PSCYHOLOGICAL NOTES UPON THE GALLERY SPIDER —ILLUSTRATIONS OF INTELLIGENT VARIATIONS IN THE CONSTRUCTION OF THE WEB.

By C. H. Turner.

At the suggestion of Professor C. L. Herrick, a great many observations have been made upon the morphology of the gallery webs. A partial summary ot the results of that study is given in this paper.

To facilitate description the different parts of the web have been named. The main expanse of the web has been called the main sheet. Ascending from the outer edge there is often a more or less vertical portion. This has been called the guard sheet The loose network of threads above the main sheet constitutes the snares. The name gallery has been retained for the hiding place of the spider.

In the meadows, the web of the gallery spider is an irregular sheet, stretched from blade to blade of grass. There is no general pattern to which they all conform. Not only the shape of the web, but also the number of sides and proportions are subject to great variation. The aim of the spider seems to be to cover as much ground as possible. The gallery is usually located at one extremity of the web; but sometimes it penetrates the main sheet from below and near its centre. If there is a crack in the ground at that place, the gallery is usually located in it. Occasionally the gallery is concealed beneath a stick or leaf, but often it is merely hi lden in the grass. Numerous observations have been made upon these meadow webs; but the conditions are too uniform to yield much of psychological value. But when the external environment becomes more heterogenous, it is interesting to note how the spiders become masters of the situation.

Example I.—Location: bottom lands bordering on a creek.

Main sheet large, horizontal, irregular in outline, attached to two logs and to the tops of several weeds.

Gallery located in one end. Guard sheet absent.

The above might be taken as a general type of the irregular web. But the following observations made in the same locality, upon the same species, at the same will illustrate how the spider adjusts its web to slight changes in the environment.

EXAMPLE II.—Location: bottom lands bordering on a creek.

Main sheet large, horizontal, irregular in outline, attached to two logs and to the tops of several weeds. In the midst of this sheet a branching weed was growing. The branches of the weed pierced the web in several places. In all cases the web was intimately connected to these branches. Gallery in one end. Guard web absent.

In the following case, the spider has certainly become master of the situation.

EXAMPLE III.—Location: stone wall, above a hole and beneath a projecting ledge.

Main sheet irregular in outline, intimately attached to the wall, extending as a horizontal bridge from stone ledge to stone ledge across a wide hole. Gallery in the back part of the web, about half way between the two extremes. Guard sheet very high, extending along the whole outer edge of the web and attached to a stone which roofs the web. Snares few, extending from inner edge of web to the stone roof.

This device is a most effectual insect trap. No doubt insects resting or walking on either ledge often attempt to pass through this trap to the ledge beyond. Once inside of the structure, there is no escape. The insect cannot escape to the right, because the wall is there; it cannot escape to the left, because the guard sheet is there; it cannot escape above, because the stone roof is there; it cannot escape celow, because the main sheet is there. But it must continue along the broad way that leads to destruction. Sooner or later it impinges against a snare, falls upon the web, and is captured by the expectant spider. Was this web the result of blind instinct? I think not. It must not be supposed that all of these irregular webs are horizontal. Usually they are so, but often they are more or less inclined. The following observation is an illustration.

EXAMPLE IV.—Location: a railroad embankment, covered with large cinders and weeds. Main sheet irregular, inclined, extending from a large cinder upwards to several weeds Gallery near one of the corners, penetrating the main sheet from below. Guard web absent.

The main sheets of all the webs so far considered are irregular in outline. This is not always the case. The main sheets of many webs have definite outlines, the outlines being determined by the environment. The triangular web is the commonest form. These are found in corners everywhere.

These triangular webs are sometimes horizontal, sometimes inclined toward the apex, sometimes inclined toward the foot. The following examples may serve as types of many.

EXAMPLE V. Location: angle between stone wall and wooden post. Main sheet horizontal, attached in the angle between the wall and post. Gallery in the angle. Guard web practically absent. Snares few.

