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827TH ORDINARY GENERAL MEETING,

HELD IN COMMITTEE ROOM B, THE CENTRAL HALL, WESTMINSTER, S.W.1, ON MONDAY, MARCH 6TH, 1939, AT 4.30 P.M.

DOUGLAS DEWAR, ESQ., B.A., F.Z.S., IN THE CHAIR.

The Minutes of the previous meeting were read, confirmed and signed and the Hon. Secretary announced the following elections:—As a Member: Dr. Albert Spanjer (Cand Notaris). As Associate: Colonel F. C. Molesworth.

The CHAIRMAN then called on Mr. B. D. W. Morley, Esq., F.R.E.S., F.R.H.S., to read his paper entitled "On Ants' Ninth Sense."

The meeting was then thrown open to discussion in which the Rev. A. Payne, Mr. R. Duncan and Lt.-Col. O'Gorman took part.

ANTS' NINTH SENSE—ONE OF THE MYSTERIES OF ANT LIFE.

BY B. D. W. MORLEY, ESQ., F.R.E.S., F.R.H.S., M.I.C.Ent., M.S.B.E., Memb. soc. ent. de France, etc.

BEFORE actually discussing the reasons for concluding that the existence of a "ninth sense" in ants is possible, if not probable, and the nature of that sense, it is proper that I should offer a few words of explanation as to why I began my researches. The original aim of my research was an attempt to establish the means by which the sub-family *Formicinæ* Mayr, of the ants (Fam. *Formicidæ* Mayr) communicate when at a distance from one another. The family *Formicidæ* is divided into eight sub-families, and have attained their highest development in the *Formicinæ*. (See phylogenetic chart.) It is known that the sub-families *Ponerinæ* Mayr, *Cerapachyinæ* Wheeler, *Pseudomyrminæ* Wheeler, *Dorylinæ* Skuckard, and the most primitive species of the sub-family *Myrmicinæ* Mayr communicate by means of stridulation, sounds being elicited by means of rubbing one smooth, hard surface against another uneven, hard surface. It is possible that some species of the sub-family *Dolichoderinæ* Forel also communicate by this method, but it is

certain that the highest developed species of this sub-family and all the species of the sub-family *Formicinæ* do *not* communicate by this method. It is probable that the species of the eighth sub-family, the *Leptanillinæ*, communicate by stridulation. I entered on this difficult and complicated problem in what seemed to me the most obvious and promising manner. I made a list of all the possible methods of distant communication between ants, and, after having obtained the opinion of various specialists on these, I summed up the possibilities of each. This reduced the possible methods to three :—Smell, Stridulation, and Ninth Sense. (See " On Ants' Methods of Communication," B. D. Wragge Morley, *Trans. Suffolk Nats. Soc.*, 1937.) I then proceeded to do a number of experiments after the following manner :—

Data.

12.21 a.m. An ant was out exploring. Sugar put down at (A), fairly near it.

12.22 a.m. Ant found sugar.

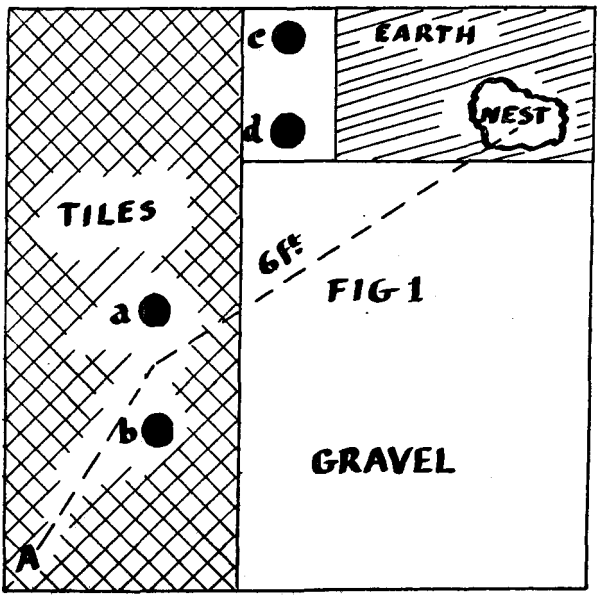
12.25 a.m. Ant still at sugar, four other ants came straight from nest to sugar, via (*a*). They did not visit *a* or *b en route.*

12.25½ a.m. One ant came from nest, missed sugar and went back again.

12.26 a.m. Ten ants at sugar, five more having come from the nest.

