

February 4, 1889.

REGULAR BUSINESS MEETING.

The President, DR. NEWBERRY, in the chair.

Thirty-seven persons present.

The Report of the Council was read, recommending:

- (1) The payment of certain small bills;
- (2) Several minor items;
- (3) The election as Resident Member of

MR. ERNEST A. CONGDON,

and presenting a list of nominations for officers for the year 1889, to be voted upon at the Annual Meeting, February 25th.

The several recommendations were agreed to, and the list of nominations approved.

The paper of the evening was then read, as follows:

OBSERVATIONS ON THE TERMITES, OR WHITE ANTS, OF THE
ISTHMUS OF PANAMA,

by P. H. DUDLEY.

The paper was largely illustrated, with specimens of all the varieties of ants, with their nests and their galleries, and beams, car-panels, and other wood-work honeycombed and destroyed by them.

When going to the Isthmus for the Panama Railroad, I was requested to make some examinations of the extensive injuries to their buildings, shops, tools, and cars by the Termites, or so-called "White Ants." In the office here in the city, I was shown many specimens of wood-work from the Isthmus so badly eaten by the Termites as to be of no further service.

Nearly all the pieces except those of ash bore evidences also of decay.

The latter fact I fully expected, for the annual rainfall upon the Atlantic side of the Isthmus is about eleven and one-half feet, and on the Pacific side it is only some three feet less. This great humidity, combined with a mean annual temperature of about 78° F., furnishes continuous conditions for the growth of fungi and the consequent rapid decay of wood.

The humidity of the climate serves in a measure to explain why it is so easy for some species of the Termites to eat even sound wood, as in furniture.

What are called seasoned woods there contain from ten to fifteen per cent more moisture than the same kinds would in the United States, and are therefore much softer. White ash, which in this vicinity is a hard wood, and extensively used in furniture, car, and coach construction, on the Isthmus absorbs moisture and is readily eaten by several species of Termites. It seems to be especially relished, and should not form any portion of wood-work to go to the Isthmus.

White pine is but little better, as it so quickly decays and then is readily eaten. Yellow pine is much harder, and in all the samples examined the tissues had first been softened by decay before being attacked by the Termites. It only requires from one to five years, however, according to the conditions of use, before the yellow pine is attacked by fungi and then by the Termites, especially *Termes testaceus* Linn., which eat out the interior portions of large timbers, such as posts and sills of buildings. It has been often suggested to treat the wood so as to check decay, and thus to prevent the work of the Termites. This course has been extensively tried, but the majority of cases have been failures, owing to the difficulty of treating the interior portions of large timbers; and measures which would protect the timber from decay in temperate climates fail in the tropics.

Upon the Isthmus, ten species of Termites have been found, representing three genera, according to Dr. H. A. Hagen,—viz., *Calotermes*, *Termes*, and *Eutermes*. The first genus is represented by only one species, *Calotermes marginipennis* Latr., and so far has only been found in first-class passenger coaches, which were in daily service. In two of the coaches, the attacks were confined to the white ash door-posts, and in the third coach the rails of twelve seats were destroyed. The wood was not attacked from the exterior, nor were any covered galleries found. Entrance to the interior portion was gained through a crevice at the joints. The wood is then eaten out in pockets or chambers, working principally lengthwise of the grain. It would seem, on looking at the chambers, as though a heading was driven by one or two workers, and enlarged by others following in close proximity. If a heading from an opposite direction was likely to meet, a thin partition wall would be left, especially when near the surface of the wood. The chambers were larger in the central portions of the sticks. The exterior portion, or the surface, was not eaten through, and the only indication afforded was the dust or *feces* falling from the joints of the

seats or door-posts. This species has not shown any evidence of using glutinous secretions in repacking the excavated chambers or tunnels; but a few of the chambers were repacked with loose pellets—*feces*. This species is very destructive to ash wood, and can readily bore hard oak. Eating out the interior of the wood in chambers, they cannot be easily dislodged.

In the classification of the *Termes* and the *Eutermes*, there is great confusion. The latter have been separated from the former on account of a supposed constant difference in the venation of the wings, which does not seem to hold good with the several species from the Isthmus at least. The present classification puts into the same genus—*Eutermes*—species having soldiers provided with long, curved mandibles, and species having soldiers with their heads terminating in a long “nose” or beak from which they eject a minute glutinous pellet or shot when attacked. Upon the Isthmus, the habits and nests of species having soldiers of the first kind are entirely distinct from those of the species having soldiers with long noses (*nasuti*). To avoid confusion, in this paper, species in which the soldiers have long, curved mandibles will be mentioned as *Termes*, and those having *nasuti* soldiers as *Eutermes*.

Five distinct species of *Termes* have been thus far collected upon the Isthmus: *i. e.*, the soldiers and workers of as many species have been found, but the queen of only one of these has been obtained. One species builds conical nests of mud or earth, after the manner of some of the African Termites, the largest found being three and one-half feet in diameter, and the same in height. This nest is near Corozal Station of the Panama Railroad.

The nest of the species of *Termes* in which the queen was found was upon a decaying stump on Kenney's Bluff, across the bay from Colon. The workers are comparatively small, less than three-sixteenths of an inch long. The umber-colored nest had very small passages,—some of them formed by eating out the wood, while others were constructed. The queen's cell was nicely formed, the interior being quite smooth. The other species of *Termes* have been collected in the pieces of wood or trees upon which they were feeding. The only portions of nests found are those obtained inside the larger posts of buildings which they were attacking. These were perhaps only auxiliary nests, as queens or their cells were not found. The *Termes* make covered galleries leading from their nests, but not so extensively or conspicuously as the *Eutermes*, at least not upon the Isthmus.

Most of the species of *Termes*, when eating the wood of a building, make galleries between boards or through the interior of the wood, never breaking through to the exterior.

The systems of covered galleries of the *Eutermes* are very extensive, being conspicuous upon many of the tallest trees in the forest. A main gallery is constructed from the base of the tree, running up the trunk to the branches, and then auxiliary galleries on the under side of all the boughs, large and small (Fig. 1).

The *Eutermes* live in large communities, and build upon small trees a nearly globular nest from six to twenty inches in diameter. In larger trees, the shape varies. In the central portion of the nest is the queen's cell, in which from one to ten



FIG. 1.—Nests of *Eutermes*. In the centre a palm-tree, with main or parent nest, and two galleries leading to the ground: on either side, supplementary nests. The main nest contains several queens; the others have none, but abound in eggs and young.

mature queens have been found. Twenty queens, not fully grown, were found in one instance in a single cell.

From the nests the covered galleries of three-eighths to three quarters of an inch wide, and nearly semi-circular, extend often one hundred and fifty to two hundred feet to some source of food-supplies,—as buildings, cars, etc. (Fig. 2).

The members of their communities consist of workers, soldiers with beaks (nasuti),—the former many times the most numerous,—and a queen or queens. In the spring there are large quantities of males and females, which have eyes and wings,

and these swarm about the end of May or beginning of June. The soldiers and workers are blind and wingless, and do not swarm.