EXAMPLE VI.—Location: angle between two logs. Main sheet inclined, passing from the apex of the angle upwards and outwards at an angle of about five degrees. Gallery at the apex of the triangle at the lowest point of the web. Guard web absent. Snares abundant.

EXAMPLE VII.—Location: angle between window-sill and side wall. Main sheet attached in the angle between the projecting window sill and the side wall. The sheet slopes gradually downward along the side wall. Gallery in the angle. Guard web, highest at the lowest point of the web. Snares abundant.

These I have called types. But the introduction of a new element in the environment is sure to call forth a modification to meet the case at hand. For example, if a ledge be near, a portion of the web is almost certain to be extended along that ledge for a short distance.

The two following adaptations are further illustrations of the same thought.

EXAMPLE VIII.—Location: angle between window-sill and side wall. Main sheet horizontal, attached to the window and to the side wall. Above this web there was a web of another spider of the same species. A tension string united the

main sheet of the web under consideration to the main sheet of the web above it. Gallery in angle. Guard web present, the same height everywhere. Snares abundant.

EXAMPLE IX.—Location: angle between window sill and side wall. Main sheet stretched from window sill to the side wall. The sheet inclined, the side next to the window being the lowest. Gallery in the angle. Guard sheet high, especially so near the window. It would be difficult to find a more effective device than this for capturing flies that come gliding down the window-pane.

The observations recorded in examples VII, VIII, and IX were made upon the same species of spider, in the same locality and at the same time. This fact gives the observations great weight. It shows that, under similar circumstances, individuals of the same species occasionally arrange their webs quite differently. Professor Morgan says that "Instinctive actions are those which are performed by the individual *in common with all the members of the more or less restricted group*, in adaptation to certain oft-recurring circumstances" If instinct be no more than this, surely these spiders have transcended instinct.

Among these triangular webs I have met with another interesting modification.

EXAMPLE X.—Location: angle between a stone wall and a vertical post. Main sheet triangular, attached in the angle between the wall and post. Web nearly horizontal, bagging slightly in the centre. Gallery in crevice between wall and post. Snares few, attached to both wall and post.

The following is an extreme illustration of the same thing.

EXAMPLE XI —Location: angle between two walls. Main sheet attached to both walls, in shape resembling an inverted Japanese hat with a triangular brim. Numerous small bits of whitewash were found in the depression. Gallery in the angle.

It is a noteworthy fact that in both these cases and in other similar ones, neighboring spiders of the same species had constructed webs that were approximately flat.

At first blush, example XI appears to give us an example of a spider deliberately constructing an incline down which struggling insects would roll to their doom. But I am not sure that such an interpretation is warranted. The bits of whitewash

in the web are very suggestive. Why may not bits of white-wash falling into such a web as is described in example X, have such so stretched that web as to produce the one described in example XI. This possibility is strengthened by the following fact: By dropping bit after bit of wood into a web of the type described in experiment X, I was enabled to produce a web of the type described in example XI.

I have, however, seen a few webs where the funnel shape was something more than a transformation by stretching of an originally slightly bagging web. The following example is an illustration.

EXAMPLE XII.—Between two vertical and one horizontal log. Main sheet funnel shape, the apex of the funnel being vertical. Gallery vertical, at the apex of the funnel. Guard web absent. Snares very abundant, forming a loose horizontal network.

Next in number to the triangular webs come the rectangular webs. The rectangular webs vary in shape from perfect squares to very long rectangles. The sides are sometimes straight and sometimes curved. Occasionally more remarkable variations are encountered.

EXAMPLE XIII.—Location: crack in an old tree trunk. Main sheet nearly horizontal, attached on all sides to supports. A short distance above the main sheet there was a parallel secondary sheet. This sheet completely hid the gallery from above. This secondary sheet was nearly as large as the main sheet. Gallery at one corner in a crack. Guard well on one side only, high near the trunk. Snares abundant.

