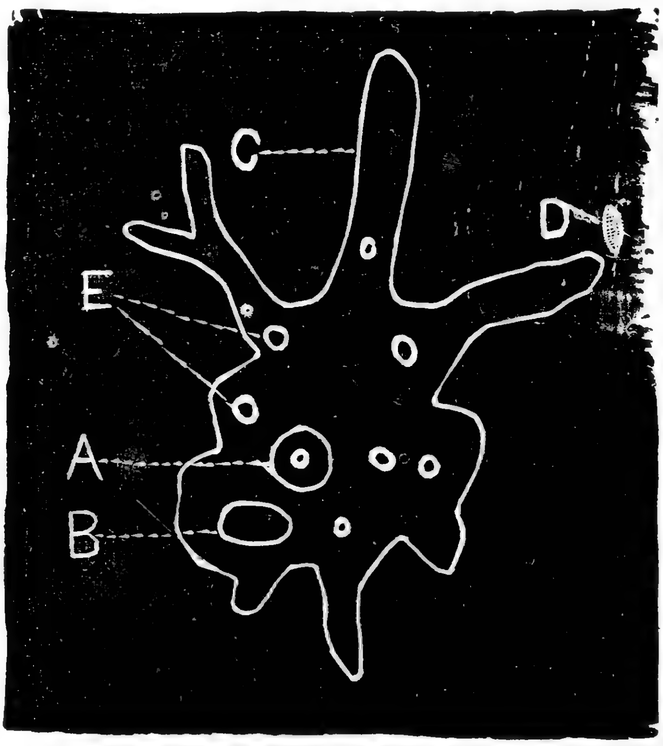
The common Protean amoeba may be taken as a type of this order. If we remove the ooze from the surface of the mud in ditches, especially in those where there is little or no current, and place it in a shallow dish for a day or two, we shall quite likely discover that this species of amoeba is present. A little of the water placed on the slide of a microscope, will probably show one or more of what are apparently minute drops of a jelly-like substance. If these be closely examined for a time, they will be seen to thrust out slender projections into one of which the remaining substance of the body will frequently flow. This little drop of jelly or protoplasm is really an amoeba, and the flowing process is its means of progression. These processes are known as pseudopodia or false feet.

Form. When perfectly at rest, the amoeba has a spherical form, but when moving and thrusting out its pseudopodia, it is so constantly changing in form as to merit the name of proteus, which has been applied to it. This change is accomplished very quickly, either by the body substance flowing forward or by some of the pseudopodia being withdrawn. As a rule, however, the pseudopodia are more frequently thrust out in one direction than in another, hence we may consider that the buds of the amoeba have an anterior and a posterior end.

Structure. When perfectly quiescent, the amoeba is seen to be surrounded by an outer substance which appears to differ somewhat from the inner- This outer substance, which may be considered to serve the purpose of a kind of envelope or skin, thus maintaining the integrity of the amoeba and preventing it from mingling with the surrounding water, is called the ectoplasm. This clearly renders each amoeba a separate organism or individual. Within this covering is a central substance, which appears to be composed of course gravels, and which is known as the entoplasm. The point here to be emphasized is that neither ectoplasm nor entoplasm appear to be separated, one grades completely into the other.

CIRCULATING SYSTEM. Examined carefully, under a high power, amoeba will be seen to possess, within its substance, a pulsating vesicle (see Fig. 66, B) usually single, sometimes double, lying near its posterior extremity. This is filled with a liquid which, upon a rather sudden contraction, of the vesicle, is expelled. Then upon slow expansion, is refilled with the surrounding protoplasm. By some observers this expelled protoplasm is said to break through the surrounding ectoplasm and escape into the water, and the vesicle is regarded as excreatory. Others think that it creates a current in the interior of the animal, thus aiding in digestion. However this may be, the pul-

FIG. 66.



Amoeba, much enlarged. A, nucleus; B, contracting vesicle; C, pseudopodia; D, food; E, food balls.

sating vesicle is clearly for circulating purposes, and must be regarded as the direct homaalogue of the pulsating organ found in higher organisms, or in other words, it is a rudimentary heart.

DIGESTIVE SYSTEM. A further careful examination of the amoeba, will show small objects in its interior. These are often opaque and frequently colored. These are food balls and enclose the material taken in by the amoeba. Bits of vegetable matter are taken in by being grasped by the pseudopodia, and then the body flows around them completely enclosing them. These particles of food are taken in at any point on the surface of the body and digestion takes place within the body, the nutrutive matter being being retained in balls known as food vacuoles or food balls (see Fig. 68, E) and within these digestion takes place, the nutritious matter being assimilated by the protoplasm in some way. When the process of digestion is completed, the food balls approach the outer surface of the body, and break through the ectoplasm at any point, but usually near the posterior end.

Reproduction. After attaining a certain size, for amoeba like all other known animals, reaches a maximum size, the individual does not die, but divides. That is, there is first a fissure of the nucleus which, in a little time, extends through the entire animal, and we have two amoebae where there was one before. This is the only possible method by which the amoebae are known to reproduce. It is noteworthy that after division no two sections or cells so formed remain joined together, each becomes separate and is, in fact, an individual.

Irritibility or Nervous System. While we can as yet point to no definite organisms, in which the nervous system of the amoeba resides, the fact that it contracts and expands, that it moves in one direction more than in another, that it takes particular kinds of food and rejects others, and above all, that it reaches out for food, or, in other words, seeks it, without waiting for the food to be brought to it, all show that the amoeba possesses a nervous system. Rudimentary and comparatively incomplete as this system is, it is sufficient to meet the wants of the amoeba, guiding it in its search for food and in its selection of it, its movements, etc.

Encystment. Under certain circumstances, like a change of temperature in the water, or upon the gradual drying up of the water in which it lives, the amoebae contract themselves into the form of a ball, the ectoplasm becomes thickened, and the amoebae remain quiescent for a time. In this condition they are able to withstand considerable drying, and may possibly be blown about by the wind. Upon reaching water again, however, the amoeba becomes animated and resumes its ordinary functions of life.

Summary. Amoeba is clearly an animal, and as clearly an individual. Although it has the power of assimulating food, it has no fixed mouth, digestive system, nor anal opening. There is no apparent respiratory system, but it is probable that the oxygen is taken in through the surface of the body wall, and that the carbon dioxide is ejected in the same manner. The circulating system is exceedingly rudimentary, but evidently present. The nervous system, although undiscovered, must be present, for it is evident that the exciting cause of movement, reproduction, etc. comes from within the animal, where the stimulus acts upon the protoplasm, which responds. Reproduction is of the simplest kind, by division, and as far as definitley known, without fertilization from any other individual, although something of the kind may take place. The progressive life of the species permanently resides within the nucleus, and it is a significant fact, and one which should be kept constantly in mind, that by the early division of the nucleus, a portion of this progressive life is insured to each half of the amoeba. In the encystment of the amoeba we see a provision for the perpetuation of the race under conditions adverse for ordinary existence.

RADIOLARIA.

These are similar, in some ways, to the foraminifera, but are provided with a silicious shell or tests, perforated with minute openings from which the pseudopodia are thrust out. The remains of the radiolaria formed immense beds of rock in the Tertiary Age, and they occur in the diatomacous rock at Richmond, Va., and in that vicinity. In the Nicobar Islands they form a deposit between eleven hundred and two thousand feet in thickness, and there is another celebrated deposit in the interior of Barbados, West Indies.

HELIOZOA, OR SUN ANIMALCULES.

These are beautiful Rhizapods and occur in fresh water. Many species float freely about, but others are attached to plants etc. by long pedestals. The pseudopodia are in the form of very delicate, tapering rays which extend in all directions from the center, whence the name of sun animalcule.

PROVINCE GREGARINIDA.

Parasitic Animalcules.

These peculiar minute forms of animal life are found parasitic within the intestinal canals of earth worms, insects, crustaceans, etc. They are covered with a membranous skin through which they absorb nutriment from the partly digested food in which they float. Thus they have no need of pseudopodia, and consequently are without these appendages. They are, by some naturalists, regarded as amoebae, and which have been placed under favorable conditions for obtaining food, and have thus become modified by their surroundings.

In propagation they undergo a kind of alternation of generation, similar in some ways to that seen in much higher organisms. When about to multiply they become surrounded by a thick cyst, which may include one or two gregarines. If there chance to be two, they loose their identity and merge into a single mass. From this mass are developed nucleated cells, which gradually become spindle-shaped. Upon the rupture of the cyst, the spindle-shaped bodies escape. These spindles produce amoeboid bodies which, in turn, develop into the original gregarina. Thus three distinct forms intervene between the adult forms in the progress of development. It will thus be seen that the offspring for three generations do not resemble the original parent form, and this alternation of generation, as this and similar methods of reproduction are called, begins quite low in the scale of animal life.

PROVINCE INFUSORIA.

INFUSORIAL ANIMALCULES.

They are the highest of the Protozoa, as they possess the most complicated structure. They are divided into two groups.

FLAGELLATA. TAILED INFUSORIA.

All agree in possessing one or more elongated, whip-like cilia, or long, slender appendages with which they move or gather their food. Some move freely about, but others are attached together in colonies, and in structure somewhat resembles the sponges. In fact, they are considered by some authors to intergrade with the sponges, but, as will be seen in a forthcoming article, there is considerable difference between the two groups.

ORDER CILIATA. CILIATED INFUSORIA.

This is a large order of animalcules, all of which possess cilia which are used as locomotive organs.

PARAMOECIUM, OR SLIPPER INFUSORIA.

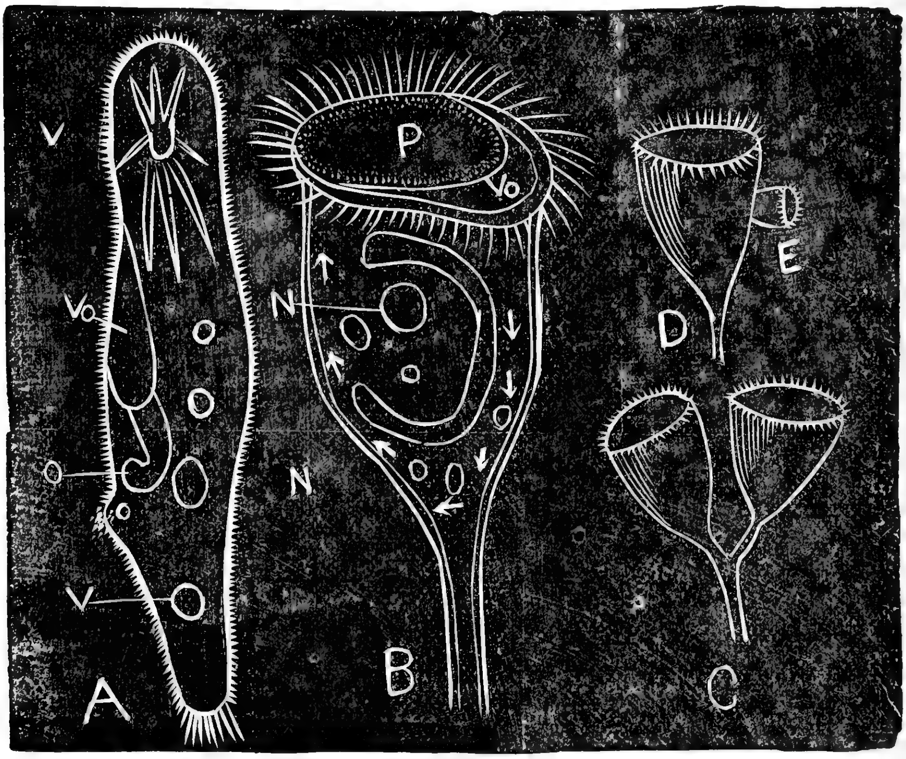
Among the many species of ciliated animalcules we find as a typical form, the slipper infusoria. If we cut up hay in small pieces and put it in water in a warm place, we will find upon examining this water after two or three days, that it is filled with animalcules, many of which will be the species in question.

FORM. The slipper infusoria differs from the amoeba inasmuch as it is unchanging in form. It is much longer than wide, rounded at one extremity and pointed at the other. Upon watching the animal for a minute, it will be seen that it moves with the larger end foremost, and we thus naturally conclude that this is the anterior or head end. The posterior end is bent a little one side leaving the slight protuberance, seen at A in Fig. 68, which somewhat resembles the heel of a slipper.

LOCOMOTION. The movements of the slipper infusoria are quite rapid, and are accomplished by cilia which completely surround the animal and which are a little larger at the posterior end than elsewhere, forming a kind of tail.

STRUCTURE. Paramoecium will be found to be of a similar, general structure as amoeba, being composed of protoplasm which is divided rather clearly into the enveloping ectoplasm and the internal entoplasm.

FIG. 68.



A, Slipper infusoria. B, bell; C. Bell infusoria dividing; D, Single female bell penetrated by a male bell, E; V, contracting vesicle; N, nucleus; V O, vestibule; O, oesophagus.

CIRCULATING SYSTEM. Circulation is accomplished by two circulating vesicles which, when contracted, show radiating lines, which are possibly of a tubular structure.

DIGESTION. At one point, near the middle of the body, will be found an opening or cavity, known as the vestibule. See Fig. 68, V o. Around this opening the cilia are a little longer than elsewhere. This is the mouth and is permanent. The food is taken into it by the aid of the long cilia and passes down into a gullet, (see Fig. 68) but afterwards form balls which are scattered through the surrounding protoplasm and in which the food is digested (see Fig. 68, D.) as we found in amoeba. When the nutritious matter has all been assimulated, the indigestable portion of the food balls is thrown out at the point mentioned as the heel of the slipper, breaking through the ectoplasm with each successive discharge. This heel is known as the anal spot.

REPRODUCTION. Multiplication of the species is accomplished as in amoeba, by division, and each individual may divide several times, as in amoeba, without fertilization, but ultimately two slipper infusoria are seen to come together and remain in contact for some time. During this time, some of the fluid contents of the nuclei are exchanged. Immediately after separating, division takes place in both individuals.

IRRITABILITY OR NERVOUS SYSTEM. The fact that slipper infusoria move rapidly shows that the nervous system is better developed than in the amoeba.

ENCYSTMENT. As in amoeba, under similar circumstances, the slipper infusoria may become encysted.

ADVANCEMENT. In reproduction we find something akin to fertilization in what is known as conjugation. A summary of all these points of advancement will show us that both physically and mentally the slipper infusoria are considerably higher than the amoeba.

VORTICELLA, OR BELL INFUSORIA.

In this peculiar form of Protozoa we find the next stage of advancement. The species is found on the stems of fresh water plants in the form of minute branching colonies.

FORM. Each individual of this colony is bell-shaped with a ciliated disk. See fig. 68, B.

STRUCTURE. While the outer and inner layers of protoplasm are a little better developed even than in paramoecium, there is a general resemblance. The same ectoplasmic and entoplasmic structure extends into the stems, by which the bells are attached to a common stalk, or directly to the plant by one stem.

DIGESTION. The vestibule which leads into the mouth in the bell animalcules, is found at one side of the ciliated disk, (see Fig. 68,V o) and the motion of the cilia causes the water, with its accompanying food, to flow into this. Then the food is ingulfed in a mouth from which it passes into an oesophagus which is provided with small cilia. These cilia cause the food to pass downward into a small chamber or crop. Here, through a whirling motion, also caused by cilia, the food is formed into balls which pass into the protoplasm of the body. Here there is a regular circulation of fluid which carries the balls with it, down one side, across the bottom of the bell and up the other side, following one course indicated by the arrows as given in fig. 68. By contractions of the central portion of the bell, known as the peristome, the undigested portions of the food are ejected through the vestibule.

Locomotion. Excepting in the male form, explained under reproduction, locomotion in the bell animalcule is confined to contractions of the disk, peristome and stem. If the dish or slide, containing specimens, be jarred, or the animal touched, it will be seen to first fold in the cilia, then the disk and and a portion of the peristome, while the stem is thrown into a spiral form. All this is done quite rapidly, but in unfolding the motion is much slower.

Reproduction is by division, from above downward, through the center of each bell, thus the stalk which bore one bell before, bears two after fission. After a short time, one of those bells folds itself as described, acquires a second belt of cilia, breaks off and swims about freely, but soon attaches itself by the base, and forms a new stalk. Before dividing, vorticella undergoes a peculiar process of conjugation. An ordinary bell will either divide rapidly two or more times, thus producing several small individuals, or a small portion of a large bell will be divided off. All of these small divisions will produce little bells which swim about freely, but which soon seek a larger stalked individual, and penetrating into its side, become absorbed by it, thus the identity of the small individual is completely merged into that of the larger.

Irritability or Nervous System. With a higher degree of specialization, we naturally expect a greater development of nervous irritability and such will doubtless be found to occur in vorticella.

Encystment. Under some circumstances, vorticella becomes encysted. The cilia, mouth, stalk, and peristone are lost, and the whole animal becomes rounded in form and surrounded by a thick membrane. In this stage, the body is sometimes seen to break up into a number of minute spherical bodies, each of which contains a portion of the nucleus. When liberated by the bursting of the membrane, each of these acquires a ciliated belt, by the aid of which it moves to some favorable spot, becomes attached, loses its belt, and develops a stalk and peristone.

Summary and Advancement. Although vorticella may, at first sight, be considered as lower in the scale than the slipper infusoria, on account of being attached to a base in its adult stage, the fact that the small, or as we must consider it the male, individual is completely absorbed by the large, or female, individual exhibits the true fertilization which we see in higher animals. This alone, as showing a greater degree of specialization, would tend to raise the animal possessing it to a higher rank than those in which simple conjugation oocurs. Thus we may safely consider the bell infusoria as one of the highest of the single celled animals.

WALKS AND TALKS BY THE SEASIDE.

BY

C. J. MAYNARD.

For some days the wind has been blowing hard from the eastward, but with increasing violence after the first night, and yesterday the tempest reached its culminating point. All day great ships, coastward bound weie striving, with double reefed lower sails and with bear poles above, to keep off the land. Last night at twelve o'clock the wind began to blow in long, sobbing puffs, with intervals of comparative quiet between. These intervals of quiet soon became isolated spaces of calm and the gale was broken; in an hour all was quiet, seemingly more than quiet after the thunderous turmoil of the last hours. Then, although I was miles away, the irregular jarring cadence of the waves came distinctly to my ears and I could well imagine just what was going on along that sandy beach that lay so far to the eastward. It is strange how far the sound of breakers can be heard; I was once cruising in a yacht down Pamlico Sound and we had put into one of those shallow bays that abound on the west side of the sound about opposite Cape Hatteras, in order to gain a harbor during one of those gales for which the region of this Cape is celebrated. At sundown the wind had subsided into a perfect calm, and then we could distinctly hear the sound of the waves that were being hurled upon the reefs and bars of that Cape of Storms, although the spot upon which they were spending their fury was at least twenty-five miles away.

I have said that I could well imagine what was going on along the beach, but I also knew without a doubt that Old Ocean in his rage was with every wave, casting some valued prize upon the sands. Thus it is, that to-day we stand upon this long reach of sandy shore in search of nature's treasures. It is one of the fairest June mournings that ever dawned; the level, seemingly boundless ocean is before us, reflecting so perfectly the azure of the clondless sky, that at the horizon line sea and sky mingle. Behind us, the hot sun rays are beginning to quiver on the sand hills which stretch away for a mile or more; but beyond this barren ground we can see the verdant hill tops, looking doubly green through contrast with the white sand. A purple mist hangs over Cape Ann, which lies just to the southward. In all this we see no sign of the tempest of yesterday, but when we glance at the great green waves that come dashing in and spreading themselves in long lines of foam upon the gray sands with a force which even now but little can resist, we can readily understand with what overpowering force the breakers must have dashed upon the land during the height of the tempest.

We cannot complain, however, Old Neptune, when he bids his Triton's pipe for the storm winds, this time did us a good turn, for the beach is fairly strewn with objects which are of the greatest interest to us, and if possible I want to tell you something about all of them. Among so many, where shall we begin? Well let us take the first thing at hand, and here it is asserting itself quite prominently. A long, brown ribbon lies out on the sand at our feet, nearly two yards in length by some four inches in breath; attached to this ribbon is a round stem quite stout. and beside it is another stem and ribbon, and both stems are firmly fastened at their roots to an object which we shall examine later. I have said that the huge brown object before us has roots, or what appear to be roots, for it is a vegetable, a gigantic sea-weed, being, in fact, the largest that we have on our shores; the fishermen call it the devil's apron string, why I shall leave you to conjecture, for I do not know. When I say that the Laminaria, as those who have given Latin names to the Algae, or sea-weeds have called it, is an inhabitant of our coast, the statement is, perhaps, not strictly correct, for not only is this plant an inhabitant of the sea, but always grows in deep water at a depth of at least fifteen fathoms, about one hundred feet, the height of an ordinary church steeple. "There is nothing on the land but what is found in the sea," is a saying that we hear repeated by almost every one who has association with the ocean, and this is true to a greater degree than those who are most familiar with the expression are aware; upon the land are are belts of timber of certain kinds representing different altitudes, thus in the lowlands are certain plants and shrubs, higher, another growth, still higher are still other kinds, and so on up the mountain slopes, we find every few hundred yards a change, until at the top all is barren save a few hardy lichens that grow on the naked rocks, inhabitants of the Arctic Zone. Yes, zone is the proper word to apply to these belts of plant growth, and in the sea we find a similar occurrence; different groups of sea-weeds occupy different zones, and as certain marine animals feed upon particular weeds, they too occur in zones.

Now to return to our Laminaria; as shown, this is an embassidor, perhaps an unwilling one, from a deep water region known, from the abundance of this kind of sea-weed there, as in the laminarian zone, hence we may judge that it has brought with it some examples of animal life that occur there. Knowing this, then, let us look more carefully at the object to which the roots of the plant are clinging.

Upon examining the object in question, we find that it is a large shell nearly six inches long, of a rich chestnut brown color, and by removing the roots, as I have termed the small divisions of the stem of the sea-weed by which it is fastened to the shell, but rather improperly, for strictly speaking they are not roots, but cables, for all the sea-weeds derive their nourishment from the atmosphere or water, and this is applied through the entire surface of the plant; I say by removing these cables we can better examine the shell. We find that the side to which the attachment was made is considerably curved, but the lower side is straight. From this lower side, near the small end, are a large number of threads, or rather something that closely resembles quite coarse black thread. This is known as the byssus and at once tells us that the shell is a species of mussel. This is true, it is the horse-mussel, Modiola modiolus, and inhabits deep waters.

The byssus serves as a cable, and in turn anchors the shell to the bottom; this cable must be exceedingly strong to hold the large sea-weed in position, yet this laminaria is small; I have seen specimens, also attached to shells, that were twenty feet long, and some occur that are longer. These seem large for plants, but they are small compared to those which grow in other parts of the world; thus we have a British species that grows forty feet in length and this is a dwarf in comparison to a South Atlantic sea-weed that attains the altitude of three hundred feet; this in turn falls into comparative insignificance beside a Pacific Ocean species that trails its enormous length over a thousand feet of water, or, according to some authors, grows to be fifteen hundred feet long. Where are the various forest trees of land beside this vegetable product of the ocean? Even the giant redwoods of California must lower their diminished heads before this towering sea plant.

But what is this singular animal that has fallen out of the sea-weed? It is another member of the moluska, or a mollusk. I hear some one exclaim, who looks at the cut which is here given, "I thought mollusks were shells." So they are shells, so to speak, as a rule, or better they carry shells, in nearly all species, on the outside of their bodies, but this squid or cuttle fish carries its shell within its body. Not all of this group are unprovided with external shells, for the various species of nautalus, which are allied to the squids, have shells, and most beautiful ones as well. This specimen is quite pretty, being reddish in color with green eyes, which are rather staring, and thus odd looking, but we must expect to see all sorts of very singular appearing animals that have their home in the great mysterious deep. Our squids are provided with eight arms that grow from the head, and the under side of these arms are provided sucking disks, such as I have figured, with which they attach themselves to any object to which they wish to fasten.

I never see one of these animals without being reminded of my first experience with a cuttle fish. We are all of us more or less familiar with stories of gigantic cuttle fish, or the octopus; how huge members of this genus have power to drag, not only men, but ships into the sea and destroy them, although for many years, tales of this description were regarded at best as being simply exagerations, well ascertained facts lately revealed, show that, as far as size goes, there are monster cuttle fish that, if so disposed, could overpower the largest ship that sailed in the days of which the tales were told. The little adventure of which I speak occurred quite a number of years ago on the island of Key West. I chanced to find myself there just after one of those fearful hurricanes that too often devastate that region. This, however, proved fortunate for me, as not only was the beach strewn with many rare and desirable specimens, but the gale had driven many animals that had inhabited deep water hitherto onto the shores, where some of them remained. I was walking along the eastern beach one morning, gathing the various objects of interest, when I noticed a whitish sphere protruding from beneath a low ledge of coral rock in a pool of quite deep water near the beach. A long experience with all sorts of animals ought to have taught me caution, but I am afraid it has not, and fear of consequences has never deterred me from investigating quite closely any living thing with which I have desired to become acquainted; accordingly, this spirit being aroused, I waded into the water, rolled up my sleeves, reached down and promptly grasped the white sphere. It felt soft to the touch and at the same shrank perceptably, and almost as promptly as my hand went down, four long arms, slender and writhing like serpents, came up, glided along my naked arm, then fastened themselves to it. The sensation produced by these cold, slimy tentacles, adhering to the flesh, with at least a hundred sucking disks, was so peculiar that I released my hold of the body of the octopus, for such it proved to be, when, evidently enraged at my invasion into its strong hold, after a sudden attempt to draw me downward, it released its grasp, which it had maintained with the remaining four arms upon the rock, and suddenly seized my other arm with them.

(TO BE CONTINUED.)

ADVENTURES OF THREE YOUNG NATURALISTS.

BY

U. R. WILD.

CHAPTER I.

THE RATTLE SNAKE.

"Don't shoot, Harry, don't do it, wait until I cut a long pole! That is too bad, why didn't you wait? I could have killed him just as well with a long stick, and then the Professor could have had him to dissect."

"I couldn't help it, Paul, I was so excited, it is the first rattle snake I ever saw and it has been the height of my ambition to shoot a big rattle snake, and besides I don't believe I have injured the specimen much."

"You've blown a big hole right through him," said Paul, going up to the huge reptile and examining it.

"Well now the animal is good for nothing. I may as well take off the rattles," said Harry, and taking out his knife he proceeded to remove them.

"I believe that is all you wanted any way," said Paul, "and you know if the specimen was uninjured, the Professor would not have liked it if you took the rattles. Of course I should like to show the rattles of a big snake like this, fifteen of them, I declare!

"The boys up in Hubtown will open their eyes when they see this. You know you would like to own it."

"I should much rather have seen the Professor make the dissection of the animal and have heard him explain the internal structure," quietly answered his companion.

The above recorded conversation took place between two boys sixteen and seventeen years of age, who were standing in the Pine Woods in one of the wildest portions of Dade County, Southern Florida.

They formed two of a party of three boys who had come to Florida in company with Professor Hall who taught natural history in a northern college.

"What have you here?" exclaimed a pleasant voice, and a gentleman, accompanied by a stout, but jolly looking boy of fifteen, came around a clump of saw palmettos which had hitherto hidden them from view.

"A diamond rattle snake! just what I have been trying to get for a long time; but where are the rattles, and what a pity you have completely spoiled it. Why didn't you cut a pole there yonder on the edge of the hammock and kill it in that way?"

"I tried to save it," said Paul, "but I guess Harry was excited and shot before he thought."

"Yes, sir," said Harry, "I was excited, for I nearly walked on it. I was looking up in the tops of the pines trying to get a sight of those little birds which are making so much noise up there, and did not see the snake until I was nearly on whim, when he began to shake that tail of his like a buz saw; then I shot at him."

"Are you sure he is dead, Harry," said George, the boy who had just arrived and who had been, during this conversation, slyly attaching a string to the tail of the reptile as it lay in the grass, while he was pretending to examine the place where the rattle had been.

"Dead! why he never moved after I fired," said Harry, "did he Paul? See here," and stooping down, he was about to turn the animal over, when George gives a sudden jerk to the string, pulling the snake backward. Harry jumped to one side, and his feet coming in contact with a bunch of zamia, a common fern-like plant which grows in those parts, stumbled and nearly fell, while George roared with laughter.

"Boys, don't play with edged tools, especially those whose mere touch may mean death,"' said the Professor.

"Why sir," said George, as he removed the string, "the snake can't bite him, can he?"

"No," replied his reprover, "but if by any chance his fangs should even prick the flesh now, the poison would quite likely flow into the wound and the result would be nearly the same as if the snake were living. Even after the head has been dried and all the moisture absorbed from the venom its virulent character remains.

"I once heard of a singular instance, or rather a series of instances, in which this peculiarity of rattle snake venom was painfully illustrated. A gentleman who was an amaeture taxidermist, had mounted a rattle snake with the mouth wide open and the fangs exposed. This piece of workmanship was his pride for some years, but after a time ti was laid away on a shelf in a closet and forgotten. A servant, in removing some article from the closet, accidentally threw down the snake and left it on the floor. The master of the house, shortly after, wishing to get something from the closet in the dark, trod upon the head and caused one of the fangs to penetrate into the leather of his boot. That night his heel came in contact with the tooth and his foot was slightly wounded. This scratch was not immediately painful nor did he notice it, but after retiring his foot began to swell, and shortly after, this swelling extending upward, the matter became serious. A physician was summoned, but not knowing the cause of the difficulty, the proper treatment was not given and the patient died, and no satisfactory reason could be given for his death. Years passed, and a son of the deceased grew up, and finding his father's discarded boots, tried them on, and upon removing them, he too received a wound, from which he died in a similar manner as his father.

Then it occurred to some members of the family to examine the boots, when the embedded fang was discovered."

"How wonderful!" exclaimed Paul, who had been carefully examining the snake, "but, Professor Hall, how does this snake differ from the rattle snake which is found in the north, I know it must be larger."

"Yes," said Harry, who had just completed measuring it with a pocket rule, which he had borrowed from Paul, "it is six feet and three inches long with the rattles, and one, a rattle snake that I saw in the window of a drug store in Hubtown that were killed in Milton on the Blue Hills, that was said to be a very large one, was only four feet long and had only ten rattles."

"Yes," said the Professor "the size is one differenee in specimens of the same age. Of the two specics, for this is distinct and is called Crotalus adamanteus, or the diamond rattle snake, while that from the north is Crotalus durissus, or the banded rattle snake, and these terms pretty well explain the difference, thus you will notice that the general color of this snake is like that of the more northern species, yellowish brown, but in this the light markings form diamonds, whereas in the other they form transverse bands."

"How old do you think this snake is?" asked George.

"Why," said Harry, "it has fifteen rattles and a button, so, according to the hunter's theory, it is eighteen years old, the button counting three years and each rattle one."

"I should think he is much older, and judging from the known great age to which reptiles live, he might have been a well grown snake when Ponce de Leon discovered Florida," said the Professor. "If you will examine the rattles, you will see that the button is really only a terminus that can be obtained by removing only one ring, and a number of rings may be actually lost at one extremity of the rattle, while others grow at the base. Now boys," he continued, "let me cut off the head, which, I see is my good fortune, to be uninjured, and I will show you something of the arrangement of the fangs and poison glands to-night."

"That will be fine," said Paul, "and won't you kindly show us how to take off the skin, as I should like a piece of it as a trophy."

"So should I," exclaimed both the other boys. The Professor took a skinning knife from his collecting wallet, and with two skillful strokes, removed the animal's head, cutting through the thin portion of the neck. This he carefully placed in tin box which he carried in his collecting basket, that he, as well as the boys, had suspended on his shoulder, resting on his back. He then made an incision along the whole length of the snake, between the large transverse scales that cover the lower portion and the smaller hexagonal scales that occur on the sides. Then he pushed back the skin from the neck, and borrowing the string from George, he fastened it firmly to the stump of the neck under the skin, and instructed one of the interested boys to hold the string, seized the edge of the raised skin of the neck between his thumb and fingers and drawing it back, easily removed it.

"How white the flesh of the snake is," said George, "It loosk almost good enough to eat."

"You are not the only one who has thought that it not only looks good enough to eat, but have actually eaten it. The Indians frequently make use of the flesh of the rattle snake for food," said the Professor, as he carefully rolled up the skin, right side out, and gave it to Paul to put into his basket.

"White men have eaten it and consider it good. Wm. Bartom, in describing the St. John's River in 1790, mentions that he, in company with the Spanish governor of the fort at Picolata, dined on roasted rattle snake which he pronounces very good."

"What is your dog doing Paul?" suddenly exclaimed Harry.

"Looks as if she was paralyzed," said George.

"Steady! Ponce, steady!" said Paul, giving one glance at his fine setter, who had been for some time quartering on the ground in the neighborhood of a clump of saw palmettos and who had now come to a point.

"She has got onto a bevy of quail, I think, let us close up and see."

The well trained dog, although holding her point, steadily glanced over her shoulder in a quick, hurried manner by turning her head to one side to see if her master was coming. Then there was a hurried changing of shells in their breach loaders. In the moment all were gathered back of the dog, spread out in a line.

"Go on, Ponce," said Paul, "go on."

Ponce's form quivered a moment, then with one nervous bound she sprang forward into the midst of some low bushes that skirted the palmettos. This bound was followed by the whirr of twenty pairs of wings, as up went the quail, scattering in all directions. Harry, who was somewhat inexperienced in this kind of sport, pointed his gun at three or four of the rapidly disappearing birds in succession, finally discharged at one that had got over one hundred yards into the pine woods.

(TO BE CONTINUED)

BOOK NOTICES.

THE GRASSES AND SEDGES OF THE NORTHERN UNITED STATES, ILLUSTRATED. AN EASY METHOD OF IDENTIFICATION, BY EDWARD KNOBEL. BOSTON, BRADLEE WHIDDEN, 1899.

This is a timely publication and one that meets a long felt want. In this little volume, Mr. Knobel has given us an easy method of identifying the grasses, sedges, and rushes which grow so plentifully about us.

The descriptive text, although short, is ample, taken in connection with the exceedingly fine illustrations, to enable even one who knows nothing of plants of these groups, to identify quickly and with certainty any species which comes to han .

The full plate illustrations are particularly fine, and well deserve special mention. No teacher can afford to be without this book.

FIELD KEY TO THE LAND BIRDS, ILLUSTRATED BY EDWARD KNOBEL BOSTON BRADLEE WHIDDEN, 1889.

In this little book Mr. Knobel has described one hundred and fifty-five species of common land birds. The method used is the comparative, one which is always the best for beginners. That is, a common species will be described, and other allied species will be compared with it.

Accompanying the text are a number of excellent illustrations which will be found of great value to the young student. The book is further embellished and rendered more valuable by the addition of nine plates, containing figures of one hundred and fifty species of birds, hand colored. Although in some cases, we wish that the shades of color, on some of the birds, had been mixed with a little more care, and in some few instances better applied regarding position, the coloring has been done with great neatness and in the majority of cases these colored figures, small though they are, will greatly aid the student in identifying the species. We cordially recommend this work as an elementary book on birds.

