

head struck at the bird, but was unable to reach it through the bars of the cage.

The evident suffering of its little friend aroused Jason's anger and he began to crawl toward the snake. His tail twitched and he licked his chops nervously. The snake was too intent on reaching the bird to notice the cat. Jason crouched a few feet from the cage and waited for the snake to come around. The copperhead slid around the cage, and when on the side near the cat raised its head to strike. As it did so Jason's form arched through the air and came down on the snake's body. There was a growl or two, a few sharp spits mixed with ugly hisses, and Jason was away from the snake with his back humped up and his tail like a scrub brush. The snake's skin had been torn by the cat's claws, but it had received no serious injury, and with its mad up to the top notch, it turned on the cat and made ready to spring. It didn't wait long before jumping, but when it landed Jason wasn't there, and before the copperhead knew what had happened it received a rake across the back from the cat's claws that made it run for the edge of the veranda, in the hope, no doubt, of sliding over and away from its assailant. But Jason had his fighting clothes on, and he didn't propose that the snake should get off so easily. Just as the copperhead began to slide over the edge of the porch, Jason grabbed it by the tail with his teeth and yanked it back. Once more the snake coiled and showed fight. It struck at the cat again, but the nimble-footed Jason was away, and once more raked the serpent's body with his claws. Again the snake attempted to escape, and again it was yanked back to the porch by the cat. This time Jason was a little slow in getting away, and the copperhead sank its fangs in his leg. The pain of the wound set Jason going at fine steam, and with a growl he snapped his teeth together through the snake's body about three inches below the head. The copperhead made an effort to break away, but Jason held on, and while he chewed the serpent's neck he lacerated its flesh with his claws.

This treatment was too much for the snake, and it shortly gave up the ghost. Jason finally let go the snake and went out into the garden and rolled in the dirt. His legs swelled up as big as a man's arm from the effect of the snake's bite, but he chewed catnip and rolled in the dirt a couple of hours, and then was about as good as new.—N. Y. Sun.

#### GALL FORMATION.

By SOPHIA ARMITT.

THE birds know better how to find the life that is inside galls than do human beings. In November and December they are searching among fallen oak leaves for the cherry galls, and opening them for the fat grubs that lie therein. An observer who is interested in the habits of birds, and had been watching them in the woods in December, 1893, brought in a lot of these cherry galls and placed them on moss inside a Dresden china cup in the family sitting room, to see what would come of them. In the course of a few days, quiet readers were frequently disturbed by the settling of peculiar flies upon them in a markedly unpleasant manner, causing involuntary and spasmodic starts. Upon investigation it was found that the gall flies were emerging from the galls, and the bird observer was requested to remove those galls to a different place. This circumstance was calculated to arouse curiosity. Were gall flies really maturing and emerging in winter? If so, how would they get along till the summer came and there were new oak leaves for them to put their eggs in?

Dr. Adler's book, reviewed in your last volume, page 88, entitled "Alternating Generations; a Study of Oak Galls and Gall Flies," solved these questions. These flies (*Dryophanta scutellaris*) do emerge, in any case, in winter from the cherry gall. It may be in nature they appear in January or in February, but always after a frost, for a thaw destroys the gall, which is their home. They are in this generation of only one sex, and they live only a few days. These flies search for little adventitious buds on the stem of the oak tree, wherein they place their eggs. In April the leaves from the buds, pricked by the flies, produce new galls, that are quite different from the cherry galls from which the flies emerged. These galls are dark violet and velvety, and are known as those of *Spathogaster taschenbergi*. In May and June the perfect flies of this new generation leave their galls. They are half the size of the mother or winter fly, and of two sexes. In a few days the females begin searching for the youngest and tenderest leaves, to prick the underside of the veins, and place there their eggs. In each pricked spot, when the egg hatches out as a grub, will begin to grow a new cherry gall, exactly like the one in which the grandmother passed the months which ended in the few days only of open-air existence.

The life story of the spangle gall (*Neuroterus leucularis*) varies from this. Every one knows the pretty spangles beneath the oak leaves in July and onward. They fall, in autumn, on the leaves, but the life inside does not die with the leaf; it lives on through the winter, and the fly comes out in April or May. The gall fly immediately begins to examine buds carefully with its antennae; when satisfied with a suitable one, it pushes its ovipositor deep therein, a long and difficult business, and lays one egg. When the bud expands, a small, round sappy gall is seen either under a leaf or on a male flower catkin. This is the currant gall (*Spathogaster baccarum*), smaller when on the flower than when on the leaf. From these the flies emerge in early June, male and female this time. The young, tender leaves are then sought for, and inside their under surfaces eggs are placed from which spangle galls will form, serving as a home for their tiny inmates, through summer and winter, till the next year's new growing time.

Much of Dr. Herman Adler's interesting book treats of the insects. There are minute descriptions of their forms and stages of life history. I have drawn the purely botanical parts together in the following paragraphs.