It is worthy of notice that the four ants when they went out to the sugar did not follow the trail of the first ant, but went direct. Thus communication was not effected by following a trail of scent, as suggested by Professors Julian Huxley and von Frisch. Neither was communication affected by means of tapping on the ground, since the vibrations could not possibly carry over that distance. Also the surface, apart from its not being the same in substance over the whole distance, was unsuitable for the latter. More experiments of a similar nature were done, communication being effected in a like manner in approximately 67 per cent. of the experiments ; thus establishing that communication was not effected after the manner put forward by Huxley or by vibration communicated through the ground. This did not mean that scent as a method of communication was disproved by these experiments, since another method of communication by scent can be put forward as

follows :—the ant, on finding the food, produced by some method a scent which was noticeable to the other ants over long distances, causing them when they smelt it to follow it up and thus arrive at the required place. This method of communication would have been possible, of course, under the conditions existing in the experiments just described. It was therefore necessary to determine whether communication could take place under conditions where this method of communication by scent was made impossible. If communication was effected under those



KEY TO DIAGRAM.

a, A flower pot, containing flowering plants which the ants were in the habit of visiting ; *b*, flower pot containing fern. The ants did not visit this ; *c*, and *d*, posts, with lattice work in between, supporting a verandah ; *n*, nest under stone ; A, first lot of sugar.

circumstances it meant that it was effected by stridulation, or some unknown sense. A good deal of consideration was given to this question—how to evolve an experiment which would supply these conditions—and a great deal of time was wasted in trying out experiments which proved unsatisfactory. It was, after all, quite an ordinary observation which showed me that

I was correct in considering this type of communication by scent as an unlikely method of communication from a distance amongst ants. Some ants had escaped (I killed them immediately) from one of my wooden observation nests, resulting in the remaining ants also endeavouring to escape. The nest was, of course, resealed before they were able to do so. The excitement had apparently been conveyed to two ants, taken from the same colony, which were in another observation nest, since they also started to rush about. If communication was effected by scent, it would be impossible, for reasons gone into in an earlier paper, for the ants to convey more than the most elementary message. It is certain that no message expressing such a communication, as would be necessary under the conditions existing at the time of this observation, could be made by means of this method of communication. This was confirmed by later experiments.

Though I was certain that communication amongst ants, far apart, was effected by one of two methods, stridulation or ninth sense, I was unable to progress any farther. It was in endeavouring to do this that I received confirmation of the conclusion drawn from the observation cited earlier. I had some ants, taken from a nest about half a mile away from where I was staying at that time, in a jam jar; an article which is often used as a temporary observation nest. I kept them for about a week, in order to give them time to settle down to a life of set habits, as is usual in an observation nest. I then proceeded with the experiment.

A jam jar was taken to the place where the first lot of ants came from, the other (first) jam jar being left behind. Both jars had tin lids. About 160 ants, together with a certain amount of earth, were scooped up into the jar, the ants being, of course, taken from the same nest as those in the first jar.

The second jar was then taken back to the place where I was staying, but was left outside the room where the other ants were, about twenty-four feet away. The windows were shut and the second jar was fairly air-tight. The ants in jar No. 2 were, of course, shaken and disturbed by the journey. The ants in jar No. 1 were, however, when I left them, as they usually were at that time, peaceful and below the surface of the earth. Entering the room I found two ants in the original nest (No. 1) running round, apparently looking for something; they continued doing so for about two minutes.

It was obvious that communication had been effected between the two jars of ants. This communication could not have been effected by smell, and it seemed probable that it was not effected by stridulation. The results of the experiment were not, however, conclusive on this point, and in any case this type of experiment is rarely conclusive, even if it be repeated many times.

Normally, one would take into account the possibility of the existence of an unknown sense, and would therefore conclude that these ants communicated by means of either that or by stridulation. In this case, however, it was necessary to bear in mind the results obtained by other entomologists, when experimenting in order to try to solve this same problem. These entomologists put forward good reasons, as mentioned earlier in this paper, for the existence of communication by means of stridulation amongst the more primitive ants. Indeed, it has been known for some time that certain ants of the family *Dorylinæ* often make, when out hunting for prey, a sound similar to, though very much weaker than, that produced by the *Orthoptera*. This aspect of ant communication will be dealt with later in the paper.