My experience with the decay of woods enabled me at once to recommend more durable woods for use on the Isthmus, which were at once adopted. In order to see whether those woods were proof against the ravages of the Termites, I arranged with Mr. J. Beaumont, Superintendent of Motive Power of the Panama Railroad, to make continued observations upon the habits of the different species, and ascertain how far the woods recommended as less liable to decay were also proof against the ants. The interesting observations of Mr. Beaumont, contained in his



FIG. 2.—Nest of *Eutermes* in the fork of a small tree, six feet above the ground: it contains four queens. At the root is a supplementary nest, with soldiers, workers, eggs, and winged ants, but no queen.

numerous letters, have been compiled by Mrs. Dudley into the following paper:

COLON (ASPINWALL), U. S. COLOMBIA, {
March 4th, 1888. }

MY DEAR MR. DUDLEY :—In answer to your questions about the habits and work of the Termites, I reply that one cannot fail to notice here, in the month of May or June, the swarming of the winged white ants,—after and during the *first* showers of the wet season. They cover and get into everything, so that one has to sweep them off from the balconies. Few

seem to know that they are white ants, but I have watched them issue from their nests, located in rotting or decayed 12x12 timber in roofs of buildings, and also on fences. At this time everything at the nest seems to be in a high state of excitement. As soon as the winged ants alight, they shed their wings, and then crawl after each other in long lines, apparently trying to pair. The winged ant is about three times the length of the workers, and I never see it at any other time of the year.

In regard to the galleries about which you inquire, I have not noticed any on the ground, but always on a post, fence, or foundation-pier of buildings. The damage this little insect is causing to the buildings of the Panama Canal Co. and to wood-work on the machinery, with the work of the fungi, must be simply immense. There is hardly a Canal building, elevated above the ground on stone or brick piers, but what has these galleries of white ants running up and around it, dooming the building or its furniture to destruction. New ash or oak furniture in our Commissary building is frequently destroyed. Kerosene will kill some, but does not prevent others from attacking the same piece of wood or furniture after the oil has evaporated. Fernoline might answer, as it retains its odor longer. I find by experience that it is best to get to the nest or colony, destroy it with kerosene, and take it down and burn it. I have one man detailed to go around every Saturday, break all the galleries, and tear down the nests and burn them.

At your request that I would break open their galleries and watch the ants repair them, I went to a place where I had noticed them, on a *lignum. vitæ* fence-post in my garden. A few days ago, I opened several tracks or galleries, and found the samples in bottle No. 2 (soldiers, *nasuti*) to be most numerous just then, and very few like specimens No. 1 (workers). This was the first time that I broke open the galleries for observation.

This morning the galleries were being repaired in some places only, while others were untouched. On disturbing other portions of the tracks, I failed to notice any workers, but swarms of soldiers or black-heads.

With the naked eye I could not distinguish the motions of the repairers, so I took my eye-glasses folded together, and made a magnifier about equal to a watch-maker's glass, and then I inwardly exclaimed, Eureka! Eureka! There were the black-heads—*nasuti* soldiers—all clustering around the break, heads or beaks pointing out, and when my breath disturbed them, giving a series of bodily jerks as though stabbing an imaginary enemy. At other times they were continually swaying their heads back and forth (Fig. 3). I failed at first to see any repairs—but stop! what was that little fellow doing? There is another:

he just puts up his head on the edge of the break, with a grain of something dark between his mandibles, and presses it firmly into position by a side movement of the head three or four times, then turns and disappears. I notice that as he turns, he has a peculiar way of showing the other extremity of his body. They all do exactly the same; the black-heads (nasuti soldiers), always allowing them room to work, swaying their beaks back and forth.

I clean my glasses and hold my breath, looking again, and discover the whole process.

Up comes a little worker with a grain of white, sticks it on the edge, and, pressing it into position with its mandibles, backs down a trifle; then up comes the end of its abdomen, and ejects upon the little grain, just rubbed in position, a drop of a semi-liquid substance of a whitish color. This whole operation only occupies a few seconds.

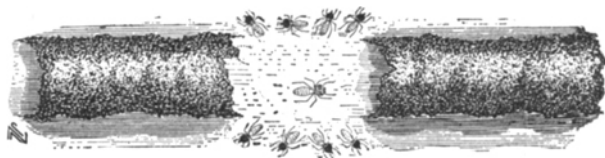


FIG. 3.—Broken gallery of *Eutermes*, showing soldiers (nasuti) guarding the break, while workers are engaged in repairing it. Natural size.

Then he trots below. Up comes another, with a grain of *brown* (soil) and pats it down, but it dips a trifle; gets hold of it again, another pat—successful. Then up comes the abdomen with the glue; and this is the process on both sides of the break.

I found two breaks in the galleries repaired, nothing being done at the others, the community apparently all quiet. I note that the sun is shining on the break; perhaps that is the reason.

I made some more extensive breaks, causing a general commotion; very few workers visible, but I captured some. This kind seems to get out of the way very fast, while the soldiers spread all around in a very excited manner; but the sun, being hot, soon drove them into the shade. . . .

In a conversation with the American Consul here, lately from Barranquilla and Cartagena, U. S. Colombia, he told me that the only wood that is proof against these ants in the houses there is Spanish cedar. They do not like the flavor or smell of it, and so it is used for floors and ceiling. He also told me of the immense destruction to buildings in that place by these ants, and added that they can be heard at work in the night when it is quiet, grinding away at the wood, and assured me that he had heard them himself.

Now a few words as to their work on moist wood. About a month ago, during dry weather, one of my workmen had some ash panels for inside finish of coaches, and laid them on his bench piled up, six or more in thickness, without anything between. The ants found them, and in a few days ruined them. This was apparently dry lumber. They attacked some white-wood along the tongue and groove, at about the same time. The carpenters tell me that the ants will not touch a board lying alone, but if several are placed over each other, they will work between them. I notice that I find fewer tracks of ants or nests in the dry season than in the wet. I have just found a portion of another "last year's nest" in an 8 x 8 stick of yellow pine, which I think may interest you, as it shows the way they construct their houses or nests. I have just been looking at a vial of ants that I have bottled for you. They are from the same place I got the others, which you class as another variety, and I agree with you from what I have seen of them. Their galleries are much smaller, about one-sixteenth inch diameter inside, and one-eighth inch diameter outside, and apparently made of soil. They are very shy and difficult to capture; and as soon as the gallery is disturbed, they disappear quickly. I have not found any working on wood yet; in fact very few wood-ants are at work just now. I have only two nests under observation;—perhaps dry weather is unfavorable. . . .

I broke two or three of their galleries, thinking to return after a while and see them at work repairing again. But when I returned it was all done. So about noon I went again, took out my glass, and broke two galleries; one was running up the fence-post, so that the sun, being directly overhead, shone into the gallery to some depth. The other, some two inches away, did not admit the rays of the sun. I noticed they seemed to be most anxious to work on the one that admitted the sun's direct rays. In about five minutes I began to see the little fellows with the cement come along and examine the break, but they brought nothing; I observed, however, that they turned and placed a little cement on the edge of the break. Six or eight did this: then one little fellow came with the first "brick," patted it into position, gave it the regulation number of rubs, then turned around and placed a little cement there for the next brick. Is this not wonderful? Who but the All-wise Creator told these little creatures of His handiwork that the dry grain would not stick on the dry walls of their galleries without first being moistened?

The other fellows with the black, shiny beaks (nasuti soldiers) seemed to do the running around. I have not seen them use their beaks, but I do not think that they open. My glass is not

powerful enough. All work together in harmony; and the rapidity with which they were laying bricks when I left them led me to judge that they would finish the break of three-eighths of an inch in about twenty minutes.

You can certainly rely upon their method of repairing broken galleries as I have described it, for I have watched them minutely and carefully many times. I have not yet seen any of their larvæ or eggs; but the time will soon come for the winged ones to fly, and then I must get some for you. . . . I have just made another observation of their repairing a broken gallery, with exactly the same result, and am curious to know where they get their material so quickly. It hardly seems possible for them to go from the top of a four-foot fence-post to the ground and back in five minutes. I have known them to repair a broken gallery a dozen times a day.