This secondary sheet is an interesting feature. Unfortunately I had no opportunity to see the inhabitant of this web. Therefore I cannot say whether it was an individual of the same species as the spiders of the neighboring webs or not. None of the other webs of that vicinity porsessed a secondary sheet above the main one.

As in triangular webs, so here the main sheet often departs a great deal from the horizontal. Among my notes is recorded one of these inclined webs which contains a noteworthy modification.

EXAMPLE XIV.—Location: ledge in stone wall in front of

a hole in the wall. Main sheet extends from the ledge upwards, at an angle of fifteen degrees, to a lateral prolongation of the rock that forms the roof of the hole. Thus we have gradual incline, passing from a lower to a higher ledge. A portion of this sheet extends into the hole and forms a carpet in the same. Gallery hidden under the stone at the top of the incline. Guard web on the outer side very high, attached to the stones above the web. Snares absent.

This is a remarkable web. Those who run may read that it serves a double purpose. The high guard web insures the capture of insects that attempt to fly out of the hole; while to walking insects the gentle incline forms a tempting bridge by which to pass from ledge to ledge. Once on the web the spider claims them for his own. Note also that the position of the gallery is such as to render it invisible from either the hole or the ledge. Is this web the result of mere instinctive construction? I think not. Here an individual has built differently than the remaining individuals of the same species. Here again an individual has transcended instinct and entered the arena of intelligence.

The main sheets of all the webs so far considered are single. I have noticed five cases where the main sheet was compound. For the sake of completeness I give them all.

EXAMPLE XV.—Panel of door. Main sheet attached to side and back of panel. This sheet consists of two divisions. The first portion slants downward, at an angle of about fifteen degrees, along the back of the panel for quite a distance. Here the second division begins and passes upward at the same angle until it reaches the level at which the first division began. Gallery in the angle. Guard web high. Snares abundant.

EXAMPLE XVI.—Location: log pile. Main sheet stretched over the logs. It consists of two divisions. One half is nearly horizontal, the other slants upwards at quite an angle. Gallery piercing the centre of the web, from below. Guard web absent.

EXAMPLE XVII.—Location: log pile. Main sheet consists of two parts. One portion is horizontal and flat, and attached to two intersecting logs. The other portion resembles an inverted, triangular Japanese cap. This portion is continuous with the first division, but it is attached to weeds instead of logs.

Gallery horizontal, located in the angle between the logs. Guard sheet absent.

Here again we meet one of those basket-like webs. [cf. example XI.] In this case, however, the depression was empty.

EXAMPLE XVIII.—Location: weeds and logs, near the ground. Main sheet is horizontal and consists of three rectangles arranged like the lobes of a clover leaf. Gallery in a hole in a log. Guard web absent. Snares abundant.

EXAMPLE XIX.—Location: two adjacent vertical posts. Main sheet double. As the posts stood there were two angles between them. These angles were opposite each other. In each angle was located one division of the main sheet of the web. These two divisions were not counterparts of each other. Sheet number one was horizontal and attached to the two logs and a neighboring log. Sheet number two was inclined and was attached to the two logs and to neighboring weeds. Gallery common to the two webs, hour-glass shaped and located between the two logs.

With one exception, this appears to be the most remarkable web that I have ever encountered. It seems as though the builder had been animated by thought similar to those which prompts a school boy to fish with two lines instead of one. It seems as though the spider has learned to kill two birds with one stone. Among the piles where this web was found there were hundreds of webs. There were also numerous places where double webs of the above type might have been constructed. Yet the above example was the only one observed in that place. That spider appeared to be the master mind of the locality.

About the posts of ancient rail fences, I have occasionally thought that I observed other webs of the kind described in example XIX. But in no case was I certain of this.

Next to the main sheet, the gallery is the most conspicuous portion of the gallery webs. Like the main sheets, the gallery is subject to great variation. But usually these varations do not consist of changes in the form of the gallery. I have noticed one case where the gallery was hour-glass shape, [see Ex. XIX] but as a rule the gallery departs but little from the usual conical shape. The variations here are of a different sort. They consist in variations in the location of the gallery.