To continue now the consideration of the results of the research undertaken by other entomologists into the possibilities of stridulation as a method of communication amongst ants. Sulzer, Scarpa, Schneider, Hicks, Lespès, Landois, and Wolff considered the existence of hearing in ants, as did many others, the majority deciding that such a sense did exist, which means, also, that they thought that the ants were able to produce sounds. Since the chief method of production of sound amongst the *Insecta* where such a sense exists, is by stridulation, this can be taken to mean that they considered that ants communicate by stridulation. But their reasons for coming to that conclusion were based on such theoretical considerations as the lack of "damp mucous membrane" on the antennæ, where the chordotonal organs were supposed to be situated, and these reasons have not been, and cannot be, accepted as satisfactory.

Wheeler, Donisthorpe, and Lubbock (Lord Avebury) have, however, found stridulatory organs in the more primitive subfamilies, and the degenerate remains of these can be seen in the more well-developed ants. Wheeler and Donisthorpe agree

in believing that the more primitive ants (see beginning of paper) communicate by this method, but do not state their views concerning the method whereby the more well-developed ants communicate. Sir John Lubbock, however, believed that all ants communicate by stridulation, though the results of his experiments with regard to ants' hearing pointed to the opposite view. Dr. Forel used the experiments of Lubbock to prove, as he thought, that ants did not possess the power of hearing. I am in agreement with Wheeler and Donisthorpe in regarding both these conclusions as incorrect. The great mistake which most of those who have applied themselves to this problem seem to have made is that they have confined their studies to either one genus, or species, of ants, or to only one side of the question—studying only the chordotonal organs, or only the stridulatory organ. They then proceeded to theorise on their results, bringing about great confusion. Taking this into consideration, together with the enormous volume of literature written on the subject and also the fact that much of the latter has been written by people who were " mere dabblers," and knew little about the other branches of myrmecology (study of ants), one can gather how confusing the subject is to study. For this paper it must suffice to say that though no one has succeeded in proving any particular organ to be a chordotonal organ, ants of the genera *Ponera*, *Atta*, and *Dorylus* have been definitely heard to stridulate, while stridulatory organs have been proved to exist in other more primitive ants.

On the other hand, the following observation of Dr. Rusby's, noted in an Andean forest, is of interest. Dr. Rusby, on opening the door of his cabin one morning, noticed an irregular line of crumbs, starting on the step, and leading towards the bush. This line he eventually traced to an ants' nest a mile away. Inside the cabin the line was traced to the table leg, and on the table directly to a small hole in the corner of a box in which there had been packed fifty pounds of biscuits (double baked). The box was empty except for a few crumbs in one corner, and had been cleaned in one night. He continues :—" . . . The information of the presence of the biscuits must have been communicated by some method unknown to science, for it is incredible that any ant messengers could have travelled the distance, at least more than a mile, to the ant hill. Speculation as to the procedure suggests some strange possibility as to

future discovery. The message being received at headquarters, there must have been some very efficient system by which countless thousands of ants could almost instantly be martialled and sent to the exact spot in a great mountain forest, where the store was located." Dr. Rusby goes on to say how extraordinary it is that the ants managed to carry fifty lbs. of biscuit crumbs over the rough and obstructed trails of the Andes.

(It will be noted that Dr. Rusby, like Maeterlinck,* mentions the fact that there must be some extraordinary power of communication in existence amongst ants. It seems unbelievable that no detailed research should have been made.) In dealing with this observation, it must be borne in mind that the ants had to make at least two journeys of a mile, this journey had to be done in twelve hours, presuming, which is unlikely, that the ants found the biscuits immediately after Dr. Rusby had retired. This means that they would have to travel at $\frac{1}{6}$ m.p.h. in both directions, one mile being done carrying a large piece of biscuit. But this would only be the case if communication with the rest was effected immediately the biscuit was found. Otherwise, most of the ants (marauding parties at that distance are very small, and the ones nearer home would not be very large at night) would have to travel two miles at $\frac{1}{4}$ m.p.h., or probably faster. This would be impossible. In fact, it would only just be possible for the ants to make two journeys at $\frac{1}{6}$ m.p.h., it being probable that slightly longer than twelve hours was taken (it would be unlikely that Dr. Rusby would investigate until after breakfast).

Therefore communication must have taken place over a distance of over one mile, and since smell (I doubt whether it would carry that distance under the circumstances, in any case) has been proved not to be the method used, and stridulation does not seem probable in this case, communication by means of a "ninth sense" is indicated. However, taking all this information, together with that gathered from my other observations and experiments, I decided that it was impossible to definitely determine whether ants of the sub-family *Formicinæ* communicate by means of stridulation, or some ninth sense, unless I could evolve some novel method of research, although it was obvious that my book work and earlier experimental work would be of great help in deciding the nature of this unknown

* *The Life of the Ant.* London, 1930.