COMMENT AND CRITICISM.

The second, third, fourth, and fifth meetings of the Maynard Chapter of the Newton Natural History Society have been held, with a very largely increased membership. Special reports of various departments of nature work were given and the systematic work in biology was begun and continued. The work of the society bids fair to be of special interest to teachers and others interested in nature work, and further membership is desired. Those wishing to join the society, will please communicate with the secretary.

THOMAS FITZPATRICK, SEC.
447 WALTHAM ST.,
WEST NEWTON, MASS.

WEST NEWTON, MASS.
ENGLISH AND CLASSICAL SCHOOL,
ALLEN BROTHERS.

May 30, 1899

Dear Mr. Maynard,

The May number of Nature Study came this a. m. I wish to assure you of the delight we take in the plates and descriptions. I am very glad you thus place in desirable, permanent form information you have gathered through personal investigation and observation in nature's haunts. An example of what facts can be had by using eye and brain, not omitting common sense.

YOUR FRIEND,
N. T. ALLEN.

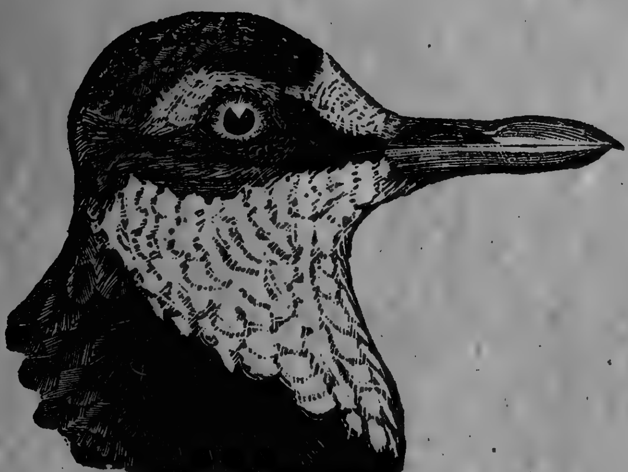
A pair of orchard orioles have nested in the vicinity of the Maynard laboratory at the present season. Although this oriole used to be a not unfrequent visitor to Newton, this is the first pair which we have seen in this immediate locality for over twenty-five years.

NATURE STUDY

IN SCHOOLS

Conducted by C. J. MAYNARD

Vol. I AUG.-SEP., 1899 Nos. 7-8



Head of Wilson's Plover.

WEST NEWTON MASS.

C. J. MAYNARD

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NATURE STUDY IN SCHOOLS.

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Scarlet Sponge, Bahamas.

NATURE STUDY.

VOLUME I. AUG. – SEP., 1899. NUMBERS 7 – 8

THE VIREOS OF NEW ENGLAND.

BY

C. J. MAYNARD.

The vireos are a peculiar group of birds, and like the warblers, are exclusively American. There are some seventy described species of vireos, and these are scattered through the tropical, sub-tropical and temperate regions of our continent and its adjacent islands. Wherever they occur they are common, and during all of my travels from Northern New England to the islands of the Caribbean, I have, in the proper time and season, seldom been long out of hearing of the songs of one or more species of vireos. Indeed, in some places where there is apparently very little to attract any birds, I have found vireos exceedingly abundant. Thus, on the island of Key West where the foliage is mainly reduced to low shrubbery and that occurs in isolated patches, I found a white-eyed vireo very common and its call song was heard all winter. The singular Bahama vireo occurs in such abundance in the thick shrubbery of the Bahama Islands as to outnumber all of the other species of land birds on the keys. Several scores, if not hundreds, can be heard giving their quaint call songs upon a still morning from almost any standpoint outside the city of Nassau, and I have found them nearly as abundant on all the keys, which I have visited, no matter how small, that are sufficiently clothed with foliage to afford the birds shelter.

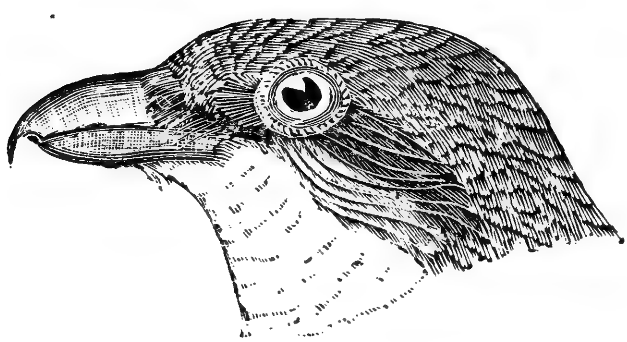
Some species of vireos are exceedingly limited in distribution, inhabiting in some cases, small islands. Thus the Bahama vireo is found only on the islands from which it takes its name. Gundlach's vireo occurs in Cuba only, Osburn's vireo in Jamaica, while Allen's vireo is confined to Cayman islands.

Nearly all of the vireos which occur from Key West southward are constantly resident where they breed, but the vireos of the eastern section of the United States, with the exceptions named, are migratory. In summer however, they are common throughout New England, so common, in fact, that it is difficult, even in the streets of our towns and many of our tree shaded cities, to find a spot which is not reached by the sound of their enlivening songs.

In spite of all this, there are many people, too many in fact to-day, who will say that they never saw nor heard a vireo to know it. Most every one who begins the study of birds finds the vireos difficult to determine. Yet they are comparatively easy to distinguish mainly on account of their songs, each species having its peculiar utterance, which is always so different from that of all other species of birds as to render it at once recognizable. For the benefit of those who know nothing of the vireos, I will begin at the beginning and try to give some points by which these birds can be identified.

The vireos of New England are, with one exception, (the yellow-throated)very plainly colored birds, greenish above, sometimes with the head bluish or grayish, and white beneath, with no streakings or other prominent

FIG. 69.



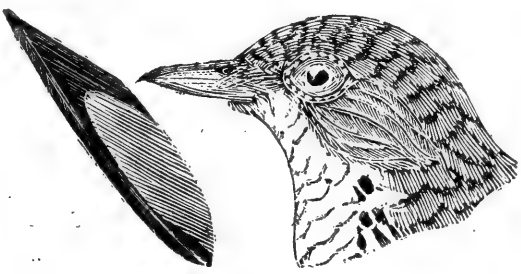
Head of Logger-head Shrike.

markings. How then shall we distinguish these birds from others which may chance to be of about the same size and general coloration? For example, a female pine warbler is not strikingly different in coloration from a warbling vireo. I answer, by form and motion. The vireos have a large, thick bill hooked at the tip, and a large head. All of their motions are comparatively slow. They even move their heads quite slowly; in short, all of their actions are performed with a deliberation quite at variance with the active, restless motion of the warblers.

When we come to examine the skins of vireos and compare them with those of the warblers, we find one reason for the slowness of movement in the vireos in the fact that the anterior toes are bound together as far as the first joint from the base. A bird with its toes so fettered cannot jump about among the foliage as readily as can one, the toes of which are free to the base, as in the warblers. Why, it may be asked, are the vireos so fettered as to cause them to be less active than many other species of small birds?

If we think a moment we shall see that this very inactivity may prove advantageous to the birds, as caution in movement may enable a bird to steal upon an insect, for example, and thus capture it more readily than if it moved with greater rapidity. That is, vireos have found it advantageous to move slowly in search of their prey, and thus their feet have become modified to suit this method of movement among the branches. There can be but little doubt but what a vireo, with its peculiarly constructed feet, is capable of grasping a twig more firmly than is a warbler with its free toes. This fact, together with the large bill, with its powerful jaw muscles, would enable the vireos to capture and kill large caterpillars more readily than could a bird which is not provided with similar appendages.

FIG. 70.



Head of Pine Warbler.

Comparative deliberation of movement, then, is one characteristic of the vireos, but I have here to state that even among the vireos there is a differerence in this respect, and that we do have one group of vireos which, as vireos, moves more actively than another group. Strange to say also, the group of vireos which is a little the more active, sings a little more energetically than the other group. Then again, correlated with these two characters we find that all of the energetic vireos have wing bands, and that they are absent in members of the other group.

While it is possible that this division into groups may be extended to all other species of this particular genus (Vireo) I will now simply apply it to the species which occur in New England. We thus have:

VIREOS. Plainly colored birds, less than six inches and a half long, with large bills, hooked at tip, large heads, and partly fettered toes. The outer primary, or first quill of the wing is always shortened. As seen in the white-eye, sometimes so much so as to become quite rudimentary, as in the solitary; in some species it becomes very minute and is misplaced, appearing on the upper side of the edge of the wing, as seen in the red-eye.

While the vireos differ considerably from the warblers in form of feet, size of head, and size and form of bill (see fig. 70, pine warbler, and contrast with fig. 75, warbling vireo), they are closely allied to the shrikes, resembling this group in having the large head and large bill with its hooked tip. See fig. 69, logger-head shrike.

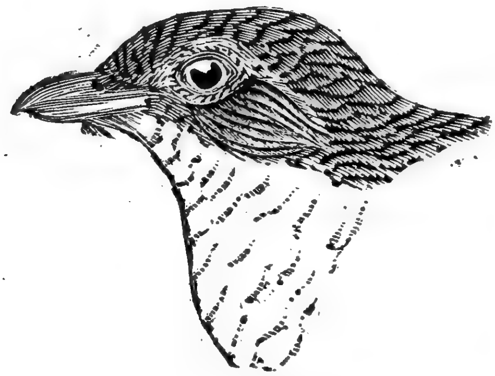
GROUP ONE. ENERGETIC VIREOS.

Wing bands, present. Song, divided into a decided, separate series of notes and uttered with considerable force, but with comparatively harshness. Movements, energetic. Three species.

GROUP TWO. LANGUID VIREOS.

Wing bands, absent. Song, not divided into a decided, separate series of notes and not given with special force, but very sweetly. Movements, rather languid. Three species.

FIG. 71.



Head of Yellow-throated Vireo.

GROUP ONE.

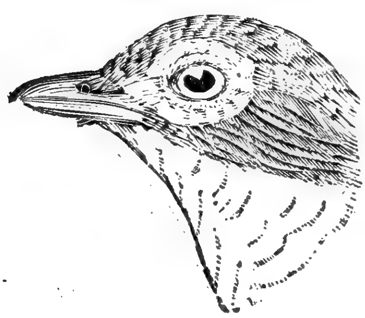
1 YELLOW-THROATED VIREO. Greenish above, quite uniform. Throat and upper breast, bright yellow. Remaining under parts, white. Wing bands, white.

Arrives from the south about May 1st, and frequents deciduous trees in open groves or on the margins of woodlands, hence often by road sides and in parks. Breeds from Florida to Northern New England, but rarely north of Massachusetts.

SONG. Distinctly divided into three series of notes given with a rather harsh, forcible intonation. The syllables are something like these, "Do you see me? Do you hear me? Here I am!" These utterances are given with sufficient pause between the series to render the separation of the notes very apparent.

NEST. Often built in an apple or other fruit tree, when such a tree is not far from some woodland, but sometimes on the margin of a woodland in a forest tree. The nest is seldom placed high and is probably the most characteristic and easily distinguished of all our vireos. Like all of them, the nest is purse-shaped, hanging below the fork of the twigs in which it is placed, but the outside of the structure, which is made up of strips of bark, grass, etc., neatly and compactly woven together, is usually covered with lichens.

FIG. 72.



Blue-headed Vireo.

The eggs are also quite characteristic, being large for those of vireos, and the spottings are not only large, but are most always brown, not black in color as is usual in most species.

The yellow-throated vireo leaves New England about the second week in September to winter in South America.

2 SOLITARY OR BLUE-HEADED VIREO. Dark greenish above; top of head dusky bluish; prominent ring, around eye, white. Beneath, white, tinged on sides with greenish. Wing bands, white.

Arrives from the south often as early as the third week in April, and frequents woodlands, seldom appearing in spring in the open country.

Breeds from Southern New England northward, probably as far as the woodlands extend, but is rare south of the White Mountains.

SONG. Not unlike that of the yellow-throat, in a general way, but lacks most of the harshness of that species.

The nest is often placed in a pine or other evergreen and is not especially characteristic, nor do the eggs differ especially from those of the red-eye.

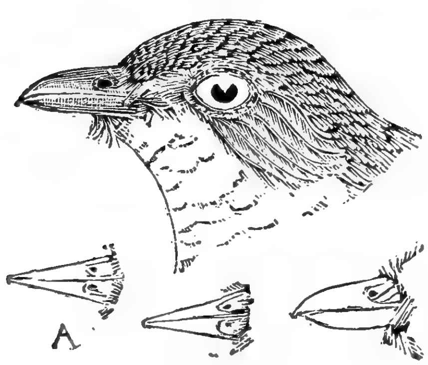
In the southward migration the solitary vireo is found in Massachusetts in middle September and is much more generally distributed than in spring. Winters in Florida and southward to Guatemala.

3 WHITE-EYED VIREO. Greenish above, tinged with yellow in a line over eye and around it. White beneath, yellowish on sides. Wing bands yellowish. Iris, white.

Arrives from the south late, about the middle of May, and frequents swampy thickets. Beeeds from Florida north to Massachusetts, but is locally distributed in New England, occurring more often near the salt water than elsewhere.

SONG. Quite peculiar, consisting of two or three syllables. Not only do individual birds of this species sing differently, but the same bird will

FIG. 73.



White-eyed Vireo.

often have several call songs. For example, I heard one at Braintree this past summer reiterate distinctly many times, "I will give you a lick," but he afterwards changed this somewhat aggressive utterance to a milder expression which was, however, untranslatable into English.. All of the vireos scold when annoyed much as orioles do, but the white-eye possesses this power to a marked degree; chattering and scolding most vehemently when his favorite thicket is approached.

It is probable that, like the Bahama vireo, which also has a variety of call songs, the white-eye occasionally gives all of these detached notes in the form of a continuous song.

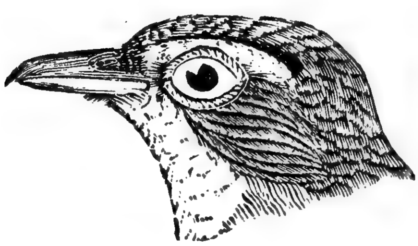
The nests of the white-eye are placed low in a thicket, and although the outside is frequently partly or wholly covered with birch bark or bits of paper, such is not always the case, when the nest is hard to distinguish. The eggs are also much like those of other vireos. The white-eyes migrate early in September to winter in abundance in Florida and southward to Central America.

GROUP TWO.

1 Red-eyed Vireo. Olivaceous green above, head slaty blue, margined above the eye with a dark line, beneath this is a light line, and from the bill through the eye a darker line. Beneath, white. Iris, red.

Arrives from the south about May 1st and frequents woodlands of all

Fig. 74.



Red-eyed Vireo.

descriptions, and even parks. Abundant. Breeds from the Southern States northward, even beyond New England.

Song. A continuous warble given with deliberation, more or less divided into distinct syllables, but not into a series of notes, sometimes on this account being called the preacher bird. After uttering a series of syllables which are difficult to translate into any English words, two notes like "Sweet William" are given with more or less distinctness, according to the individual. Nests usually placed in woodlands, either high or low according to the fancy of the bird. Both nests and eggs are decidedly vireo-like, but otherwise there is nothing very characteristic about them. The red-eyes depart for Central and Northern South America about the middle of September.

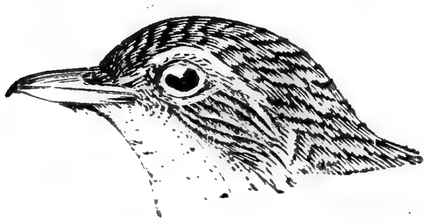
2 Warbling Vireo. Dull greenish above, top of head scarcely different, no distinct line through eye. White beneath, slightly yellow on sides. The plainest of all our vireos.

Arrives from the south often the last week in April. Breeds throughout the United States, but rare north of Massachusetts in New England. Frequents the trees by roadsides, often in towns and cities. Poplar trees are its favorites, however.

SONG. A continuous warble, given very sweetly, but uttered with no distinct syllabication from beginning to end. Although the opening notes resemble those of the purple finch, the conclusion of the song is quite different. It has less of the vireo intonation than any of the species of the family which occurs with us.

NESTS. Placed in some shade tree by the roadside, often a poplar is chosen, but of late years I have found these nests as often in maples as elsewhere. There is nothing characteristic about either nests or eggs. In fact, all of the eggs deposited by the species in group two are white, more or less spotted and dotted with black.

FIG. 75.



Warbling Vireo.

The warbling vireo departs for the south in early September, wintering in Mexico. It is rather singular that all of our vireos, excepting in accidental cases, avoid the West Indies and pass to the south-west to their winter quarters, excepting the solitary and white-eye, some of which winter in Florida.

3 PHILADELPHIA VIREO. Rather smaller than the warbling vireo. Similar in general coloration, but rather brighter above and more decidedly yellowish beneath. Skins can always be distinguished by the apparent absence of the outer quill, which is shortened, and misplaced but which is always present in the warbling vireo.

Although the Philadelphia vireo is not uncommon during the migrations, especially in autumn, in Pennsylvania, it is exceedingly rare in Massachusetts.

It occurs in Northern New England in summer and breeds there and northward to Hudson Bay, but the nest and eggs have been seldom taken. The song is not unlike that of the red-eye, and to my ear is distinguished from it with difficulty.

The Philadelphia vireo should be looked for in Massachusetts in May and September. It winters in Costa Rica and Panama.

THE WOOD FROG.

BY

MABEL ROBINSON.

In walking through the woods you may often have startled into motion the little wood frog who will proceed to make himself scarce with a series of leaps exceedingly long for so small a creature.

If you are fortunate enough to capture him for examination you will find him a curiously beautiful frog. The general color, except for the bronzed effect, is very much like the dead oak leaves where he was cosily hidden when you roused him. The dainty little black mask which he wears gives him the name of Maryland yellow-throat from its resemblance to the markings of that bird.

This spring, the very first of May, some eggs of the wood frog were brought to me from a neighboring swamp. I kept them away from sunshine and heat until they were fairly well started on life's journey which was not long after. A slight movement was noticeable in the eggs the next day, and by the next, many had eaten their way out of the jelly and were swimming around, tiny black morsels of life.

Of course with such a goodly supply of nourishing food it was unnecessary to give them anything more for awhile. In fact, it proved fatal when a few, as special treat, were given some Indian meal. This, however, with bread crumbs, was the principal article of their diet as they grew larger and were put in the fish bowl to live with two tadpoles which had been all winter changing into bull frogs.

The last week in May several of the wood frog tadpoles, though much smaller than the bull frogs had been at the same stage, acquired back legs. These at first appeared very helpless and lay stretched parallel to the tail, but gradually the joints strengthened and the little fellows seemed very proud to be able to kick them about. The second week in June they developed all the symptoms of hard cases of mumps. They became very much swollen on both sides below the throat, and close examination showed, protruding slightly through the tiny hole on the left side, a wee elbow. In every case the left leg came first to be followed the next day by the other front leg.

Then followed rapidly a series of tragedies. The little body changed very quickly, the mouth widening, eyes protruding, and tail shrinking. This last seemed to be a signal for the end, for as soon as the tail had shrunk to within a quarter of an inch of the body, in spite of all care and precaution, the little frogs were found every morning floating on the surface, dead. Thinking the bull frogs, who had gone through all the changes successfully, to be the cause, I removed them, but it had no effect.

At last all were gone but two, and when I looked in the morning, one of them was floating, nearly dead, on the surface. In despair, I placed him on the bit of wood that the bull frogs had used to climb upon and left him to die. Returning in a little while to take him away, I found a very lively young frog and then the truth dawned upon me. The lungs of the wood frog must develop much sooner than those of the bull frogs, and therefore, though their bodies were not completely changed, they had needed air and had actually been drowned. They had not tried at all to make use of the floating stick, perhaps were not strong enough.

Everything was easy now. I placed the remaining two in a jar with just enough water to keep their skins moist, and they changed rapidly to little Maryland yellow-throats about as large as one's thumb nail. They seemed to have no fear, and would sit on my hand or take their exercise in long leaps over the table.

However, since catching flies and dainty tid bits is not very satisfactory, I decided as a means for their own preservation, that my little friends must become self-supporting and learn the joys of freedom and the woods.

NOTES ON THE NESTING OF THE LEAST FLYCATCHER.

BY

JOHN K. SAVELLE.

(Read before the Maynard Chapter of the Newton Natural History Society, June 30, 1899.)

On June 3, I found a least flycatcher's nest. It was about fifteen feet from the ground on a horizontal branch of an apple tree. The nest was made of dried grass, bark, cloth, and a little hair, and contained one egg. The second egg was laid on June 4, the third on June 5, and the fourth and last on June 6.

The eggs are small and creamy white in color. During the four days that the female laid her eggs she sat on the nest all the time. The result was that the eggs hatched out one by one. Through the twelve days of her setting, the female left the nest a great many times, and once she stayed off during a thunder shower, but probably she had some good reason for it. During this period I never saw the male near the nest, and he was easily distinguished by his call note.

On the eighteenth of June, two of the young ones appeared, and on the following day the remaining two chipped the shell. When they were large enough to be fed, the female went to and fro all day getting them insects, the male never fed them, but stayed near the tree and chased off other birds. About June 21, the young ones opened their eyes. To-day, June 30, I went up to see the nest and three of the young ones flew out. I found some crickets in the nest.

NESTING OF THE WHITE-BELLIED NUTHATCH IN NEWTON.

BY

THEODORE PARKER.

(Read before the Maynard Chapter of the Newton Natural History Society, June, 23, 1899.)

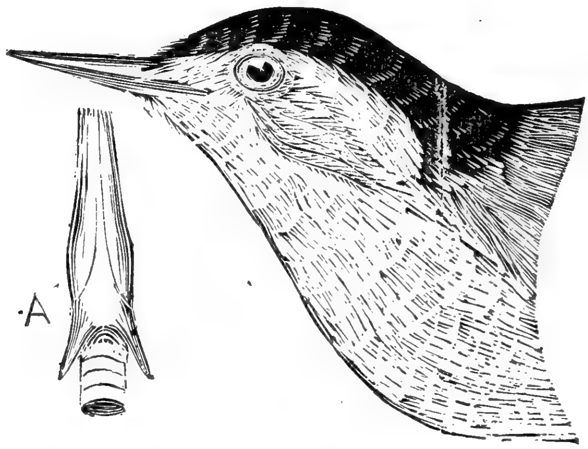
On May 10, I found a nest of a white-bellied nuthatch in an apple tree six feet from the ground. The way I found it was by seeing the male nuthatch fly up to this hole with an insect in his mouth. I climbed up and found there were young birds in the nest. They were only a few days old as they had no feathers and their eyes were not open. I found that the male nuthatch almost always brings a small gray moth to the female. One time the male brought a moth for the female, but she was not in the nest. He went inside the hole and then came out again with the moth still in his bill. He did not seem to know what to do, and he went in again. Then he came out with the moth still in his beak and ate it himself.

The female was very much more shy than the male, and would not come to the nest while I was around, but the male would come any time he wanted to.

On May 23rd, I found that the young birds had their feathers on, and one young bird was climbing up the side of the nest. On May 26, I found that three young birds had flown, and there was only one left. As I jumped from the tree to the ground, I frightened a young nuthatch that was on one of the limbs of the tree. He flew to the ground and I caught him. The mother bird came around and spread her wings and flew very near me, but she soon flew away. At night the other young bird was still in the nest, but the next morning he was gone.

On May 27, as I was going home at night, I found a young white-bellied nuthatch sitting on a fence, and I caught him in my hand. As soon as I let him go he flew about twenty feet and began to climb up an apple tree. On May 30, I got the lining of the nuthatch's nest. I found the hole was six inches deep, and the lining was made of feathers, inner bark of trees, string, and a kind of wool.

FIG. 76.



White-bellied Nuthatch.

Birds are now migrating southward by millions, and the question naturally arises as the source of this vast movement southward. There are several theories in regard to this, and those who wish for information upon the subject will do well to consult Gätke's "Heligoland," various articles in the "Auk," an Ornithological Magazine published in New York, and Maynard's "Contribution to Science," Vol. III.

ADVENTURES OF THREE YOUNG NATURALISTS.

BY

U. R. WILD.

(CONTINUED)

But promptly upon their first rise, Paul's and the Professor's shots rang out and down went two birds into the saw palmetto. A second shot from Paul's gun rolled over another, fifty yards away, out into the pine woods, and the Professor wheeling, caught a fourth as it was entering a hummock behind him. George discharged both barrels without taking any aim whatever, but was fortunate enough to secure a single bird.

"I must have made the feathers fly out of mine," excitedly exclaimed Harry, and off he darted out of the woods to try and find this evidence of his skill.

"I saw mine go down right over by that tall palmetto leaf," shouted George. "I'll go and find it before someone carries it off, for it is my first quail."

"Hold on!" said Paul, "Ponce will do that for you, find Ponce," for the good dog had dropped into the bushes at the first shot. She now rose and dashed into the palmettos, emerging in a moment with a quail in her mouth which she laid at the feet of her master, returned to the palmettos and brought another and still a third.

"That's my bird," said George, as that one came out, "I saw the tall palmetto leaf move when Ponce picked it up."

"What small quail," said Paul, who had been accustomed to shoot this game in the north.

"Yes," said the Professor, "and also note how dark they are. See this male, the breast is one mass of black, completely obscuring all the other markings. This is the typical Florida quail, technically termed a sub-species, on this account, according to the latest officially recognized code of nomenclature, is called Colinus virginians floridana."

The dog soon found the bird that fell in the hummock, and having carefully plugged the mouths of the birds with cotton, wrapped them in paper and carefully placed them in collecting baskets, our naturalists were proceeding toward the bird that fell in the pine woods, when they met Harry returning, carefully holding a feather between his thumb and forefinger.

"There," he exclaimed, as he came up to the party, "I knew I hit that bird, there's good evidence enough for you.

"It was a pretty long range," said Paul, "but some stray shot may have struck the bird."

"Stray shot," said Harry, "I never miss! I shot right on time, and although he kept on I am sure he went down dead, over by that palmetto tree, and Ponce shall find him.

"Let me look at the feather," said the Professor. As he glanced at it he asked, "What kind of bird did you say you shot at?"

"Why, sir, a quail to be sure," answered Harry.

"Well, this feather grew on an owl, and as it is highly improbable that a quail was carrying it about with him, a more plausible explanation is that you picked up a feather accidentally dropped by an owl."

As this explanation was greeted by shouts of laughter from the three boys, Harry felt a little chagrined, but quickly recovering he said;

"The feather is red like that of a quail."

"Yes, it is red," said the Professor, "too red for that of the quail, but there are other differences. The barbs are longer and terminate in a flowery fringe and not so abruptly as in that of the quail. This fringing to the edge of owls' feathers enables them to move with an absolutely noiseless flight, whereas the quail, as we have just seen demonstrated, move on the wing with a whirr which is very conspicuous."

"What is the reason for the difference in the flight of the two species?" asked Paul.

"There are anatomical reasons which I will explain to you at some future time when we get an owl to dissect," answered his instructor.

Ponce, during this conversation, had found the fifth quail, and this being transferred to Paul's collecting basket, the four companions now proceeded across the level pine woods, leaving the quail to get together their scattered forces as best they might.

"How scarce birds are now," said Harry. "Just as I shot the snake the trees were full of them, and now there is not one in sight."

"If I mistake not, by the sounds I have just heard, you will not have cause to complain much longer," said the Professor.

At this moment a harsh "Cach-cach," was heard in the high pine trees over head.

"Brown-headed nuthatches," said the Professor, looking upward and drawing his collecting gun out of its sheath as it hung on his side, he stepped backwards, took a quick shot, and a little brown-headed bird having a short tail, fell to the ground. At the report of his gun, a louder and more querulous note was heard. Paul fired a shot from his breech loader and brought down a woodpecker, with a black and white banded back, and having tufts of red on the sides of the back of the head.

"Isn't it a cockaded woodpecker"? he asked the Professor after he examined it.

"Yes," was hurriedly answered, for by this time the trees overhead were swarming with birds, and shots rang out repeatedly. But in a few moments all was quiet, the trees being apparently deserted. Some twenty-five specimens of a dozen species, consisting of warblers, nuthatches, woodpeckers, etc. had been secured, however, and our collectors returned homeward, concluding that they had taken enough for one day.

As they proceeded on their way across the sunlit pine woods, with the balmy, invigorating breezes which sweep over tropical Florida, blowing in their faces, I will introduce the party more fully to the reader.

Harry Jones was the son of a rich merchant of Hubtown who, one evening that Professor Hall said he was going on an extended collecting tour, and as Harry exhibited some taste for the study of natural history, induced the Professor to take him with him.

Paul Webber's parents were dead ; his father dying some years before, had left enough property to give his son the rudiments of an education, and as the boy was naturally bright and studious, the Professor had asked him to go on the trip, defraying his expenses on condition that he render him some assistance.

George Johnson was also the son of wealthy parents, and as he was a friend of Paul's, and also exhibited a decided taste for studying nature, it was concluded to place him under the care of the Professor.

Professor Hall was one of those decided lovers of science whose name was known on both sides of the Atlantic on account of his original investigations in his favorite studies.

Ponce, Paul's dog, the last on the list, was a black and white setter which had been presented to him when she was a puppy by a gentleman who had seen Paul shoot quail on Cape Cod. Paul had trained her, and a the dog was intelligent and apt to learn, she was not only a first class bird dog, but also an expert at finding birds' nests, or any object that her master requested her to find.

The Professor had selected this lonely portion of Florida, partly because the objects he wished to obtain were more plentiful there, but mainly because the remnants of the tribe of Seminole Indians lived there and he wished to become acquainted with the customs of a race of men which were rapidly passing away.

The little party had gone to Key West from New York, and came to this point up the Florida Reef in a wrecking schooner to the mouth of the Miami river, and had pushed their way some three or four miles up this stream. They had pitched their three spacious yale tents on the north bank of the river. This was their first collecting trip. After arranging their belongings and getting their camp in order, the intention of the Professor was to gather specimens in all branches of natural history, but he was most desirous of collecting birds, their nests and eggs, and mammals.

CHAPTER II.

First Acquaintance with the Seminoles.

As our little party drew near the open section that skirted the river near which their camp was placed, Paul, who was walking in advance, suddenly exclaimed, "See there! Who are those?" at the same time pointing up the stream, the waters of which were plainly visible from where he stood.

"Seminole Indians," promptly answered the Professor, looking in the direction which Paul indicated. There were two of them seated in a dug-out, or canoe, made of a single cypress log. One man was seated in the stern of the little craft, while the other was crouched near the middle. Both were using long, double bladed paddlers and, as they had the current in their favor, were gliding along very rapidly. When first seen, the canoe and its occupants were a considerable distance up the stream.

"I wish to speak to them," said the Professor, "so let us intercept them.

Thus saying, he hurried forward followed by the boys who did not utter a word, so astonished were they, for although they had heard the Professor speak of the Indians, it had not occurred to them that they would encounter Seminoles thus early in their trip. The party reached the river bank a little in advance of the Indians who. after giving one glance at the whites, fixed their eyes straight down the stream.

Of course they must have been greatly surprised, not only to see the tents in such a lonely place, but also to see the strangers, yet not an expression of any emotion whatever was visible in their countenances. The river at this point was only some thirty or forty yards across, and as the Seminoles kept the middle of the stream, were within easy speaking distance.

"Will they stop now?" asked Paul.

"Wait a moment," said the Professor, "and I will see what I can do to induce them to do so."

By this time, the canoe and its occupants were nearly opposite, but neither of the Indians appeared to pay the slightest attention to the strangers.

"Os leitz ta car," now exclaimed the Professor, using the melodious Seminole language. Suddenly the Indians paused in their regular paddling and turned their faces toward our party. Both answered almost involuntarily, "Un car."

The Professor now beckoned to them to land, when the man in the stern uttering a few words to his companion, gave a quick stroke or two with his paddle, causing the dug-out to deviate from its course and glide along the bank directly at the feet of our interested party. As the canoe touched the shore, the Indian nearer the bow threw out a piece of coral rock to which was attached a rope made of twisted palmetto leaves. The current then carried the craft along beside the bank and the men stepped out.

One of the Indians was small, of rather spare build. His face wore a most sinister expression, for his forehead was low, overhung with coal black hair cut squarely across, banged, as George afterwards said, and the beating brow protruded over sparkling, though somewhat bead-like eyes.

Harry, who was standing near, involuntarily recoiled as the man came ashore. The other Seminole, however, was a man of powerful build, tall, and straight as an arrow, with splendid proportioned, muscular limbs. The face of the first was forbidding in the extreme, but this Indian had fairly fine features. A nose, slightly aquiline in outline, open, massive forehead, with the facial angle as slight, or as nearly at right angles as that of the white man, while the eyes, though dark and piercing, were large, and altogether he was a fine looking man.

Both Indians had their hair banged in front and braided in several strands on the sides and behind, the braids being long enough to rest on their shoulders. Around their heads were twisted highly colored shawls in the form of turbans. Each wore a hunting frock of deer skin, fringed around the bottom which reached to the knees, and their leggins were of the same material, while their feet were protected with moccasins. Each had a pouch or bag of deer skin hung to his side, and both were armed with rifles which they took in their hands as they came on shore.

The small man had no ornaments of any kind, save a pair of silver earrings of quaint device. On the other hand, the tall Seminole wore, besides earrings, two silver crescents suspended to his neck and hanging across his breast, one above the other. The tall man at once grasped the Professor by the hand and shook it heartily, repeating the salutation in Seminole, while the Professor exclaimed, "Heedles cha, Heedles cha, Tiger," and turning to the smaller Indian, who also shook hands with him, called him Billy.

Then began a conversation in mixed Seminole and English in which the Professor, who had become acquainted with these Seminoles during a trip which he had made years before, explained who his companions were.

The boys had been regarding the Indians "Real live Indians, wild, too," with open mouthed astonishment. Both Indians shook hands with them, and Tiger, standing his rifle up against a tree, took Paul's modern breach loader in his hands and examined it with the greatest interest, at the same time talking to himself with a peculiar tone in Seminole. The Professor explained the mechanism of the gun to him and showed him a cartridge which Tiger immediately pulled to pieces, cooly appropriating the ammunition. Suddenly catching sight of George's small collecting gun, Tiger took it in his hand, exclaiming "Child gun," meaning that it was a young gun, but expressed his opinion as to its merits, exclaiming in Seminole, "Ho-li wa-cus car," meaning that it was worthless.

A red-bellied woodpecker at that moment chanced to alight on the side of a tree some fifteen yards away and Paul took a quick aim at him. The powerful little gun spoke out with its deadened report and down came the bird. Billy picked it up, brought it to Tiger, and both Indians examined it with the utmost attention, chatting over it in Seminole like two magpies.

The little gun then underwent an examination, but this time was handled with due respect for its prowess. The Professor then showed the Indians a rifle which he had with him and this was also examined with care and great interest. Further conversation followed, the Professor inquiring for old friends whom he he had known among the Indians.