April 4th, 1888. To-day a box-car was sent to the shop for repairs; it has been lying on a side-track up the road, and was eaten by these ants from brake-beam to roof,—good for nothing but fire-wood,—it is a sight to behold. I have just had quite a “picnic” with the Termites in it, and my hands have a pungent smell yet, in spite of frequent washing with soap. When the men began to break up the car, they found under the roof in one corner a large nest, about the size of a half-bushel basket, globular in shape, with an outside covering, samples of which I send to you. This nest was held in place, or supported, on the under side at intervals, and when touched with the fingers would crack, but not break away. I at once took this large nest in my hands, and broke it in two on the flange of a car-wheel, when, to my delight, I found the largest white ants I have sent you, with embryo wings. These seemed to be congregated in the centre of the nest. I recognized them as the winged ants that issue forth in such quantities at the commencement of the rainy season. They are then longer, and smaller in diameter, and of a darker color than the samples sent. I hastily collected a number in the palm of my hand, and bottled them. The other samples sent were taken at random from the fence-post nest; I think there are three kinds. I took a portion of the latter nest on my desk, and collected in one bottle all the white ants I could capture. They are of a retiring nature, and hid in the cells of the nest, from which it was difficult to dislodge them. There seem to be two kinds; the smaller are the ones that carried the cement and built up the galleries. The others are longer, and with amber-colored heads, and are seen only when I break largely into the nest. The other kind was that with the beak and shining black heads. From your description, I think the white ones are females or queens, and rarely leave their cells.

April 8th, 1888. This morning I have been studying the Termites (*Eutermes*), with the following results:—I watched their actions for forty-five minutes without intermission or abatement of interest, and, using a more powerful lens, I confirmed many of my previous observations. I wished to-day to note whether the *Eutermes* would attack ants or other insects, or be much disturbed by their presence. So I made a break of about three-eighths of an inch in a gallery on a fence-post. None but those with the shiny black heads with beaks (nasuti soldiers) put in an appearance for at least fifteen minutes. So I caught a common black ant, killed it, and pinned it in the centre of the broken gallery. The nasuti soldiers approached it very cautiously with their feelers and seemed afraid of it. In a few moments a worker came with the prepared glue, barely touched it, then turned around and dropped a speck of glue, then another, and so on until six had done so; then some grains of sand were brought and placed on the ant, which was now securely glued down. I withdrew the pin, but the ant was fast and immovable, and they seemed to leave this work. In the meantime, I had broken other galleries, to which I was giving attention. One, a very small break, I noticed them closing up without using any grains of sand, or but a very few. I watched this closely: some of the ejections were darker than others; some were very profuse, while others were scarcely discernible, but all of about the same consistence. The color at first was a light yellow, but in a moment or two of exposure to the sun it became very dark or brownish-black. The workers, when making this deposit, made a sweep with the abdomen, spreading it along the edge of the gallery. While the aperture of the gallery was being closed, the black-heads—nasuti soldiers—kept their heads and antennæ over the edge, until finally there was only room for the antennæ of one in the opening; these were then pulled in,—another drop, and the world to them was shut out. While watching this operation I found that my little prisoner—the black ant—had been excluded from the gallery by building a curved portion around him, joining the ends of the former gallery,—just wonderful! (Fig. 4).

May 3d. Yesterday I met our friends the Termites again, and found them more interesting than ever. I disturbed a block of wood, of which they had entire possession, and turned it up edgewise. In doing this, their runs or galleries were broken, and several workers were wounded and crushed. These were removed at once by other workers, and taken carefully into the galleries. The order to do this seemed to me to be given by the soldiers, but in no case did they assist in their removal. I watched with interest their evident intention of connecting the

broken gallery, which was now on the top edge of the block, with the one at the bottom, a space of six inches. The soldiers seemed again to be directing the work, and in about fifteen minutes it was planned and commenced. The soldiers took position in a double line, while the workers ran up and down between them. This evidently meant the direction of the new



FIG. 4.



FIG. 5.

FIG. 4.—Gallery of *Eutermes*, broken and repaired. Original position shown by dotted lines, while the new portion is built around the obstruction. The latter consists of an ant, pinned in the middle of the break for experiment, and forthwith enclosed in cement by the workers. Natural size.

FIG. 5.—Portion of a double line of *Eutermes* soldiers (*nasuti*) enclosing and guarding workers while constructing a gallery. Natural size.

gallery; and the former did nothing but sway their feelers back and forth. I left them with the impression that the soldiers were directing the work (Fig. 5).

There has just been brought to me a portion of a nest of another colony of Termites: the result I send as a separate story, calling it

THE "BATTLE OF THE EUTERMES."

May 3d, 1888. I have never seen or heard of such a marvelous exhibition of intelligence and warlike skill as I witnessed to-day, after putting together workers and soldiers of two different nests of *Eutermes*. Their skill and dexterity in despatching an enemy are astonishing.

There was a slight difference in color between the occupants of the two nests, which was very favorable for accurate observations. And the better to designate the combatants, I shall call those of one nest "yellows," and those of the other "whites."

The yellows had the advantage of being at home, which was a block of wood six by six inches and three feet long, and literally honeycombed with tunnels or headings containing a numerous community. At the moment of attack the yellows were busily repairing a break in one of their galleries, "trowel in one hand and sword in the other," as it were, when I approached with the nest of the whites and dropped a single worker from the nest to the yellows' block, expecting to see it mingle with the latter unobserved; but had I dropped a miniature dynamite bomb, I could not have caused more confusion. A soldier (nasutus) of the yellows first discovered the intruder—by scent, I think—and rushed to the galleries where the workers were busy, and gave the alarm; instantly a worker of the yellows rushed at the intruder with open mandibles, grappled with it, and soon laid it on its back motionless and apparently dead. The yellows were now mustering out in great force, so I jarred my nest of the whites over the block, causing hundreds to drop on the "field of battle"; instantly the workers from the different nests rushed at one another with mandibles open. The battle was raging fiercely, in a rough-and-tumble manner. I dropped my nest, and took out my lens for observation. In a few moments the bodies of the workers of the whites were strewn all over the ground. It was very exciting to see them grapple together, and then roll over and over, the workers of the yellows being generally victorious. I now jarred from the nest of the whites another large reinforcement, mostly workers, there being but few nasuti soldiers in the nest. The yellows had many soldiers, which were rushing around, directing and urging the workers of the yellows to battle.

I was astonished how quickly they killed each other, but after a little closer observation I discovered the trick; the workers of the whites which I thought were dead were still alive, but *hors de combat*,—dismembered, in other words,—their feet or legs, and antennæ bitten off.

In all probability this was their first pitched battle, yet they fought like skilled warriors.

The yellows were evidently the most expert. I picked up a worker of the yellows and placed him on the nest of the whites, and he dismembered half a dozen of the latter before he was made to bite the dust. I could distinctly see the mangled legs of the slaughtered covering the battle-ground like white dust. I now left them, wrapped in astonishment at the wonderful works of the Creator. After dark, I returned with my lantern, and saw the workers of the yellows running among the slaughtered, nipping off a leg closer to the body of any which still struggled. There was fully a pint of the slaughtered bodies. It was astonishing how quickly they were despatched.

May 4th, 1888. Yesterday afternoon we had our first rain of the season, with thunder and lightning; and, as I have before remarked, the winged ants came forth, and I will send you some samples. . . .