By far the most common position for the gallery is in some angle of the web, [see example X]. It is usually located in that angle which contains a crack or a hole or some foreign body within which or under which the gallery can be concealed. But this is not always the case. I have often seen the gallery in a corner which contained no contrivance which might be utilized as a shield for the web, when, at the same time, another corner of the web afforded ample facilities for such concealment.

When the web is inclined, the gallery is sometimes in the lowest portion of the web, as in example VI and sometimes in the highest portion of the web, as in the following example.

EXAMPLE XX.—Location: window-sill. Main sheet is inclined, highest at one place upon the wall, from which it slopes in three directions to the sill. Gallery at the highest point. To prevent the roof of the gallery from collapsing, tension lines extend from the top of the gallery, over the main sheet, to the sill. Guard web absent. Snares absent.

Although the gallery is usually situated in an angle, it is not always thus located. It is often appended to one of the sides of the web. Example III is an illustration. There the galleries situated half way between the two extremes of its web. In the shadow, half way between the two extremities of that treacherous bridge, the spider awaits its victim. Could man have selected for it a better station? I will cite one other example.

EXAMPLE XXI.—Location: angle between a stone wall and a wooden post. Main sheet triangular, attached in the angle between the wall and post. Gallery in a hole in the wall at about one third of the length of the web from the intersection of the wall with the post. It is a noteworthy fact that in this case there was a crack in the corner in which the gallery could have been constructed. Guard web quite high, highest near the wooden post. Snares very scarce

The following example is a more striking illustration of the same thing.

EXAMPLE XXII.—Location: angle between stone wall and wooden post. Main sheet triangular, horizontal, attached in the angle between the wall and the post. Gallery on the wooden post at quite a distance from the intersection of the

stone wall and the post. In this case there is no hole in the post, but there was a crack between the post and the wall in which the gallery might have been hidden. Guard sheet practically absent.

The spider that constructed this web was a member of the same species as the spider that constructed the web recorded in example V. Here again we have an example of individuals of the same species, under similar circumstances. constructing dissimilar webs, and here again we have an example of something that transcends instinct.

We now come to consider variations in the morphology of the guard sheet. In some cases it is absent. In horizontal webs it is more often absent than present. According to my observation, in horizontal webs, the ratio of the times present to the times absent, is as one is to two. When the guard sheet is present in horizontal webs, it may be either low or high. Compare example III with the following.

EXAMPLE XXIII.—Location: rectangular space formed by water pipe, side of house and fence. Main sheet horizontal, rectangular attached to fence, house and pipe. Gallery behind the pipe. Guard web exceedingly low. Snares few.

Occasionally webs are encountered in which the guard sheet is present in some portions of the outer side while it is absent from others. The following observation is an illustration of this.

EXAMPLE XXIV.—Location: between stone wall and wooden post. Main sheet attached in the angle between the post and wall. The sheet is horizontal, bagging slightly in the center. Gallery in crevice between wall and post. A low guard web is present near each extremity of the exposed side of the web while the guard web is absent from the middle of that side. Snares few, attached to both wall and post.

Among inclined webs, the guard sheet is more often present than it is in horizontal webs. But even here the number of times the sheet is present predominates but little over the number of times that it is absent. Example IV, VI, XII and XX are illustrations of cases wnere the guard sheet is absent, although the web is inclined.

As in horizontal webs, so here, the guard sheet is some-

times high and sometimes low. Examples number VII, XXI and the following example are illustrations of a modification that is quite common.

EXAMPLE XXV.--Location: angle between brick wall and water-pipe. Main sheet triangular, attached in the angle. Inclined, lowest where it joines the pipe. Guard web highest at the pipe, gradually diminishing in height as it approaches the brick wall. The following is an extreme case of the same sort.

EXAMPLE XXVI.—Location: angle between the book case and and the wall at level of the top of wainscoting. Main sheet inclined sloping at an angle of 45 degrees from the top of the wainscoting up to the book case. Guard web present only at the lower extremity of the web. There it forms a low fence along the outside of the wainscoting. Snares few. Here again we have an incline up which insects may be tempted.