Suddenly Tiger looked up at the sun, uttered a few words in Seminole to Billy, then both got into their canoe and paddled rapidly down the river. The boys watched the little craft and its occupants until they disappeared behind a point covered with mangroves where the river made a sharp turn, then they drew a long breath in concert.

"Who is the tall Indian?" asked Paul.

"His name is Tiger," answered the Professor. "He is a son of the celebrated Seminole chief Tigertail, whom Tiger tells me is still alive and well, although nearly, or quite, a hundred years of age. Tiger, as son of this chieftain, wears those two silver crescents, one above the other which you saw suspended to his neck, as a mark of rank. He is a fine fellow, for an Indian, a good shot, and an excellent hunter.

"What a cross looking chap the small Seminole was," said Harry. "I don't believe it would take much to induce him to scalp a white man."

"Yes," said George, "I was trying to peep into that pouch that he had hung to his back, when he gave me such a look with those little black, sparkling eyes of his that it went right through me, clear to my back bone and fairly made me shudder."

"Well," remarked the Professor, "Billy's looks are certainly in his disfavor; I am certain, however, that he will not scalp any of us to-day, yet there is something about the man that makes one distrustful of him.

"What were the words which you used to attract their attention when they were coming down the river?" queried Paul.

"Os leitz ta car, are the words, and they are a form of salutation, but literally translated they mean, 'you have come' and the response, accord-to Seminole etiquette, is un car, 'I have come'; but" he continued, "we have all these birds to skin, so let us proceed to the tents, get some dinner, and go to work."

(TO BE CONTINUED)

EXPERIMENTAL LESSONS.

LESSON ON THE CLAM IN A SIXTH GRADE, WILLIAMS SCHOOL, AUBURNDALE, MASS.

BY

HARRIET B. SPOONER.

The following is a paper written by a pupil as the result of a half hour's lesson on the clam given by Mr. Maynard. The children reasoned out nearly all of the points made from facts which they observed in studying the shells of clams or specimens with the siphons extended, preserved in formalin. They were also greatly assisted by the knowledge which some of them possessed of the habits of living clams.

THE CLAM, BY CLARENCE TOWER.

The clam's home is in mud or wet sand. He is generally found about a foot or a half a foot down. He always stands on his head with his siphon up. His siphon is composed of two tubes, one larger than the other; the larger one is to take water in and the smaller to let it out. He takes in water to get air and food. To keep him from going down farther than he wishes to, his shell is rounded at one end, and so he can come up easy his shell is pointed at the other end.

After he has taken in water he draws it through his gills and gets the air out, and then gets the food. When he has eaten enough, he has a little thread that pounds the food up till it is all digested. His foot is near his head and on that foot is a rudimentary ear.

WRECK OF THE "PHYSALIA" PORTUGESE MAN-OF-WAR.

BY

C. J. MAYNARD.

As I walked the shores of an island
In the deep Caribbean Sea,
I saw the wreck of a gallant bark
Upon the sandy lea.

This ship had sails of purple
Deeper than Tyrian dye,
Cordage and cables of azure
That rivaled the hues of the sky.

No mortal planned the model
Of the vessel that here did sail,
For the plankings of her pearly hull
Were fastened without a nail.

And at her launch no hammer stroke
Resounded along the shore;
She sprung full rigged from ocean's wave
As perfect as Venus of yore.

She asked for no clearance papers,
For to no port was she bound,
Yet with many a joyous argosy
Sailed she the waters round.

Long, long she sailed on the ocean,
Where she breasted many a gale,
Yet in the darkling hurricane
She never reefed a sail.

She lightly sped o'er the billows
In many a tropic noon,
And often lay becalmed by night
In th' path of the brilliant moon.

She has sighted many headlands
Along these southern shores,
From Haiti's high, majestic cliffs
To Jamaica's fairy bowers.

Then through th' lofty Carib Isles
With many others in her train,
She caught the breath of the south-east trades
And cleared the Spanish Main.

Alas! among these verdant isles
This ship no more we'll hail,
For broken is her goodly hull
And drooped her azure sail.

She lies upon this distant key
Abandoned by the wave,
This lonely beach her resting place,
Where the sand will form her grave.

Oh Physalia, child of the ocean,
Wanderer on the wide, wide sea!
Few in the race of humanity
Care aught for the fate of thee!

But I, Nature's child on Life's Ocean,
A wanderer on that vast sea,
Knowing not where my bark may be stranded
Can sympathize with thee.

CAYMAN BRAC, APRIL 6, 1888.

SYSTEMATIC ZOOLOGY FOR TEACHERS.

BY

C. J. MAYNARD.

(CONTINUED.)

PROTOZOA ; GENERAL CONCLUSIONS.

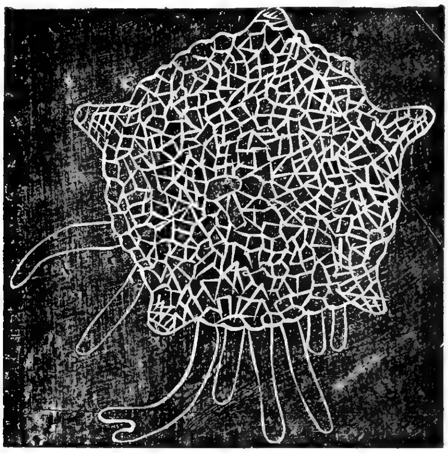
Minute and inconsequental as the organisms known as Protozoa at first sight appear, we have seen that they are really of great importance to man. To them we owe much of the limestone of the world. Many of the species are scavengers, devouring bacteria, which, if not kept in check by this means, would prove very injurious to man.

From an evolutionist's standpoint, the study of this lowly group of animals is exceedingly interesting and instructive. With these, or similar organisms, which lived in the ages past, life began. In fact, today all life, from man down to the lowest form of animal existence, begins with the single cell.

From the single celled animal then all animal life has been derived. From this simple beginning, we can trace all gradations in the mechanisms of animal life up to the complicated structures found in man. From the single celled animal we can, in much the same way, trace all gradations in mind up to the intellect of the most intelligent man living. For undoubtedly with these minute organisms mind began. Let him who is not inclined to believe this, watch the movements of an amoeba for a time. See it flow smoothly through the water in any direction it chooses to go. Most assuredly these movements are made at will, are performed in response to some inner impulse, in answer to the commands of some mind, rudimentary and imperfect though it be. Let those who would deny that the amoebae have a mind, study with care the structure of the shells of some of the species. These are made of minute sand grains. (See fig. 77). Note with what care each of the varying grains is selected in order to fit the interstices formed by other grains. Angular pieces of many sizes all fit together with a mathematical precision which is truly wonderful. And more remarkable still is the fact that all of these pieces in combination form a structure, the design of which must have been preconceived. A man who, with similarly formed pieces of stone, but of a larger size, could construct a habitation of a design like that in which this species of amoeba lives, and do it as well would take high rank as an architect and stone mason.

No two of these amoebae gather material which is exactly alike, but all construct habitations so nearly alike that is quite easy to distinguish the species which live in them by the form of the coverings. The shells of one species being as different from those of another, as are the shells of different species of mollusks.

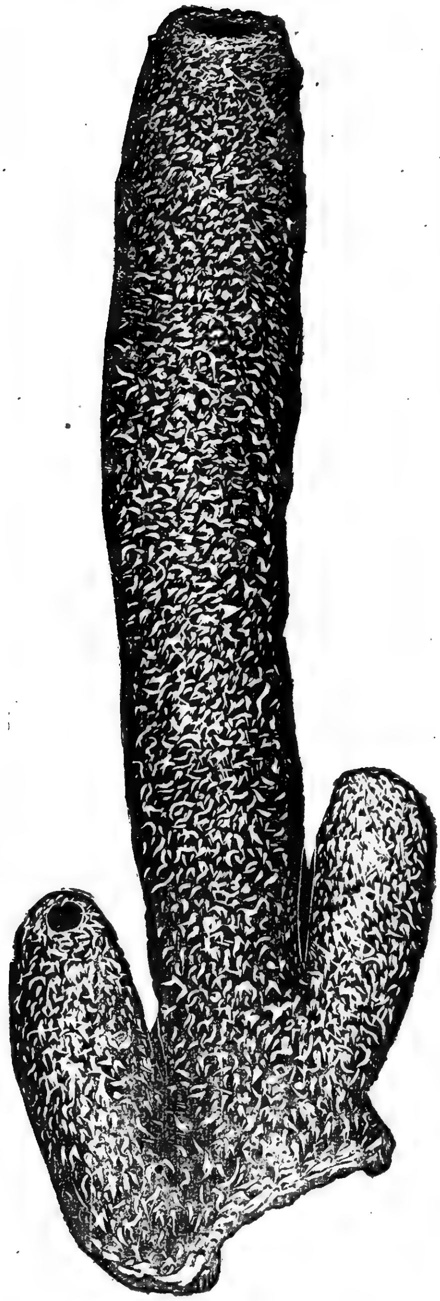
Fig. 77.



Crowned Amoeba. Diffulgia corona Wallich. From a pond in Auburndale, Mass. Aug. 3, 1899

Some may consider that the amoebae labor instinctively, making habitations exactly as their ancestors have made them for many generations, and that the forms of the animals themselves within the shells are as specifically different as are the forms of the animals in the species of shell formed by mollusks. While this may be true to a certain degree in regard to the forms of the animals, and I have but little doubt but what we should find specific differences among them could we manage to study them, it must be kept in mind that there is a wide difference between the unconcious secretion of a shell by

Fig. 78.



Tube Sponge, Bahamas. showing buds.

the mantle of a mollusk and the careful selection of sand grains by an amoeba.

While all of my readers may not have arrived at a point in psychical reasoning, where they can agree with me in considering instinct as inherited reason, the accumulated intelligence of many generations, the fact still remains that each of the stone laying amoebae has to select material which differs in form from that used by their progenitors, and that in using this varying material, they must display intelligence, not only in the selection, but above all, in placing this material so as to accomplish such very similar results in structures.

In other words, the same inner impulse, or a similar one, which guides the intelligent stone mason in selecting material for constructing a wall, guides this little atom of seemingly unorganized protoplasm to select peculiarly formed sand grains for its habitation.

I have selected this type of protozoa as an example of intelligence, but a few moments of careful observation of the movements of the varying species of the one celled animals contained in a drop of ditch water, placed under a good microscope, cannot fail to convince the observing and thoughtful student that these animals display intelligence. In their most hurried movements through the water and in their many evolutions in search of food they not only avoid accidental contact with one another, but also avoid inanimate objects. In fact, in all of their changing movements, these minute organisms show that they are endowed at least with some rudiment of a mind.

Points of Advancement.

Among the protozoans themselves we find several degrees of advancement both structural and mental. The lowest forms of the group, the monera, are so very simple in structure as to be almost formless. They propagate by simple fission, or by rupture, when small cells are liberated, which are at first globular, but which gradually change into amoeboid forms. These in turn settle down into a jelly-like mass and this mass obtains food by thrusting out pseudopodia. Then the jelly-like mass is finally transformed into globular forms that reproduce by rupture or fission as before. Here but little intelligence is required.

The foraminifera, and allied forms, gather lime from the sea which, being passed through their organisms, produces shelly coverings. Little, or no, selection on the part of the animal is here required, consequently there is a very limited amount of intelligence, but a rather complicated protoplasmic structure must be present. Locomotion is produced by pseudopodia.

The shell covered amoebae, with at least as complicated a structure, and considerable more intelligence, carefully select material with which to build up their domiciles. Propagation is by division. This form certainly possesses a circulatory organ. Locomotion is accomplished by pseudopodia.

In the slipper infusoria we find locomotive organs present in the form of cilia by the aid of which the animals move rapidly through the water. Here we also find the first evidence of the interchange of a fertilizing element. Propagation by division. On account of the exigencies of a wandering life, more intelligence is required to avoid accidents and to maintain the species intact.

In the bell infusoria we see a slight retrogression in the fact that the animal is attached by a stem to a base. But on account of the length and flexibility of this stem, the animal enjoys a considerable degree of freedom, while by its direct act of fertilization, it establishes an advance in the method of propagation over most of the other protozoa.

As a summary of advancement in protozoa, we have physically; first, the skillful construction of an outer covering; second, the appearance of rudimentary muscular action; third, locomotion, slow, by pseudopodia and more rapid, by cilia and flagella; fourth, circulation by a contracting vessicle; fifth, fertilization by conjugation, as in the slipper infusoria, and direct as in the bell infusoria; mentally, intelligence displayed in the construction of an intricate outer covering of acquired material, and in the avoidance of accidents in rapid motion.

Collecting and Preserving Specimens of Protozoa.

Although most of the species of this group are so small that a microscope is required for their study, nd for this reason they must be mounted upon glass slides, a few can be seen with the unaided eye or with a common magnifying glass. In order to mount objects as small as are the greater number of species of protozoa, considerable skill and experience is required, but the larger forms of foraminifera, such as the Orbitulina adunca, found in the sands of beaches and shallow water, (see fig. 55) and the red species, found beneath coral, both from the Bahama Islands, can be kept in vials.

Other species of Protozoa occur in the ooze of mud of fresh and salt water, damp moss, damp earth, and clinging to water plants, submerged sticks, stones, etc.

FIG. 79.

Filamentous Sponge, Bahamas, showing variation.

BRANCH METAZOA.

MANY-CELLED ANIMALS.

Although the animals included in this group begin life as a simple, single cell, (ovum) this single cell divides into many cells when placed under the proper conditions for development. These divisions, in most cases, no longer remain simple in form, but become changed (differentiated) into varied forms, like nerve cells, muscle cells, bone cells, etc. The cells thus changed assume varied functions to meet the wants of the animal of which they form a part. Propagation is accomplished in three ways; primarilly, however, it is always by eggs, and these eggs are always fertilized by the accession of another cell in the form of a spermatozoon. The secondary method, but one which is found in the lowest invertebrate forms of animal life only, is division, much as we have found it in the protozoa, and this method is accomplished without special fertilization. A third method, less common even than division, is budding. This is also accomplished without special fertilization. The first method of propagation is known as the sexual method; the second and third methods as asexual.

The animals included in the present group from the lowest, to the highest are so very devious in character that but little can be said which will apply to all of the forms. As they all begin life, however, as a simple, single cell, known as the ovum or egg, we will trace this cell through its preliminary stages, which from the lowest form, the sponge, to the highest, man, are essentially the same.

EGG DIVISION OR SEGMENTATION.

The ovum or egg is the product of the female, either as an individual or as a portion of an animal.

When the ovum becomes sufficiently developed to receive the fertilizing element, it is said to be ripe. The fully developed spermatozoca, although variable in form in different animals, always consist of two parts, an enlarged head and a very slender tail like organism. The head alone appears to contain the essential element for fertilization; the tail is simply a vibrating or propelling organ. By various methods the developed spermatozon is brought in contact with the ripe ovum and penetrates it. Without entering minutely into the complicated changes which occur after the spermatozoon has entered the ovum, I will briefly give the most prominent points. First, the spermatozoon approaches the nucleus of the ovum and the two seem to fuse together. Really, however, both elements still remain separate, but become intimately connected. Now ensues an intricate, though orderly process, the result of which is the division of the apparently fused male and fe-

FIG. 80.

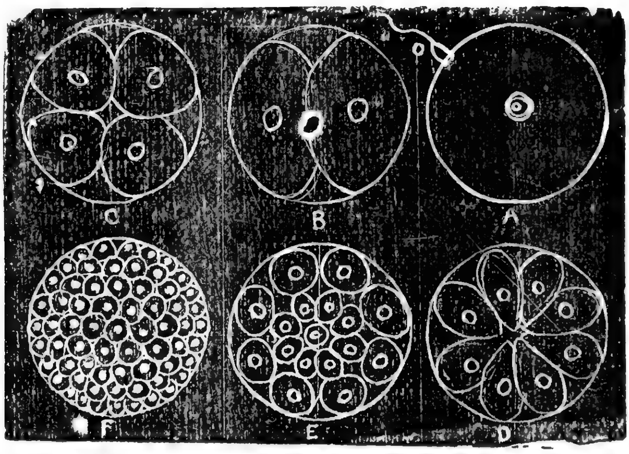


Diagram showing process of segmentation of egg. A, ripe ovum into which a spermatozoon, o, is penetrating. B, segmentation begins and continues progressively through the figures to F.

male nucleus, and this nucleus division is followed by a division of the entire ovum. Thus we find two cells where there was one before (see fig. 80, B) each of which will have its nucleus. But what is important for us to note is that each of these nuclei contains an equal portion of the male and female elements. The two cells again divide, producing four (see C) which in turn redivide and produce eight; (D) these produce sixteen, (see E) and so divisions continue until the ovum is divided into numerous cells. (See F). The next change to be noted is the passing of the spherical ovum with its multiple cells, into another form, and as it is at this point that there is a divergence of form in different groups of animals, we will leave the subject to follow it in those special groups.

SECTION INVERTEBRATA.

The animals grouped under this head are so very diverse in form and structure that they cannot, as a body, be defined by any positive characters which are presented by all, hence negative characters must be used describing them.

Invertebrates are animals which are not provided with a notochord, which is a prolongation of nervous matter extending backward or downward from an enlarged nervous body, called the brain, which is situated in the head, and this prolongation is usually protected by a continuous chain of bones known as vertebrae.

PROVINCE III.

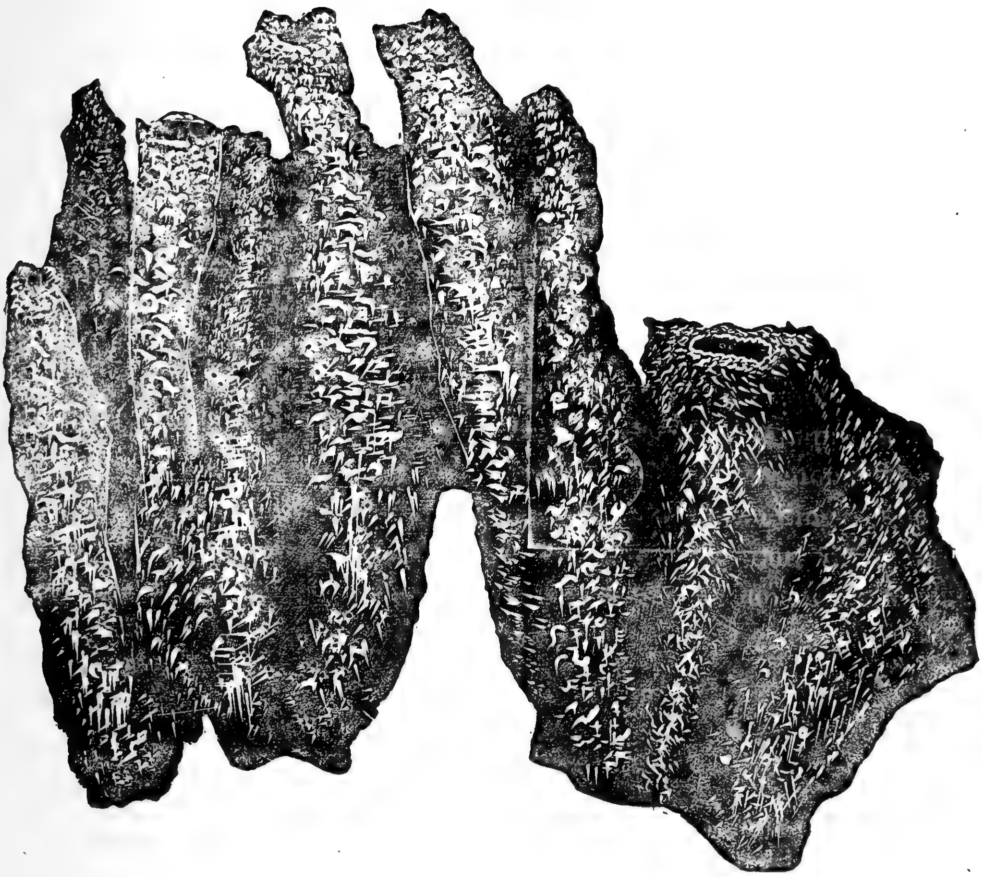
Sponges, Poriferae.

Sponges, which we now so cleary know as animals, were not many years ago regarded by most of our prominent naturalists, as belonging to the vegetable kingdom. They were thought to propagate by freely swimming spoors, much as seen in some of the sea weeds. Even after the discovery of the cilia and collar cells and their accompanying whip-like pseudopodia, which forever settled the question of the animality of the sponges, naturalists, not fully comprehending the importance of these organs, placed the sponges among the Protozoa.

It was only as late as 1875 that Prof. A. Hyatt in his "Revision of the North American Poriferiae," raised the sponges to the rank of a province, "equivalent structually to the Vertebrates or any of the large divisions which are characterized by the most important structural differences."

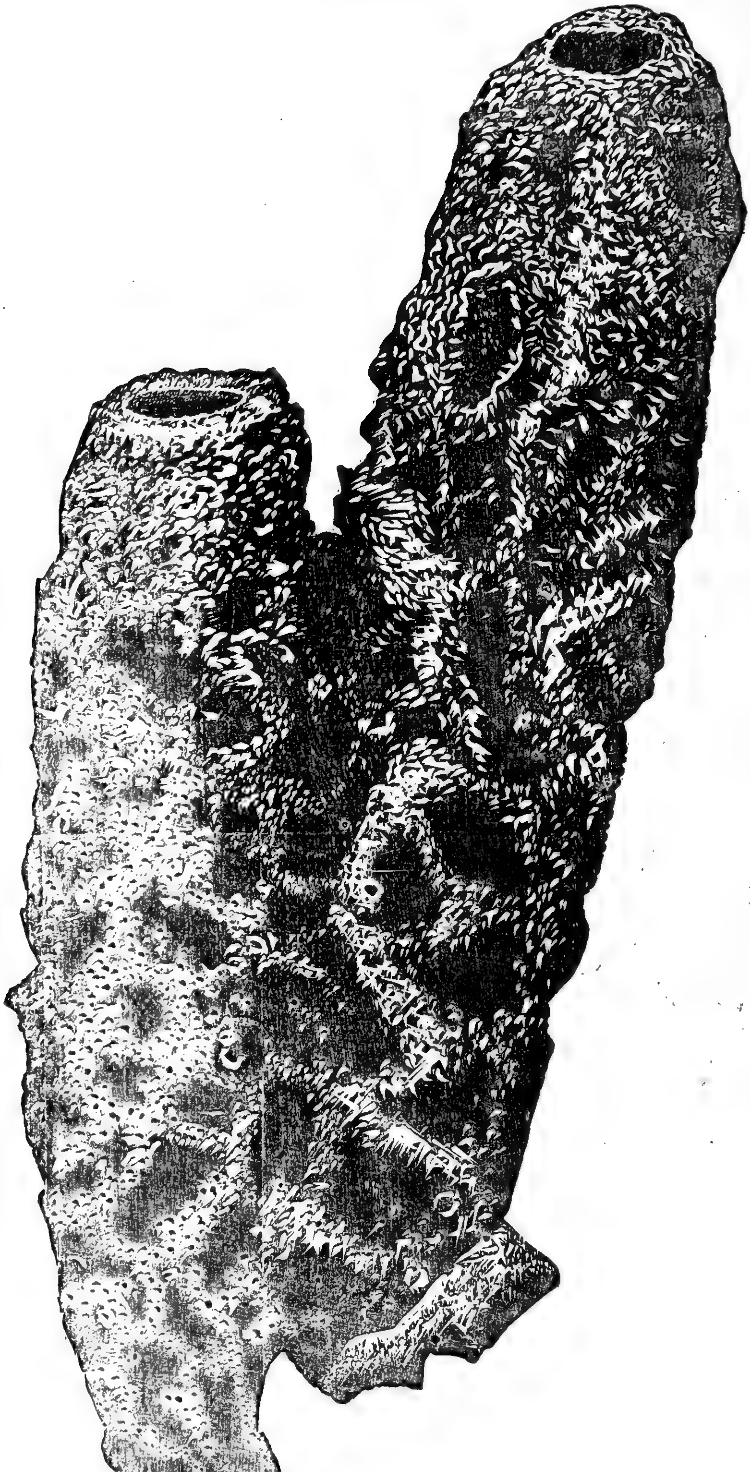
No naturalist with any scientific training to-day doubts that sponges should be separated from the one-celled animals, yet in some ways they are closely related to them. Some of the higher infusoria with long, whip-like flagella are not unlike some of the sponge animals and all of the sponges in the free swimming stage, closely resemble the ciliated infusoria. While any one would be excusable for mistaking a young sponge in this freely moving stage for an infusoria, no one, with our present advanced state of knowledge, would mistake a sponge in an older, or fixed, condition of growth for

Fig. 81.



Filamentous Sponge, Bahamas, typical.

Fig. 82.



Tube Sponge, Bahamas, showing double tubes.

even a colony of single-celled protozoans, for the multiplicity and differentiation of cells is very apparent.

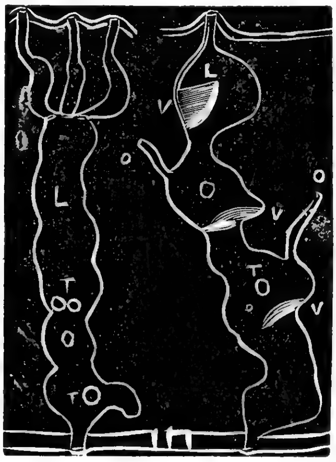
General Characters.

Sponges are animals of vegetable-like appearance, fixed when adult, free when very young. They are generally composed of two substances; (1), a protoplasmic-like material which, although always soft, varies in firmness from a jelly-like consistency to about the solidity of beef liver; this is known as sarcode, and is always present; (2) a horny substance which forms an inner skeleton, but which is sometimes wholly absent, as in the fleshy sponges. This horny skeleton is often supplimented by spicules of either silica or lime, or is more rarely wholly replaced by them.

The sponge flesh, or sarcode, is penetrated by numerous tubes, usually

Fig. 83.

a a



Water system of sponge.

ramifying in all directions. (See fig. 83.) These are of three kinds and each kind has a separate function, but all together form a water system. One set, smaller than the others, open externally and are termed incurrent tubes. Through these the water is taken into the interior of the sponge; (see fig. 83, a) here it is taken up by a second set of tubes, which are a little larger than the incurrent, but which are continuous with them, and conveyed to the third kind, which open on the outside, and are called excurrent. From them the water is thrown out.

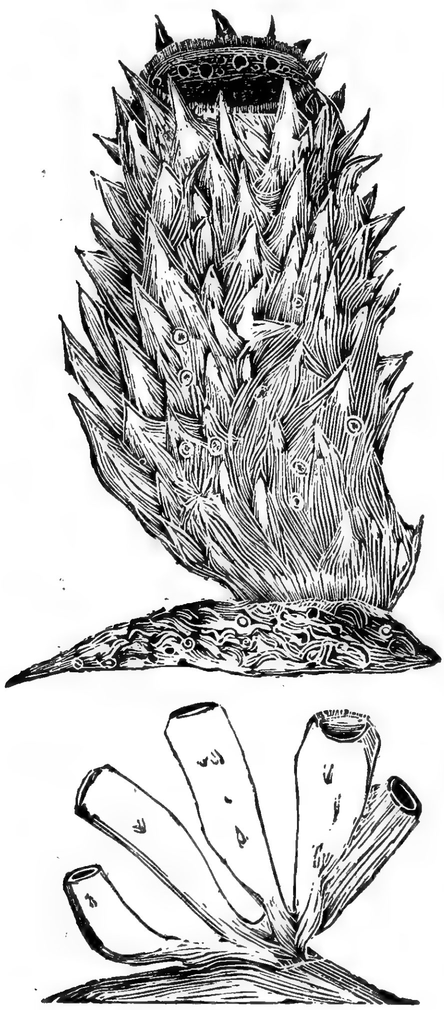
FIG. 84.

Tube sponge on rock.

The tubes not only answer to the respiratory system inasmuch as water containing air is constantly passing through them, but this same water also carries food with it and thus supplies the sponge with nutriment.

The second set of tubes, as stated, are larger than the incurrent openings, in fact they are considerably enlarged in places, forming chambers. (See fig. 83). From the sides of these chambers protrude peculiar cilia, each of which is made up of three parts. (1) A base which is more or less cylindrical and hollow. See fig. 88, B. Protruding from this is (2) a smaller

FIG. 85.



Tubular form of sponge. Upper figure single tube. lower. cluster, size reduced.

cylinder, having an open top. This is known as the collar cell (B.) From this is thrust out (3) a slender whip-like organ which is the true cilia (B) These collar cells and their accompanying bases and cilia are very numerous, being packed closely together all over the surface of the chambers. See fig. 88 A, where is given an ideal section of the cilia chamber of a sponge. These whip-like cilia are in constant motion and these movements cause the water to be drawn in through the excurrent tubes and pass around through the chambers and their connecting tubes into the excurrent, or cloaical, tubes. In passing out into this large tube the water is prevented from returning by sphincter valve which can be opened or closed at the will of the sponge.

As particles of food pass the whip-like organs, they are captured by them. Then the whip is suddenly withdrawn into the collar, carrying the

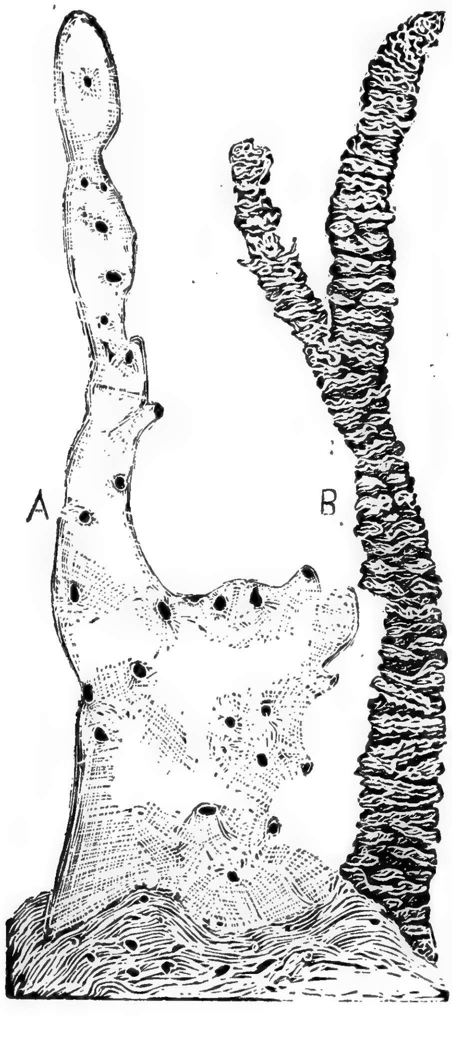
Fig. 86.

Branching forms of sponges.

food with it. This food then passes into the basal portion of the cell where it is digested. The refuse matter is thrown out of the excurrent tubes. This constitutes the digestive system of the sponge.

As the sponge possesses the peculiar organisms explained, it will be clearly seen that each of these is made up of one or more cells. For example, each of the portions of the cilia are separate cells, the base being one, the collar another, and the whip the third. In the flesh surrounding the chambers and tubes, are also to be found many separate cells. Some of these

Fig. 87.



Elongated forms of sponges.

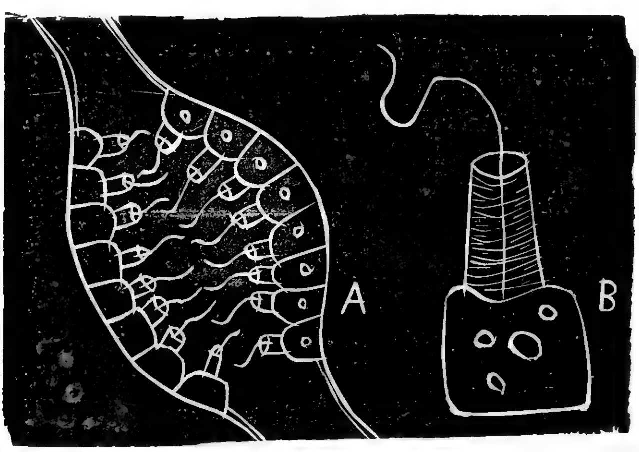
are muscle cells, some are nerve cells, and another set are reproductive cells, and as we shall see later, there are even male and female cells.

It will thus be seen that in the sponge there is not only a multiplicity of cells, but that there is a diversity in the form of cells. As already shown the sponge began life as a single cell, and this cell was more or less spherical in form. This spherical form was maintained up to the point shown in fig. 86 F, when a change takes place which will be explained under reproduction. I will now state, however, that from this point on through the life of the sponge, the cells are not all alike and few remain spherical in form. They become changed, differentiated, into other forms. As seen, some assume forms suitable for producing muscle cell, some, nerve cells, some, cells for producing the skeleton, spicules etc.

Forms and Species of Sponges.

Glancing back to the single-celled animals a moment, we will find that among them the form of the cells differ somewhat. In the amoeba it was spherical when the animal was at rest, but could be changed at will. In the Paramecium or slipper infusoria, it had a definite shape in the mature animal. This was also the case in the bell animalcule and in many other kinds. That is, in dividing, an amoeba always produces two animals which are similar to itself, and the same is true of other protozoans. I say produce animals similar to themselves, for there is always, probably, individual variation; in other words, there are no two slipper infusoria which are exactly alike, any more than there are any two men or women exactly alike, and slight though that difference may be, there is a difference. This is individual variation, but this variation is always limited. That is, limited if the slipper infusoria always lives under the same condition of environment; consequently the animals within these limits possess certain characteristics which render them recognizable as slipper infusorias. What is true of slipper infusorias is also true, not only of other protozoans, but of all animals, through the ascending scale, up to man. Animals alike, within these limits, and thus divided from other animals within other limits, constitute what we call species.

Fig. 88.



A, ideal section of cilia cell; B, collar cell of sponge

VACATION STUDIES IN GEOLOGY.

BY

M. Eva Warren.

(Read before the Maynard Chapter of the Newton Natural History Society, Sep. 15, 1899.)

Although the results of glacial action can be seen in every gravel-pit and on every stony hill-side in the form of boulders, rounded pebbles, and other debris, it is not always so easy to find the marks known as glacial scratches made in the solid, or bed rock. These scratches were caused by the passage of the great ice sheet, which, in ages long passed, swept slowly, but with irresistable force over the country.

This ice-sheet (which we have reason to believe was about a mile in thickness) broke off fragments of rock from projecting ledges which it passed, and often carried them along with it embedded in its substance.

Following the law of gravitation, these rock fragments gradually settled down into the ice-mass, the heaviest sinking to the bottom. Thus, in time, the lower surface of the glacier must have been thickly studded with pieces of rock of various sizes and forms, making of it a huge sheet of sand paper covering an area of thousands of square miles.

A foot of cubic ice weighs one hundred pounds. A pile of these cubical blocks a mile in height would weigh nearly three hundred tons. From this we can get some idea of the pressure of this immense mass.

Think then of this huge sheet of ice moving slowly over the rocks which form the earth's crust. Its grains were often huge rock points, and these, with three hundred tons pressure above them, were rasping over the rocks beneath; and no matter how hard their surface, it must needs show some evidence of this powerful sand-papering.