May 6th. To-day I collected specimens of two more varieties of white ants, and have numbered them 3 and 4. The nest of No. 3 (identified by Dr. Hagen as *Termes testaceus* Linn.) I discovered in the window-casing of my office, which they have nearly destroyed, as also the frame. They came through the paint in one spot, and were then discovered. I procured specimens of soldiers and workers. They are very different in form and color from what I term the common wood-ant. Their bodies are longer, and the soldiers, in place of the beak, have powerful mandibles of a dark brown color, with yellow heads, and white bodies which turn yellow in alcohol. The workers are milk-white, and hold their color in alcohol. Both have a fat, white, waxy look under the lens. The soldiers, when disturbed by being touched roughly, strike with the mandibles, and then vomit forth a drop of gelatinous, milky fluid. When slightly disturbed, they make the same spasmodic vibration that I have noticed in the nasuti soldiers of *Eutermes*; but as their bodies are somewhat longer, the movement is more conspicuous. I placed a number on a sheet of writing-paper lying loosely on my desk, and was astonished at the rattling noise they made. Balancing themselves on their feet, they would tilt their heads up and down, and strike their long mandibles on the paper so rapidly as to sound like a stream of fine gravel dropping on the paper, and could be heard for a distance of ten feet. I thought this movement a method of communication among them, as they made frequent use of it. Of course, the paper did not lie solidly on the desk, and so acted as a sort of sounding-board.

When attacked by other ants, they made wicked use of their powerful mandibles, and if the enemy was too much for them they would vomit a drop of the milky fluid, which seemed to suffocate the enemy. I noted that when dropped into the alco-

hol they would discharge the same milky juice, which may be seen adhering to the mandibles of some of the specimens.

Species No. 4 I found on a post near our coal-bin, and I think they are the same as those sent with my first samples to you. They have the same appearance as No. 3 (*Termes testaceus* Linn.), but are much smaller, and without the milky secretion in the soldiers.

I placed a number of *Termes testaceus* L. (No. 3) in a glass jar,—both soldiers and workers,—adjusted my lens, and then dropped in several of No. 4, and watched their manœuvres for some time. They rushed to battle at once. No. 3 made use of both mandibles and milky secretions. A No. 4 worker caught hold of a No. 3 soldier by the abdomen and pierced it, and out burst quite a flow of milky fluid, apparently nearly suffocating the assailant; while No. 3, very much reduced in size by loss of its secretions, turned in a rage on No. 4 and nearly clipped it in twain.

I punctured the abdomens of several soldiers of No. 3 with a pin, and the same discharge of milky secretion followed as they seem to vomit when disturbed. I procured soldiers, workers, and winged ants from the same post. I consider this important, as the different species swarm together, and it would be difficult to distinguish them otherwise.

I took some of No. 3 (*T. testaceus* L.) to No. 1 (*Eutermes* worker)—what I call the common wood-ant—and though they had mustered hastily and turned out in force to repel the invading army of their own kind a few days before, they avoided the *milk-men*, and attempted to push them away from their broken galleries in one or two instances. They seemed disgusted with the milky secretions, and only desirous to be left alone.

May 7th, 1888. To-day I tore down a portion of the casing of my office window to solve the mystery of No. 3 (*T. testaceus* L.). I found the wood-work a mere shell, and the space that was once solid occupied by a mass of pasty material, evidently composed of what seemed to be wood chafings mixed with some moist glutinous substance formed by the ants, and constructed into runs and galleries. What surprised me most was its *moist nature* in such dry weather. I am now satisfied that this is the same kind of ant that formed the nest in the tie-beam that I sent you. The material, as a nest, is entirely different in character from No. 1 (*Eutermes*). I observe that No. 3 (*T. testaceus* L.) does not form runs or galleries on the *surface* and away from its work of destruction, but confines itself *within* the beam or post where it is working. No. 1 (*Eutermes*) will make nests up in a tree, or on a fence-rail or post, or under the roof of a building, away from its work of destruction, and then run its tracks or galleries there-

from in almost every direction, in search of choice wood or material to work upon and devour.

When I took down the side of my window-casing, it was a wonderful sight to behold,—thousands of milk-white ants, soldiers and workers only. I secured a number of workers, as they soon disappear. The soldiers evidently thought they would secure me, and bit viciously at my hand; their mandibles, once fixed, stayed until pulled off by force, separating their bodies before letting go their hold. I secured several fine samples of their galleries. The whole window-frame is destroyed, and will be replaced by a new one,—when more treasure may be found.

What interested me most were the places where they broke through the surface of the paint,—*the holes would be carefully puttied*. On breaking them open, the ants could be seen filling them again, the soldiers always standing guard around the edge, as with *Eutermes*. I caught sight of the workers bringing the grains of material and placing them in position carefully, but not turning around and cementing them together as the *Eutermes* do. These grains were of a reddish color, soft and pasty. They were always of the same nature, as though prepared for the occasion. Under the lens they looked like little pellets of some adhesive substance. I will send you some to be analyzed.

I feel gratified by having my observations made known to such a good authority as Dr. Hagen, and still more to learn from him that they were of some value. I wish there was some authority here for me to consult on the subject, but there is none save my own observations. I trust these are made as carefully as possible, and that they will be criticised in the same manner.

The remarks in your letter made by Dr. Hagen, on certain ants vomiting masticated wood, throw a little light on some of my notes, and happily may verify his statement on this point. I do not think my observations will allow me to agree entirely with him that two or more species of Termites occupy the same nest.

Mr. Clark, chief engineer of the steamer *City of Para*, was with me this morning, and I took him out to see my ants (*Eutermes*) repair their galleries. I broke one on a lignum-vitæ cross-tie; and in five minutes, to my delight, he saw them, with the naked eye, turn around after placing the grain, and with my lens saw the secretion deposited. He is the first one to whom I have shown this. The little workers repaired about one-eighth of the break while under observation.

May 13th, 1888. When going to my house this morning, I found tracks of *Eutermes* on a box of plants belonging to my wife;

so I can make observations with more ease and comfort. I also saw a boy wheeling away in a barrow the *outside* of a new washstand, the *inside* destroyed by *Eutermes*. This could be seen at a glance from my window, a couple of rods away. It is a common thing for them to attack washstands and bureaus in houses here, especially if made of ash. This reminds me of your question, "Have you many cars destroyed by ants?" I have only seen the one mentioned, and that had lain on a side-track for several months. As a rule, our cars do not stand still long enough for their work to commence. We had a Cook locomotive belonging to the Canal Co. sent to our shop some time ago, that had been standing out of use in one of their sheds for several months, with the wood-work attacked by *Eutermes*.

I have just had the pleasure of showing my wife the *Eutermes* repairing their galleries on her plant-box. With the lens she saw them set the grains, then turn around to spread the mortar. I also found their track or tunnel from one corner of the box under the soil for an inch or two from the side of the box, and some little depth below. I think their tracks are constructed with fine grains of sand or particles of soil, in combination with their secretions; but their nests are made of finer and more durable material, as the fine cuttings of wood, perhaps partly digested, and their secretions. Their nests are delicately constructed and the surfaces smoothly finished. . . .

In order to make more exact observations of my pets, I have established two "Termitariums" (name original), portable, in which I have very conveniently watched them hour after hour, in mute admiration of their skilful work.