The arrangement of the snares is so irregular that I will pass them by with a few words. These snares are sometimes absent; at other times they very from a few threads to a dense meshwork. Occasionally the arrangement is peculiar.

EXAMPLE XXVII.—Location: pile of vertical and horizontal logs. Main sheet irregular, nearly horizontal, arranged so that insects could pass from the top the logs on to the web. Gallery in one corner. Guard web absent. Snares abundant, at a short distance above the main sheet these threads from a horizontal network.

The secondary sheet cited in example XIII may be but an extreme of such a horizontal net work of snares.

A number of experiments have been made to test the spider's ability to vary the arrangement of its web to suit the environment. These experiment consisted in taking spiders from varions localities and subjecting them to a different environment.

EXAMPLE XXVIII.—A large number of spiders were placed in cylindrical bottles and left two days. Each bottle was closed with a perforated cork and only one spider was placed in a bottle. When captured some of these spiders were occupying triangular webs, some were occupying rectangular, and some were occupying irregular webs; but none were occupying circular webs. The majority of the spiders constructed webs. All the webs were circular. As a rule the webs were constructed

near the top of the bottle. In all cases the gallery was against the side of the bottle, and penetrated from below. These spiders were now placed in a large box in which had been arranged facilities for constructing webs of any shape or size. The majority of the spiders died. Of the survivors, some built triangular webs, some built rectangular webs, others built irregular webs. Some of the webs were horizontal, some inclined. In some the gallery was in one position, in others the gallery was in a quite different position.

EXAMPLE XXIX.—Another lot of spiders was collected, care being taken not to collect any spiders that were residing in quadrangular webs. These were isolated in cylidrical bottles and left several days. The survivors constructed circular webs. They were now placed in the box used in the last experiment. Many died. The survivors constructed webs. A few of these webs were rectangular. Here, then, we have a case where the same individual successively constructed three differently shaped webs. This experiment has been repeated several times. Whenever the spider survived the ordeal the result was the same as here.

I now come to an experiment of a different sort.

EXAMPLE XXX.—In the angle between a projecting window-sill and the wall of the room, a spider had constructed a large triangular web. The gallery and a small portion of the main sheet were on the window-sill. With a broom I demolished that portion of the web which projected beyond the sill. During the night the spider reconstructed the web. The web was again destroyed, with the same result. This was repeated four times. But the fifth time, although the spider began to reconstruct the web, it only extended the structure a short distance beyond the sill. Was this variation a mere chance, or did the spider realize that there was danger beyond this sill and act accordingly? This is an isolated example.

EXAMPLE XXXI.—A tear was made in the free border of a triangular web. The spider patched the web.

EXAMPLE XXXII.—A large hole was made in a triangular web. The hole was situated near the free border of the web. During the night, the web was patched. In some unknown way the hole had been increased until it divided the free border

of the web. The distal corners of the patch were attached to the supports a little above the former web.

EXAMPLE XXXIII.—A small hole was made in the main sheet of nine different triangular webs. In each case the web was patched. The new spun web usually extended beyond the border of the hole but in no case did it cover the entire web.

EXAMPLE XXXIV.—A large circular hole was made in the main sheet of three different triangular webs. A slender post was erected in the centre of each hole, care being taken not to allow the post to come into contact with the main sheet. One spider did not patch its web. The second spider partly patched it. The patch being attached to the main sheet and to two adjacent sides of the post. The third constructed a complete patch, attaching it to the main sheet and to the post.

The three preceeding examples teach us that, as in the orb weaving spider[1] and in the purseweb spider,[2] so here, the spider patches its web whenever circumstances render it necessary.