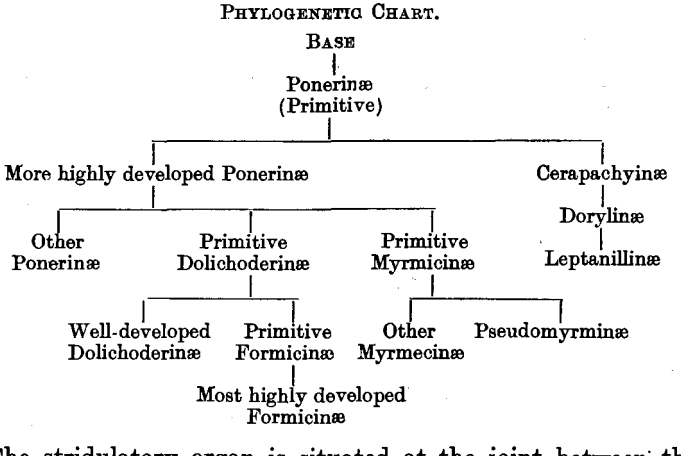
sense, if it could be proved that communication was not effected by the emission and reception of sound (stridulation). At first I could think of no such novel method of research, but one day, when reading a description of the ravages of an army of ants of the genus *Dorylus*, their horible smell, and the curious peeping noise they made (stridulation), an idea occurred to me: Surely it is very strange that the stridulation of these ants is audible, while that of more well-developed ants, which are supposed to be able to stridulate, is not. Has, therefore, the stridulatory organ decayed? I determined to pursue this line of research.

Before acting on this it was necessary to make a thorough study of the phylogeny of ants and, in fact, to settle the confusion which existed concerning this subject. The reason for the existence of confusion in this subject was very different from that which caused the confusion concerning myrmecological (study of ants) communication. My study of the subject has, I think, enabled me to get rid of a great deal of this confusion; nevertheless, it is impossible to give more than an abbreviated and simplified outline of the phylogeny of the *Formicidæ* in this paper. Before doing that I had better give the reader some idea of the confusion that existed concerning this subject, the reasons for it, and the manner in which I have tried to clear much of it away. The cause for the confusion was disagreement amongst those best qualified to give their opinion on the subject. For Emery, Wheeler, and Forel were undoubtedly the three people who were (all three are now dead, Wheeler dying in 1937) best qualified to solve correctly the difficult problems which have to be faced when studying ant phylogeny. It would not be right to say that the opinion of any one of these three should carry more weight than either of the others, but it must be borne in mind that Emery's opinions were formed at a much earlier time than those of the other two, and should, I think, therefore, carry rather less weight.

Now both Forel and Wheeler agree that the sub-family *Ponerinæ* is the base of the phylogenetic tree, though Emery placed the *Dorylinæ* in that position. I think there is no doubt that Forel and Wheeler were right. The position of the *Cerapachyinæ*, *Dorylinæ*, and *Leptanillinæ* is disputed only by Emery. Wheeler and Forel disagreed, however, over the fact that the *Myrmicinæ* were directly descended from the *Ponerinæ*. I agree with Forel that the *Myrmicinæ* are directly descended

from the *Ponerinæ* (through the genus *Metapone*). The fact that the *Dolichoderinæ* are directly descended from the *Ponerinæ*, through the genus (fossil) *Protaneuretus*, is indisputable; but the manner in which the *Formicinæ* descended from the *Ponerinæ* was, when I started my study, the subject of dispute. Forel said that the sub-family *Formicinæ* was descended from the *Ponerinæ* through a missing link. If, however, one examines the internal anatomy of both the sub-families; take, for example, the poison apparatus, one will see that the position is untenable. The *Ponerine* poison apparatus could not have degenerated so quickly into a structure like the *Formicine*, as would be necessary if the *Formicinæ* developed directly from the *Ponerinæ*, through a missing link, as suggested by Forel. On the other hand, the poison apparatus of the *Dolichoderinæ* forms a direct transition. This has been gone into fully in another paper. The external anatomy of these two sub-families also agrees with my theory concerning this point, it being noteworthy that in the last century the *Dolichoderinæ* were classed as belonging to the *Formicinæ*. Having determined the correct base and branches of the phylogenetic tree* (see chart), I proceeded to study the stridulatory organ in relation to the former.

PHYLOGENETIC CHART.