I procured two telegraph-jars from the battery-room, and with these formed my Termitariums. The first nest of *Termes testaceus* L. was put in the jar a week ago and is working well; this was taken from my office window when the new frame was put in. We had quite a "picnic" at that time; I never saw so many ants before. The winged ones swarmed in such numbers as to fill my office; the floor, desk, and outside were alive with them. The swallows or martins soon found them and had a feast. The carpenters were covered with them and badly bitten by the soldiers. I picked up winged ones by the handful, and also workers and soldiers, for yourself and Dr. Hagen, and am thus certain that they all came from the same nest. I could not find the queen, though I hunted for her long and carefully.

The second Termitarium was formed on May 20th, 1888, from the *Eutermes* nest under my observation for a long time. These are the most interesting, active, and intelligent of any of the three varieties of which I have sent you samples. I formed the Termitarium in this manner: First a half-inch layer of damp

soil, then a circular piece of white pine board about two inches less in diameter than the glass jar, which is six inches wide by nine deep. I placed the board on the soil for them to feed upon, and then filled up between the circular board and the sides of the jar with more soil, for them to use in building galleries. Then, without disturbing or breaking the roof of a nest, I carefully selected a piece of irregular form and trimmed it to go into the jar, leaving it about 6x4x5 inches, and placed it in the jar so that two sides touched the glass. It rested on the board, leaving a portion exposed for observation. The nest, I judge, contained several thousand nasuti and workers, the latter predominating. In a few moments they accepted the situation, and began throwing up earth-works, repairing the broken nest, forming tunnels under the soil, stopping up holes, and cementing the sides of the nest to the glass jar,—all working harmoniously and after a well-defined plan. The gelatinous secretions were used sparingly at first, as the soil was moist and they were in a great hurry. It did not take them long to find that they could not crawl up the slippery sides of the glass, and they wasted no time on the attempt.

It was interesting to watch them tunnel the soil next to the sides and bottom of the jar, sometimes ramming the soil with their heads, and again removing large grains to the surface, rarely using any secretions under ground. They put me in mind of a large crowd of men at a fire, only in this case they were all busy and none standing idle. Even the soldiers scurried around, apparently directing the workers to different places; their function seems to be as guards or sentinels to alarm the workers, and they do it well. They do not appear to fight or work.

Having partially repaired their nest, and made a general survey of their work, they began to divide into parties, each having apparently a certain portion to accomplish. The workers were busy eating the wood, gnawing, tugging, and pulling in good earnest.

On the second day, a scouting party of soldiers (nasuti) on the top of the nest looked up anxiously to the top of the jar, and waved their antennæ upwards, standing on tip-toe. They kept this position a long time, while others were running up and down. I soon divined their intention to be to find a way of escape from the jar. Meanwhile, thousands of workers were eating the wood and working at nest-building as though they intended to stay there; not one appeared idle, sick, or even tired.

On the evening of the second day, I saw a party of workers starting a track of cement up the side of the jar, using no soil,

only their secretions, which showed through the glass like a brownish frosting. It looked beautiful, as well as wonderful, and their method of doing it was very ingenious.

The next day, they commenced two tracks up the sides of the jar, by backing-up as high as they could reach with the extremity of their abdomens, and then making a deposit of the glutinous secretion. Each one would go up head-first, as high as it could climb on the secretion, and apparently mark the place of

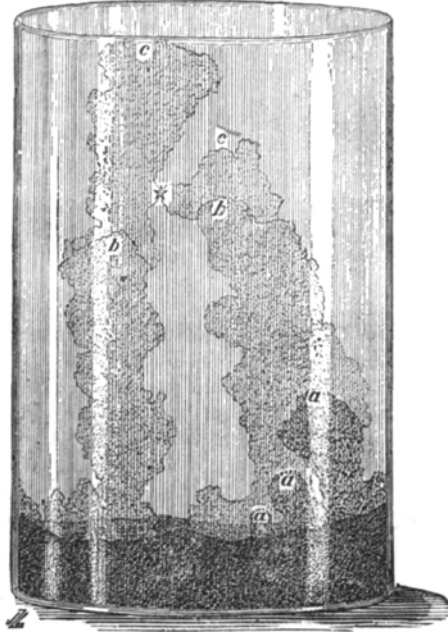


FIG. 6.—Device of *Eutermes* to escape from a glass jar, in Mr. Beaumont's Termitarium, by coating the inner surface of the glass with cement, supplied from the eductors of the workers, so as to afford a foothold. The lower part of the jar is occupied with earth, and the cement-tracks were carried thence to the top in three days' successive extensions, reaching to *a, a, a*, on the first day; to *b, b*, on the second; and to *c, c*, on the third. The two tracks unite at the star; and escape was effected at the top. One-third natural size.

deposit, then turn around and back-up again. I think this was wonderful. These little fellows had never been in such a situation before, yet, nothing daunted, they were equal to the occasion. While admiring their perseverance, I regretted seeing their attempt to escape from me, as I wished them to settle down and be contented. While this work was being done upon the sides of the jar, the majority were busy eating the pine wood and nest-building,—the work seeming to be divided up into sections (Fig. 6).

On the morning of the third day, they were within an inch and a half of the top of the jar ; so I placed a writing-pad on the top, for fear that they would be out before I returned from breakfast. But this was not sufficient ; for my boy came running to my office, saying that my prisoners " were escaping by the hundred." I told him to place the jar in water until my return, and on reaching them, I found a regular procession of several thousand. They had plastered the under side of the pad, to gain a foothold until they reached its edge, and then they were free. . . . From all this I derive the following conclusions: 1st. The soldiers are chiefly watchmen and directors for the workers. 2d. The workers make continuous use of their profuse secretions in the construction of their nests and galleries, and in the burial of their dead (enemies), or in escaping from confinement.

May 23d, 1888. Last night I took a worker *Eutermes* from a nest in my garden, and dropped it into the midst of workers in my Termitarium. Instantly it was pounced upon by all that could get to it, legs and antennæ clipped off, and in less than five minutes the workers were backing up to it and depositing their secretions upon it, while others were bringing grains of soil and covering it. In about fifteen minutes they had literally buried it alive in a hermetically sealed coffin. I procured others, and they were treated in the same way. I was now curious to know if they would recognize members from their own nest after five days' absence, and resolved to make the test. It was a success. I had noticed a piece of a wooden barrel-hoop lying by a part of the old nest, from which I had taken a portion. It was hollowed out in the centre and contained hundreds of ants. I carried it carefully and stuck it into my jar so tenderly as not to disturb or crush one. Wonderful to relate, without any visible demonstration, they intermingled as if they had always been together. Those which had been in the jar for five days seemed glad and excited at the acquisition of the old barrel-hoop, and began to incorporate it with the nest ; new galleries were commenced over it, and they all seemed happy. They evidently recognize members of their own nest, in distinction from their own kind from another nest. They must detect a stranger from another nest by the sense of smell. They also notice fragments from a strange nest as quickly as they do the ants. A strong light from either lamp or sun does not seem to be noticed by them in the least. I laid a piece of lead-pencil on the soil in my Termitarium. They at once formed a procession of inspection from either end, and in passing each other they would drop from the smooth surface, about the rate of one each second. In a few moments, the glue was called for, and they

stood upon their heads on both sides, reaching up with their abdomens, dotting the sides, and others on the surface. In a short time, there were none falling, the pencil was specked all over, with occasionally a grain of soil.