EXAMPLE XXXV.—An arachnarium was constructed in the following manner. Took a large battery jar and covered the bottom with moist sand to the depth of about one inch. Moist sand was then smeared on the sides of the jar, to within three inches of the top. Such a jar formes an excellent arachnarium. Ordinary spiders can ascend the glass only so far as the sand extends. In the centre of the bottom a slender four inch post was erected. An angle was formed of paper and placed in the jar. The apex touched the side of the jar. The two extremities touched the jar on opposite sides of the apex and at a distance of about one fourth the circumference of the jar from the apex. This angle was about four inches high. A spider was taken from a triangular web and placed in this jar.

1. *F. Dahl*—Versuch einer Darstellung der psychischen Vorgänge in den Spinner. *Vierteljahrsschrift f. Wiss. Philosophie.* Bd. IX, p. 162.

George J. Romanes Animal Intelligence. pp. 211 (1883)

2. *Henry C. McCook*—Nesting Habits of the American Purseweb Spider. Proc. Academy of Natural Sciences of Philadelphia. 1888, part II, pp. 206.

A.—After two days had elapsed, the spider constructed a web the main sheet of which extended from the top of the paper to the top of the central post. There was no guard sheet. The spider concealed himself in a crevice between the paper and the side of the jar. There was no true gallery. But the main sheet, which extended over the top of the paper angle to the side of the jar, was pierced at one place by a cicular hole. Through this hole the spider came and went. At first this web occupied only half of the available space. But the next night the web was increased until it formed a complete horizontal partition in the jar. I destroyed this web.

B.—The web was reconstructed. In all essentials it agreed with the web first constructed. I destroyed this web.

C.—The web was reconstructed, but in a different part of the jar. This time the main sheet extended obliquely upwards from the floor to the side of the jar opposite the paper angle. The lowest portion of the web was near the central post, while the highest was opposite the paper angle and about three inches above the level of the sand. There was no guard web. The vertical gallery was built against the glass at the highest point of the web. This web was not disturbed.

D.—The above web had not been completed two days, before the spider remodeled it. The main sheet was extended horizontally from what had been the highest point of the web to the central post. The upper portion of the gallery was increased by the addition of a horizontal tube about one inch long and a half inch in diameter. Near the side of the jar the gallery expanded into a large room with a diameter, along the side of the jar, of from two to three inches The roof of the gallery was supported by tension strings which extended from the distal edge of the roof to the opposite side of the jar.

EXAMPLE XXXVI.—An arachnarium was arranged as above; but, instead of having one central post and a paper angle, four posts were arranged so as to form a square.

A.—One spider was placed in the jar. After the lapse of a few days a web was constructed The main sheet was horizontal and attached to the side of the jar and the top of one post. A vertical gallery was constructed against the side of the

jar. In a few days this web had been increased until the main sheet formed a horizontal partition in the jar. This sheet was attached to the tops of all of the posts. I destroyed this web.

B.—A small rectangular tube was placed on the ground between two posts. The web was reconstructed. This time the gallery was located on the ground near one of the uprights. The gallery was held extended by tension strings which extended from the sides of the gallery to the tube and to the side of the jar. There were two main sheets, one extending form each extremity of the gallery, outward and downward to the floor. During the second night a vertical guard sheet was erected, which extended from the gallery to the post diagonally opposite. A few days after this web had been completed the spider was disturbed while resting in the gallery. It immediately left it. The web was not injured in the least.

C.—The night following its hasty retreat from the gallery, the spider constructed another web. The main sheet was horizontal and on a level with the top of the posts. It was pentagonal, being attached to the jar, to three posts and to the upper edge of the guard sheet of the lower web. Where they met the main sheet of the lower they were completely fused. The gallery was an L shape tube It consisted of a horizontal portion extending along the sand and of a sub-vertical portion ascending along the jar.

The two webs thus unequaly combined formed a two story house; and the L shaped gallery formed a stairway leading from the first to the second story. Indeed the spider used sometimes one story and sometimes the other. At one time it would await its prey in the upper gallery; while at another time it would await its prey in the lower gallery.

SUMMARY.