The stridulatory organ is situated at the joint between the first and second segments of the gaster, the third and fourth segments of the abdomen, in the *Ponerinæ*, *Dolichoderinæ*,

* *An Outline of the Phylogeny of the Formicidæ*, Bull. Soc. ent. de France, 1938.

Formicinæ, *Cerapachyinæ* and *Dorylinæ*, but in the *Leptanillinæ*, *Pseudomyrminæ*, and *Myrmicinæ* is situated on the post-petiole (third and part of fourth segment of the abdomen). The reason for this apparently different placing of the organ is the anatomy of the *Myrmicinæ*; these ants having a post-petiole, as well as a petiole (the *Leptanillinæ* and *Pseudomyrminæ* are similar in this respect). Thus the organ, though appearing to the layman as being in a different place, in reality is not so. The result of this research, as to whether the stridulatory organ developed, or atrophied, as the ants developed from the primitive *Ponerinæ* to the highly developed *Formicinæ*, was conclusive. In the *Ponerinæ* the organ is well developed, it then atrophies, the teeth become rounded and ridged, and the curve of the base of the second segment of the abdomen flattens out, until in the *Formicinæ* the organ has so atrophied as, I consider, to be incapable of producing sound. This means that the organ must have been functionless after a certain period, presumably while some new method of communication was being evolved, for organs which are in constant use, as a stridulatory organ would be, do not become atrophied, but more highly organised.

Thus it is probable, I consider, that there exists among the *Formicinæ* some ninth sense.

It will be seen that the requirements of this "ninth sense" are as follows:—(1) Communication must be instantaneous, and must not be affected by atmospherics or other mechanical physical conditions. (2) The method of production whereby communication is brought about, and the method by which the communication is received, must not be mechanical. (3) The method must be such that it can be produced under the required conditions, and by the required means, by ants. Communication is instantaneous, as was shown by my experiments and observations. This is supported by the observations of M. Maeterlinck, as is shown by the following quotation from his book, *The Life of the Ant*: "Whenever two ants meet, they almost invariably tap one another rapidly with their antennæ, as though they had something to say. Have they no other means of communication? It is certain that the alarm, when a formicary is attacked, or merely disturbed, is propagated with such lightning-like rapidity that we are almost compelled to explain it by a complex of cellular reactions, instantaneous and unanimous

such as occurs in our own bodies when they are seriously threatened or injured." It is obvious that communication would not be instantaneous if it were affected by atmospherics or other mechanical physical conditions. The reason that the method of production must not be mechanical is that if it was, it would necessitate there being organs for the production and reception of the means whereby communication was established. There seem to be no such organs. The reason for the third condition is obvious.

The conditions set forth above rule out the method of communication that, among entomologists, is wrongly known as "wireless telepathy," or sometimes "telepathy." This "wireless telepathy" is communication by means of waves produced aeroscepsically in the ether (I do not, myself, believe that waves in the ether can be produced aeroscepsically). Thus we are left, I believe, with one possible form that this "ninth sense" can take, that is, the transference of waves produced by the brain of one ant directly to the brains of the rest of the community. This complies with all the conditions; also the fact that this method would explain that phenomenon that develops, curiously enough, with the atrophy of the stridulatory organ, namely, that a colony of ants seem to act as one body, and not as many independent bodies, gives added support.

NOTE 1.—The *Formicidæ* have eight other senses: sight, smell, touch, taste, a kinæsthetic sense, a sense of orientation, a sense of topochemical smell, and in those sub-families which communicate by stridulation, hearing. In the *Formicinæ*, sense-motility, though this is not usually classed as a major sense, I have called this sense, whereby the *Formicinæ* are held to communicate, "ninth sense" to avoid confusion.

NOTE 2.—Although I am of opinion that all species of ants have evolved from a few basic species, as I have demonstrated in several papers on the phylogeny of ants ("An Outline of the Phylogeny of the *Formicidæ*," Bull. Soc. Ent. de France, 1938; "The Phylogeny of the *Pomerinæ*," *Idem.* March, 1939, "The Phylogeny of the *Cerapachyinæ*, *Dorylinæ*, *Leptanillinæ*," *Idem.* April, 1939), this does not mean that I, of necessity, concur in the view that ants have evolved from other *Hymenoptera*. It has been suggested by some entomologists that the *Formicidæ*

(ants) might have evolved from the *Mutillidæ*, and I myself have elsewhere pointed out that this group most nearly resembles the *Formicidæ*, but the only Formicine species which might form a link with the Mutillids is *Mystrium voelzkowi*, a primitive and specialised ant, it is true, but one which differs greatly from the Mutillids in all but its external anatomy. Also the Mutillids have lost their wings once, would they therefore be likely to acquire them again in the ants? Surely not. It has more recently been suggested that the *Formicidæ* have evolved from the *Scoliidæ*; but several missing links must be found before this can be stated with any certainty. Thus there seems to be some doubt whether the ants have descended from any other group of insects; but a problem of such magnitude, concerning as it does the whole structure of the theory of evolution, can hardly be discussed in such a small space as this.