I have just closed up a small box to send to you. It contains samples of nest of *T. testaceus* L., from my office window. The old nail I found imbedded in a solid mass of the nest about three inches thick. This seems to prove that as these ants devour the wood, they fill up the cavity thus made with their nest; hence the nail was incorporated. . . . I am now trying my pets, *Eutermes*, with different kinds of wood, to see which they relish best. I have found them at work among a pile of *lignum-vitæ* ties.

June 2d, 1888. The ants are to me an inexhaustible subject. . . . It is now about three weeks since they took up their abode on my study table, and they are apparently happy and contented, and they seem fatter than when they arrived.

I have been lately closely watching the soldier *Eutermes* (the *nasuti*), with a view of giving you a better definition of the peculiar functions of their horn-like beak or proboscis,—but without much success, and shall have to continue to call them a soldier-guard. They seem more inquisitive than their fellow-workers, and at the same time more cautious. If the point of a pencil is placed among the group gently, they will touch it with their antennæ, and then retreat a little, or hurry off to warn the rest. A worker will come along, feel carefully at the pencil, and then crawl up it, at once, in a sociable way. I can always pick up a worker in this manner, to examine with my glass; but a soldier is too wary, and requires finesse to capture him,—such as rubbing the point of the pencil on the nest, to give it a similar odor,—and this must be its own, for each nest has its own peculiar odor *to them*.

The vibratory movement that I first noticed in this species seems to be common to the three kinds of wood-ants that have been here noted; it seems to be a part of ant-language, for the soldiers make the most frequent use of it. Ants are wonderfully inventive in adapting themselves to a change of circumstances and situation; for instance, out of doors they are *never* seen at work, but are always under cover, and can only be observed,—and then, of course, not at work,—when the nest or gallery is broken. But here, in my glass Termitarium, I can feed them with different kinds of wood, on which they fall to work with great avidity, exposed to view, and in strong light, with no attempt at concealment, and this on the first day after instalment. Why this sudden change in their method of work? How did they learn that they were not exposed to the weather,

or to danger from other ants, in their new location? They have worked in this manner for over two weeks, and every two or three days I would take out samples of their wonderful wood-carving, and insert fresh pieces for them, and in a few moments they would be patiently feeding on the new samples, without demur at the frequent change,—except yesterday, when I gave them a piece of ash, their favorite wood. To my astonishment, this morning it was incased and entirely hidden from view. They evidently intended to have this choice morsel all to themselves this time. The frequent changing must probably annoy them a trifle, and they intend to prevent it. Pages could be written upon their winning ways and marvellous skill. To-night they were feeding on a strip of ash, one inch by three, as many on it as could stand closely together, all workers except a few soldiers on the outskirts. . . . I watched them closely, and kept my eye on one until it cut out a minute sliver, and then went off with it to the nest, to masticate or chew the cud. Others seemed to get their mouths full, and then went away, their places being taken, so that the table was always full. In cutting, they seem to fix one mandible in a cell of the ash, and then perform a see-saw movement with the head, sidewise of course, until the particle is severed. Sometimes they drop back suddenly, as though it cut through before they expected it. *Query*,—Do they eat this wood to live? It seems to be so, for these *Eutermes* have had nothing but wood, water, and soil for three weeks. There are always a number resting or masticating, and always as many more feeding on the wood. I have watched them at all hours of the night, and find them the same as in the day, and can easily tell now when they are getting hungry or have not wood enough to eat. When they are short of food, they soon get short of secretions.

It puzzles me very much to find out where or how the soldiers (*nasuti*) feed; the workers must set a private table for them inside, of prepared wood, perhaps. They never seem to do anything but watch, and wave their antennæ up and down, right and left; they are in constant motion, however, and frequently relieve guard.

There are all shades of color in my Termitarium, from white to nearly jet black, according to the *age* of the worker, I think; the oldest and largest have the top of the head black, and the body or abdomen a dark yellowish brown. The very young and small ones are of a transparent white, and as they grow older the heads get darker and then the body. The soldiers seem to remain of the same color.

When a nest is disturbed, and there is any fighting to do, the soldiers and mature workers issue forth, while the young white

ones hide away. Hence it was the yellows or natives that issued from the block of wood on the field of battle; while in the case of the foreign or strange nest—which was only a fragment of a nest—in transporting it some distance, these older ones had dropped off on the way, leaving only the white ones in the inner recesses, and these had to be jarred out on the block. Of course there were some nearly mature, but the majority were of a lighter color,—hence I use the terms yellow and white, though all were probably the same species; and no wonder the yellows were masters of the field, being older.

To see if there was any fight in the soldiers, I placed two, from separate nests, in a clean white saucer. These soldiers are much smaller than the workers, and only discernible to my unassisted eye. The attempt succeeded, and with my glass I could see that it was a fight in self-defence when they came together. Such rapid vibratory movements, or jerks, with the beaks, could hardly be imagined, and in scurrying around one of them got a leg stuck on the saucer and could not pull itself loose, the saucer being so smooth. Looking closer, I thought it was stuck by some liquid ejected from the beak, a few small specks being visible. After being liberated, they collided again, and more spitting ensued, until their legs were entangled or stuck together, so that I used two pins to pull them apart; they appeared to be limed all over, and stuck to everything that touched them.

I have seen a common black ant attack a *nasutus* soldier, drop it, and go off wiping its feet and antennæ, evidently having received a dose of something sticky. It would, therefore, seem safe to say that this beak is a weapon of defence, though further examination would be desirable. I have repeated this experiment with the soldiers several times, with the same striking results. To vary the trial, soldiers from the *same* nest were placed in the saucer; these would run about all right, until disturbed by a pin, then they would go through the vibratory process, and be stuck with their own secretion.

June 3d, 1888. I have had the good fortune at last to secure to-day six queens of *Eutermes*—also eggs, soldiers, and workers, all from one nest, but did not find any winged ones there. The queens are about five-eighths of an inch long. I will forward them to you, as these are the first queens that I have seen. . . .

I hope you will be successful in discovering some simple method of circumventing the ants in their marvellous and rapid destruction of valuable property; and in this connection would suggest appealing mainly to their sense of smell rather than of taste.

June 16th, 1888. To-day notes the capture of two beautiful

queen *Eutermes* from a nest in an old car used for stores in the shop yard. I had the pleasure of taking them from their nest myself. They both lay in a cell close together. Their bodies are pure white, with dark brown bars across above and below. In another part of the nest, eggs were stored in large numbers (Fig. 7). . . .

At one time I marvelled at the numbers of ants contained in one of their nests; but now my astonishment is great at the number of the nests, and of one species only, the *Eutermes*. Some new evidence of their skill and intelligence can be daily noted. Yesterday (June 23d, 1888) I took my chair and sat down in front of a box of growing plants in my garden; the *Eutermes*

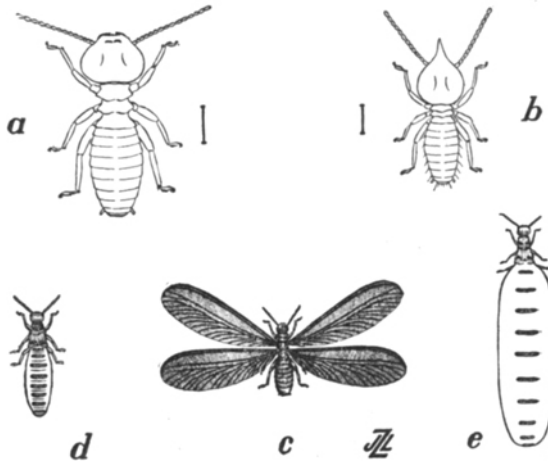


FIG. 7.—*Eutermes* sp. a, worker; b, soldier (*nasutus*); c, queen, before swarming; d, same after impregnation; e, same matured and full of eggs. a, b, enlarged five diameters; c, d, e, natural size.

have several tracks over the box, one of which runs along the top edge. I made a slight break in the track or gallery, and watched their movements through my lens. A worker drops off the edge of the box to the soil below; in coming up again, it runs against the track several inches away from the break, and begins at once to cut a hole in the track; in a few moments the gallery is pierced, enough for a soldier to squeeze through, and three come out to stand guard outside until the worker makes the hole large enough to admit its entrance. Presently it enters, the soldiers follow, and the workers at once proceed to seal up the hole from the inside,—the whole operation only occupying about ten minutes.