Various writers from Fr. Dahl[1] to McCook[2] have informed us that the orb-weaving spiders vary the structure of their webs to suit the environment, and that they patch their webs, when

1. Op. cit II.

2. American Spiders and Their Spinning Work.

accident renders it necessary. The purseweb spider also patches its web. [3]

The above examples teach us that the gallery spiders conform to the same rule.

The main sheet undergoes all variations from a flat expanse [Ex. I] to a funnel shape bag [Ex. X–XII].

The main sheet may be either horizontal [Ex. II] or inclined [Ex. IV, VII].

In fence corners and other places where the environment is simple, the shape of the web is apt to be governed by the shape of the environment, [Ex. V–IX, XXI]; but where the environment is more complex, the shape of the web can not be predicted [Ex. III, XXXV, XXXVI].

A web usually contains but one main sheet, but on rare occasions the web may consist of two or more such sheets. In such cases the sheets may be fused into one compound sheet [Ex. XV, XVI, XVII, XVIII]; or the two sheets may be united by a common gallery [Ex. XIX]; or, they may so unite as to form a two story house [Ex. XXXVI,C].

The gallery may be located at any portion of the main sheet [Ex. III,V,VI,XII,XIX,XX,XXI,XXXVI]; sometimes the gallery is absent [Ex. XXXV,A].

In spite of all this variety, if individuals of the same species constructed similar webs, there would be no indication of intelligent action. But such is not the case. Under the same external conditions, individuals of the same species construct dissimilar webs [Ex. VII–IX; V,XXII].

Not only so, but under the same external conditions the same individual constructs webs that are quite different. At one time a spider may construct a flat web in which a hole in the main sheet supplies the place of a gallery [Ex. XXXV,A]; later, under the same conditions, that spider may construct a web with a very conspicuous gallery [Ex. XXXV,C].

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3. *Henry C. McCook* Nesting Habits of the American Purseweb Spider. *Proc Acad. of Natural Sciences of Philadelphia, 1888, part II, pp. 206.*

At one time a spider may construct a web which contains but one main sheet [Ex. XXXVI, A]; later the same spider, under the same conditions, may construct a web with two main sheets connected by a common gallery [Ex. XXXVI, B]; still later the spider may remodel this web and transform it into a compound web having an upper and lower story connected by a special gallery [Ex. XXXVI, C].

The gallery spiders patch their webs, when accident renders it necessary [Ex. XXXI–XXXIV]. They also remodel their webs [Ex. XXXV, D, XXXVI, C].

The fact that all of these webs consist of a more or less expanded sheet to which a gallery is attached seems to indicate that there is an inherited tendency in gallery spiders to contruct galleries.

On the other hand, if instinct dictated the details of construction, then all webs constructed by individuals of the same species should be identical. But this is not the case. Even where the external environment is the same, webs of different individuals of the same species are often dissimilar. Furthermore, on the grounds that instinct is the only determining factor, how can we account for the fact that under the same external conditions, the same individual constructs dissimilar webs.

All things considered, I think we may safely conclude, that an instinctive impulse prompts gallery spiders to weave gallery webs, but the details of construction are the products of intelligent action.

ADDITIONAL PSYCHOLOGICAL NOTE UPON THE GALLERY SPIDER.

By C. H. Turner.

Example XXXV, E.—After my last paper had been printed, this spider made a unique addition to its web. At a height of about five inches above the main sheet of the web [see Ex. XXXV, D, supra. p. 107], the spider constructed a funnel-shaped web. The circumference of this web was attached to the sides of the jar and the apex was directed downwards. In form this accessory web was a true cone. It was a sort of pyramid-shaped body, composed of several unequal flat surfaces. It was fastened to the lower web by tension cords. Its apex was about an inch above the lower web. Snares were abundant, but there was no gallery This addition to the web converted it into a miniature model of a lobster-pot. The spider usually rested in the gallery of the lower sheet. Every fly that fell upon this upper sheet was doomed to die. Every struggle carried it nearer the apex of the funnel. Sooner or later, it was sure to fall into the trap below. There it was at the mercy of the spider.