We should expect to find such evidence on the exposed rocky hill-tops; but if we look for this, we shall, in most cases, be dissapointed. We have not perhaps taken into consideration the lapse of time which has occurred since the ice passed over the hill-tops. Rock exposed to the action of the elements for a thousand years changes greatly, being worn away by the rains of summer and the ice and snow of winter. How great then must have been the effect of the wear and tear of fifty thousand years!

For evidence of this glacial marking, we must find some place which has not been exposed to such corrosive action. Such places are to be found where sand, gravel, or other glacial debris has been recently removed. Such an one is to be found on Lowell Ave. in Newtonville, near the stone crusher. Here a section of rock has been exposed by the removal of gravel. The rock is serpentine, and is in the form of a sloping cliff about twenty-five feet high and a hundred feet long. The cliff lies parallel with the ave. which runs about north and south.

An examination of the surface of this newly exposed ledge shows furrows in the rock an inch or an inch and a half deep. Further examination of these scratches shows that they were made by a rough surface, moving very nearly, but not quite parallel with the face of the cliff, and striking it a little obliquely.

Another newly exposed rock-surface (a cliff of slate by the roadside at the back of a gravel-pit) is to be seen at Newton Center, a little over two miles from this serpentine quarry. The cliff is about fifteen feet high and faces the north, and an examination of it shows that the glacier struck it directly on its face. Slate is softer than serpentine, partly on this account, and partly on account of its situation, the scratches here are deeper and wider than in the former ledge. The upper surface of this cliff is smoothly worn into huge scallops by the action of the moving ice.

An inspection of these two cliffs shows the general direction in which the glacier moved. While it passed obliquely along the side of the serpentine cliff, which runs nearly from north to south, it struck the slate cliff, which has a northern exposure, full on its face It is thus evident in both places that the ice was moving from the north-east to the south-west.

Between this slate ledge and the village of Newton Center, is a freshly exposed bed of conglomerate rock, or pudding stone. This shows admirably the powerful grinding action of the glacier. Here the hard, flint-like pebbles which form the pudding-stone are ground down, so that they are often exposed in perfect sections; while the rock in general is nearly as polished as a glazed surface.

A visit to these places will amply repay those interested in the study of glacial action.

NOTES ON SOME FRESH WATER CLAMS.

BY

AUSTIN CLARK.

(Read before the Maynard Chapter of the Newton Natural History Society, Sep. 15, 1899.)

There is no branch of Natural History more fascinating, perhaps, than the study of shells, and among the shells, some of the most interesting groups to study are those inhabiting our ponds and rivers. I refer especially to those called fresh water clams or mussels.

Although in our vicinity we have few very striking species, still even our smaller ones are sufficiently beautiful to justify a close study of them.

We have, or used to have, right here in Newton a very large local race of a shell called Unio nasutus, or long-nosed clam, from its having its siphon end very much lengthened. The specimens I have came from Lake Cochichuate in Natick, and are of ordinary size. The specimens which used to occur in Bullough's Pond in Newtonville before it was drained, were almost, if not quite, twice as long as these, and of a beautiful pink inside.

Another of our clams is the Alasmodon arcuata, a long, narrow shell, occurring sometimes five inches in length. It lives in running streams, wherever the pearl-hunters have not exterminated it.

With the exception of these two clams, our New England mussels are of no interest to those who do not make a specialty of them. But if we go westward, into the Mississippi basin, we find clams which at once attract attention from their size, shape, or peculiar coloration. We have good reason to be proud of our shells when we remember that, of all the species of fresh water clams discovered, more than half are native of the United States.

One of the most striking of our clams is the Unio alatus, or winged clam. It occurs, generally sparingly, in most of our western rivers, and also in Lake Erie and Lake Champlain. It prefers a muddy bottom, and is generally found buried to the base of the hinge or "wing." Sometimes it occurs on gravel, or on rocks, lying on the surface. When in the mud it clings so well with its foot as to be difficult to pull out. In size it is one of the largest of mussels, sometimes being found six inches long, by four wide. I can recall at this moment but one larger clam, and this occurs in the Ameer region of China.

Another large clam, weighing far more than the last, is Unio plicatus, with its varieties, Unio undulatus and Unio multiplicatus. Although not having as much surface as the foregoing clam, I have specimens weighing almost three pounds, while the other hardly ever weighs more than one. This shell is the commonest mussel of the west, and occurs wherever it can get a foothold. In some mussel-beds, the individuals are numbered by the thousand. This clam may be easily recognized by its rough shell and its weight.

But the western shells are not all large. The Unio perplexa is indeed smaller than most of our own shells. The peculiar lobe on this shell is present only in the female, the male lacking it altogether. This shell rarely occurs larger than this.

This rugged shell with the rectangular outline is called the Quadrula cylindrica. When not worn, the shell is very handsome, being marked with dark green triangles like a tent olive. The animal within this shell is yellowish, with an orange foot and black mantle. When living, this shell stands high out of the mud, or lies horizontal upon it.

One shell interesting, not for its color or size, but for its numerous variations, is the Alasmodon rugosa. It occurs throughout the west, and also in the Hudson River. In some rivers it is large and heavy, as in the Spoon River, and in others small and thin as in the Clinch River. In some rivers it is black, and in others greenish. Sometimes it has stripes, and sometimes none, but it may always be recognized by the undulations near its siphon end. The meat is orange.

The Alasmodon truncata also occurs in the west. It has a very thin shell, and a peculiar truncated shape. The meat is orange.

One mussel from Georgia has three or four spines projecting outward from its valves. It is rare and local.

There is another group of mussels called the Anodons, which have thin shells, and are more adapted for living in ponds and quiet waters than in braving the swift rivers. This shell, the Anodon suborbiculata, is one of them.

We New Englanders can scarcely realize in what numbers clams can occur in favorable localities. In some western rivers there are beds of acres in extent, numbering thousands of individuals. Wherever there is a foothold strong enough to admit of the shells resisting the high tides, there is a clam. They generally seem to prefer rather shallow water. Sometimes, indeed, they occur in water so shallow that when a low tide comes, they are all killed. A friend of mine told me of a river, the banks of which were lined for ten miles with clams killed in this way. They were so thick one could walk the whole ten miles without stepping off a shell.

The only value of clams is in the pearls they sometimes contain, and in their ability to be converted into buttons. The pearl fishery is a great industry on some western rivers, and many valuable pearls are taken out every year.

COMMENT AND CRITCISM.

PROTECTION OF BIRDS IN NEWTON.

Proceedings of the Maynard Chapter of the Newton Natural History Society.

At a meeting of the Maynard Chapter of the Newton Natural History Society, held Sep, 22, when there were some forty members present, Mr. Maynard made some remarks regarding the protection of birds in Newton. He said that a few evenings previous, when on his way to visit the bird roost which is in the vicinity of the laboratory in company with three pupils, a gun shot was heard, apparently coming from the roost. Almost as soon as the sound of the shot reached our ears, we saw an immense cloud of birds, which we had estimated a few evenings before to number about 7000, rise in a body, but soon settled again only to be greeted by another shot. The birds again rose, and some large flocks left the place. Hastening our steps, we succeeded in reaching the woods in time to prevent two boys from shooting again, as they were preparing to do. Upon being remonstrated with for disturbing the birds, the boys informed us that it was not illegal to shoot crow black-birds, as they called the bronzed grackles, which were the principal species of birds gathered there. When told that the law of common sense and of humanity ought to have taught them better than to attempt the wholesale slaughter of birds, which were of no use to them, and which had been objects of study for the teachers and pupils of the schools for some time, the boys appeared very much ashamed of their conduct and said had they been aware that this bird roost was being studied, they would not have thought of disturbing it. Promising that the offence would not again be repeated by them, they took the six moulting birds which they had killed and left the place.

How much the promise of such boys can be depended upon, it is impossible to say, for, as it was afterwards proved, this being brought out at the meeting of the chapter, they had been informed of the fact that these birds were under the protection of the Maynard Chapter only a short time before the two shots were fired, their informant being a member of the chapter, but to him they paid no attention.

The speaker then told of other instances where birds had been wantonly killed in numbers by irresponsible boys. He then stated that he thought the time had come when our Newton birds should receive special protection, and suggested that the attention of the city government be called to the matter.

Mr. W. R. Davis, after remarking that he thought the time had come when stringent measures should be taken to protect our birds, made a motion that the facts in the case should be laid before the city government by Mr. Maynard, the president of the chapter.

In seconding this motion, Mr. Quincy Pond also deplored the needless and wanton slaughter of birds, and called attention to the fact that as the discharge of fire arms anywhere within the city limits was already prohibited by the city authorities, he thought that the police would be ready to enforce that law should their attention be called to it. Mr. Davis's motion was passed by an unanimous vote.

Mr. Thomas Fitzpatrick then called the attention of the chapter to the disfigurement of certain pieces of wood lands from their being used as "dumps". In some cases, where it was the evident intention of the owner of the land that rubbish be deposited in pits, it was scattered over the land to such an extent as to destroy the foliage. Mr. Maynard then remarked that if we wished to keep our birds, we must leave them suitable places in which to build their nests in summer and into which they could retreat at other times. Thickets, such as are found in abandoned gravel pits and fence corners, form just the places which birds like, and it is well to preserve these as far as possible.

Upon motion of Mr. Davis, it was voted that the president appoint a committee of three to inquire into this matter and report to the chapter next meeting. Mr. and Mrs. W. E. Davis and Mr. Fitzpatrick were named.

The communications of the evening were by Mr. Maynard on the anatomical structure of the Pied-billed Grebe, showing its adaptability to the environment. A peculiar development of the upper end of the tibia was shown and with the articulation of the bone, compared to a row lock and oar of a boat. The wing was shown to be an additional paddle which the bird used when moving under water.

Systematic Zoology was then taken up, and an account of the life history of the flexible corals, or gorgonias, given, illustrated by specimens.

In calling attention to the city authorities to the protection of our birds, according to the requests of the Maynard Chapter of the Newton Natural History Society, and in presenting the above recorded facts, I wish to add that as a result of the shots fired by the boys in the bird roost last week, I find upon investigation that the event which I feared has occurred, and that of all the thousands of Robins and Grackles which resorted to this place every night not one, as far as I can see, now comes there. I say mainly as a result of those shots, for from that time many birds left, but the finishing stroke to work of driving the birds away was no doubt done by a few boys who, eager to get the first burs from chestnut trees in the woods, remained there so late as to keep away what remaining birds attempted to come there.

Now, aside from any sentimental point of view, the driving away of these birds is truly deplorable and becomes an actual loss to the citizens of Newton. We know that thousands of dollars worth of damage are done yearly to our gardens and lawns by insects, and we also know that birds are insect destroyers.

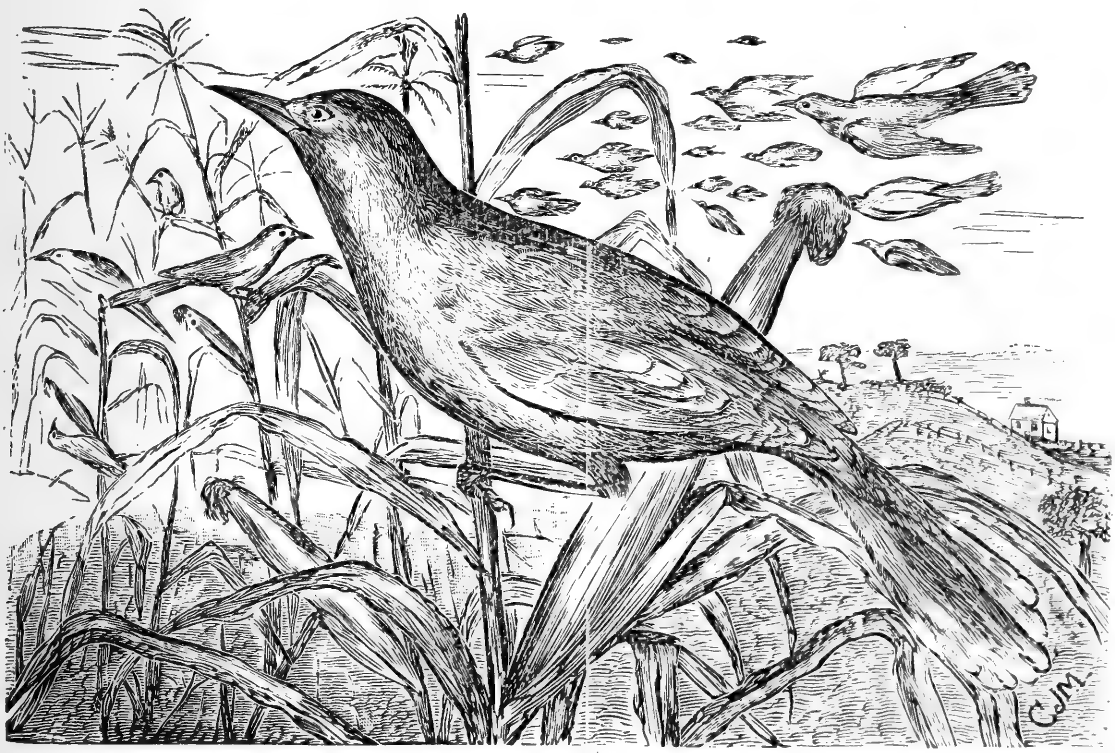
We have only to glance today at our lawns and note the damage which is now being done to them by the larvae of the June Beetle, to see what a pest insects can become. A field near the bird roost is infested by these grubs, and one night, as I stood near it with some members of my class, watching the birds, I called attention to the fact that this particular field was covered with robins. There must have been a dozen of these birds to a square rod, and each bird was busy in digging up the grub of the June beetle. How many insects were destroyed there I will not attempt to estimate, but the number must have been large in that short time. Reports from other places in Newton by members of the chapter show that the grackles are foremost in destroying these grubs, alighting on the lawns in large flocks for the purpose of digging them up.

Now then, with these facts before us, let us glance at what has occurred. In order that two boys might follow out that brutal instinct which prompts so many to the desire to kill something weaker than themselves, thousands of useful birds have been driven out of the roost, and probably wholly from the city, and this work of the depletion of the roost has been completed in order that three or four other boys might linger into the twilight and gather a few cent's worth more of chestnuts. I will venture to say, to put it within bounds, that each of those birds was worth at least a quarter of a dollar a year to the citizens of this city as an insect destroyer. As we have stated that there were at least 7000 birds which came to the roost every night, it is easy to estimate the loss incurred by their having been driven away. And this loss might have been prevented by the presence, in the roost or in its vicinity, of a single policeman for an hour each evening.

Since writing the above, Mr. Fitzpatrick informs me that a few birds still continue to come into the roost, but these are mainly grackles. On the evening of the twenty-fifth I saw but five robins and no grackles and I remained near the roost until after six o'clock.

C. J. MAYNARD, PRESIDENT.

FIG. 89.



Bronzed Grackle. Massachusetts.

BOOK NOTICES

Our Common Birds. Suggestions for the study of their life and Work, by Prof. C. F. Hodge.

This is the second of the Nature Study Leaflets in the Biology series issued by Dr. Hodge, and contains many valuable suggestions for the study of birds in schools.

The bird census will be found useful and attractive to children, but we are particularly pleased with the description given of taming wild birds, it is excellent. Other articles in this little pamphlet are also good, and we wish that it might be in the hands of every teacher in the country. The only criticism which we have to offer is, that, while we agree with Dr. Hodge in considering "stuffed" or, as we presume he means, mounted birds unfit for school use, we do not find the same objections to skins of birds, and we can never believe that pictures of natural objects should replace these objects in the schoolroom when the specimens themselves can be procured.

Observation Blanks in Mineralogy by Herbet Ernest Austin, Boston, D. C. Heath & Co.

This is an excellent text book or guide to observation lessons on minerals, written by one who is thoroughly conversant with his subject. The printed matter is in the form of questions, followed by a blank space in which the answer is to be written by the pupil. In order to answer these questions correctly, the pupil must examine the specimens. While the questions do not in any way give a clew to the answer, they are so skilfully given as to call the pupil's attention to the facts which the author wishes observed; thus the subject of the lesson is drawn from the pupil. In other words, he is taught how to reason upon the subject in hand in a clear and concise manner. It goes without saying, that this is the ideal method of teaching, and if we are to have text books at all, we wish that they could, in the first place, be written by those who are as thoroughly familiar with their subject as is Prof. Austin, and in the second place, that they could be written in the form of suggestive questions.

NATURE STUDY

IN SCHOOLS

Conducted by C. J. MAYNARD

Vol. I OCTOBER, 1899 No. 9

West Newton Mass.

C. J. Maynard

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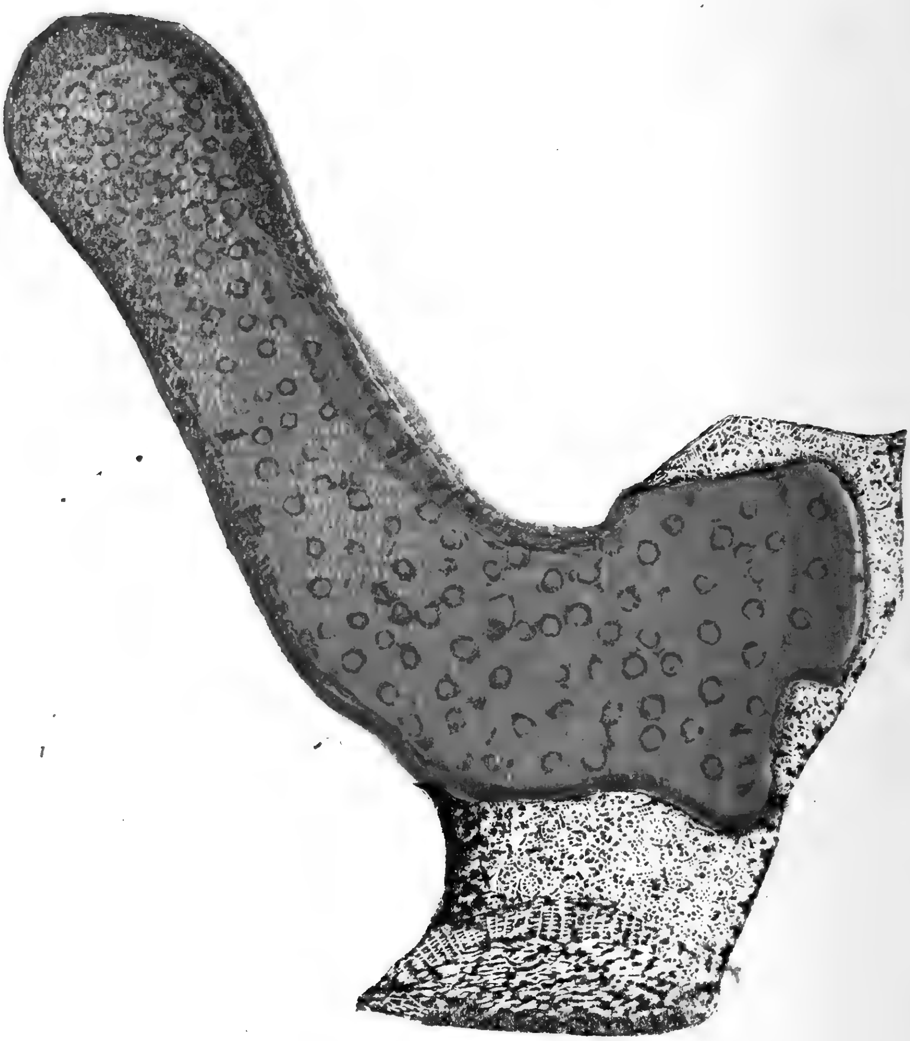
PLATE X.



Green Encrusting Sponge.

NATURE STUDY.

Volume I. OCTOBER, 1899. Number 9.

SOME OCTOBER BIRDS.

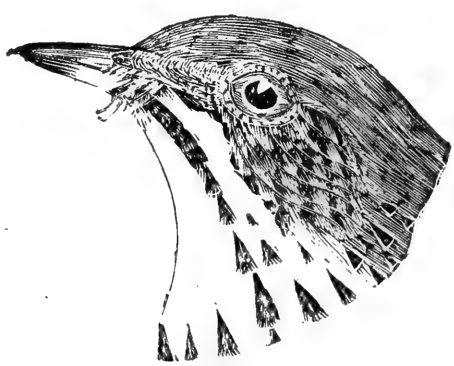
BY

C. J. Maynard.

Although it is probable that many more birds migrate southward in September than during any of the autumn months, October has a fair share of migrants.

During the first week in October the olive-backed, gray-cheeked, and hermit thrushes pass through Eastern Massachusetts. As a rule, all three of

Fig. 90.



Hermit Thrush.

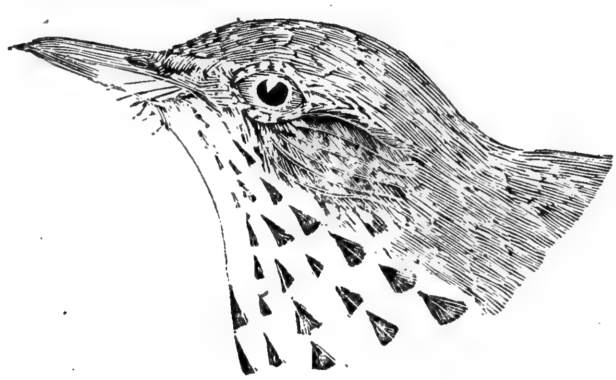
these species are wood inhabiting birds, but they may be tempted out of the woodlands by any unusual display of food. For example, early in this month we found a large number of all three of these species feeding upon the berries of the poke weed, or Indian tobacco, which grew in an open place by the side of a cart path which leads to one of the stone quarries in Waltham.

At this time (about 5, p. m.) the birds were silent, in fact, they did not even utter a sound, for they were intent upon securing a supply of food before nightfall, and the members of my bird class who were with me, had an excellent opportunity of observing the characteristic motions of these thrushes.

They saw the peculiar way in which the birds sit upon their perches, with the wings slightly drooped and the tail a little elevated. The habit which these birds have of sitting perfectly quiet when they think themselves observed, was noted, and their direct darting flight was seen.

Just before we had found the thrushes, we had come upon a number of cedar birds which were feeding upon insects in some oak trees. The peculiar fluttering, almost butterfly-like flight of these beautiful birds was observed, as they darted into air to catch some passing insects, looking quite

FIG. 91.



Gray-cheeked Thrush.

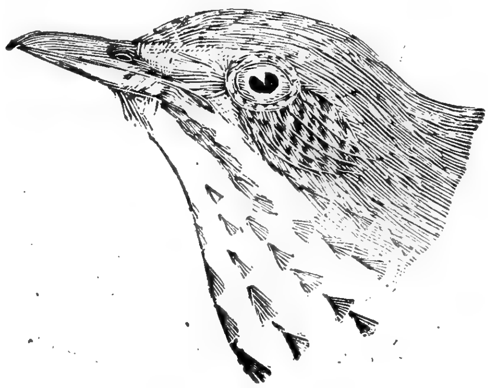
like the genuine flycatchers. This resemblance was heightened by the habit which the cedar bird possesses of sitting perfectly quiet after returning to its perch.

The cedar birds have been unusually common this season, and as late as the first week in October we found the young in the first or nestling plumage. This plumage is easily recognized by the stripings beneath. Ever since I have known the cedar bird, and I made its acquaintance many years ago, I have been listening for some attempt at a song, but I have never heard anything save the sharp lisping note, which is evidently used in most cases as a cry of alarm. I think the bird wholly incapable of uttering anything else.

On the same trees in which the cedar birds were perched, were quite a flock of warblers. They were at once recognizable as such by their slim forms, rather slender bills, and restless movements. It was not so easy, however, to determine the species, but a little observation revealed the white wing bands, greenish back, and slightly streaked yellow under parts, which characterize the black-polls, and as some of the birds darted off the trees, a patch of yellow at the base of the tail betrayed the yellow-rumps. On this day we also saw juncos.

On October 7th, we observed a large number of swamp sparrows in a marshy place in Newton Highlands. This was rather late in the afternoon, and we did not hear the morning song which this species sometimes gives early in the day in autumn. We did, however, a little later hear the full

Fig. 92.



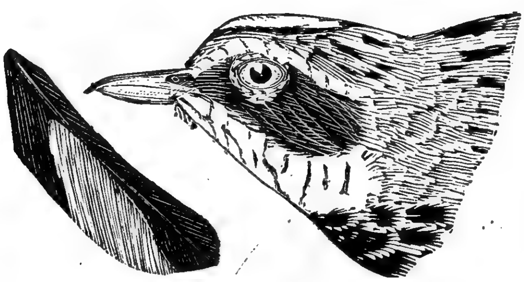
Wilson's Thrush.

cantata of the song sparrow given several times from some alders in a meadow. We were admiring the beautiful colors of the foliage, with which the woodlands have arrayed themselves this season, and as all of our spirits were in tune with autumnal sights and sounds, this song, from its very unexpectedness, sounded exceedingly sweet, like an echo of the past summer.

We saw numbers of white-throated sparrows that day, also chippies, and savannas. Both white-throated and chippies have been reported to me as singing this autumn, and today (Oct. 14) when with my class at Scituate, we heard a savanna give its full summer song. Here at Scituate we also saw Ipswich, swamp, and song sparrows all together in one scattering flock. On the way to Scituate, several white-bellied swallows were seen from the cars. This is a late record for this species, but I think I have seen them fully as late at Wood's Hole in former years. These belated swallows feed upon the berries of the bayberry or wax myrtle, the waxy covering of which evidently furnishes them with a supply of nutritious food.

At Scituate we saw a dead parasitic jagur gull in the hands of a boy. We also observed large flocks of the so called "coots" flying along the coast, but well out to sea. Examples of those birds which we saw hanging on the verandas of some of the cottages of the gunners showed them to be the American scoter, velvet scoter and surf scoter. We also saw dead specimens

FIG. 93.



Yellow-rumped Warbler.

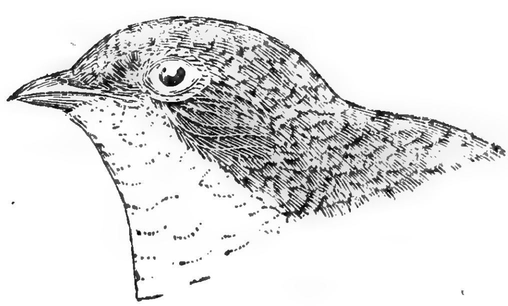
of the red-throated diver, or loon, and also a few living specimens out in the bay. A few old squaws were seen among the flocks of scoters. There were a number of boats anchored near the mouth of the harbor containing sportsmen, or men who probably called themselves such. These men kept up a constant fusillade with their guns. We counted eight or ten shots fired at a single flock of "coots" and feared there might be considerable slaughter going on among the ducks. We felt considerably relieved upon this source, however, when we came to examine a boat which came in as we were about leaving the beach, and found that all the birds which her two occupants could show as a result of their skill were a single Wilson's tern and a velvet scoter. We were informed by the men that they did not remember a time before when they had so little "fun" as they had experienced that day.

Now, although it is probable that the sea ducks of all species are not killed to any great extent, so much shooting at the birds as they approach their feeding grounds, must tend to drive them away, and we can readily foresee the time when few birds will approach our coast. In fact, comparatively few come here now in comparison with the immense numbers which frequented the mouths of rivers and tide ways in past years.

While the somewhat doubtful gastronomic attraction of a "coot stew" may offer an excuse for shooting these birds, it seems a pity they should be driven from our waters. Any attempt to stop this shooting through an appeal to the Massachusetts Legislature, would probably prove ineffectual, yet it would seem that even the sportsmen themselves ought to perceive that, as birds are growing fewer year by year, some measures ought to be taken for their protection. If a few of the rivers in which the birds resort, could be kept as sanctuaries for them, no shooting being allowed there, the ducks would speedily learn to recognize these places of safety, and would visit them in numbers and thus be again attracted to our coast.

A few years ago, the proprieter of a hotel, which stands on Indian River, Florida, a man wise for his day and generation, prohibited all duck shooting from his water front, which was somewhat extensive. As a result, the true coots and the scaup ducks came to the place in considerable numbers, and became so tame that they would often sit upon the banks of the water, regardless of the passing guests, who frequently walked within a few feet of them.

FIG. 94.



White-bellied Swallow.

THE NESTING OF A PAIR OF BLUEBIRDS.

BY

THEODORE PARKER.

(Read before the Maynard Chapter of the Newton Natural History Society, Sep. 8, 1899.)

On July 11th, I found a bluebird's nest with four eggs in it. The nest was in a natural cavity in the limb of an apple tree, five feet from the ground and right beside a road. When I went there I heard the bird, but did not see her.

On July 13th, I found the eggs were still in the nest, but again I did not see the old bird. But the next day as I came up to the nest, the mother bird flew off, and alighting on a telegraph wire, watched me for a few minutes and then flew away.

On July 15th, I visited the nest twice. The first time, the female flew off, and when I looked in I found two young birds and two eggs.

The second time I came I found the male on a wire near the nest, and the female was just coming out of the hole, head first. I put up my hand and stopped her, and she went back again. When I put my hand in, I found that she had turned around and her tail was facing the entrance. How she did it in that narrow place, I do not know. I took her in my hand, and pulled her out, and at that she struggled and gave a call note. Immediately, the male flew right at me and came within three feet of my head. As soon as I let the female go, they both flew away. I found that the young birds had no feathers on, and that their eyes were not open. July 17th. As I came to the nest, the female flew off. I found that there were still two young birds and two eggs. July 19th, I found the male bird on a wire with food in his mouth. There were still two eggs in the nest.

July 20th. The young birds are growing fast, but their eyes are not open yet. The eggs are still in the nest, so I think they are bad and will not hatch. The male was near the nest.

July 24th. When I came up to the nest today, I did not see any of the old birds around. I found that the young birds had their eyes open.

July 28th. Today I found that the young birds had quite a number of feathers on. They are growing fast.

August 1st. This morning I took one of the young birds out of the nest. It flew right out of my hand, and alighted in the road. I caught it, and put it back in the nest, but it flew out again. The male and female were flying about my head all the time. The young bird seemed fully grown and could fly a little.

August 2. Today when I looked in the nest I found it empty. The young birds had flown.

ADVENTURES OF THREE YOUNG NATURALISTS.

BY

U. R. WILD.

(CONTINUED)

CHAPTER III.

FIRST LESSONS IN SKINNING, DISSECTING, ETC.

Upon arriving in camp, our party found that Joe, a negro servant engaged for the trip by Professor Hall at Key West to do the camp work had dinner all ready.

The boys did ample justice to the repast, as the bracing air of the piny woods had given them a fine appetite, and the canned meats, vegetables, and baked sweet potatoes disappeared like magic. The meal despatched, the Professor led the way to one of the tents set apart for the purpose of storing skins and preparing them and other specimens.

It was provided with a table, the legs of which could be folded up for convenience in transportation, some camp chairs, three chests furnished with trays ready to receive bird skins. Two large cans of alcohol, cotton, cans of dermal preservative, and other material for preparing specimens, completed the contents of the tent.

Professor Hall seated himself at the head of the table and spread out the birds, captured that day, before him.

"Twenty-five in all," said George. "How will you ever get through with them before night, Professor Hall?"

"Let us see," was the answer. "It is now two o'clock, that gives me four hours of day light, and if I do six in an hour, which I can readily accomplish, the task will be completed by night. Let us first glance at the species which we have obtained. How many do you make in all, Paul?"

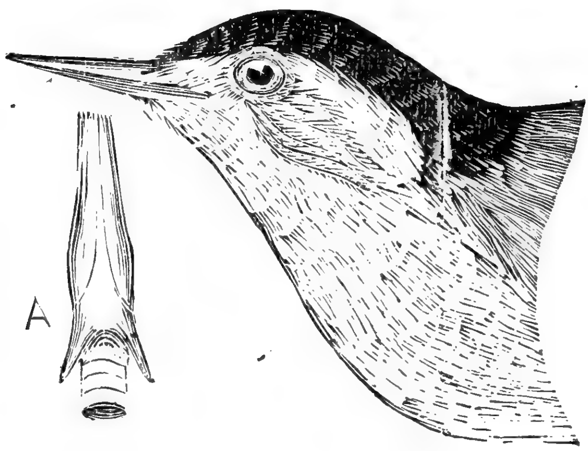
Paul, who was examining the birds, began: "This is a bridge pewee I should think, although it looked out of place in the piny woods where I shot it. This is surely a yellow-rumped warbler.

"Yes," interrupted Harry, "that is my bird, and I am sure that it is rare. See the yellow spot on the lower part of its back."

"That is no proof of its rarity," resumed Paul, "I have always found yellow-rumps common enough north, besides I've seen at least a dozen today. But with the exception of these bluebirds, the quail, and these two species, everything is strange to me; I should like to have you tell me about them, Professor Hall."

"Well," said the Professor, "these little birds are brown-headed nuthatches. Note the peculiarly pointed, and seemingly upturned bill. See also

FIG. 95.



White-bellied Nuthatch. A, tongue.

the peculiar tongue as I draw it out of the mouth. Its tip looks as if it had been broken off irregularly."

"Why is the tip so irregular?" asked George.

"It is probably due to the fact, that as the nuthatch feeds largely upon the eggs of insects, which live in the crevices of the bark, where the bird cannot get at them with its bill, hence uses its tongue to remove them, it thus it becomes worn away irregularly. The tongues of all of our nuthatches are similar. Here is the figure of the head of a white-bellied nuthatch, a well known northern species with the tongue beside it."

"What is this bird with the crimson top to the head?" asked Paul. "Is it a red-headed woodpecker?"

"It has a red head," answered the Professor, "but it is not the specie usually called the red-headed woodpecker. You can see that this is transversely banded on the back with black and white, and grayisn beneath, with a red tinting on the abdomen. This is called the red-bellied woodpecker on this account. The red-headed woodpecker is red, black and white in masses. That is, the head and neck are red, the wings and back, black, with a wide band of white across them and the tail is black. All the colors are thus in masses with no fine markings.

"Yes, we may see the red-head here, as they occasionally occur in Florida," he rejoined, in anticipation of a question which he saw George was about to ask.

"Here is another woodpecker," said Paul, "which is black and white. with a tiny spot of red on either side of the back of the head."

"It looks something like a downy woodpecker," remarked George, "but it is different, for it is banded on the back, not streaked, and the red, as Paul says, is in two small patches on the back of the head."

"I think that will do for a first lesson, as far as the birds are concerned," added the Professor. "Now I must begin to skin these birds, and I will give your first lesson in this also."

The boys were requested to seat themselves at the table in such a way that they could see, and not impede the light, then the Professor began his instructions as follows.