To-day I have been watching how they enlarge their nests, which they appear to do periodically, or rather as necessity requires. The nest was somewhat globular in shape, and they were making it one story higher or larger all around, by forming upon the old surface a number of cones or pillars of irregular shape, but all about the same height, a half inch or so, and then uniting or roofing over these pillars. Some were roofing, while others were raising the cones. I have sent you samples of this roofing material; it is very delicate, but answers the purpose as a protection from the sun and rain. It somewhat resembles the surface of a nutmeg grater, having minute openings, supposably for ventilation.

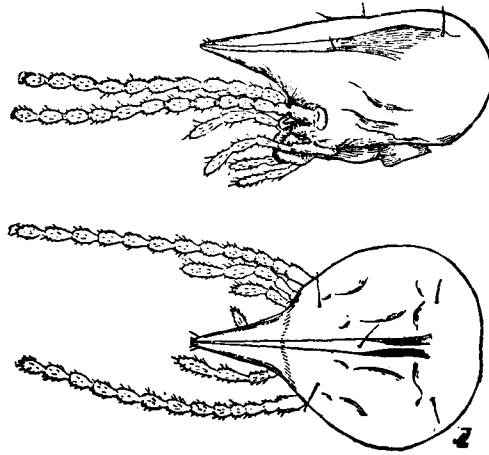


FIG. 8.—Head of *Eutermes* soldier (*nasutus*) enlarged 25 diameters, seen sidewise and from above. Five tactile hairs are shown; and the interior tube or "gun" is visible through the chitine of the head.

One of the functions of the *Eutermes* soldier seems to be to act as a guard to the worker, and it ejects a glutinous liquid, probably from the beak, in self-defence or when alarmed (Fig. 8). It still puzzles me how and upon what it feeds. I can find nothing inside their nests, no fungous growth, and am ready to believe that they are fed by the workers. This will be a difficult point to settle, for without doubt they are fed inside the nests.

June 23d, 1888. While walking in front of our new round-house this afternoon, I detected the ants at work on one of the posts, and saw at a glance that it was the species mentioned as No. 3, *T. testaceus* L., the same that completely destroyed

my office window. This insidious little worker has not been credited with its full amount of destruction, and therefore should receive some notice, especially as you ask "whether the *Eutermes* do most of the damage, according to my observations?" Two months ago I should have replied in the affirmative, but *now* shall be cautious in answering.

I have sent you a full description of the species, and specimens of their soldiers, workers, and winged ones, and also their nests and work. They labor in a different manner entirely from the *Eutermes*, working endwise into the heart of the wood, keeping out of sight and away from the surface, so that they can only be detected by an experienced eye. For this reason they are the more dangerous of the two species, and the kind which destroyed the tie-beams, a sample of which I sent you. Since then, I found a nest of them in the heart of a yellow-pine post; the nest continued twelve inches below the surface of the ground, and below that the post was sound. Samples of their work are quite a study, and I have a good collection of them. I have not yet found a queen of this variety, and you quote Dr. Hagen as saying "a queen of this species has never been seen." So far I have only observed their work upon buildings.

I feel very much indebted to you for intelligent help in directing my studies of the Termites. Your conclusions are right in regard to the loss of the antennæ. I noticed the peculiar movements of a worker in the Termitarium after having a battle. It was walking about with its head drawn around to the left, and seemed very awkward. Then I saw that the left antenna was cut off during the fight. The other workers seemed to sympathize with it, and gave it considerable attention.

I frequently observe the workers apparently washing or cleaning each other; the soldiers never do this, though they receive the same attention. This operation takes place during the period of rest. In my Termitarium there were always some at rest; and this must be one of their habits, as I find them in their tracks and galleries whenever they are broken, either day or night; and otherwise these would be sometimes found empty.

The charming book of Sir John Lubbock's, "*Ants, Bees, and Wasps*," which you kindly sent, came to me all right, and its contents were eagerly read. Please accept my sincere thanks. It will be a great help to me, and stimulate me to further effort in studying the Termites. I have the best opportunities all around me for making observations; in fact, the subject presses itself upon my notice every day in some way or other, and the study grows more and more fascinating. Sir John Lubbock's work is the first authority on ants that I have seen, and I am pleased to find that many of my observations are corroborated by him.

I find the species *Termes testaceus* L. far more numerous and destructive than I at first conceived, but have only found them attacking the framework of buildings and fence-posts when the wood is partially decayed. They have entire possession of the sills of our new round-house, erected only two years ago; in some places they have nearly eaten through the sill, commencing between that and the weather-board. They construct galleries from the ground up to the wood-work, of a somewhat different form from those of the *Eutermes*; but having once entered on their work of destruction, they keep more concealed from observation, having always a connection with the soil. A few days ago, I had the sill bared, and showed it to our General Superintendent, Col. Rives, and he was astonished that such destructive work could be done in two years, even by the united work of fungi and wood-ants. I cut out a short section of this yellow pine 8x8 sill, and it looks even worse than the sample of tie-beam sent to you. I think it is the same colony of *Termes testaceus* L. that is still at work. They are more difficult to exterminate than *Eutermes*.

Your original and useful study of the decay of woods gave so much value to your advice that some treated lumber has been ordered for our use. This is a step in the right direction to prevent the destructive effects of fungi and wood-ants in this exceptional climate. I venture to assert that the Panama Canal and Railroad Companies are losing thousands of dollars of valuable material annually from the lack of proper attention to these two destructive agents alone. I am satisfied that if the lumber imported here was prepared with some antiseptic to resist the growth of the fungi, the wood-ants would give it a wide berth. Such a method would not only lengthen the life of our cars and buildings, but greatly reduce the expense of keeping them in repair.

July 4th, 1888. I send you a package to-day containing four different species of wood-ants, found at work on our shop buildings. The contents of vial No. 1 are immature winged *Eutermes*, two queens, with some eggs, soldiers, and workers; No. 2 contains winged *Termes testaceus* L., soldiers and workers; No. 3 contains soldiers and workers of the smallest kind yet seen, which I am unable to name; No. 4 contains winged *Eutermes*, soldiers and workers; No. 5 contains winged ones, soldiers and workers.

You call my attention to some of the worker *Eutermes* having darker heads and bodies than others. This difference, I observe, is common in all the nests examined, and I think it entirely due to age. The youngest and smallest are of a transparent white, and shade to those having dark-brown bodies and black heads.