There was no obstructions to prevent the flies escaping by the same opening which they entered; but I have observed numerous flies tumble into the web and not one thought of escaping by that opening. Whenever a fly was so fortunate as to become disentangled from the lower sheet before being captured by the spider, it was sure to make for the highest portion of the trap. There, hemmed in by the web on all sides, it became an easy victim.

There is another point I wish to add here. In many of the webs constructed by my imprisoned spiders, the gallery had two openings. One of these openings led on to the main sheet, while the other led to the sand below.

For a long time I was at a loss to know what the spiders did with the remains of the dead flies. Although the spiders

captured a number of flies, yet the webs seldom contained more than one or two flies; and sometimes the webs were entirely empty. One morning I saw a spider carry a fly down the gallery and drop it on the sand below. This led me to examine the sand in all my arachnaria. Upon the sand I found the remains of a large number of flies. Although I did not observe my spiders take but one fly and place it on the sand, yet the facts seem to warrant the conclusion that the spiders remove dead bodies from their webs. I do not, however, believe that the observed facts warrant the conclusion that they are always conveyed down the gallery. Indeed the location of many of the flies seemed to indicate that they had been carried to the edge of the web and dropped over.

INTELLIGENCE IN ANIMALS.

I.

A CASE OF ABSENT-MINDEDNESS. A tame raccoon, which has been observed for some time, still has the habit of washing its food. On several occasions food was given him when hungry, in such small morsels that on the way to his water pan he devoured it completely. He continued toward the pan and assumed the customary position before observing that he no longer had anything to wash This was repeated several times until he seemed at last to "recollect himself," as we say, and the small fragments were no longer carried toward the water. This simple and probably familiar observation indicates a similarity between instinctive and habitual processes of some interest in forming opinions upon instinct.

II.

LOGICAL INFERENCE IN A DOG. The following incident related by T. H. Pritchard, was kindly communicated by Professor G. W. Manly. From a personal letter to the latter we are permitted to quote as follows:

"WILMINGTON, N. C., July 22, 1892.

PROF. G. W. MANLY: The facts about the dog are the following: Some fifteen years ago I was hunting in Wake Co., N. C., *with a handsome young pointer dog*, called Dr. Pritchard,

as I had given him when a puppy, to President F. P. Hobgood, and he had named him after me, with my consent. This dog was sent to me from Salisbury, by my kinsman, Baldy Boyden, and was said to have been of excellent stock. I do not think he was more than two and a half years old at the time the incident occurred which I am about to relate.

The dog leaped on the fence, not having smelt birds before; for a time he remained stationary; I saw him and knew that he was standing birds. After a little while he carefully crawled down on the same side of the fence from which he had approached it, and then went down the fence some forty or fifty yards, leaped the fence, cautiously approached the covey from the other side and when he got at the proper distance, stood them as usual. I have often instanced this case as demonstrating the power of legitimate, logical reasoning in a dog. As a mental process I believe it was as clear a case of reasoning as was ever done by Sir Isaac Newton. He knew that if he jumped over the fence, they were so near that they would fly, which was a thing he must by all means avoid; so, after turning the matter over in his mind, whatever sort of mind it was with which he was endowed, he concluded that he could reach them by going down the fence and coming up on the other side.

When this dog died his obituary was published in an Oxford paper. In that obituary he was spoken of as President Hobgood's faithful friend, Dr. Pritchard, and many persons thought it was I that was dead."

AN ILLUSTRATION OF THE TAXONOMIC APPLICATION OF BRAIN MEASUREMENT.—FULICA.

BY E. G. STANLEY.

To illustrate the way in which the present system of bird classification is looked on by ornithologists, we quote from the Encyclopaedia Britannica, Ninth Edition, Vol. III, p. 699:

"The difficulty of applying this very valuable morphological grouping [Professor Huxley's], and making it fit with one that is more general and distinctively zoological (that is, having reference to every character, external and internal), does not take