"I shall begin with the small birds first because they are apt to spoil the quickest. So I will take this brown-headed nuthatch. As you see, I lay the bird on its back, with its head a little to the right. I then part the feathers on the abdomen, disclosing a naked space. I run the point of my skinning knife down under the skin of this space, beginning at a point on the lower part of the breast bone and going backward quite to the vent. With my thumb and forefinger I peel back the skin on either side. Then by pushing up on the right leg, I disclose the knee joint; pushing my knife beneath this, I sever the leg at this joint. Then I pull out the leg, skinning it to the heel, or tarsal joint. With my thumb and forefinger nails, I break the tip of the bone at its upper extremity, and pull down the muscles to the heel. With a twist these muscles are brought together and all cut with one sweep of the scissors. The other leg is treated in the same way. I now grasp the tail firmly with my thumb and second finger, and with one downward stroke of my knife, I sever the small vertebra of the tail. The extent of the downward stroke is ascertained by feeling with my fore finger, which I placed beneath the tail, and thus avoid cutting through the skin.

Taking hold of the end of the exposed tail vertebra which projects from the body, with the thumb and fore finger of my left hand, I peel down with my right hand all around the body, taking care *push* rather than pull the skin off. I now come to the wings. With a motion of my thumb and fore finger, I p sh the skin off the upper wing, and expose a portion of the fleshy part of the forearm taking care, however, not to detach any of the secondaries from the bone. I cut off the lower, or basal portion of this fleshy part of the fore-arm diagonally, rub a little preservative on the cut end, and treat the other wing in the same way. As you see, the skin is now turned over on the neck and head. The eyes are removed with the point of the knife. The back of the head is cut off and two cuts made from the lower part of the skull back. This removes a portion of the back of the skull, and with this portion the brains also come out all in one piece. Dust the skin well with preservative, place a ball of cotton in each eye socket, then turn the skin right side out again, by pushing the skull forward through the neck. I give the skin a slight shake and the work is finished as far as skinning goes, and here will end your first lesson."

"Why," said Paul, who with the other boys, had given this interesting operation their closest attention, "you have been only four minutes skinning the nuthatch."

"Yes," said his instructor, "I think I have been about that time, but birds must be skinned quickly in order to look well when made up into skins."

"I saw you kept dusting the bird's body with preservative as you skinned it," said George. "Why did you do this?"

"In order to keep the blood and other fluids contained in the body, from injuring the feathers," was the reply. "Now," continued the Professor, "I want each one of you to take a bird and try and remove the skin as carefully as possible. Then I will criticise your work."

Accordingly, each of the boys, guided by the instruction of the Professor, selected a suitable specimen and eagerly went to work. The result of their labors will be given in another chapter.

CHAPTER IV.

HOW PAUL DID NOT GET HIS FIRST DEER.

All of our party were up the next morning before the sun had pushed his shining face out of the broad Atlantic. Already Joe had cooked the bodies of the quail shot the day before; these and baked sweet potatoes constituted a morning's meal, not to be despised anywhere.

The repast concluded, the boys were not long in getting ready for another trip, and soon all were walking along a narrow footpath, which bordered a line of prairies that stretched along the Miami River until it made its way out of that immense, wide-spread marsh, known as the Everglades. The wind was blowing from the west, soft and balmy, for it came across the level marshlands from the far-away Gulf of Mexico.

Although it was early in February, flowers were blooming in profusion, and the green grass on either side of the path was enlivened with their brilliant hues. Masses of fleecy clouds hung low in the blue sky to the westward, the remnants of some far off thunder storm, which at this season lie over the waters of the gulf. The mellow whistle of the bluebird came to the ear from the neighboring pine woods and mingled with the louder, wilder notes of the Florida meadow larks, as they rose from the grass and balanced themselves on the tops of the tall thistles in front of the party as they proceeded rapidly on their way towards the Everglades, while away to the westward, from the marshes behind some distant cypress swamps, came the harsh notes of the sandhill crane, but softened by distance, they harmonized well with the more melodious notes near at hand.

Our friends proceeded along the path in silence, even the usually irrepressable spirits of George were subdued, and no one uttered a sound, for upon starting, the Professor had informed the boys that if they kept quiet they might obtain a shot at a deer when they came to the cypress swamps that bordered the Everglades.

Hence it was that the boys, although overflowing with life and elasticity of spirit, of one accord silently followed in the footsteps of the Professor, who, with the well-trained step of one accustomed to the life of a hunter, was covering the ground with great rapidity. After pushing on in this way for about an hour, they perceived the open country before them.

Here a consultation was held, and it was decided that Professor Hall and George should proceed in a north-westerly direction, while Paul and Harry were to follow along the margin of the river; when both parties reached the marshes, they were to turn toward each other and thus meet. Paul and Harry, whom we shall follow for a time, had gone about a mile. when they perceived a small cypress swamp in advance of them, recognizable at once by the tall, straight, nearly white, stems of the trees. At this moment Ponce, who followed at the heels of her master, stopped and sniffed the air as if she scented game. This caused Harry, who was walking behind her, to call Paul's attention to her; he stopped, and after observing the dog a moment, looked carefully around him, especially examining the open space in front of the cypress swamp, for the wind was blowing directly from it, and the slight odor of any animal concealed in it, or near it, would be perceived by the dog. Paul examined this space with attention several times, when suddenly a reddish object caught his eye, and this, upon more careful examination, resolved itself into a deer with a fine pair of antlers. Then two similar objects presented themselves, which a second look revealed as a doe and fawn.

"Down!" said Paul excitedly. "Deer over there!"

"Where, where?" hurriedly whispered Harry, who at Paul's 'down' had dropped on his knees, and partly rising, said, "Let's shoot them."

"Keep down out of sight!" exclaimed Paul. "There are three of them over by that cypress swamp."

The deer, of which there were a buck, doe and fawn, had seen the boys, and the buck was standing in advance of the doe, while the fawn stood between them; all were as motionless as the tree trunks behind them; hence the reason why Paul did not at first see them.

"Let's try and crawl onto them," said Paul. "They are too far off now even for a shot with my rifle. We can keep behind that clump of palmettoes, and from them we can get to that prostrate log and then we shall be about one hundred yards from them, and I can fire with my rifle, while perhaps you can get a chance with your buck shot."

All this conversation was carried on in a hurried whisper, then at Paul's suggestion, the boys stopped to take off their cartridge belts in order that they might not be incomoded by them. Paul retained only his rifle, which he always carried suspended from his neck with a strap. Harry quickly put two buck shot cartridges into his gun, and leaving Ponce to guard the things left behind, both boys began the nervous task of crawling on all fours toward the deer Although the boys were out of sight when on their knees, as there was a slight rise between them and the deer, the curiosity of the animals had been aroused, and as is their custom, even when they know they are in danger, and cannot quite make out what is going on, remain quiet, gazing at the object of their solicitude, thus in the present case, the boys' heads occasionally bobbing up in sight, was enough to rivet their attention while they were incapable of understanding what it all meant.

While passing from their starting point to the bunch of palmettoes, mentioned by Paul, our young hunters were nearly, or quite, concealed from their game, but when they emerged from behind this shelter, and were endeavoring to reach the large log, which, as Paul had judged, was about a hundred yards from the deer, they were in open sight, yet as they were creeping, or rather drawing themselves along, with their bodies as close to the ground as possible, and as it was highly probable that these individual animals had never been approached by human beings in this manner, they were completely puzzled.

After a moment or two, the boys reached the shelter of the log. Paul now hurriedly whispered to Harry that he would shoot first, and immediately proceeded to push his rifle barrel over the log. As the boys passed out of sight, the buck, alarmed at the near presence of some danger, the evidence of which was now invizible, began to show unmistakable signs of fear, and as Paul looked over the log to shoot, he saw the buck pacing up and down in front of the doe and fawn, stamping his foot, tossing his head, and exhibiting other marks of uneasiness. All this tended to make Paul nervous, and as he drew his rifle to his eye to fire, before he could aim, he involuntarily pulled the trigger, and the ball whistled harmlessly beneath the deer. Although Paul felt instinctively that his ball had not struck the mark, it was difficult for him to believe that he had not shot at least one of the deer, for the effect produced by the discharge of the rifle was most peculiar, The buck, upon hearing the report, had sprung to one side, coming in contact with the fawn with such force as to throw it to the ground, directly beneath the feet of the doe, tripping her up. As she fell, the momontum acquired by the buck, also overset him, and he lay sprawling on top of his two companions. Then occurred one of the strangest mingling of hoofs and horns that was ever a hunter's lot to witness.

Harry, frantic with excitement at such a spectacle, sprang to his feet and shouting at the top of his lungs:

"Come on, you have killed them all!" dashed away toward the deer. After going a few steps, he discharged one barrel of his gun into a bunch of zamia which grew at his feet and the other into the tops of the cypress trees. This singular action on the part of Harry, so thoroughly frightened the entangled deer that they made some desperate efforts to regain their feet, and after a struggle or two succeeded, then immediately rushed into the swamp. This fact did not deter Harry from continuing the chase; without the slightest hesitation he ran into the knee-deep water of the swamp in track of the frightened animals, calling lustily,

"Come on, we'll catch them; we'll catch them," reiterating the cry with every plunge in the deepening water.

Meanwhile Paul was undergoing considerable mental excitement. After the accidental, or rather involuntarily discharge of his rifle, he had remained in the same attitude he had assumed when he fired, seemingly in a semi-stupified condition, the natural results of reaction after intense excitement, accompanied by bitter disappointment. As Harry disappeared after the deer, Paul recovered somewhat, rose to his feet, drew a long breath and exclaimed to himself:

,, I wish I could do that thing over again."

Being, however, in a thoroughly healthy state of mind, and having been accustomed all his life to make the best of everything, his natural boyancy of spirit began to assert itself.

"Well," he murmured, as he slipped a fresh cartridge into his rifle, "I shall have another chance at the deer soon I am certain, when I shall try and not let my nervousness run away with my good sense. What's the matter with Harry?" he added, for at this moment he heard him calling from the depths of the swamp.

"I'll go and see." So off he ran wading into the swamp, easily following Harry's course by the muddy water. Proceeding into the swamp for some distance in this way, he at length perceived Harry. He was standing on the edge of a cypress log looking considerably frightened, and as Paul approached, he pointed to the other end of the log, on which lay a huge water moccasin. The reptile had drawn himself into two or three bights and his head was thrown back on one of these bends, while his mouth, the inside of which was white, was wide open, disclosing the long, curved fangs.

"Shoot that snake quick," said Harry, his teeth fairly chattering with terror.

Paul took a quick aim with his rifle, pulled the trigger, and the reptile's head head fell from its body.

"There's another," said Harry, pointing toward a second snake that occupied another log a short distance away, "the whole swamp is full of them and I have left my shells out in the woods so can't load my gun."

"I don't think that one will do any harm," said Paul, "so what is the use of killing it."

"Yes," said Harry, "shoot it, for it might take a notion to swim over tow a d us."

"He won't leave that log in a hurry," remarked Paul. "But where are the deer?"

I don't know," answered his companion. "I think they ran right on t ough the cypress. But let us get out of this place. Come on this is the ay," starting to lead the way deeper into the swamp.

"I think if you go far in that direction you will bring up in the everglades," said Paul. "Wait until I get the moccasin's head and I will show you the way out."

He secured the head, placed it in a tin box which he had in his basket just as he had seen the Professor do with the rattlesnake, then led the way back towards the piny woods. The boys had gone but a short distance when a shadow, crossing the sun, caused Paul to look up just in time to see a large owl sailing off through the tree tops, and following him with his eyes, saw him alight in a huge cypress swamp a few hundred yards away.

"See that owl!" he exclaimed. "Wait until I go on ahead and shoot him. I can see where he stopped." Going forward a few rods, he took a deliberate aim with his rifle; the report rang out and in a moment a heavy splash announced that the bird had fallen. Upon picking it up, Harry, who had gone ahead, while Paul stopped to reload, exclaimed in a

FIG. 96.

Young Florida Mottled Owl.

tone in which disgust was apparent, "It is nothing but a common barred owl and not worth shooting, we had better throw it away."

"No," said Paul, "don't hrow it away. This must be the Florida barred owl about which Professor Hall told us. Yes," he continued, "this is the sub-species, for the toes are quite destitute of feathers." So the owl was transferred to his collecting basket, and in a few moments the boys found themselves in the open piny woods.

"Here is where I shot at the deer," remarked Paul. "I wish I could do it over again," he once more said regretfully.

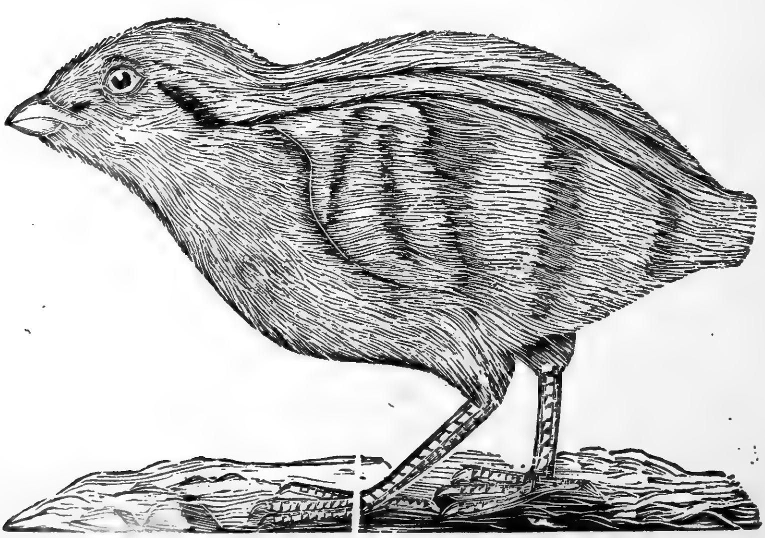
"I don't see why after knocking them all down, we did not get some of them," said Harry. "I'm sure I gave them both of my charges."

"I don't think either of us hurt them much," replied his companion, smiling at the recollection of how Harry gave them both charges. "But I can't boast much about my shot this time. There is Ponce over there. Let us get our things and try and find the Professor and George."

Accordingly equipping themselves, with the articles laid one side, much to the delight of the dog, who now considered herself released, the boys turned to the right and proceeded along the cypress swamp. They had not gone far when they perceived their friends advancing to meet them. Mutual explanations and relation of adventures followed. It transpired that George and Professor Hall had procured about a dozen birds, among which were some fish crows, known, as George, who was evidently freshly posted, eagerly explained by the long, slender middle toe, which was equal in length to the tarsus, not shorter than it, as in the common species.

Our party then proceeded campward, gathering a few more birds as they went, arriving in time for a good afternoon's work.

FIG. 97.



Young Quail.

OCTOBER, 1899.

BY

C. J. MAYNARD.

She comes in the misty twilight
In the shade of th' waning moon,
When from the lakes resounds the cry
Of the southward flying loon.
Then silently and viewlessly
The glorious goddess comes.

She steals through the deep wooded glens
Which lie between hilltops high,
Where rustling leaves alone proclaim
That the goddess passeth by.

And on the purple mountain sides
When the morn breaks o'er the lea,
She hangs her crimson banners out
From many a woodland tree.

All nature feels the mystic power
Of the goddess's magic sway,
As with pencil fine and colors rare
She paints the maple spray.

The walnuts cast their treasures down
At the enchantress's hidden feet;
While chestnut burs are opened wide
Her sunniest smile to greet.

The blue jay's bell is ringing
From every bosky tower,
While from the glen the partridge's drum
Gives praise to the welcome hour.

From hillside fields and valleys low
The asters gaze with starry eyes,
And from the meadows by the brook
The blue-fringed gentians rise.

They rise and ope their fairy bells
When the goddess draweth nigh;
And each azure cup in brightness vies
With the azure of the sky.

And stooping low as soft she treads
Beside their humble bower,
October gives her sweetest kiss
To New England's fairest flower.
Then silently and viewlessly
Onward the goddess moves.

PLAN OF AERIATING MACHINE FOR AQUARIUMS.

BY

PROF. ARTHUR. M. MILLER.

My device is my own and quite inexpensive. I first thought of getting a plummer to put me in a blower to be run by the hydrant pressure, but found that it would cost me about $75. Mine, made entirely of glass and rubber tubing, a glass jar of about three quarts capacity, syringe and bicycle valves and pieces of grape-vine twigs, did not cost me in materials two dollars. I have piped the air over a doorway and all along one side of a room, where it supplies air to six jars. By turning on more water at the stop cock, I could increase the number of jars indefinitely.

There is no secret about it. Some of my colleagues have admired it, and I have been urged to write a description for some of the Naturalist's Journals. I enclose a sheet containing a diagram of it, with the dimensions obtaining in mine. Those of course could be varied within certain limits.

The water is admitted to jar J through tube A. The filling of the jar drives out the air through tube D. The height of the siphon tube C, determines the amount of air pressure it is possible to obtain. The water rises in the tubes C and B at about the same rate. When the jar fills up to mouth of air tube D, it rises rapidly in all three of these tubes, but not so rapidly in the air tube D as in the others, on account of the resistance to

Fig. 99.

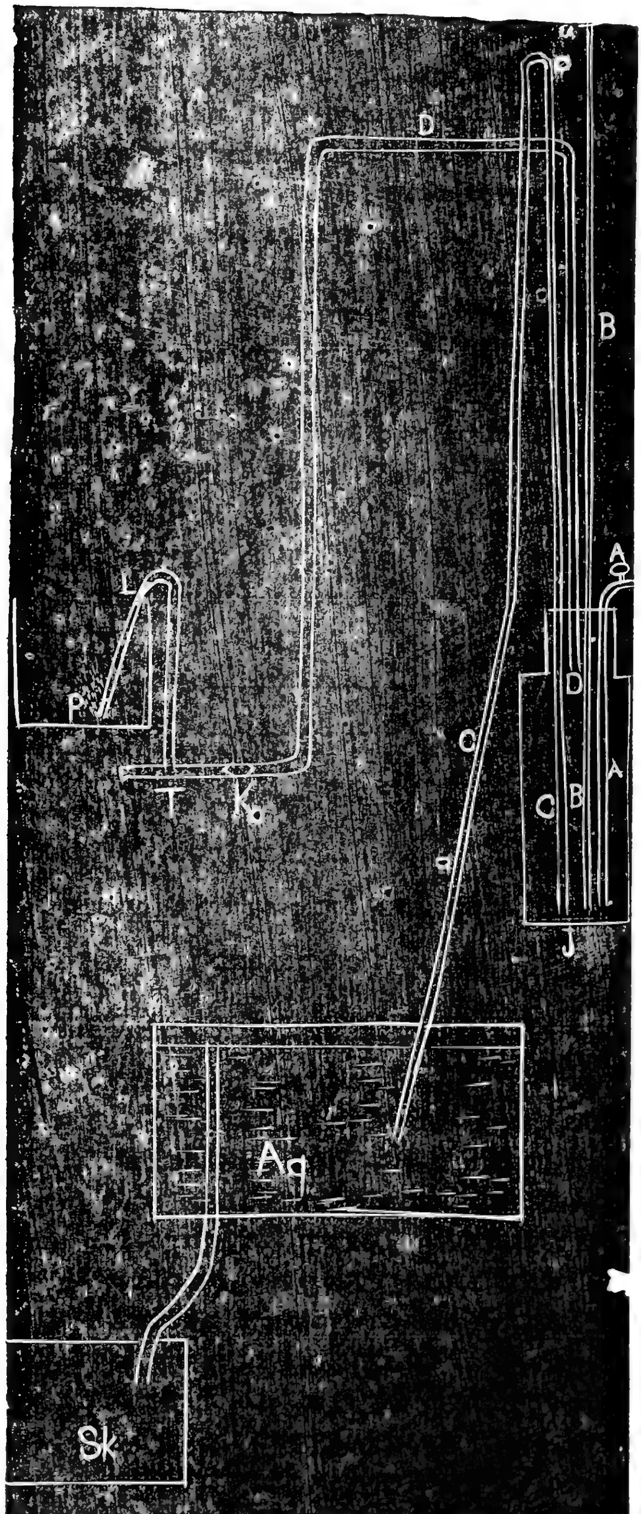


Diagram of aeriating machine for aquariums escape of the air at the grape-vine plugs immersed in the tank of water (or tanks as the case may be). During all this process of the filling of the jar and the tubes, the bubbles escape in a constant stream from the end of this plug (or these plugs, when the tanks are connected up in series). When the water in tube C reaches the bend at top, it begins to siphon out, and if the influx has been gauged properly, runs out faster than the water is delivered. A syringe valve at K prevents the water from sucking back into tube D. Air is sucked in through tube B to replace the water in the jar. During this time the bubbling of the air out of the grape-vine plugs intermits. After the jar empties, the process begins over again. My apparatus works automatically for months with scarcely any attention.

Morgan and Wright bicycle valves placed in the individual tubes that supply each jar contributes to the successful operation of the mechanism. Where a number of aquaria tanks are connected up in series, it is necessary to adjust these valves so that air will be forced out through each of them.

I use my jars or tanks, thus aerated, for keeping alive hydras, copepod crustaceans, and other forms of minute fresh-water organisms, that readily wash out of an aquarium through which a stream of water flows.

SYSTEMATIC ZOOLOGY FOR TEACHERS.

BY

C. J. MAYNARD.

FORMS AND SPECIES OF SPONGES.

(CONTINUED)

Among species of sponges, the simplest forms which we find are single cylinders. A species which often grows as a single cylinder is the tube sponge, (see plate VIII, May No.) but these sponges frequently produce buds from the base, (see fig. 78, page 172, also fig. 99, page 217) a process to be described under reproduction. These buds grow upward, and thus, in some cases, form colonies. See fig. 82, page 180 and fig. 84, page 182, where two cylinders are seen growing side by side. Sometimes other buds form, and under favorable circumstances, a number of cylinders may be seen growing side by side. I have found as many as twenty cylinders in one case in a single colony. The cylinders usually remain separate, often growing upward, as in the specimen figured on page 182, but sometimes they adhere together for the basal portion, as seen in the specimen given on page 180. More rarely, however, the cylinders are found fastened together for the entire length. Such a specimen is given in fig. 100.

Now it is extremely probable that the original form of sponges was a single cylinder, pushing up from a base, but as under certain conditions, for example, where a sponge grew in a swift tideway, it became advantageous for the species to produce a number of cylinders which adhered together, a sponge of a more complicated structure was the result.

As seen, although the tube sponge nearly always, or always, grows in quiet waters it, exhibits an inclination to form masses of tubes, that is, it takes one step in the direction of evolving a species with several tubes joined together.

FIG. 99.

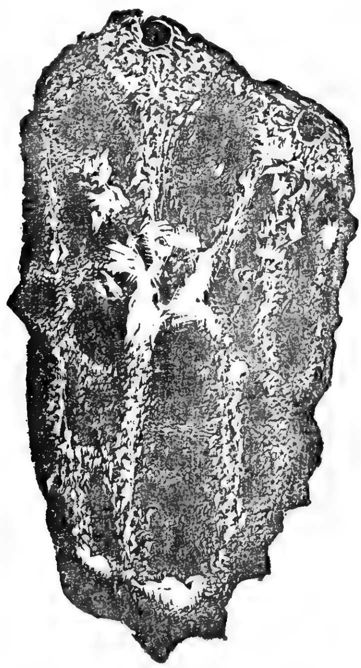
Tube Sponge.

Such a species we actually find in a specimen of sponge closely allied to the tube sponge, in fact, belonging to the same genus (Verongia). This is the filamentous sponge, and in this species we not only find a number of tubes joined together, but the tubes are greatly reduced in size. A specimen of the filamentous sponge is figured on page 179. Here, as will be seen, there are about eight tubes joined side by side. Thus step by step, we can trace the evolution of the sponge through such forms as the net sponge, fig.

106, where a single tube is given to more complicated structures, like the logger-head sponge, fig. 101, and the scarlet sponge fig. 102, up to the commercial sponges.

Taking a step in another direction, we find that the tube sponges are not all alike in diameter. While some grow small and slender, others produce cylinders which are more cup like. For example, compare the sponge figured on page 178 with that given on plate VIII. This leads us to a group of forms which have the excurrent tube, or cloical opening, very large. These

FIG. 100.

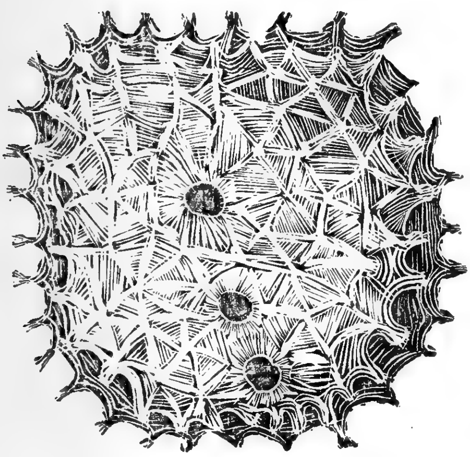


Tube Sponge.

are the cup sponges. And a species quite nearly related to the tube sponge is the giant cup, (seefig. 103) a sponge which grows to the height of two feet or more and nearly as much in diameter. Two other forms of cup sponges are given in figs. 104, 105, but these are not at all closely related to either the giant cup or to the tube sponge. They are, in fact, spiculigenous sponges, and they may have had their origin in such a form of spiculigenous tube sponge, as the finger sponge given on page 183, fig. 85, which grows singly and also in groups. This form of spiculigenous sponge is exceedingly variable in the diameter of the tubes, some being found an inch across, while others occur which are five or six inches wide at the top tapering to the baes, and are thus perfect cups

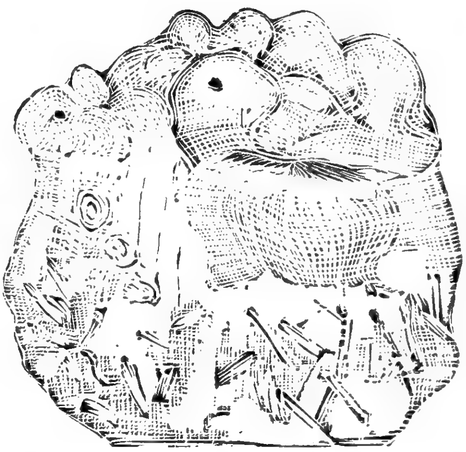
Leaving the upright forms of sponges for a moment, let us try and trace sponges from their origin. Encrusting stones, dead coral, etc. in tropical waters, we find protoplasmic-like masses which, when we come to study their structure, we find are really sponges, but in the cases which we have under consideration, are wholly without fiber or spicules of any kind. This group of sponges is known as the fleshy sponges, and in some such structures, sponges must have originated. That is, sponges with a protoplasmic structure must have been the originators of sponges with both horny fiber and spicules. As they exist at present these fleshy sponges have a rather complicated water system. A figure of this water system is given in fig. 107.

FIG. 101.



Logger-head Sponge.

FIG. 102.



Scarlet Sponge.

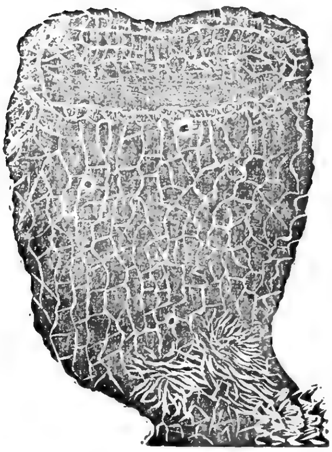
It can readily be seen that what was at first some accidental accumulation of either spicules or of horny matter, proved of such benefit to the fleshy sponge, that it became an inherited habit with these sponges to secrete either fiber or spicules. A careful study of the species of sponges would tend to show that spicules were the original supporting skeleton of sponges, and that horny fiber appeared afterwards.

While there is some evidence to show that these spicules may have formed first around the excurrent tubes, thus causing them to be projected upwards in the form of comparatively narrow tubes, it may be possible that wide disks were formed around cup-shaped depressions, and in place of the tubes evolving cups, the cups themselves may have evolved the tubes. The constant inclination of the finger sponge to produce cups, shows a tendency in this species to revert to an original cup-like form. On the other hand we find (as will be seen later) that the tube sponge shows decided inclination to produce narrow tubes, or filamentous growths, indicating that it had its origin in some even more slender forms than it at present shows. From this we may judge that the small types of the single cylinder was the first form.

Of course both forms may have become evolved at separate times, and both produced their own types of sponges. In this case, I think we have reason for believing that the spiculigenous sponges originated from cup forms, and the horny sponges from tubes.

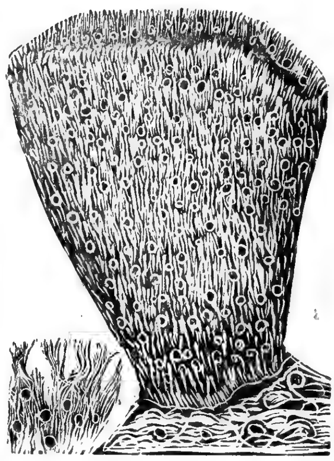
Before leaving the subject of encrusting sponges, I will say that a num-

Fig. 103.



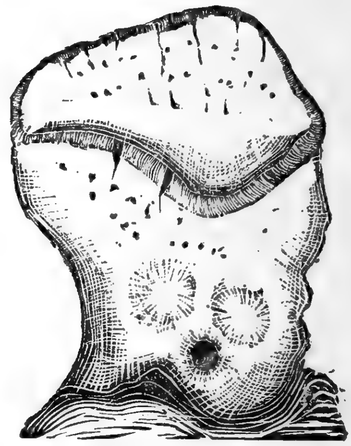
Giant Cup Sponge.

Fig. 104.



Green Cup Sponge.

Fig. 105.



Gray Cup Sponge.

ber of species of these sponges are provided with spicules. Among these is the beautiful green encrusting sponge, (see plate X) the spicules of which are spherical in form with points projecting out in all directions over the entire surface. Thus the spicules resemble somewhat the pollen grains of some plants, like the asters, for example. At first sight it might appear that these encrusting sponges which have spicules were evolved directly from the fleshy encrusting species. But I do not think that this is the case, for we find that the young of this particular green sponge is partly free growing in sheets before it adheres to rocks, showing that it had its origin in some species which grew upright.

Now returning once more to the tube sponge, we find that this species is not only inclined to produce filaments, (see fig. 105) but this inclination is even more pronounced in the filamentous sponge, this tendency in this last named species is well illustrated in the fine specimen figured on page 175. The filamentous spouge grows in swift tide ways and in shallow water which is probably the cause of the elongated filaments. In swift tide ways and at greater depths, thus where there is considerably less force

NATURE STUDY

IN SCHOOLS

Conducted by C. J. MAYNARD

Vol. I NOVEMBER, 1899 No. 10

Lapland Longspur.

West Newton Mass.

C. J. Maynard

CONTENTS.

NATURE STUDY IN SCHOOLS.

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NATURE STUDY.

VOLUME I. NOVEMBER, 1899. NUMBER 10.

SYSTEMATIC ZOOLOGY FOR TEACHERS.

BY

C. J. MAYNARD.

FORMS AND SPECIES OF SPONGES.

(CONTINUED)

of water, we find that this inclination to a filamentous growth has produced an elongated form of sponge in which the excurrent openings are on the sides of the long branches.

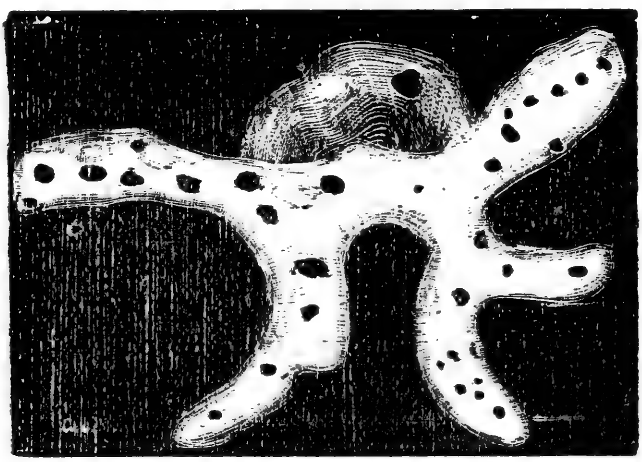
These species of sponges, known as rope sponges, live prostrate on the sea bottom, or climb over rocks, much as do climbing plants on the land. An example of a horny sponge, but of a different genus from the rope sponge, may be seen in the cord sponge (fig. 86 on the left) showing the anastomosing, or joining together of two branches. The figure to the right shows a branching form of spiculigenous sponge which is common on the New England coast. Another branching sponge may be seen in fig. 87, B, where the forked termination is given. Beside it, at A, is an elongated form, the purple sponge. A peculiar form of prostrate sponge is the creeping sponge, fig. 106, where the branches have become greatly thickened. These branches are quite large, some specimens reaching eight or ten feet in length, with branches which extend several feet in diameter.

REPRODUCTION IN SPONGES.

Sponges reproduce in two ways, sexually, by eggs, and asexually, by buds. Two kinds of reproduction cells occur in sponges. Those which produce ova, and those which produce the male or fertilizing element (spermatazoa) The ova are fertilized within the sponge and are thus ready for development when they are thrown out of the excurrent openings. Segmentation begins as soon as the eggs are deposited, or probably as soon as they are fertilized, and proceeds as described on page 177, and illustrated by fig. 80.

After the embyro has advanced as far as the last stage given, another change takes place. The egg which has hitherto been spherical in form, becomes slightly flattened at one point. This flattening proceeds and finally develops into a cavity which, becoming deeper and deeper, at last occupies the greater portion of the body of the egg, which has now become somewhat elongated. By this arrangement it will be seen that the cells are crowded out of the center of the body of the young sponge, leaving a cavity. (See fig. 107.) This cavity serves as kind of stomach into which food is drawn by the action of cilia that are developed from the outer walls and along the margin of the cavity. Thus it can be seen that the young sponge begins

FIG. 106.



Creeping Sponge.

life as a kind of anamated stomach ; this stage of its existence is known as the gastrula stage, and all of the lower foims of animal life up to vertebrates acquire nutrition in the earlier stages of their lives in a similar way. The young sponge moves about for a time, by the aid of cilia, which are developed on the outer walls then settles down in some situation best adapted for its growth and development.

SPONGE FLESH.

The embryo sponge, when it settles down in what will be its permanent resting place, is composed, as we have seen, of cells of protoplasm. These cells go on accumulating, but from this point on gradually change ; become differentiated, into cells of other forms from those of the primitive gastrula. They form muscle cells, nerve cells, and reproductive cells, all of which taken together, constitute what is known as sponge flesh.

Skeletons of Sponges.

Early in the history of young sponges, we find that they develop skeletons. That is, after the sponge flesh has become formed to some extent, and the growth of the sponges has proceeded, upward to such an extent, as to require the support of a skeleton, we find one forming. Then certain cells are set apart, and in place of protoplasmic material, produce, in the horny

Fig. 107.