Galls occur on buds, leaves, flowers, bark or root; but, wherever they are, they originate always from the same parent tissue, from the formative cells that are called the cambium ring. A layer of this tissue extends through every plant, from the finest root

fibers to the most distant leaves. All vegetable life springs from the cambium layer; its cells are the theater of actual metabolism, and yet they are not differentiated into a stable tissue. It is from these cells that all gall formation proceeds. When a gall fly pierces the cambium layer and deposits an egg there, gall formation does not certainly follow; it only begins when the larva emerges from the egg.

In this statement Dr. Adler differs from Sir John Lubbock and others, and he limits it to the action of oak gall flies, having observed that flies producing willow galls pour into the wound a secretion which causes new cell formation in the course of a few hours. On the oak tree procedure is different; it is only when the larva breaks through the egg case and touches the surrounding cells with its tiny mandibles that rapid cell growth is set up. Once begun, however, it goes on so quickly that while one end of the larva is still in its egg case, a wall-like mass of cells has risen up in front of it. This rapid cell growth is due to the irritation of the biting grub upon the highly formative cells of the cambium, which possess every condition for growth.

One gall fly (*Trigonaspis crustalis*) pricks the leaves in May; it drives its ovipositor into the vein of the leaf, leaving always a distinct mark. Months pass before any gall formation can be seen, it is not till September that the egg hatches out, and the delicate mandibles of the larva start the active cambium cells into gall formations. A gall is not parasitic in the surrounding tissue, it is of the same elements, only substituting itself for them by faster growth and still growing proportionately to the growth of the cellular layer around it. In a leaf gall the formation begins in the layer of formative cells on the under surface. Those of the upper surface having already become stable, they can undergo no further change, and therefore respond to no irritation: they are incapable of forming new cells. At first the cell growth only affects a small zone around it, but as it acquires a vascular system of its own it begins to grow as an independent structure. It is different when the eggs are laid in a bud. Then the biting larva touches rudimentary leaves consisting of still unmodified cells, all equally capable of development whether of upper or under surfaces. Then both surfaces take part in gall formation, and when the leaf comes to be unfolded it is found that there is an absence of leaf tissue, and that the resulting gall grows through the leaf substance.

Again, it is different when eggs are laid in the cambium layer of the bark. Here the cells which first form round the larva cannot be distinguished from adjacent cambium tissue, but in later growth there is a great contrast. The outer zone of the cambium ring produces the cells of the bast parenchyma, while the central zone of the cambium produces the wood parenchyma, and in these galls there is, too, a soft zone of sappy parenchymatous cells and a hard central zone of wood parenchyma. In all bark galls the woody center penetrates into the woody tissue of the tree, while the soft fleshy circumference proceeds from the bark. New cell growth is arranged in concentric layers round the larva, accompanied by changes in cell contents. The cells next the larva swell out, the cell contents become cloudy, and a multitude of starch granules appear. The rudimentary gall draws its first nourishment from the surrounding tissue, later it is more independent, for a new element comes in. From the spiral vessels lying in the cambium ring processes are driven into the rudimentary gall; the entrance of these vessels occurs at a definite spot on the lower surface of the gall, whether it is connected with the parent tissue by a broad base or a small stalk. The gall has now become an independent structure and is practically withdrawn from the direct influence of the cellular area around it, from which it sprang. Its individuality of organization is shown by complicated transmutations of cells originally alike, especially in the cells of the exterior, which develop peculiar pigments and hairs of various kinds, both in great variety of forms. It is the value of these different structures, as protective contrivances, which has secured their evolution by the gall. Sometimes the hairs exude a sticky sap which keeps off parasites. Even smooth galls, like *Aphiloterix sieboldi*, secrete a juice which attracts ants. These protect the galls, like sentinels, driving other insects off and often constructing a protective mantle of earth around them. If the larva perishes before the gall is mature, its formation is stunted. The influence of the larva is necessary not only for the commencement but for the completion of the gall. When a roundish inner gall is found undeveloped, parasites are always present. A gall pricked by parasites grows in an anomalous manner. Galls contain not only the larva that form them, they are often taken possession of by insects that are called "inquilines" or lodgers of the oak gall flies. These creatures enhance the natural difficulties of observation of gall formation; they are so nearly related to the true gall flies that they can only be distinguished by the minutest characteristics. It is not doubted that they have developed from the true gall flies. By the use of a gall already formed the prosperity of their progeny is more certainly insured. Unfortunately, these lodger flies are more easily reared and collected than the true gall makers. The gall fly proceeds with great care in the choice of tender leaves, or terminal buds, or flower buds, but in spite of its care galls often fail to appear where eggs have been laid. The greatest number fail in the buds where only one egg is laid. Species emerging in summer can only prick winter buds which are waiting the coming of the next growing period, and in many seasons a premature and anomalous development of winter buds may be absent. This is not the only reason; the egg must be placed exactly in the cambium ring, which lies like a fine seam in the base of the bud, and if the egg is not laid in this fine seam, it perishes without forming a gall. Considering the difficulty to be overcome in placing the egg in precisely the right spot, it is not surprising if many eggs are laid amiss. Failures occur less frequently in leaf galls pricked in bud, because the fly has choice of much wider territory—the whole of the rudimentary leaves in the bud. Failures are not usually observed at all where the fly pricks the surface of bark or leaf, because the cell region to be struck is always at one uniform depth below the surface. Gall formation is dependent on the growing period of the tree, and ceases at its close. Most galls mature in the space of a year. Those which require

two years are bark galls; the first year the rudiment is formed and then development ceases till the next spring, when it is resumed with the new period of vegetative activity.