Discussion.

The Chairman (Mr. Douglas Dewar) said: As a fellow field naturalist I welcome Mr. Morley's paper. Not being an entomologist I can remark on this interesting paper only as a naturalist interested in all living creatures. In my view the adoption of the theory of transformism has tended to retard the study of animal psychology, because the theory assumes that the senses and faculties of animals differ in degree rather than in kind from those of human beings. This notion, I think, is wrong, and I feel sure that Mr. Morley is right in believing that ants have at least one sense quite unlike any possessed by human beings.

Having discarded the theory of evolution, I am particularly interested in the part of Mr. Morley's paper dealing with the phylogeny of ants. While I grant that it is possible that all the sub-families of ants are descended from one sub-family, I do not consider this proved. If, however, this be the case and Mr. Morley's researches have enabled him to draw up a correct family tree, we are forced to the conclusion that what he terms the ninth sense of ants has evolved independently on at least two occasions, viz. in the *Formicinæ* and in the *Myrmecinæ*, and perhaps on a third occasion in the *Dolichoderinæ*. Now, I find it extremely difficult to believe that an entirely new sense can have come into existence *gradually*

in any species. I cannot conceive how it could have thus originated, or that it can have been of the least use to its possessor until it had developed to a considerable extent. If this ninth sense be merely an alternative to stridulation, why did it arise, and why, after it developed, did stridulation cease? Before believing that this happened twice or thrice I should require very strong evidence. The earliest known fossil ants are fully developed and the rocks have yielded no intermediaries between them and the non-ant ancestors imagined by evolutionists. May it not be that from the beginning there have existed non-stridulating and stridulating ants? May not some ants all along have possessed the ninth sense of Mr. Morley?

Dr. Rusby's ant story fills me with astonishment. The first thing that strikes me, a mere dabbler, as strange is that in the part of the Andean forest to which the story refers there was apparently only one ant's nest in an area of which the diameter was two miles. Secondly, is it usual for ants carrying food to leave crumbs strewed all along the track from the food supply to the nest? If this happened then thousands of ants must have left untouched food lying in their tracks and have taken an unnecessarily long journey, and, at the end, the climb up the leg of the table. Thirdly, is it usual for ants to forage as far as a mile from the nest? Fourthly, as there were still crumbs left in the biscuit box, why were the ants not still at work when Rusby returned? Finally, the ninth sense of Rusby's ant (he gives it no name) must either have enabled it to discover food from a distance of nearly a mile, or, if the discovery was made by one straggling ant, have enabled this individual to communicate to the occupants of the nest not only its find, but the precise location of this. I am sure we shall all be very grateful to Mr. Morley if he will answer my questions which, perhaps, are merely those of a cobbler who has left his last. In conclusion, I ask you to accord a hearty vote of thanks to Mr. Morley for his valuable paper.

Lt.-Colonel P. W. O'GORMAN, M.D., made the following observations: Although not a scientific entomologist nor a myrmecologist, during residence in India and East Africa I have been interested in insect life, and I have hatched many caterpillars from eggs to

maturity. I have also made a personal collection in India of butterflies, moths, and stick insects equal if not superior to many collections I have seen.

I have long maintained that all animals communicate ordinarily with each other and with other species by a species of mental wireless telegraphy or telepathy, as well as by various physical means. When congregated together in groups circumstances dictate whether the sounds they yield, vocally or by stridulation, are indicative of pleasure or of the discovery of food, or of anger and pugnacity or fear and alarm, or, if on the wing, of direction of flight. But generally silent telepathy seems to be the usual mode of communication. The term " telepathy " is employed for want of any better word, for we do not quite know what it is. And man is also endowed with the same power, and it can be cultivated to keen sensitivity. It is a psychical and not a spiritual power, and so we must be wary of reading high intellect into its manifestations among animal life, although in man its implications or conclusions may be heightened by abstract reflection.