I have been observing the use they make of the antennæ, by causing a large drop of water to fall on a worker, which completely covered it for an instant, and made its antennæ curl up and stick to its head. It moved aimlessly about, apparently blind, until another worker, noticing its helpless condition, commenced at once to lick it dry, and then straightened its antennæ, upon which it walked away as though nothing had happened. Very different was the next experiment. I immersed in water for about two minutes another worker, then took it out, and laid it on dry paper a moment, then returned it to the Termitarium, placing it on a chip. It was just able to stand. Four soldiers were first to approach and notice it; one ran to the nest, the other three stood at a distance of about three-eighths of an inch, waving their antennæ, evidently smelling that something was wrong, but careful not to touch it. Presently a worker came out of the nest and cautiously approached, touched it with its antennæ, then gave it a cruel nip with its mandibles on the head, and went away. The poor sufferer remained motionless all the time, apparently blind and not knowing what to do. A second worker came, approached cautiously, as did the first, and touched it with its antenna, then suddenly seized it by the thorax and severed its head, without a struggle. The head rolled off the chip; the executioner then turned around and deposited a drop of the ever-ready cement on the headless body, and deliberately walked away. There was no excitement or alarm, and the nest was not disturbed; they did not treat it as a stranger or an enemy. *Query*—Did they kill it to end its misery? And why did they treat it so differently from the one not immersed? . . .

July 15th, 1888. I have successfully established another novel Termitarium. I desired an arrangement that would afford me facilities for observing their internal habits, as to the way in which soldiers were fed, and how the workers cut and masticate the wood upon which they feed. My success has been beyond my expectations, though some of the conclusions will need confirming by further and, if possible, more careful observations. Others are established facts that may, as you say, destroy some present theories.

I have increased the power of my lens by uniting two small ones: a worker, under this combination, appears to be about five-eighths of an inch in length. With this lens and my new Termitarium, I have been able to see without obstruction:—

The workers feeding the soldiers, and
The workers feeding each other, on masticated particles of wood;

I have actually seen the particles pass from one mouth to the

other; have noted the time taken to cut a cube of wood from the feeding-boards; have observed them masticating the same wood; and noted the number of times that the mandibles open and shut per minute while masticating.

On one occasion I could distinguish the minute saw on the left mandible. . . .

This Termitarium is made of two glass fruit-dishes,—the largest eight inches diameter by four and one-half inches deep, the other or upper story six inches by three and one-half, with flaring sides. You will notice that I can look directly down upon the ants on the feeding-boards. I can also, on one side, look directly into the upper retiring-room, and see the thousands congregated there,—some sleeping, others masticating, and some feeding and washing each other. They have chosen to leave the old and exposed nest on the *lignum-vitæ* block, and gone through the perforations to the secluded retiring-room below, just as I desired and expected. The Termitarium contains a population of from five to ten thousand. Their time seems to be chiefly occupied in sleeping, eating, “hewing wood, and drawing water” from wells dug in the soil when not otherwise provided, making galleries, and arranging earth-works in the retiring-room, the nature of which I do not yet understand.

When a worker has severed a particle from the feeding-boards H, H, it usually goes to the retiring-room, D, to masticate, and then feed to others,—soldiers and young workers,—and, if necessary, to itself. Then it commences at once to masticate on the board. Here it will perhaps be met and robbed of the morsel of wood by another worker, the latter deliberately pulling it from the other’s mandibles. The only resistance offered is a tug, that perhaps results in an equal division. Then both proceed to masticate. In a moment or two, according to the size of the piece, they will be ready for work again, and all the time perfect harmony prevails, one yielding to the other good-naturedly. When a worker has secured rather a large mouthful, it will twist and turn its head, while masticating, much as a cow does with a large slice of a turnip in its mouth. The mandibles open and shut about forty times a minute by the watch, the particles of wood meanwhile being turned by the *maxillæ* and *palpi* every time the mandibles are opened.

I noticed further about their habit of licking each other. I have seen four workers at once washing another worker, and observed another washing a soldier. After the body was done, the soldier held out each leg in succession to be cleaned. The fact of their beak being in the way,—and no mandibles,—prevent their “hewing and drawing,” so that they seem to have an easy time of it, being fed and cleaned by the workers.

With the aid of the lens, I picked up on the point of my pen a small particle of wood that a worker let fall ; it will give you an idea as to size, though I have seen them have larger pieces. It is gummed to the inclosed sketch, and the spot is marked thus ☉. You will have to use your lens. I consider this remarkable, and hope you will receive it all right.

While at Gatun Station, a few days since, I obtained two specimens of separate nests of the species No. 5 in my last package to you. On opening one nest, I found one-half of it occupied by an entirely different species—a black ant, not a Termite. There

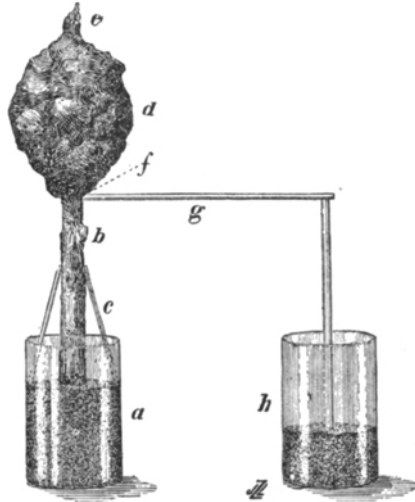


FIG. 9.—Improved Termitarium of Mr. J. Beaumont. *a*, glass jar, 6 × 9 inches, filled two-thirds with earth; *b*, *e*, small tree-stem, fixed into the soil and bearing a sub-globular nest of *Eutermes*; *c*, *c*, braces to steady it; *d*, nest, 10½ inches long, and raised 18 inches above the earth in the jar; *f*, opening made in the nest, from which the "bridge," *g*, leads to the "annex jar," *h*, partly filled with soil. When in use, the jars are placed in vessels partly filled with water, to prevent escape.

were the eggs, larvæ, and winged ones of the black variety. In the other half, occupied by the Termites, were larvæ also—doubtless their own. Here also, to my surprise, were the tracks of those called *Termes testaceus* L., on a fence-post, but no nest visible. While riding over the Panama Railroad during the week, I noticed the well-known tracks of the *Eutermes* running up the whole length of a creosoted telegraph pole. It will be interesting to know whether they will penetrate wood so prepared. There was also a green surface growing over the north side of these poles. I have since been told that these poles were not

filled with genuine creosote, but some preparation of crude well-oil. Can you enlighten me on this point?

I hope you are not tiring with my notes about my pets, for believe me, the half has not been told of their winning ways.

February 11, 1889.

STATED MEETING.

The President, DR. NEWBERRY, in the chair.

Fifty-five persons present.

A communication was read from the Royal Bohemian Society of Sciences in Prague, announcing the death of the President of that body, Mr. Joseph Jirecek, on November 25th, 1888, in the sixty-fourth year of his age.

The second lecture of the public illustrated course was then delivered by Professor ALPHEUS HYATT, of Boston, upon

MODES OF EVOLUTION IN FOSSIL SHELLS,

with an extensive series of lantern views, showing the nature and variety of modifications in species and groups.

The lecturer gave a few preliminary remarks on the meaning and general bearing of the doctrine of evolution, in which he held that this word is properly applicable to all kinds of variation into new life-forms, as well retrogressive as progressive, and objected to the use of such terms as "avolution," or the like, as proposed by some writers who would limit the idea of evolution to an implied advance. He followed these observations by showing stereopticon figures of his series of shells of *Planorbis* collected at Steinheim, in Germany. These illustrations gave the audience, in a succession of views, the evolution of a number of distinct forms, which had arisen from four varieties of one species, *Planorbis levis*. This species was almost equilateral, the whorls revolving nearly in the same plane during their growth. One of the series evolving from this form gave rise to a large turbinated variety resembling what are usually called Trochiform shells. Other series were less changed, though showing a tendency to evolve into similar