Dr. Adler's book is beautifully illustrated; all the galls he experimented upon are portrayed in color. The greater part of the volume is occupied by a detailed account of his years of experiments and observations on the oak galls and their inmates. The life cycle of each gall fly is made up of two generations, each one of which produces its own sort of gall different from the other. One generation consists of two sexes, the other of one only. The life of the gall fly is generally very short, of days only, while the life of the insect inside the gall may be months or years. These facts seem to be common to all the gall flies investigated. Many of the life stories are more curious than the two I have only touched upon as being perhaps the best known galls. There are the artichoke galls, the oak apples, and the marble galls; but your readers will doubtless prefer to have the best part of an interesting book to study for themselves.—Science-Gossip.

[NATURE.]

#### A FEW MORE WORDS ON THOMAS HENRY HUXLEY.

Two scenes in Huxley's life stand out clear and full of meaning, amid my recollections of him, reaching now some forty years back. Both took place at Oxford, both at meetings of the British Association. The first, few witnesses of which now remain, was the memorable discussion on Darwin in 1860. The room was crowded, though it was a Saturday, and the meeting was excited. The bishop had spoken; cheered loudly from time to time during his speech, he sat down amid tumultuous applause, ladies waving their handkerchiefs with great enthusiasm; and in almost dead silence, broken merely by greetings which, coming only from the few who knew, seemed as nothing, Huxley, then well nigh unknown outside the narrow circle of scientific workers, began his reply. A cheer, chiefly from a knot of young men in the audience, hearty but seeming scant through the fewness of those who gave it, and almost angrily resented by some, welcomed the first point made. Then, as, slowly and measuredly at first, more quickly and with more vigor later, stroke followed stroke, the circle of cheers grew wider and yet wider, until the speaker's last words were crowned with an applause falling not far short of, indeed equaling, that which had gone before, an applause hearty and genuine in its recognition that a strong man had arisen among the biologists of England.

The second scene, that of 1894, is still fresh in the minds of all. No one who was present is likely to forget how, when Huxley rose to second the vote of thanks for the presidential address, the whole house burst into a cheering such as had never before been witnessed on any like occasion, a cheering which said, as plainly as such things can say: "This is the faithful servant who has labored for more than half a century on behalf of science with his face set firmly toward truth, and we want him to know that his labors have not been in vain." Nor is any one likely to forget the few carefully chosen, wise, pregnant words which fell from him when the applause died away. Those two speeches, the one long and polemical, the other brief and judicial, show, taken together, many of the qualities which made Huxley great and strong.

Among those qualities perhaps the most dominant, certainly the most effective as regards his influence on the world, were on the one hand an alertness, a quickness of apprehension, and a clear way of thinking, which, in dealing with a problem, made him dissatisfied with any solution incapable of rigid proof and incisive expression—he seemed always to go about with a halo of clear light immediately around him; and, on the other hand, that power of foreseeing future consequences of immediate action which forms the greater part of what we call sagacity. The former gave him his notable dialectic skill, and mark all his contributions to scientific literature; the latter made him, in addition, an able administrator and a wise counselor, both within the tents of science and beyond. These at least were his dominant intellectual qualities; but even more powerful were the qualities in him which, though allied, we distinguish as moral; and perhaps the greater part of his influence over his fellows was due to the fact that every one who met him saw in him a man bent on following the true and doing the right, swerving aside no tittle, either for the sake of reward or for fear of the enemy, a man whose uttered scorn of what was mean and cowardly was but the reciprocal of his inward love of nobleness and courage.

Bearing in mind his possession of these general qualities, we may find the key to the influence exerted by him on biological science in what he says of himself in his all too short autobiographic sketch, namely, that the bent of his mind was toward mechanical problems, and that it was the force of circumstances which, frustrating his boyish wish to be a mechanical engineer, brought him to the medical profession. Probably the boyish wish was merely the natural outcome of an early feeling that the solution of mechanical problems was congenial to the clear decisive way of thinking to which I referred above, and which was obviously present even in the boy; and that it was not the subject matter of mechanical problems, but the mode of treating them which interested him, is shown by the incident recorded by himself, how when he was a mere boy a too zealous attention to a post-mortem examination cost him a long illness. It is clear that the call to solve biologic problems came to him early; it is also clear that the call was a real one; and as he himself has said, he recognized his calling when, after some years of desultory reading and lonely irregular mental activity, he came under the influence of Wharton Jones at Charing Cross Hospital. That made him a biologist, but confirmed the natural aptitude of his mind in making him a biologist who, rejecting all shadowy intangible views, was to direct his energies to problems which seemed capable of clear demonstrable proof. In many respects the biologic problems which lend themselves most readily to demonstrable solutions capable of verification are those which constitute what we call physiology; and if at the time of his youth the way had been open to him, Huxley