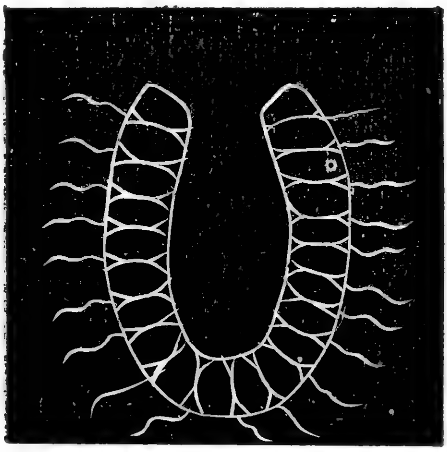


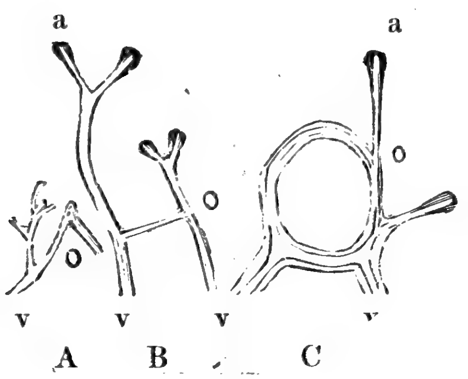
Diagram of young sponge.

sponges, a horn-like material, which increases in thickness with the age of the sponge; hence older sponges are of a firmer structure than when young. In the tube sponge, in which the fiber of the skeleton is quite large, we find one of the best species for study.

The general color of the skeleton is amber, light when young, but darking with age. The fibers are cylindrical, well rounded and seldom flattened, even at the points of jointure. They are hollow, and at the extreme tips of the new growths are composed of a single, soft membrane which is yellow in color and opaque. This soon becomes covered with a layer of pale, amber-colored, horn-like matter, which is nearly transparent, and successive layers of this horny matter are deposited; thus the older growths not only become larger in diameter, but darker in color on account of the continuous thickening of the deposits. See figs. 108 and 109 where I have given an enlarged cut of the fiber, a, being the new in A, C and B in fig. 108, and v the old; then compare with the old growth in fig. 108 C, in this the original hollow membrane may be seen through the transparent walls.

New twigs of the fiber arise from division at the extreme tips of the of the new growths. (See fig. 109, C, and fig. 108 a.) The twigs thus formed, although of an equal length at first, do not always remain so, for the onward growth of one may assume a different direction from that of the other, so that it may come in contact with the tip of another tube, forming a comparatively small mesh in the net-work of fiber, while the other may grow to a greater length, and then, anastomosing, form a larger mesh, (see fig. 110, K and S, where I give a life-size section of the growing skeleton of tube sponge, and the different sizes of the meshes of the net-work may be seen) consequently this forms an irregular anastomosis.

FIG. 108.



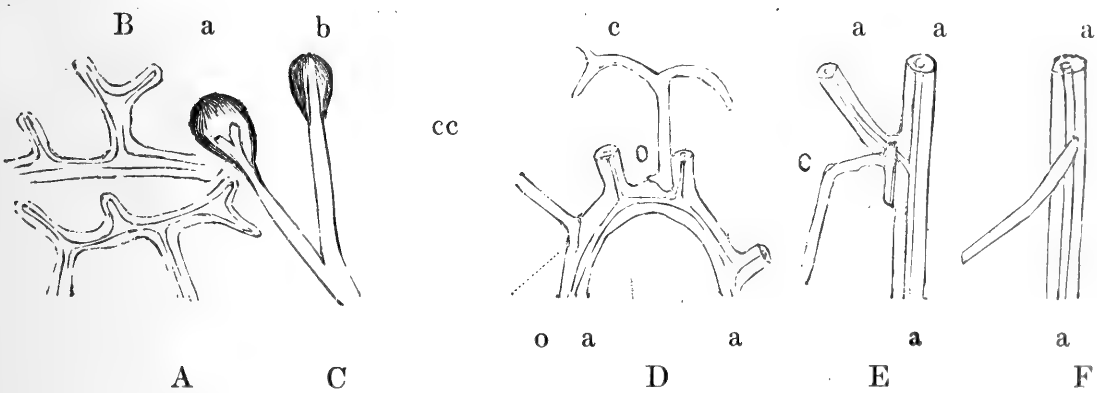
Illustrating the anastomosing and twig division of the fiber of the tube sponge. B. a, division of twig. C, a new twig before dividing; o, o, o. in all is the anastomosing point

As the direction assumed by a new twig is rarely the same as that taken by the one immediately behind it, sometimes the new twig comes in contact with the thick skin covering of the outer surface of the sponge, or with the lining membrane of the central tube; in either case the hollow at the tip of the growing fiber becomes closed, and afterwards permanently sealed with horn. For examples of these arrested growths, see fig. 109 A and B, and fig. 110 A to J.

Thus it is easy to distinguish between what is continuous, or new growth and an old, or arrested, growth. The growing twig being much more slender than the old growth, is destitute of horny matter at the extreme tip, and above all, the termination in the new twig remains constantly open, while it is closed in the old growth. Thus by simply observing the condition of the termination of the twig, we can ascertain whether a sponge is growing in any particular direction or not.

Of course as the skeleton is formed from the sarcode, or sponge flesh, this always grows in advance of the horny fiber. The fleshy matter is rather more dense around new fiber, especially around the tips of the growing twigs. When division of the twig is about to take place, the thicker sarcode becomes more bulbose about the extreme tip of the growing twig than at other times, and in this bulb the division of the twig occurs. See 109, C, a, where there is a divided twig, and compare with b, in which division is not taking place.

FIG. 109.

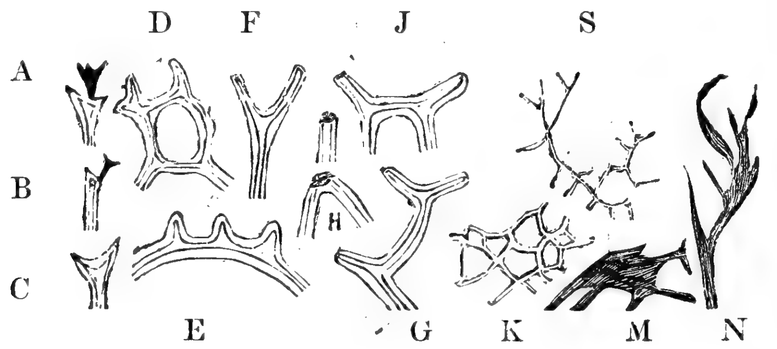


Fiber of Orange Tube Sponge. A and B arrested twigs from the inner tube. C, new growths. D E and F, new anastomosing against old; a, old growth; o, new.

I may here say, in passing, that the best way to examine the skeleton for a new growth is in an alcoholic specimen. The flesh may be easily removed, bit by bit with a needle, taking care not to break the delicate terminal fibers. But although it is quite easy to satisfy one's self as to the method of growth, it is not always easy to find a twig in the act of dividing. I have, however, found several, and have a number of times traced a complete series, from the very earliest division to the point of anastomosis or to arrested growths.

The growth at the terminal portion of the tube is most rapid, and of course upward and slightly outward, but never inward, and branches of the fiber continue to grow, sending out many twigs before any anastomosis takes place. Or in other words, that portion of the cylinder which is the most advanced, produces branching fibers which push upwards without anastomosis: fibers which send out lateral branches are the ones which anastomose. Anastomosis appears to take place by the tip of one growing twig coming in contact with the side of another growing twig. This combination must take place near enough to the termination to have the inner membrane naked or not covered, even with a single layer of horny matter, then a perfect anastomosis takes place; that is, the tip of the anastomosing fiber absorbs that portion of the other's tubular membrane with which it comes in contact; thus the hollow becomes continuous from one fiber to another. The growth of the twig coming in contact is at once checked and horny matter is deposited over the place of jointure. See fig. 108 where I give three examples of the anastomosis of growing twigs at A, B and C; o, being the point of jointure, and as will be seen this is not always at the same angle, that at B being at right angles, that at C being obliquely downward; while at A it is evident that the tips of two twigs came directly in contact, and upon anastomosing the growth of both was checked.

FIG. 110.



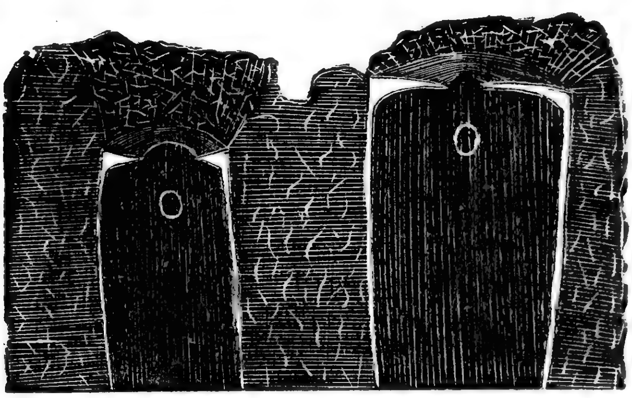
Illustrating the skeleton of Tube Sponge. A, B. arrested twigs with secondary growths; C. twig arrested just after dividing. D, arrested twigs from external surface. F. G, J, same from surface of central tube. H, and above, the same with cup-like depressions. K and S, portion of skeleton enlarged four times. M and N, flattened fibers from the filamentous growth. E, arrested twigs which came in contact with a hard surface.

It is absolutely certain according to my most carefully made and often repeated observations that no buds ever start from the side of a twig or branch. Hence the interior of the skeleton of the tube sponge presents a very finished appearance, there being no protruding twigs or arrested growths which have not anastomosed. See fig. 110, K, where I have given a portion of the interior of the skeleton, enlarged. This is not true, however, where the twigs have come in contact with the skin of the outer surface, or with the membrane lining the central tube, for here, as I have previously remarked, we may find many short, protruding twigs.

As both sarcode and skeleton become arrested as soon as they become covered with the lining membrane of the central tube, it will at once be seen that there can be no inerease of growth inward after this membrane is grown; and that the form of the sponge is determined by it. The tendency of the growth of the sponge is thus upward, and although, somewhat singularly, the upward growth sometimes considerably precedes the thickened lining membrane, (see fig. 111, A) the inclination of growth is very rarely, or never, inward. For proof of the assertion that the lining membrane arrests any inward growth. See fig. 111 A and B, a, a, a, a, being the lining membrane of the tube, also in the young specimen, fig. 112, B, where the tendency of growth is outward so as to gradually form a wider tube.

Returning again to arrested growths of the twigs of the skeleton, we find that those on the outer surface of the sponge differ as a rule from those on the inner. The differences are slight, but very constant. Externally, the growth appears to be checked gradually as it comes in contact with the outer skin, and as a consequence, the arrested growths are pointed. See fig. 110, B and C; the two twigs in the latter named being normal, that at B

FIG. 111.



Section of Tube Sponge. O, tube above which is the closing membrane.

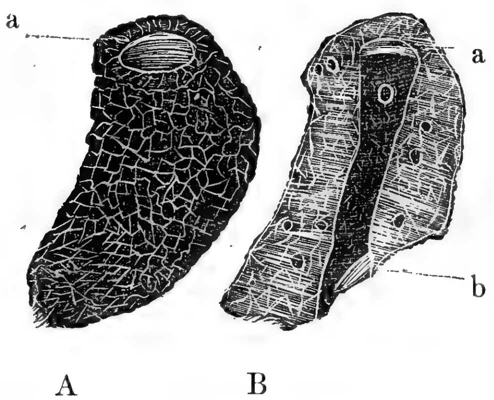
having become arrested on the external surface, and the sponge having become finished in that direction, a kind of secondary growth appears that is quite independent of the hollow structures of the fiber. These form minute, rather opaque, often branching twigs, having their origin directly on the end of the arrested growths. An example of this may be also seen in fig. 110 A.

Internally, or against the lining membrane of the central tube, we find the growth much more suddenly arrested. Hence the twigs present a more truncated appearance. (See fig. 110, F, G and J, and fig. 109, A and B. In some cases, the arrested twigs of the interior present a cup-like depression at the extremity. (See fig. 110, H, and the one directly above it.) In these twigs the hollow membrane is sealed, but is covered with only a thin layer of horny matter. This is evidently the consequence of the twig having passed a little beyond the sarcode into the lining membrane of the tube. Or rather this is the condition under which such twigs are found, but it is quite probable that the lining membrane has absorbed a portion of the sarcode and grown around the twigs before the usual quantity of horny matter was deposited on their extremities.

Variations in Skeleton Growth.

I have said that new fibers usually anastomose with new growths, and this is true where an unbroken internal membrane occurs; thus this is the

Fig. 112.



Young Tube Sponge, life size. A. whole sponge, B, section; a, terminal closing membrane; b' extra closing membrane in broken portion.

normal method of growth, but where new and growing fiber comes in contact with an old growth, a kind of anastomosis takes place. In this case the growing tip of the new twig comes in contact with the horny side of the old growth and is soldered there by an accumulation of additional of horny matter, secreted quite likely by both the old and the new sarcode. But in all such anastomosis there is no connection between the internal hollow membrane of the fiber of one growth with that of another. That is, the growth does not penetrate into the horny covering of the old growth as it does into the membrane of the new.

Another peculiar feature of this method of anastomosis is that when the new growth comes in contact with the old, the new twig, no matter at what angle it comes against the horny side of the old growth, usually continues to grow for a short distance, thus ensuring a greater surface of attachment. But as I have never succeeded in finding a case where this growth continued beyond the point of jointure, it is probable that the horny matter, was secreted by the sarcode upon both the old branch and the new twig, thus preventing further growth.

THE MAN-OF-WAR BIRDS AND CORY'S GANNET.

BY

C. J. MAYNARD.

As the teiminal point of an eight month's journey through Florida, the Bahamas, Hayti, and Jamaica, which I made in 1887–88, I had fixed upon the smaller Cayman Islands. These islands lie in the Carribbean Sea, about one hundred and twenty miles due south of the middle portion of Cuba and about the sсme distance north-east of Jamaica.

I left Kingston on the morning of March 18 on board a small schooner, which was outward bound for Grand Cayman, an island which lies some distance south of the two keys which I wished to visit, namely, Cayman Brac and Little Cayman, but for a consideration, the captain agreed to go a sufficient distance out of his way and drop me on Cayman Brac, and by daylight of the second day out we were off the east end of that island.

Cayman Brac is a small key, twelve miles long by an average width of two miles. The eastern end is high, cliffs rising abruptly from the sea to the height of one hundred and eighty feet, but on the northern and southern sides this pile of rock is bordered by a strip of intervale, or lowland, several hundred yards wide, though even here the cliffs maintain their percepitous character.

As we rounded the head of the key, and opened the cliffs on the north side, I immediately saw that there were a large number of birds flying about their rocky sides. A moment's inspection proved that these were the beautiful tropic bird and a species of gannet. As I landed on the west end of the island at a small settlement, I did not have an opportunity of seeing any of the gannets until after a month or more when I went to Little Cayman which lies seven miles west of Cayman Brac.

Here on the south side of the key I found a large colony of gannets and man of war birds breeding. The gannets proved to be a species quite new to science and I called it Cory's gannet (Sula coryi) a description of which I published in my Contributions to Science, 1889, Vol. I, page 40. Little Cayman is about six miles long and about a mile in width, and on the south side near the west end is the only settlement on the island. This consists of about ten small houses, scattered along the shore for about a half mile.

Between the houses and the sea is a fine grove of cocoa-nut trees which extends along the shore to the eastward for about a mile and a half beyond the houses, terminating in a large mangrove swamp that stretches from the

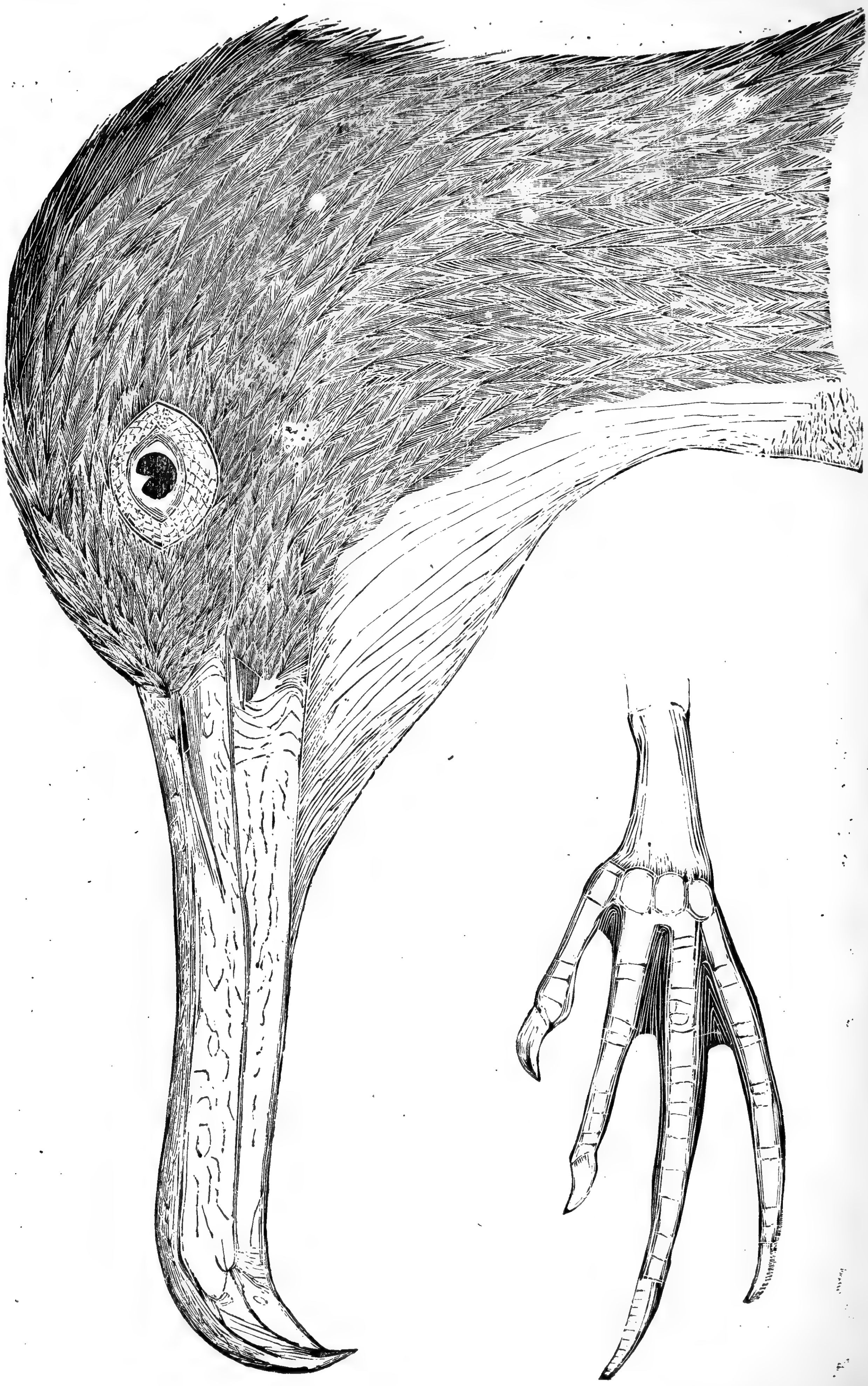
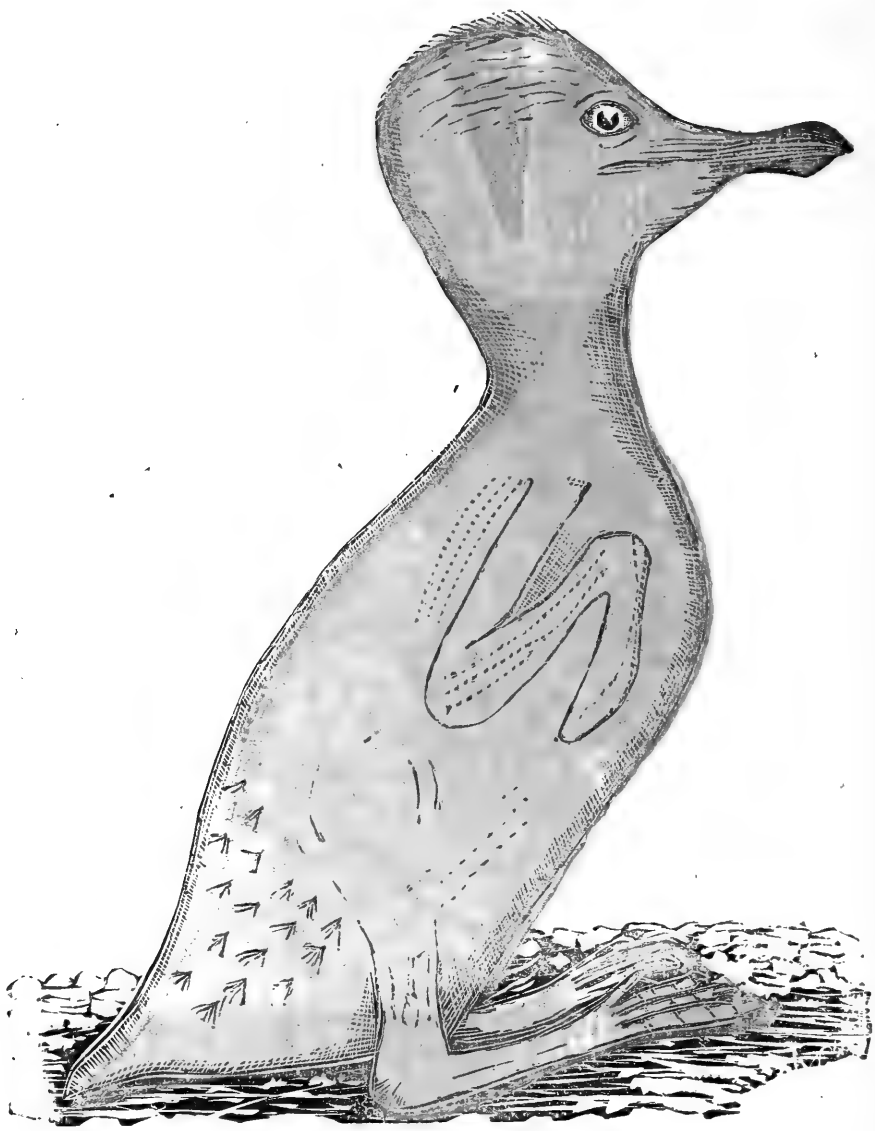


FIG. 114.



Young Common Gannet.

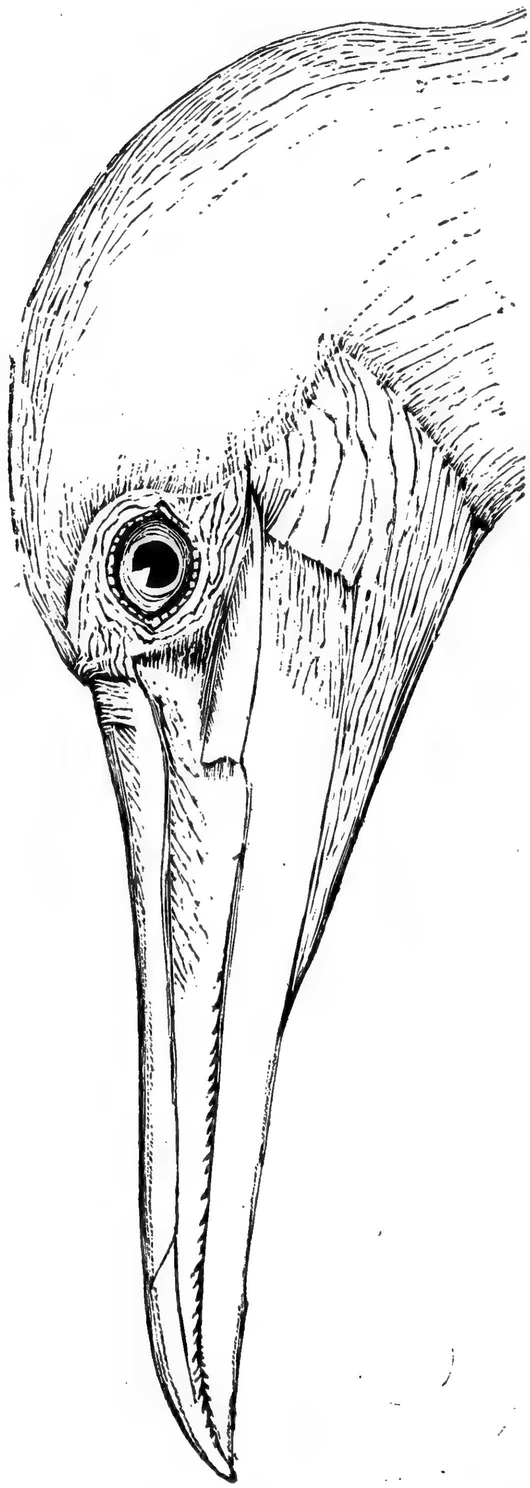
water some distance back into the interior. Bordering the cocoa-nut walk as it is called, is a growth of trees averaging some twenty feet high. They are mainly sea grapes which, although further north, in the Bahamas and among the Florida keys, is nothing but a trailing shrub, or at best, only reaches the height of some ten feet, here becomes quite a large tree, having long branches and a wide, flat top.

These trees, beginning about four hundreds yards east of the last house in the line, and extending to the mangrove swamp were occupied as a breeding ground by Cory's gannets. The nests were very numerous, five or six being placed in each tree. As this locality had been occupied as a nesting site for many years, a large number of the trees had been killed by the droppings of the birds, and on the long, naked branches were perched thousands of gannets, sitting side by side in a row; a motley array, comprising all stages of plumage, from the newly fledged, wholly dark brown young, to the creamy dress of the perfect adult. Almost every nest was tenanted by a young bird, usually well grown, clad in a beautiful garment of long, pure white down, from which protruded the dark brown wings and tail, while the air was filled with hundreds of birds departing and returning from fishing excursions, all giving utterance as they came and went, to harsh cries that were answered by those perching, consequently the place was constantly resonant with sound.

The most remarkable thing about this gannetry was its situation in such close proximity, not only to the houses, but to the cocoa-nut grove in which the inhabitants were constantly at work, for the birds could have retreated to the fastnesses of the mangrove swamp, where they could have been perfectly secure from intrusion. The people, however, rarely disturbed the birds, at most taking only a few eggs at the beginning of the nesting season for cooking. I was informed that the gannets had formerly occupied a small key, or islet, containing about three acres of land, that lay just opposite the gannetry as I found it, a few hundred yards from the shore; but this spot had been burned over some thirty years prior to my visit, when the birds all removed to the section where I found them. Since that time the birds had steadily increased in numbers and had considerably extended their breeding range. The presence of the gannets was regardrd favorably, as they not only killed the trees, thereby opening sections in which the cocca-nuts could be planted, but also greatly enriched the soil.

The nests were rude structures, not unlike those of herons, and in most cases contained a single young bird, never more, and rarely a single egg, and this egg, whether it contained an embryo or was spoiled, was jealously guarded by one of the parents, for both sexes sat on the eggs.

Fig. 114.



Head of adult Cory's Gannet.

FIG. 115.

Young Cory's Gannet.

This care of their offspring was extended to such an extreme degree that I found a gannet sitting on an abortive egg that was not more than one third the usual size. Eggs which had been spoiled did not seem to to be abandoned at all and probably were never left until they actually burst from the accumulation of gasses within.

This extreme care of the eggs may be partly due to the fact that there was but one, and partly to the fact that the embryo is greatly affected by exposure. I judge that this is the case from my observation upon the newly hatched young. They are perfectly naked when they emerge from the eggs and cannot endure a few degrees of change in temperature without perishing. I removed a young gannet, which was two days old, from the nest in order to make a drawing of it, at noon time when the thermometer must have stood at eighty-five degrees above zero, carried it in my collecting basket across the key to my house, a distance of about two miles, and when I arrived, the bird had nearly perished with the cold. I at once placed it in a door way in the sun, but in a draught of air, when it revived and sat up, but upon looking at it fifteen minutes later, I found it completely dead, it having been killed by the heat of the sun.

This almost abnormal sensitiveness to change of temperature has probably increased through the fostering care of generations of parents, while it is quite likely that the origin of the several species of small gannets with comparatively delicate proportions, that occur in the tropics, can be ascribed to this habit which must tend to cause physical degredation in these species.

This hypothesis becomes more plausible when we consider that this sensitiveness is not exhibited to any marked degree by the naked young of the stronger, larger northern gannet, for the young of this species, when only a few hours old, will live, as I have myself seen, when exposed for hours to a cold northern storm.

What better illustration could we have of the care that Nature exercises over her offsprings than this? Operating through her mysterious laws, she hastens to supply the debilitated gannet, hatched under the burning tropical sun, with a warm covering of down, while the more hardy gannet of the borial clime must endure the cold without being clothed in its most helpless stage of existence. In the north a survival of the fittest has produced a hardy, long enduring species, by simply withholding clothing at a critical period of the bird's life, thus allowing the weaklings to perish that the species may survive. In the south an opposite law has attained a similar result; species have been evolved and perpetuated by the weakening of offsprings and consequently of adults. This physical weakness has, in a great measure, incapacitated them for long flights. Thus when, by chance, one or more pairs have become blown to an island moderately remote from their original home, the lack of strength will govern their inclination, and they will remain where they chanced to alight, forming the nucleus of a new colony. Thus no one locality is overcrowded, and all can obtain a supply of food.

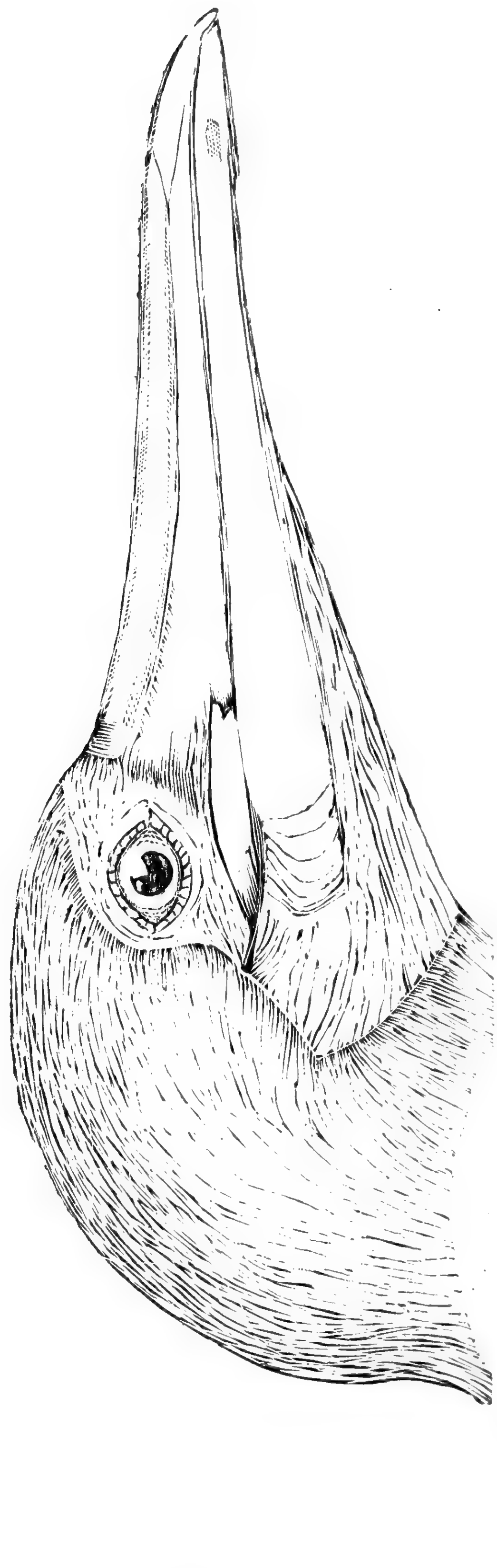
I have related with what extreme care the egg is guarded by the parents; their solicitude for its safety was so great as to overcome all fear of my approach. I could climb a tree on which a number of nests were placed, some of which contained birds that were incubating, without them taking flight; even when I was in arms length of them they would not move, but would sit perfectly quiet, regarding me with attention. When I stretched out my hand toward them they would not even attempt to escape, but would merely bow the head downward, nearly touching the breast. They uttered no sound at this time, neither did they evince any sign of hostility. I was so completely deceived by the amiable and dove-like behavior exhibited by the first bird that I encountered, that I unhesitatingly reached out my hand to feel beneath her in order to ascertain upon what she was sitting She maintained her state of composure until my fingers were within a foot of her, when without a moment's warning, she launched out her bill fiercely seizing my hand with a vice-like grip. Then she almost instantly jerked back her head without opening her bill, thus cutting my hand badly above and below, with the sharp, serrated edges of the mandibles.

I did not fail to profit by this hint, and ever after carried a short stick then when I wished to find out what a gannet had in its nest, would push the occupant off with this weapon, at which, however, the birds were too sensible to strike. When thus forced to vacate the nest, they would seldom fly, even when there was only an egg, and never, if there were newly hatched young. They would, in these latter named cases, simply retreat a few feet along the limb on which their domicile was placed, then would return as soon as I removed my stick and bending down, would touch their helpless offspring with the tip of their bill, repeating this several times in succession, at the same time looking at me with a most piteous expression in their brown eyes, entreating me with every motion, more eloquently than words could have done, not to injure the object of their tender care.

When the young are fully clothed with down, which occurs in ten days, they are not so persistently covered, but are still carefully guarded by their parents, in fact, when they are as large as the old birds it is usual to find either the male or the female sitting beside them, and at night both birds are there.

The young, in all stages of growth, are very fearless, and when I was ascending the trees, in order to examine the nests, I would often feel something tugging at my coat, and turning would see a young gannet holding on,

Fig. 115.



Head of young Cory's Gannet.

doing his best to impede my progress. Or one near which I was passing, would reach out and catching my hat by the brim would pull it off, then drop it on the ground.

When in the down, the young gannets are exceedingly playful, and a fine one that I carried to my house on the opposite side of the island, that was nearly, or quite, as large as the adults would play with small sticks by balancing them in his bill, and would then pile them nest fashion on the box in which he sat. Young birds in the gannetry would also often play with a noose that I always carried dangling from the end of a pole, in order to catch any bird that I wished to examine, whenever I put it within their reach.

The young of all sizes cling to the trees very tenaciously and the older nestlings climb well, aiding themselves with bill and feet, but the short, nearly rudimentary, wings are never used for this purpose, as they are evidently easily injured.

The newly hatched gannets are fed at first by true regurgitation, that is the fish eaten by the parents is converted into a peculiar glairy fluid which is given to the young. The old birds introduce the terminal portion of the bill into the mouths of their offspring and the liquid is literally poured down their throats. Later the fish is given to the young in half digested fragments and in the same manner, then the size of the pieces is gradually increased, until finally whole fish are disgorged for them. In all cases the fish are swallowed by the adults and so carried to the gannetry.

The young remain in the nests until two thirds grown, then leave them and perch on the branches near. Here they remain until wholly fledged, and evidently for some time after. In fact, they appear to fly with considerable reluctance, sitting on the branches long after they are capable of using their wings. I have often taken such birds in my hands and by tossing them gently into air, induced them to take wing, and in all cases, when once launched, they would fly readily, frequently keeping in air for some time. On several occasions, I have seen the adult gannets trying to compel their young to take wing, by flying against them in order to push them from the branch, the young remonstrating by struggling and screaming lustily, but the parent would invariably accomplish its object after a trial or two.