Striking examples are numerous. I make mention of just a few. In India food has to be protected against the inroads of ants, for instance, by placing the legs of a table containing articles of diet in bowls of water. Ants circumvent this by climbing up the walls of the room to the ceiling and aeroplaning down to the desired quarry. Here surprising intelligence is shown, no doubt sharpened by hunger and aided by their sense of smell ; but the information of discovery may be conveyed to fellow ants by telepathy. The latter is a common method adopted by scouts from the nest when searching for food, soon resulting in the arousing of swarms. Direction is observed either by telepathy or by communication by touching of the antennæ of returning messengers. The carcase of a dead cricket, for example, is assailed by numerous labourers, each often pulling in wrong directions, yet there seems to be some right directing force which moves the mass towards the nest entrance.

Again, female silk-worm moths just born from their chrysalles, have been placed in cages and otherwise watched, and have been visited by male moths at night in a mysterious way. How do they communicate their presence ? It appears they do so by means of vibrations of their antennæ which seem to carry to immense circum-

ferential distances. Experiments, I remember reading somewhere, clipping off these antennæ arrest their communications.

A remarkable confirmation of the possession of this mysterious power of telepathic influence is given in a recent highly interesting book by Eugene N. Marais, *The Soul of the White Ant* (Methuen). He spent ten years in experimentation and careful observation on animal life in South Africa, rivalling the renowned Fabre, "the Insects' Homer." He maintains that instinct is really hereditary or racial memory, which, however, is apt to be interfered with by experiences from individual memory. In the higher animals it is less durable than among the lower and is amenable to modification by environment and experience. It is not our purpose here to go further into this very important subject, but the author concludes from his experiments that the subconscious mind of man is nothing more than the old race-memory in a state of abeyance subject to be aroused into action under favourable conditions.

What concerns us here is Marais' experiments on the termite or white ant which led to the discovery that this insect in its various forms, living in complete darkness, is totally blind and possesses no vestige of free will, but is guided throughout its sleepless days and nights by an outside power. He discovered that this power emanated from the queen ant herself. "This invisible influence streams from the organism of the queen alone. It is a power beyond our senses; it can penetrate all material barriers, even such as thin steel or iron plates." He evolved a strange theory that the termitary or ant-heap is in some way intimately connected with the lives of its inhabitants somewhat though distantly akin to the corpuscles of blood which circulate in our blood-stream, so that when the inhabitants die the whole termitary disintegrates. He suggests that the healthy maintenance of the termitary is dependent on some kind of power projected from the living stream of insects which influences the chemical constituents of organic bodies as in the human body. To our thinking, who know the habits of the termite, the more prosaic reason appears to be the withdrawal of the continuous supply of moisture which the white ant is well known to be the conveyor from very great depths in the soil during its life time. Yet it is the cessation of the activities of the termites which bring this about.

But the matter which concerns us particularly is Marais' discovery that convinces him that the queen ant possesses some power of "signalling" which eludes explanation. The queen, from her hidden cell, broadcasts continuous messages to every member of her enormous family. These messages penetrate to the colony isolated by means of a thick metal plate or even rock. If the queen were injured or killed, their whole activity and even life would suddenly be extinguished as if a switch had been turned off at the power station! Separated thus for months even, the termites continued to work systematically, but no sooner was the queen injured or removed from her cell, their activity came to an end. This invisible influence operates within a certain radius only. On one occasion, while examining the queen in her cell, Marais witnessed an accident to the queen, a piece of hard clay fell from the roof of the cell and struck her on the head. Although she seemed not to mind overmuch and merely moved her head rhythmically once or twice, the incident threw the whole of the termitary into panicky confusion. Even to the remotest recesses of the nest the ants stopped working and the usually semi-conscious "guards" which surrounded her awoke from their lethargy and ran away. After certain curious "treatment" by the alarmed ants, the queen recovered and the termitary resumed its normal life!

These observations indicate the existence of a peculiar yet vital "telepathic" influence which certainly affords us much room for thought. If among insects, why not among higher classes of animate life, and even in man? These observations, however, which we quote tentatively need to be confirmed by other experimenters.

Marais, however, relates another discovery which confirms his view of wireless insect telepathy. Periodically after rain swarms of newly developed winged termites escape into the air as emigrants seeking new colonies. The female may fly long distances but instantly on landing she casts her wings and with uplifted tail sends forth some kind of "vibrations," until they are responded to by a winged male. The pair then enter the soil to begin a colony, the prospective queen yielding a constant stream of eggs which eventuate in developing the requisite forms of worker and soldier termites.