The cry of the young to the parents, when they desire food, is a kind of chatter, much like that emitted by young herons, under similar circumstances. When annoyed they will give a harsh squeak and at the same time will launch out the bill at the intruder. As in all birds, there is a large amount of individual variation in respect to disposition; some being very irritable, and these would even attempt to reach me with their bills when I was walking along the ground; others were good natured from the beginning Such would even permit me to stroke and pet them as they sat in the trees or on the nests. The one that I kept at my house and that I afterwards carried to Kingston in company with a young man-of-war, was very tame and soon learned to recognize me, evincing his enjoyment upon being petted by a tremulous motion of the head. Singularly, a young snake bird, that I got in Florida many years ago, and the adult white pelican, Johnnie, that I kept in the north for four years, had a similar habit.

The adult gannets give harsh cries when annoyed, and upon returning from a fishing excursion, just before alighting, they give a series of nearly continuous croaks. Both yovng and adults sleep by lying down upon whatever they may be perching, often with the head hanging directly downward, the neck stretched at full length. So singular is this attitude, that the first time I saw an adult in this position, I was so sure that it was dying, that I went to it and caught hold of the head, before it was aware of my presence; the result was a surprise for both of us, the gannet recovering with such marvelous celerity, as to astonish me, and it, in turn, retreated screaming, badly frightened at this uncerimonious awakening.

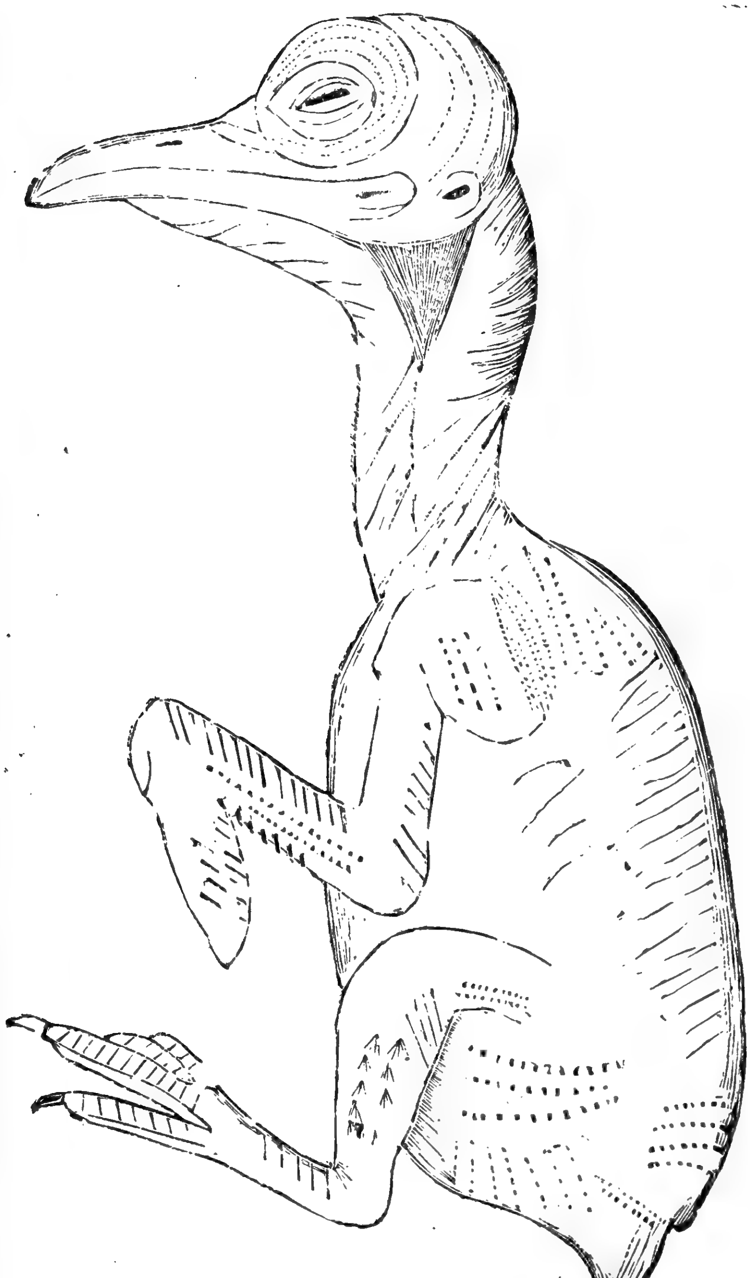
One hears the cries of the Cory's gannet very frequently, when they are annoyed by the man-of-wars which rob them most persistently as they come in from fishing. In returning from their fishing excursions, the gannets invariably come on to the land directly opposite the gannetry, often skirting around the key to do this. The man-of-wars are aware of this habit, and as they breed on the margin of the mangrove swamp, often placing their nests on the same trees with the gannets, they are always in waiting, scores cruising up and down in mid air, along the bay on which the gannetry was situated. The gannets return in small flocks, varying from three or four to twenty, and they are allowed to approach within a quarter of a mile of the shore, when the enemy sallies out to meet them. Sometimes only two man-of-wars will go, but oftener eight or ten will band together and make a rush at the gannets. The object of the aggressors is to separate a gannet from the flock, and this is usually accomplished. The poor bird is at once surrounded and harassed by loud cries and buffetings, two or three man-of wars frequently seizing it by the tail or wings. When thus surrounded, the persecuted gannet has only two alternatives, either to drop upon the water, where the man-of-wars at once leave it, or to disgorge its fish. The falling fish is either taken in the air, before it gets to the water, by one of the pursuers, or is picked up before it has time to sink. It sometimes happens that the gannet will only give up one of its fish, hoping to escape while its persecutors are after its prey and gain a point over the land, where it is seldom molested, especially if flying low, as the man-of-wars cannot pick up the fish from the ground. In case only one fish is dropped, the piratical birds perceive at once that they are being deprived of a part of their booty, and quickly continue the pursuit. They evidently demand all the gannet has to spare for its young, for a bird robbed of both fishes, at once turns and flies out to sea again for more.

I say it is rare for the man-of-wars to pursue a gannet over the land, but I saw one so pursued, on one occasion, and it was so hard pressed that it fell upon the ground. It is impossible for a gannet to gain wing from the ground, and they usually scramble along with the aid of wings and feet until they reach some bushes, into which they climb and from the top of which they launch out.

The instinct for avoiding all land, excepting the section occupied by the breeding ground and space immediately in front of it, between it and the water, is most peculiar, inasmuch as it submits the gannets to much persecution from the man-of-wars that might be avoided. Thus gannets returning from fishing on the north side of the island, flying as they often do, at the height of a thousand feet, must see the gannetry on the south side long before they reach the border of the land opposite it. In fact they probably do see it, for I have frequently observed them, especially at night when companies are returning to roost, come nearly over the shore in front of my house, which stood opposite the breeding ground, when one, evidently the leader of the party, would give a cry and dart away from the land, often flying a quarter of a mile to sea, instantly followed by the others. Then all would skirt the key around the west end, to the gannetry, and thus run the gantlet of the cordon of man-of-wars, when they could have crossed the mile of country between the shore and the gannetry, in a few moments, and not have been disturbed at all by their enemies. In passing to and from their fishing grounds, which are always in blue water, the gannets fly in long lines, or more rarely in wedges, something after the manner of our wild goose, but the lines are not maintained as perfectly as in that species.

Cory's gannets are very peacable birds, seldom quarreling among themselves; in fact, I never saw them even attempt to attack the man-of-wars that were breeding in the margin of the swamp, with their nests often on the same tree with those of the gannets. The young of both species appear to live on perfectly good terms, and two that I had, became quite attached to one another.

FIG. 116.



Young Man-of-war Bird

COMMENT AND CRITICISM.

The fifteenth and sixteenth meetings of the Maynard Chapter were particularly interesting, and a number of highly instructive papers were given. Among these was an account of the cone bearing trees by Miss A. S. Weeks. The species of pines, spruces, hemlocks, etc. were clearly defined and the differences between them noted.

Miss Genevieve Doran gave an excellent account of the pines, showing how the environment had produced different habits of growth, peculiar leaves, roots, etc.

Miss Margaret Haskell spoke of the winter berries, showing the different species and brought out the idea that, although many of these berries were, from their peculiar acid, or bitter quality, unfit for food of birds during the beginning of the fall, this condition was, in a great measure, changed by the action of frost and then the fruit was eagerly eaten by the birds.

Mr. Walter Gerritson showed specimens of the evergreen ferns and gave an interesting account of their habits. The speaker showed that the fruiting fronds became broken down early in the season and by thus lying prone on the ground, afforded better protection to the spoors.

Miss Helen M. Noyes gave one of her interesting talks upon mushrooms, the late fall species being described and their habits noted.

The faunal areas of Mexico was the title of an interesting communication by Mr. L. R. Reynolds. The changing fauna, with the elevation of the land from the coast into the interior, formed the substance of the paper.

A fox sparrow was shown that was brought in by Mr. Greenleaf. This bird had been found lying dead with three others, and a post mortem examination showed that it had been killed by striking some hard object, like a telegraph wire, the carotid artery having been ruptured.

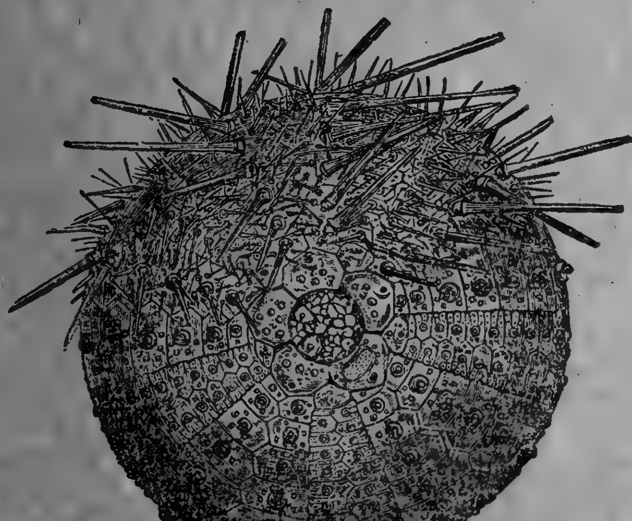
A bittern was mentioned by Mr. Maynard that had also been killed by a wire. Mr Quincy Pond remarked that in some parts of England the mortality was so great among tde grouse from flying against the wires, that the telegraph companies had been obliged to suspend wooden blocks from the wires at intervals in order that the birds might see the wires and avoid them.

Arrow-head Warbler.

NATURE STUDY

IN SCHOOLS

Vol. I DEC.-JAN. No. 11-12



West Newton Mass.

C. J. Maynard

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NATURE STUDY IN SCHOOLS.

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NATURE STUDY.

VOLUME I. DEC.-JAN., 1899. NUMBERS 11-12

ANNOUNCEMENT.

I greatly regret to have to state that with the issue of this double number (concluding Vol. I) the publication of Nature Study in Schools will be suspended at least for a season. What time I can spare from my work with the teachers and in the schools, I feel should be given to original investigation in science. This work has been much interrupted on account of the personal attention I have been obliged to give to the publication of this magazine.

The regret which I feel upon abandoning the publication of the magazine is greatly heightened by the rememberances of the many kind words of approval which I have received so often from subscribers and others interested. In conclusion I tender my thanks to all who have lent a helping hand during the past year to the support of the magazine. With kind wishes to all who may read these lines, I remain

RESPECTFULLY YOURS,
C. J. MAYNARD.

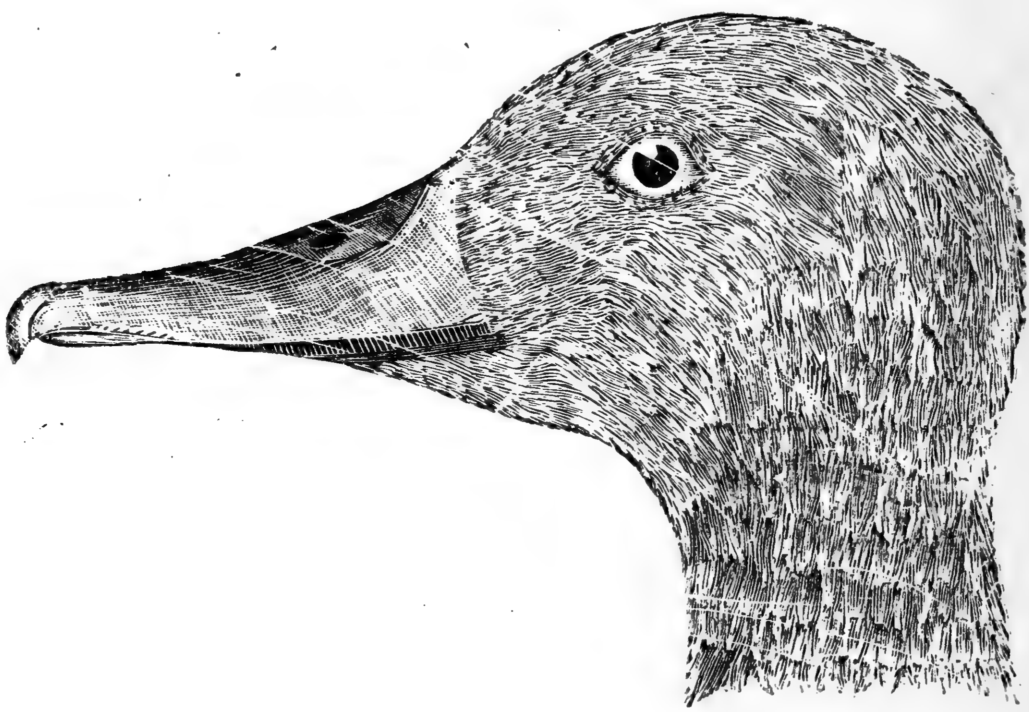
HOW YOUNG BIRDS BREAK THE EGG SHELL.

BY

C. J. MAYNARD.

Although almost every one who reads these lines is familiar with young chickens and the young of other species of birds, few know just how these little birds get out of the egg. Of course we all know that the egg is broken open in some way, but just the method by which this is accomplished, is not clear to many.

FIG. 117.

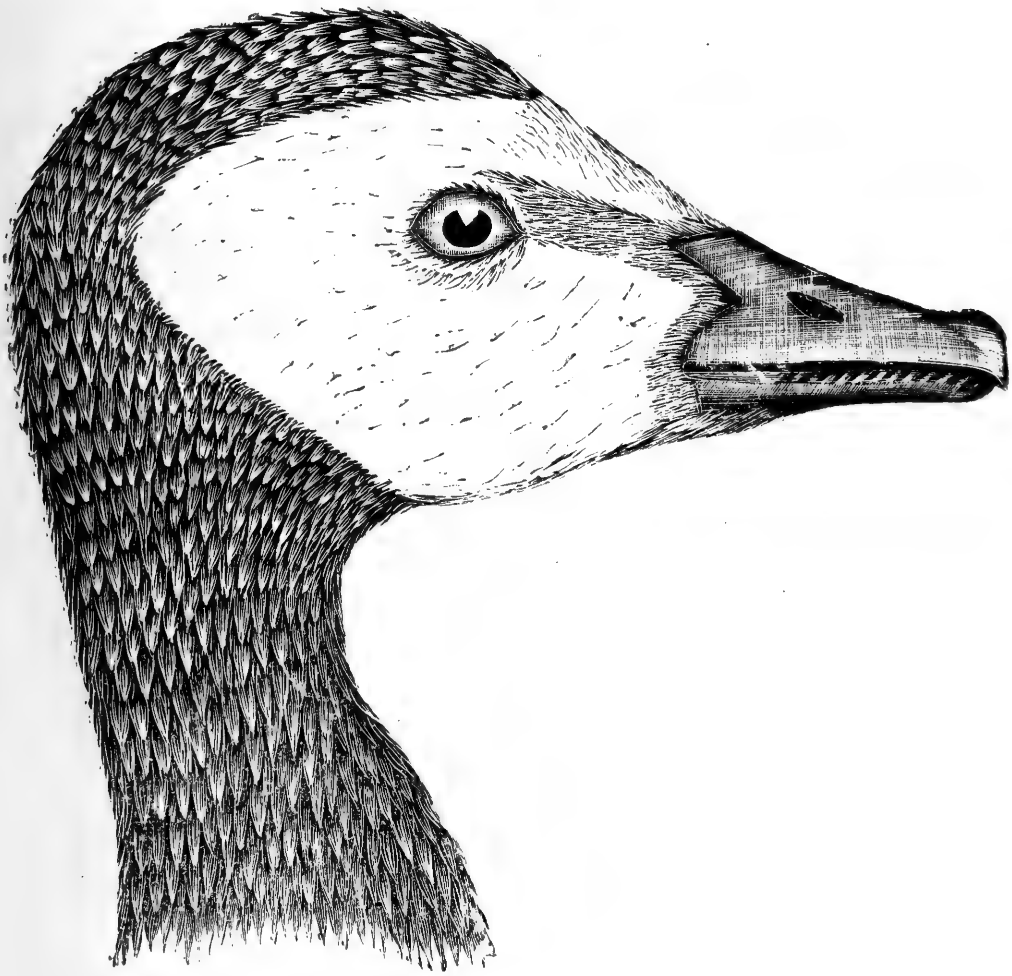


Head of Tree Duck.

Looking back into the early geological times, we find sufficient evidence to lead us to believe that the first birds were derived from the reptiles, and that one way in which they show their reptilian affinity is by the possession of true teeth. These teeth, however, were lost quite early in the process of evolution of birds and now no known birds have true teeth. So obvious is this fact that we often hear the expression, "As rare as hens' teeth". To be sure ducks and geese have peculiar serrations on the edges of both mandibles, (see fig. 117 and 118) but these are not true teeth, simply horny projections from the bill.

Returning to young birds we find that they have, at least, two ways of breaking the shell, these methods varying with the species. If we examine

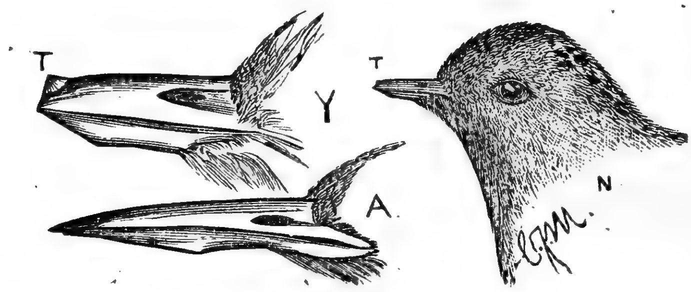
FIG. 118.



Head of Barnacle Goose.

a newly-hatched chicken or the newly-hatched young of almost all land birds, we shall find on the tip of the upper mandible of the bill a little pointed tooth developed which is very hard, being, in fact, apparently composed of limy material. It is with this tooth that the young chick breaks the shell by pressing and rasping against the egg shell. See fig. 119 where I give a figure of the head of the least tern, life size, and T is the egg tooth, as it is called. At Y is given an enlarged beak of the same specimen, where the tooth can be more plainly seen.

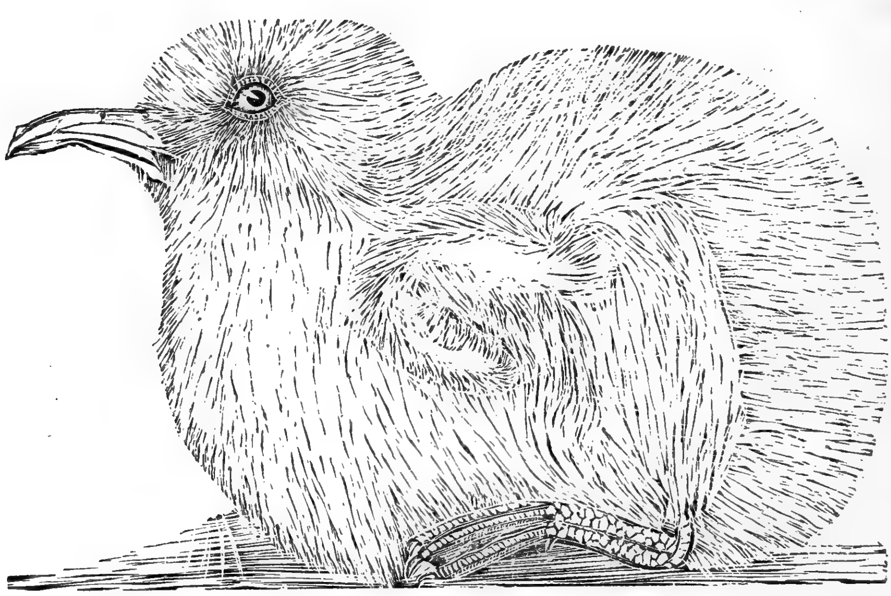
FIG. 119.



N. Head of Tern; A, bill of adult; Y, bill of young, enlarged; T, egg tooth.

The bill of the little tern, when it is in the egg, is proportionately shorter, blunter and stouter than in the adult, partly that it may not be in

FIG. 120.



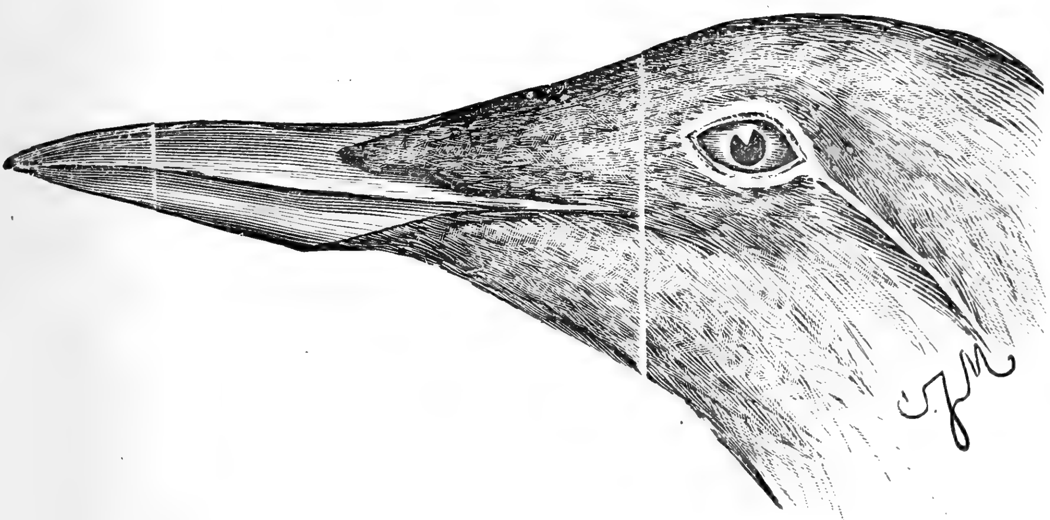
Young of Audubon's Sheerwater.

the way, and partly that it may be stronger and better fitted to break the shell.

In the young chicken, as can be seen by examination, the egg tooth drops off after a few days, but in some birds it wears off. This is true of the young of Audubon's sheerwater, a bird allied to the petrels which live in tropics, spending most of its time at sea. The nests of this species are usually made under rocks in the Bermudas and Bahamas. At fig. 120 I give a cut of a newly hatched young.

In certain species of birds which have long bills, the egg tooth is more developed. An example of a species of this kind may be seen in Wilson's plover, a bird which inhabits our southern coast in summer. The diameter of the egg of this species is about one inch and this is also about the length of the head and bill taken together. The tip of the bill is hard, and judging from the position in which the young bird lies in the egg, this tip comes in contact with the shell, and by moving it slightly, bits of the shell are

FIG. 121.



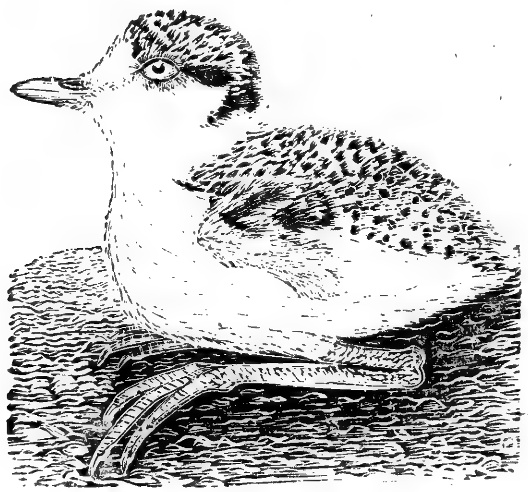
Head of Ringed Murre.

forced outward. In all cases the breaking of the egg shell is rendered more easy by the fact that, as the period of hatching draws nigh, the shell becomes more and more brittle through losing its moisture. At fig. 122 I have given a life-sized cut of Wilson's plover when two hours old, and at fig. 123, the head of the adult male, also life size. As will be seen upon comparison, there is really very little difference between the two heads.

It is probable that the young kingfisher also breaks the shell much as does the plover. At fig. 124 may be seen a cut of a young kingfisher which was removed from the egg just before hatching, and as will be seen there is no indication of an egg tooth.

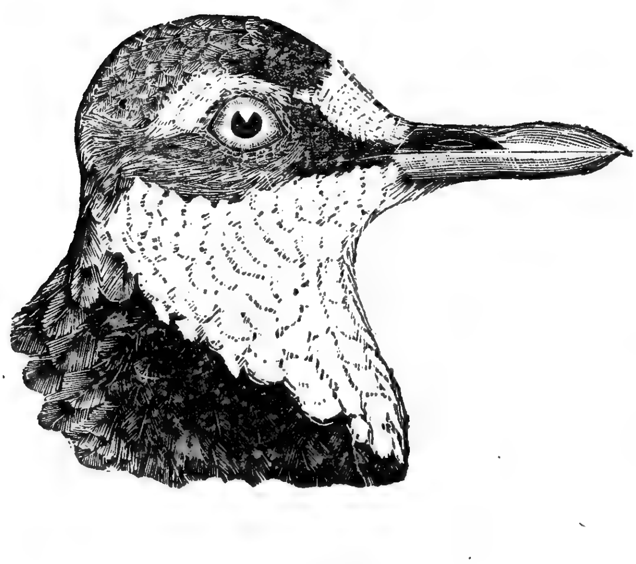
It will be interesting to ascertain just how the young of such birds as the murre, a species of water bird which deposits its eggs in rocky cliffs on our northern sea borders, manage to break the exceedingly hard egg shell in which they are enclosed. On page 249 I give the cut of the head of an adult of the ringed murre, and as will be seen, the bill is quite long in this species.

FIG. 122.



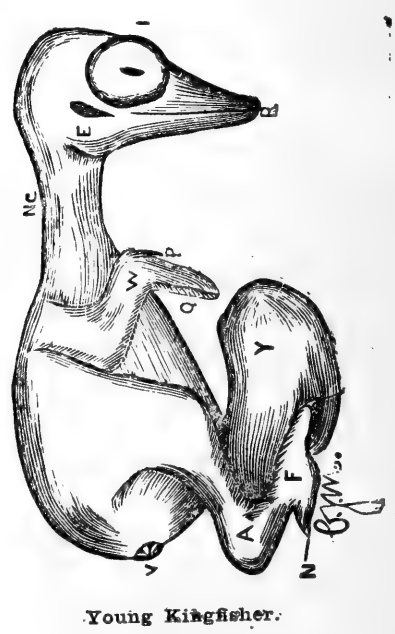
Young of Wilson's Plover.

FIG. 123.



Adult Wilson's Plover.

FIG. 124



Young Kingfisher.

THE NATIONAL FLOWER MOVEMENT.

BY

GENEVIEVE DORAN.

During the second century of our national independence, there has been developed throughout the United States a popular movement to bring about the adoption of a national flower. This is a matter of pure sentiment and a question of taste, but it has led to the formation of national societies, and to the calling of a national convention.

The desire for a national flower — now so widely felt among the best people of our country — springs mainly from two sentiments, which are the love of our native flowers, and the love of our native land. For us, a fitting national flower would bring to the service of patriotism an emblem whereby our love for the fatherland would find expression through the fairest of earthly things. If our people ever come to enjoy the benefits of such an emblem, surely every true American must rejoice.

The first society formed for this purpose was, "The National Floral emblem Society of America," which was organized at the time of the World's Fair. Its object was to obtain a genuine expression of the will of the people which shall lead to the adoption of a national floral emblem and a selection of state flowers; as far as these have not already been chosen.

An entirely independent orginization, although in friendly relations with the Floral Emblem Society, is the "Columbine Association," which to-day holds a leading place in the national flower movement. Its single aim is to bring about the final adoption of the columbine as a national flower of the United States.

The desire to have the coulumbine as our national flower may be said to have had its origin at the Columbian Exposition and in many ways is worthy of consideration. It is graceful in poise, under no circumstances becomes a noxious weed, and wears an air of prosperity as it swings its tiny bells from the crevices of bare rocks. It also wears our national colors — red, white, and blue, — and grows in every section of our country.

The time of flowering for the whole country extends through the spring and early summer, making it available on our national holiday, the Fourth of July. They are at their very best on Memorial Day, when we have the most need of a national flower. From the point of view of decorative design, the columbine possesses great advantages from the fact that its national associations are expressed not only in the name, but in the form and colors assumed by the various parts.

The different societies were much helped in their efforts to reach these who did not clearly understand just what sort of a plant is desirable for a national flower, at the National Flower Convention held at Ashville, North Carolina, in 1896. This convention, called to recommend a national flower for adoption by Congress, was composed of delegates from various states of the union, chosen by their respective governors at the request of Governor Carr of North Carolina. The main result of this convention was an agreement as to the qualifications which should decide the fitness of a flower to be our national emblem. Although they thought it not suitable to decide or recommend any special flower at that time, it was evidently the sense of the majority of the delegates present, as shown by an informal vote, that the columbine is the only flower which meets the requirements set forth, in the qualifications decided upon. It was announced in a recent Ashville paper that arrangements are being made for a second national flower congress, to be called by President McKinley at Washington, D. C.

The maize or Indian corn is thought by some to be a fit national flower for our country. The highest authorities on geographical distribution of plants have agreed that the maize is a tropical grass, which, so far as known, has never grown wild within the limits of the United States. Can a plant be a national flower which is not native to our country and has not in many senses of the word a flower at all?

The first of all flowers to be suggested as our national emblem was the trailing arbutus, in 1887. The best recommendations for the adoption of it, are that it was one of the first blossoms seen by the Pilgrims at Plymouth, and by Washington's army after their winter at Valley Forge. But the reason why we should not want it, is that Nova Scotia has adopted it.

The golden-rod was next mentioned in 1888. For a time it was popular as it grows wild in such profusion everywhere and is such a bright adornment of the roadside. A change soon came; for when it was wanted for use, it was not in season, and was found to be unhealthful if used for decorating indoors. It is also considered impossible for such a purpose from the fact that it is a weed detested by farmers, and harmful to cattle and human beings.

The violet, pansy, pond-lily, larkspur, the native aster, sunflower and several trees and shrubs, such as the sugar maple, elm, mountain laurel and magnolia are thought by some to be appropriate.

If ever an opportunity occurs for any of you to help in this movement, I hope you will assist the Columbine Association in having that flower become the national emblem. The objections to it are of less weight than those against the ones now prominently mentioned. It is surely the opinion of the majority of the people in the Union that the columbine is the only flower which can possibly meet the conditions essential for Columbia's floral emblem.

DISSIMULATION OF FRUITS AND SEEDS

BY

STANLEY W. SCOTT.

(Read before the Maynard Chapter of the Newton Natural History Society, Dec. 1, 1899.)

It is said that the ultimate object of every plant is its own perpetuation. If this be so, then the dispersion of the seed is an important operation. This is not accomplished by any one means, but through various agencies and in a multitude of ways the seeds are scattered

One agency is the wind, which wafts seeds that are provided with wings to their destination. Another is water in which they are floated to a congenial spot. Another is by application of local force, by elasticity by means of which a seed is forcibly ejected. Another is agitation, as the wind shaking them out, or a person hitting the stem and jarring them out. The last means is that by which various animals and persons carry the seeds about.

In the case of the mahogany tree both wind and expulsion are used to disperse the seeds. Each seed is winged, and when the capsule explodes, the seeds float off on the breeze till they find a resting place. The capsules explode with such violence as to break entirely up, and it is difficult to find a perfect one.

The balsams, which, a few years ago, were such great garden favorites in country districts, were very sensitive and would throw out the seeds if touched. From this habit they got the name of touch-me-not.

A remarkable instance of violent dehiscence is to be seen in one of the cucumber family named, from its habits, the squirting cucumber. It has a small oval fruit about one and a half inches long and is covered with spines. When ripe, it detatches itself from the plant and jerks out its juice in which the seeds are mixed, through a little hole in the base. It was formerly used as a medicine, but since given up is rarely cultivated.

To descend a little lower in plant life, let me speak of the bird's nest fungus. We have noticed that the grass around a spot in which a number of cups of bird's nest fungus were growing sprinkled to the height of six or eight inches with the ejected sporangie. Passing to the dispersion by the wind we find that the members of the composite family have a coronet of pappus placed on top of each seed. This is composed of little hairs that are as light and feathery as possible. This is solely to aid in the dispersion of the seed.

In the goatsbeard this coronet is placed on top of a long beak to contract the weight of the seed.

The coronet of the dandelion is placed on a pedicile and is much used as a clock by small children.

The down of the thistle is sessil and is at times plumed like a feather. The coronet of the Carolina thistle is remarkable for its elegance and spread of plumage. The down of the milkweed is long and silky and is also sessil.

In direct opposition to these, the coronet of the blue bottle seed is of stiff, hairy bristles indented with hooks. This does not aid the plant in its flying excursions, but directs and hastens its descent to the ground.

In the Canada thistle the whole plant breaks off on a level with the ground, and drifts across the prairie till it piles up in drifts against the fences. The coronet of hairs is not the only means. Often the side wall of the ovary expands and form wings which reach their highest development in the trumpet flower, where they are three or four inches long, on which the seed floats about like a butterfly.

Many spiny fruits are found in the vegetable world, and it is evident that these rigid spines aid much in their distribution. The name caltrops has been applied to many of these. One of these, the Tribulus terristris is widely distributed on account of the way it clings to the wool of animals. It has an elegant star like form with very rigid spines.

We are familiar with the way in which the burs of the burdock, another member of this family, cling to our clothing. Others of this family are beggars ticks cleavers, and grapnel plant. One lately found in South America is said, by Frank Buckland, to have been purposely created to stick in the tails of horses and buffaloes. The horns of this species are about seven inches long. It is easy to see how members of this family are transported, but I think it would be harder to see how they are able to stay at rest.

To take a paragraph from Sharpeyes, speaking of this family it says, "There are those queer grown, flat jointed affairs, for instance, that stick closer than a brother, either in pieces or in strings and broken chains in all sorts of devices. What was their history, how have they fallen from grace? There is a whole troop of them which are populaly supposed to belong to the same chain gang, but there are at least a half a dozen species among them and a little study will enable us to distinguish them. I will not attempt to, as they are all sinners and mostly black sheep from promising and comely ancestors."

Another single instance is that of the Egyptian bean where about 20 seeds grow in a receptacle. After a time this breaks loose and floats down the river. The beans begin to germinate within the receptacle, but after a time drop out and root in the mud.

One of the tropical fruit cells which is very interesting is the monkey pot. This is large and urn shaped and has a round cover. The monkeys are very greedy after the saparcaia nuts that are found in them. When the fruit is ripe, the cover loosens and the nuts drop out, then it becomes a hard, woody shell. This is filled with sugar and placed where the monkeys frequent. The monkeys pick out the sugar leisurely well enough, but when frightened they stick their fist in and grasp a handful and start to run, but they cannot get their hand out and so are run down.

The squirrel plants many oaks as does the bluejay, who hide the acorns under the leaves and in holes.

The nuthatches pull off the beech twigs and try to poke them in the holes of trees and in so doing knock off the nuts that grow in the spring. It is said that the migration of tribes can be followed by the plants that are found; for instance, the kochia of the Asiatic steppes has been found in Bohemia and Carmola and the sea kale in Hungary and Moraria. The North American Indian calls the plantain the foot print of the white, and a common species of vetch marks, a former abode of Norwegian settlers in Greenland. One of the most striking instances of this is the extension of the thorn apple over the whole of Europe. This plant has followed the Gypsies from Asia. The Gypsies make frequent use of this poisonous plant in their unlawful proceedings, and it is much cultivated by them. It also occurs uncalled for near the place of their encampment.

There are many species of the water chestnut. One of these, much cultivated in China, resembles the head and horns of a buffalo. Another that is cultivated in Cashmere has the horns replaced by sharp spines. This is cultivated so much as to become a large part of the food of the people. Lake Oller is said to produce 128,000 mule loads of nuts every year.

There is still another that has four spines at right angles to each other. It is curious to notice the way in which some seeds are held. One instance is found in a sedge where the stamens lengthen out and form a net which holds the nut containing the seeds for some time after it has detatched itself from the plant. The same happens in the mangrove.

When walking in the pine woods in March on a warm day, if you happen near a pine tree you will hear a curious chuckling noise, always accompanied by a fall of buff colored seeds. The cones of the pitch pine are firmly cemented together in the fall, but in the spring the heat dries up the gum and the scales spring open and let the seeds drop. If the cones are brought into the house and exposed to artificial heat, they will open with a great snap and often jump quite a distance. It is very amusing to watch a squirrel open a cone to get the seeds. He knows that if he started at the top or side he would have to gnaw through about one-half inch of wood almost as hard as flint. But the sagacious animal turns the cone over and easily eats the scales where they are thin and join the branch. Here he easily pulls off the scales and eats the seeds.

SOME MAINE BIRDS.

BY

MILDRED A. ROBINSON.

(Read before the Maynard Chapter of the Newton Natural History Society, Dec. 29, 1899.)

It seems very probable that one of the reasons which tempt the migrating birds to pass through our own region into the woods of Maine, is the abundant supply of food with which the Maine woods are provided. Even if this were not so, who could blame the birds for deserting the very limited woods bordering the city, for the wild tree forests along the coast of Maine, where even the English sparrows are undreaded and where few people ever disturb their peace?

Early on the morning after our arrival, I lay listening to the many songs with which the neighboring woods were echoing. From the distance came the notes of the wood thrush; a woodpewee was plaintively calling to his tiny gray mate; a goldfinch and a redstart were running opposition lines from across the orchard, and from the meadow beyond, came the happy, rollicking song of the bobolink.

We were sure that a Maryland yellow-throat had his nest in the low alders not far away. Hardly a day passed that the male, and often the female, were not seen in that vicinity, and at all hours their jerkey fitful notes of "witch-er-ty, witch-er-ty, witch-er-ty, witch," could be heard. But though we floundered about, up to our waists in the tangled underbrush, the nest was never discovered.

On one occasion, as we were following the winding course of a trout brook which led us several miles into the densest part of the forest, we were fortunate enough to see the black-throated blue warbler. This bird is easily distinguished by the small white patch on either wing.

The same day we saw a flock of red crossbills, a chestnut-sided warbler, black and white creeping warbler, black-billed cuckoo and the vesper sparrow. Once while driving slowly along a country road, a male and female pine grosbeak were accomodating enough to fly into the road directly in front of us and to remain there until we had had ample time to identify them.

The cedar waxwings and purple finches were seen quite frequently on our walks. The myrtle and the chestnut-sided warblers, the golden-crowned kinglet, and the kingfisher were also seen.

And still the crowning feature of the summer had not yet been observed. Ever since our arrival, we had listened in vain for the song of the hermit thrush. Often in the evening as we came home from a walk in the woods, the song of the wood and of the Wilson's thrushes would ring out o'er the now quiet woodlands, but not once did that much described song of the hermit reach our longing ears.

The evening before we came away, a friend offered to take us into a place in the woods where she had once heard the hermit sing. Full of expectations, we started off at about dusk and by the time we reached the chosen place, the woods were very quiet. We waited until the stars came out and when at last were about to give it up in despair, suddenly a clear, melodious song broke the stillness, and we paused in silent admiration. How that song echoed and reechoed through the fast gathering daikness. Was there ever another song which compared with it? And then suddenly it ceased and we realized where we were. That was the heimit's vesper song, and now he was going to rest, but long afterwards I could hear that ringing note as it resounded through the sleeping forest. On the next day we left for home, perfectly satisfied with our visit.

SYSTEMATIC ZOOLOGY FOR TEACHERS.

BY

C. J. MAYNARD.

(SPONGES, CONTINUED)

At the termination of the excurrent tube in a number of species of sponge may be found a membrane, which in life extends partly (or in rare cases wholly) across the opening. This is a continuation of the lining membrane, and an example of it may be seen in fig. 111, above o, and also in a top view of the same sponge in fig. 125. It will be seen that the hole in the membrnae on the left is larger than that on the right. Age in the sponge appears to have very little to do with the absence or presence of this membrane. It is very little developed in the old sponge figured on page 180. Yet in the young specimen given on page 228, fig. 112, it extended wholly across the top, but this may have been due to the fact that this individual had a hole broken at the base as shown in the figure at b. On the other hand, a young sponge (see fig. 126) does not have any extention of the membrane at all. Without being able to speak definitely as to the function of this membrane, I am inclined to think that it is for the purpose of retaining the ova within the tube for a certain period.

Silicious Sponges.

In this group we find sponges in which the horny fiber is partly or wholly replaced by spicules of silica, but as has been already stated, the horny and spiculigenous so completely intergrade that it is impossible to

Fig. 125.

Top of Tube Sponge.

draw a hard and fast line between the two groups. The spicules of sponges are of various forms, but one of the most common is needle shaped. (See fig. 127, B.) The green encrusting sponge, figured on plate VIII, has spherical spicules which are provided with points. These spicules remind one strongly of the pollen grain of some plants.

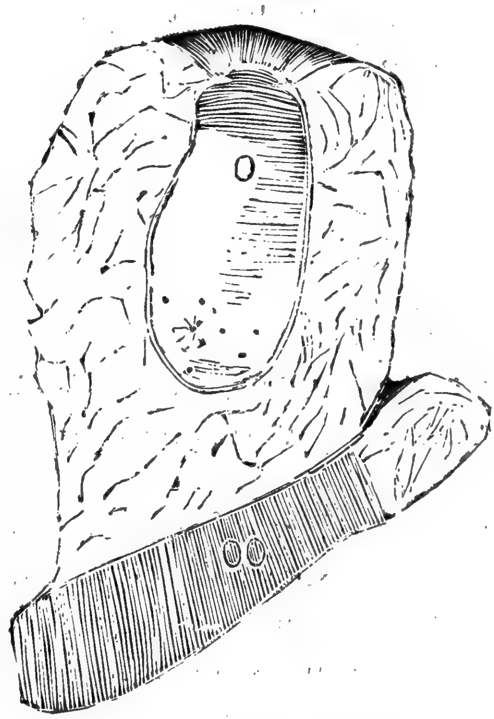
Fresh Water Sponges.

These are often green in color and cling to bridge piers, submerged sticks, weeds etc. Some species attain a large size, often growing a foot or more in diameter. These are flat in form, but as a rule the green branching species appear to produce ova in the fall and then the sponge dies, leaving the eggs enclosed among the spicules. These ova are large enough to be seen with the unaided eye. Fresh water sponges may be found common in sluggishly flowing streams and in ponds and ditches.

General Conclusions.

We find that a sponge is an animal with several sets of similar organisms, which are probably controlled by nervous force and which act in harmonious concert in certain emergencies, just as the organisms of higher animals act under like circumstances. Although reproduction is sometimes accomplished by buds, the young are mainly derived from fertilized ova; consequently the sponge is a metazoan.

Fig. 126.



Young Tube Sponge.

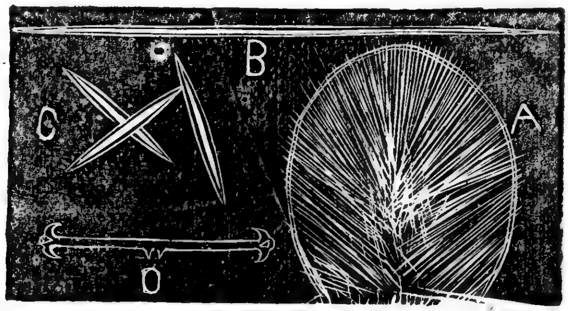
Points of Advancement.

In sponges we find a number of points of advancement over the single celled animals. The first, and perhaps the most note worthy fact is, that there are a number of cells combined together to constitute one individual. The cells so congregated have become differentiated to perform different functions. Among these functions are primarally the reproductive organs, male and female, all set apart for the propagation of the race.

Second, the digestive and circulatory system which is adapted to meet the wants of the individual.

Third, the nervous system, which not only guides the other organisms in their labors, but is of a sufficiently high order to cause the various cellular tissues to band together to repair damages which are detrimental to the individual.

FIG. 127.



Spiculigenous Sponges.

PROVINCE COELENTREATA.

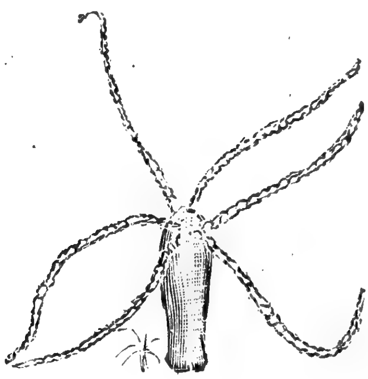
HYDRAS, HYDROIDS, SEA ANEMONIES, CORALS, ETC.

In the type of this class of animals we find that the cells have become even more differentiated than in the sponges, producing true tissues and not simply a kind of rudimentary flesh. There is a body which contains a fixed mouth that opens into a sac, suspended within the cavity of the body, the stomach. The mouth serves for the purpose of taking the food, while the undigested portions are thrown out of it. See fig. 128 with explanation of parts beneath the cut. Between the stomach sac and the walls of the body are often chambers which serve as digestive, circulatory and reproductive cavities. See fig. 128. The mouth is surrounded by tentacles, the function of which is to gather food, serve as respriatory organs, and in some cases as organs of locomotion.

ORDER I. HYDRAS OR FRESH WATER POLYPS.

All small animals, but sufficiently large to be seen by the unaided eye. They possess a cylindrical body, surrounded by from six to eight tentacles, within the center of which is the mouth. This opens into the stomach through a short gullet. (See fig. 128) The tentacles are provided with roughened, bead-like projections which are arranged spirally. From these are thrown out threads that are provided with darts by which animals are paralized, then grasped by the tentacles and transferred to the stomach. These darts are easily seen under the microscope.

FIG. 128.



Hydra, enlarged. A, life size.

Respiration is doubtless accomplished in the hydra by the absorption of oxygen through all parts of the body wall.

Digestion also by the absorption of the nutricious portion of the food engulfed in the stomach.

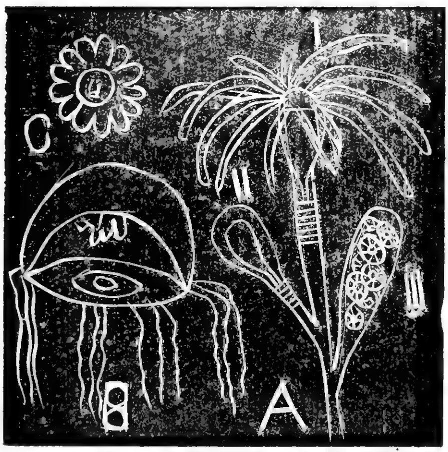
Propagation is accomplished by two methods; first, sexually by budding, that is through the accumulation of cells at a certain point on the body wall, a protuberance grows out that ultimately produces a small hydra. When fully developed, this drops off and leads an independent existence.

Second, eggs are produced within the body wall which become fertilized either by spermetazoa, which are developed by the same individual, or which reach the ova from some other hydra. The eggs, when in proper condition, either burst out through the outer wall or through the inner into the stomach cavity. They undergo segmentation and pass into the gastrula stage much as in the sponge. They swim about freely for a time, but finally settle down and produce hydras.

Locomotion is accomplished in the hydra either by the animal sliding along its base or foot, or by the animal grasping objects with its tentacles and drawing itself along. A rare method is by bending over, grasping some object, which is on a level with its foot, with its tentacles. The body is then straightened, when the hydra stands, mouth down, on its head. The body is then bent down in the opposite direction, the foot takes hold and the animal rights itself, having turned a complete summersault.

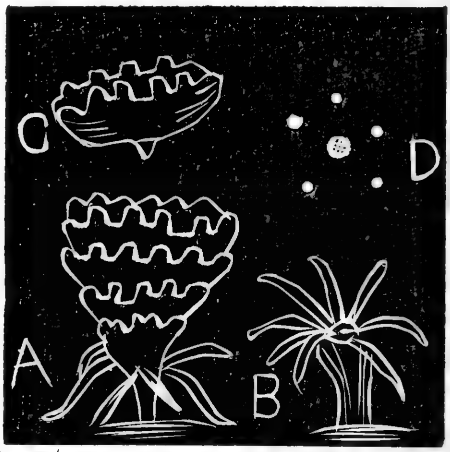
Hydras are, under some circumstances, very tenacious of life, and although it is probable they seldom, or never, propagate by spontaneous division, they may be cut into several pieces, each of which will produce a perfect hydra. Many interesting experiments have been made upon them; one of the most

FIG. 129.



Alternation of generation in bell polyp.

FIG. 130.



Alternation of generation in Millipore.

noteworthy of which is the inverting of the body by thrusting a wire into the mouth. When thus turned, literally wrong side out, the hydra so treated lived in that way and digested its food with what once its outer wall. The hydra can withdraw its tentacles into the body.

Hydras occur in abundance in many ditches, pools and river coves, but rarely in swiftly flowing water. I have found three species in this vicinity, of which two, a pale brown species, and a smaller green species, are the most common. They occur clinging to submerged sticks and water plants from May until the ice closes over the water in late autumn or early winter.

ORDER II. HYDROID POLYPS.

Differ from the fresh water hydra in living in salt water and, in most species, in living in colonies which form branching moss-like clussers attached to a common stem. Although each individual is small, the whole colony form prominent objects when found growing from bridge piles, or from sea weeds, rocks, etc.

Hydroid polyps also differ from hydras in other ways. The tentacles cannot be withdrawn or enfolded within the body cavity, but simply shortened.

The process of propagation is also much more complicated than in the hydra. If we examine some species of branching hydroids, for example, a bell polyp, we shall find that there are buds which appear not from the body of some hydroids, but from the stem. This bud will unfold and, in process of time, produce a bell which is formed like the parent stock. (See fig. 129, A, 1.) A further examination of the clusters will reveal other buds which

FIG. 131.

Portugese Man-of-war.

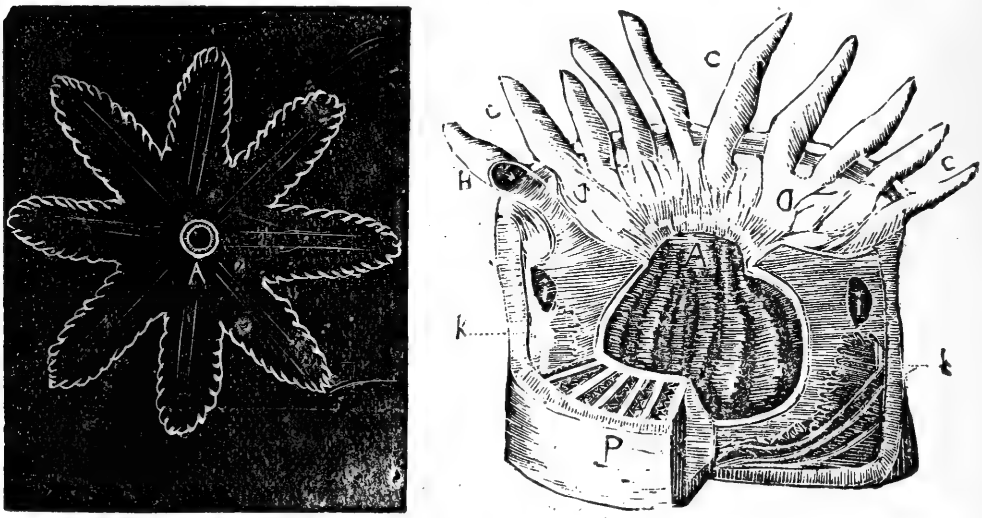
are longer and larger than the polyp buds. They are also more opaque, but are still translucent enough for us to see that these buds contain little disks. (See fig. 129A III) These buds, or cases, for such they are, rupture and liberate the disks which are now seen to be provided with little projections on the edges. (See fig. 129, C.) They move with these projections and in time produce a small jelly fish, similar to that seen at fig. 129, B.

These jelly fish produce eggs which, undergoing segmentntion and gasticulation, settle down and produce a polyp like the original bell which, by budding, grows up into a branching colony.

This wonderful process of multiplication is called alternation of generation and occurs in quite a number of animals.

Another class of hydroid polyps which live in the tropics secrete a stony base. This stony base, once considered a coral, (see fig. 135 C) if examined with care, will be found to be filled with small holes systematically arranged. That is, there will be found one large hole with five small ones around it. See fig. 130. From the small holes grow polyps which, being provided with

FIG. 133.



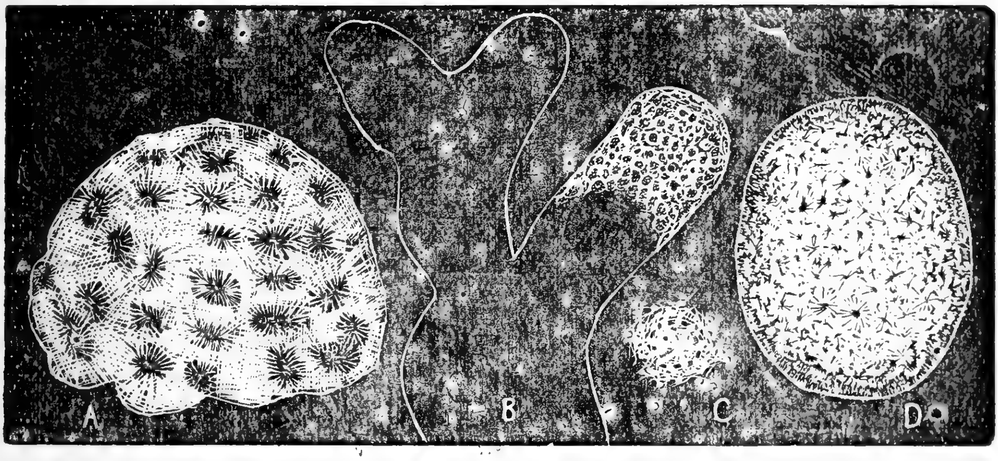
A B

A. Eight-armed. fringed Polyp of a Gorgonia, Plexaura. B. Dissection of an Actinia essentially similar to a coral polop; c. c, c. arms or tentacles; A, mouth, below which is the cavity, of the stomrch; D, body. B. opened tentacle, the arrow showing direction of water into the inter-spaces, k, k, the water flowing from one to the other, through the openings, i, i.

darts, procure food for themselves and the central polyp, which is the reproductive polyp. This, at certain times, droops its tentacles, and from what was the mouth emerges a saucer-like disk. Beneath this grows another disk, followed by others until quite a pile has been produced. Then the top disk, being now provided with projections, similar to those which we found in the young of the bell polyps, drops off and swims away to produce a jelly fish. This jelly fish produces eggs that, undergoing the usual transformation, become polyps like the original millepore polyp. All the other disks drop off in turn and when the last is gone the polyp brings its tentacles up and assumes its life as before. See fig. 129, A being the polyp, B the saucer-like disk. This is also alternation of generation.

The millepores are very common in the tropical waters and frequently encrusts gorgonias, sponges and corals. They are called stinging corals from the power which they possess of stinging the hand when incautiously handled.

Fig. 134.

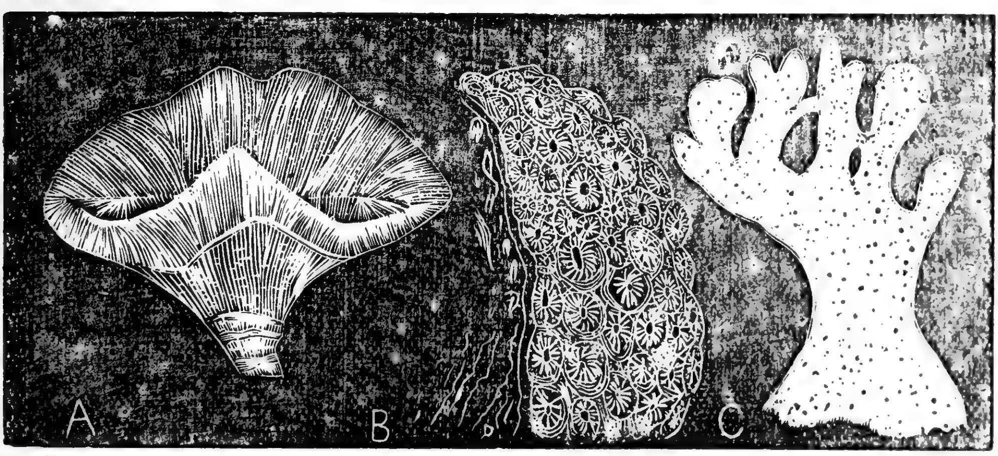


A, Globe, B, Forking, C, Polyp Cells enlarged, D, Rolling Coral.

ORDER III. COMPOUND JELLY FISH. Siphonophora.

Members of this group are free swimming jelly fishes, often with many similar organisms and in this respect somewhat resemble the hydroids. Here

Fig. 135.



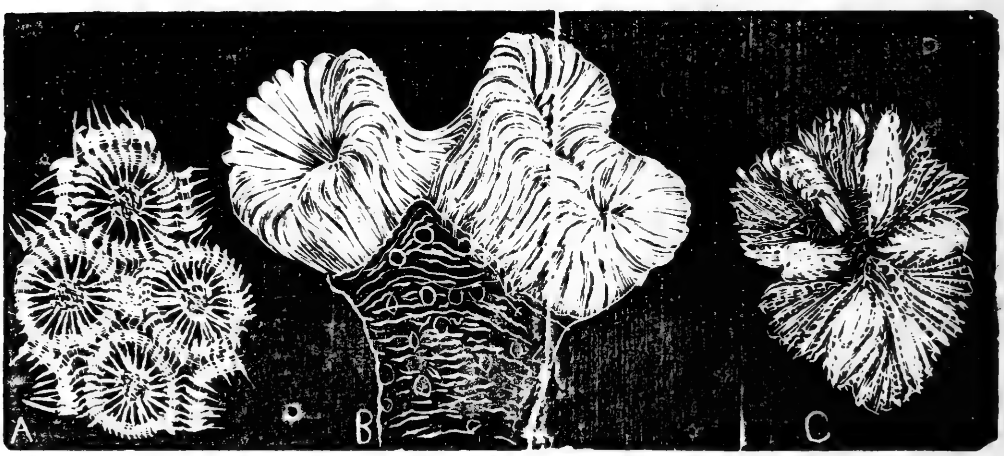
Rose Coral, B, Rock Gorgonia, C. Millipore.

too, we also find sets of buds and organisms which have different functions An example of these compound jelly fishes may be found in the Portugese man-of-war. In this species we find the umbrella of the jelly fish transformed into a float, beneath which, and attached to it, are the various polyp-like organisms. There are several sets of these. One set feeds for the colony and is provided with powerful dart cells, one possesses reproduction functions and still a third set propel the colony. Alternation of generation also occurs in this species.

ORDER IV. JELLY FISHES.

Here we find some species of animals which reproduce without alternation of generation. Jelly fishes occur in abundance off our coast and vary in

FIG. 137.



A, Large Star. B, Tooth, C. Lancet Coral.

size with different species. Some are only an inch or so in diameter while some measure five feet in diameter and are provided with tentacles which are often forty feet in length. These species sting severely, and swimmers have been known to have become entangled in their folds, paralyzed and drowned. In some of these forms are found alternation of generation.

ORDER V. SEA ANEMONIES.

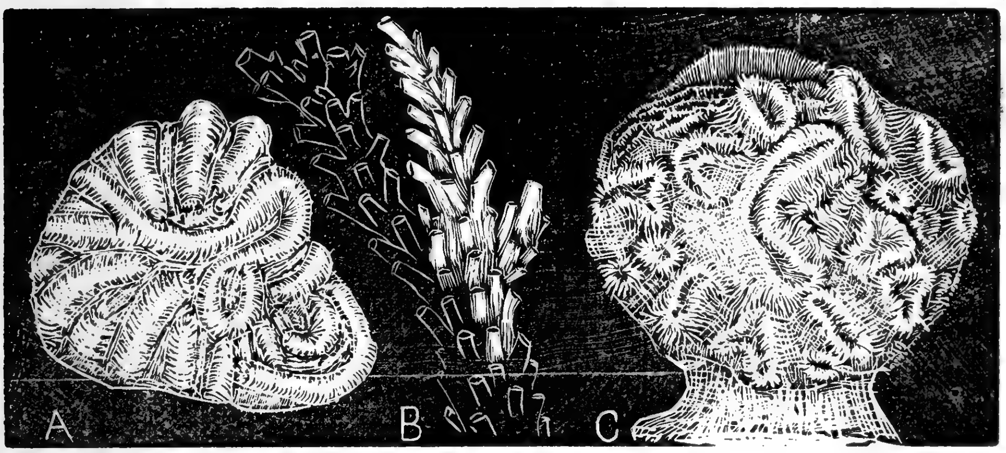
Among these are some of the most beautiful and varied forms of animal life which inhabit the ocean.

The true anemonies are rarely compound and differ from the hydras in having the stomach cavity suspended within the body cavity or attached to it by folds of the lining membrane of the outer wall, known as messenaries. See fig. 133, P. The tentacles are numerous and hollow. Through these hollow tentacles water is drawn into the chambers between the partitions, (see fig. 133 B) and there serve a double purpose; first, it oxydizes the body by having the enclosed air taken up by the surrounding surface; second, it serves as a kind of circulatory medium for conveying the digested food to various parts of the body. Anemonies possess dart cells and feed much as explained under the hydras.

Reproduction is by eggs which are produced in the ovaries, which lie within the base of the body. See fig. 133.

Some species of anemonies possess eye specks and most of the species are exceedingly sensitive, perceiving the approach of danger quite readily.

Fig. 138.



A, Plate, B, Branching, C, Elliptical Coral.

Anemonies may be found clieging to bridge piers, rocks, stones and shells and are exceedingly common objects all along the coast from New England southward.

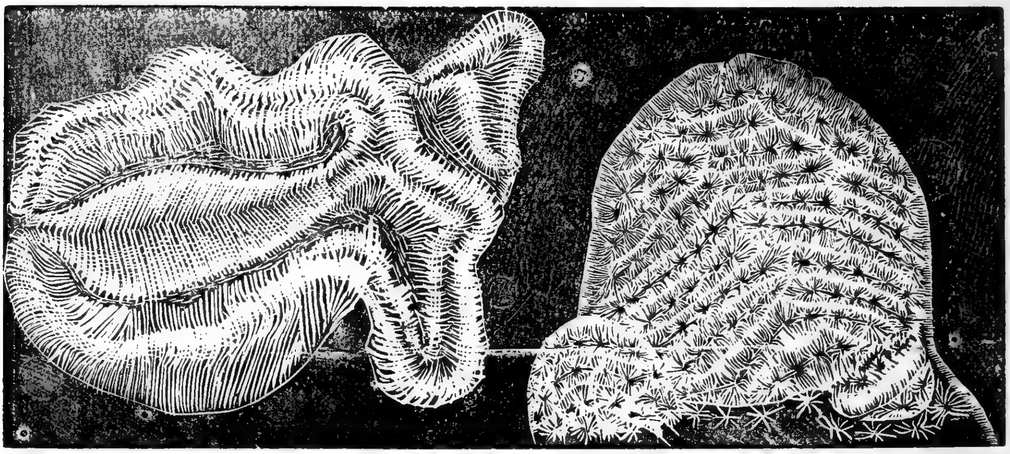
ORDER VI. CORALS.

Coral polyps are practically anemonies which secrete a stony base which serves as a support for them and a place into which they can retreat in time of danger. Owing to this protection, coral polyps can exist in heavy sea ways where anemonies would be dashed in pieces.

Coral polyps propagate in three ways; by buds, by division, and by eggs. A good example of the budding may be seen in the branching coral.

(See fig. 138, B.) Here the polyps grow upward and from their sides start buds which form polyps that may develop into branches. Division takes place in many species. When the polyp has attained a certain size it divides, and this division is indicated by the skeleton. See fig. 138, C, occelated coral, and fig. 137, B, tooth coral, both of which show polyp cells where division has occurred. Eggs are deposited much as in the anemonie.

FIG. 139. FIG. 140.



Brain Coral. **Propeller Coral.**

FORMS OF CORALS.

The corals may be divided into two groups, according to habit, reef building and lagoon inhabiting.

The reef building species in our Atlantic waters are, the plate, fig. 138 A, the brain, fig. 139, the head and the fan coral. Among the lagoon inhabiting may be found the branching, fig. 138, B, the occelated, fig. 138, C, the propeller, fig. 140, the large star, tooth, lancet, fig. 137 A, B, C, the globe, forking and rolling. See fig. 134, A, B, C and D.

[NOTE. Systematic Zoology for Teachers will appear in book form at a future date and will be sold to subscribers to Nature Study in Schools at a discount.]

THE DOWNY WOODPECKER.

BY

J. HUBERT SCOTT.

Tiny little tapper of the trees,
Why so earnest in thy quest today?
Can it be the Fates to thee decreed
Work should never yield to play?

With that flock of sparrows flashing by,
Flinging noisily into bush and tree
Hast thou ne'er an answer to their cry;
Does it not appeal to thee?

Art thou greedy, art thou bashful? Why?
Is it pride in yonder crest of red?
Say my little 'ristocrat so shy
Hast thou ever seen thy head?

Up and down and round and round you go,
Every spot thy zealous glance hath seen;
Thus it is when all is white with snow
Thus it is when all is green.

Pause one moment little bird I pray,
For I fain would see if bird thou art;
Man or bird that knows no moment's play
Ever fails life's truest part.

COMMENT AND CRITICISM.

The Maynard Chapter of the Newton Natural History Society is contemplating establishing a museum of specimens for the use of the teachers and pupils of Newton and for members of the chapter. The nucleus of this collection will be some three thousand specimens owned by the original society and which have been accumulating for some twenty years.

This collection is to be placed in a room ajoining the laboratory, on Crafts st., West Newton, where the chapter holds its meetings. Specimens are to be loaned to applicants who are entitled to their use, in a similar manner that books are loaned from a library. Teachers and others who desire specimens to illustrate particular subjects will be guided in their choice by Mr. Maynard or by some skilled assistant.

Money, which is necessary for the furnishing of a room suitable for the purpose of a museum, is to be raised by a series of lectures that are to given in Newton by members of the chapter.

This plan, which must be of great benefit to teachers and others is the realiaztion of an idea which, Mr. Maynard, its projenitor, has had in mind for a number of years, and bids fair, judging from the enthusiasim with which it has been received, to meet with success.

It is remarkable that the closing month of the present century brings to us, here in Eastern Massachusetts, a large number of white-winged crossbills, a species of bird which has not visited this section for a number of years.

Pine siskins are also present, but up to date, Dec. 20th, not in any great numbers.

The red-bellied nuthatch was reported by Miss L. A. Young at a recent meeting of the Maynard Chapter, as being common this season in Newton and vicinity. They are also common at Chestnut Hill.

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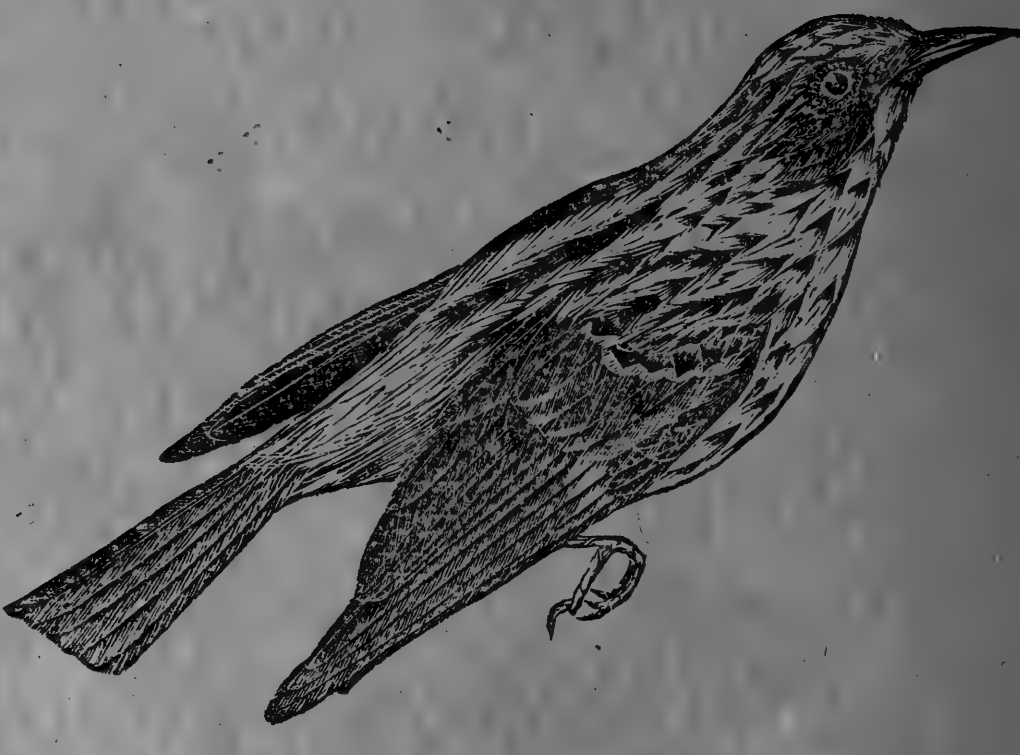

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