A very interesting article by L. Hugh Newman, " The Butterfly Farmer," in *Pearson's Magazine* for September, 1937, p. 354–363, supplies confirmatory information in regard to psychic " wireless " communication amongst insects, derived from both observation and experiment. The female Vapourer moth is one of the wingless varieties, similar to the wingless Winter moths that we try to trap on greasebands round the trunks of fruit trees. At " the sembling hour " the winged male manifests a curious faltering flight, flying round and round in wide circles, or up and down in the air in spirals. " This suggests they are sensitive to electric disturbances in the atmosphere and are in their own way attempting to pick up messages transmitted by the wingless females." Mr. Newman discovered by experiment on the Emperor moth that the newly-hatched female enclosed in a cage at a certain hour, began without any warning to violently tremble her wings and the body began the familiar rhythmical pulsations that are the two signs that she is " calling " for a mate. Only a few minutes later male moths scented the female and whirred around and soon almost buzzed round his head, and shot straight towards the cage, running feverishly up and down searching for an opening. Mr. Newman recognised, by a clip of the corner of each wing he had made, one of certain males he had removed to Dartford Heath, about two miles from his farm, but the other two were perfect wild ones. The " scent " is the terminal indication of the presence of the female. A male moth has been known to diligently search, for hours at a time, an empty box which had previously contained a virgin female ! " But this does not explain how moths travel considerable distances, and on windy days *against* as well as *with* the prevailing wind." Mr. Newman says : " I have also been able to show by a simple experiment that males will come to a female in a closed wooden box ; but if the box is made of metal and earthed, they will *not* come. This would appear to strengthen the theory of communication by some form of electricity." A photogravure of the antennæ of the male and female Emperor moths shows that those of the male are pectinated and resemble a large double tooth-comb or fern-leaf appearance, while those of the female are plain and with pointed ends, and present only a few shortened comb-teeth. The former are apparently receivers and the latter are transmitters in a type of " wireless."

Author's Reply.

In reply to Mr. Dewar, I should like to point out that in my paper I only *actually claim* the existence of a "ninth sense," for communication, in the *Formicinæ*, not in the *Dolichoderinæ* or in the *Myrmecinæ* as Mr. Dewar states. It is true that the more highly developed species of the *Dolichoderinæ* may communicate by means of ninth sense for they do not communicate by stridulation (*see p.* 80); indeed, it seems probable that they do. This does not mean, however, that the sense need have arisen twice, for the *Formicinæ* are descended from the *Dolichoderinæ*; the "ninth sense" having presumably existed in some degree in the common base of both the *Formicinæ* and the highly developed *Dolichoderinæ*.

I can find no statement in my paper which refers to the existence of "ninth sense" in the *Myrmecinæ*. I make no such claim and (*see* p. 80) believe that the ants of this sub-family communicate by stridulation.

In answer to Mr. Dewar's query with regard to the possibility of the gradual development of this "ninth sense," I would point out nowhere in the world of nature can one find instantaneous perfection —wireless had to be developed through many years of experiment before it reached its present reasonably perfect state; plants when they are moved to new climates change their habits gradually, not all at once, until they once again suit their environment to perfection; man had developed his various languages over a long period of years from a very imperfect vocabulary, supplemented by a more frequent use of gestures, to the fluency of speech which exists to-day.

Surely one would expect a new sense to develop gradually? Who can say whether our own very primitive "extra-sensory perception" may not overthrow speech as our primary means of communication in the years to come? This seems even more probable when we realise that God Almighty uses this method of informing us of His wishes (only we call it conscience and other such names), in preference to vocal speech.

With regard to the disappearance of stridulation after the development of "the ninth sense," I would point out that the usual rule of this world is the survival of the fittest, both in animate and inanimate things. "Ninth sense" being better than stridulation, the latter disappeared.

Some South American ants might quite well forage a mile away from the nest, the first ants who find any food claiming it for their colony.

Crumbs might well be left on the track while the main body of the food was being removed, though they would presumably be taken to the nest later ; this was, one gathers, what they were doing when Dr. Rusby found them. " Ninth sense " is not a sense capable of being used for finding food, though it could certainly be used to communicate the precise locality, etc., over a distance of a mile. With regard to Lt.-Col. O'Gorman's citation of M. Marais' observations and conclusions as set forth in the book *The Soul of the White Ant*, I feel that I must say that though Marais spent much time observing Termites (which are not, of course, *ants* despite their name " White Ants ") and doubtless knows a great deal about those insects, I cannot accept his observations or his conclusions on *this* matter as scientific data, unless it be with great reserve ; though doubtless he made many observations in other branches of termitology which have much scientific value.

With regard to Mr. Newman's observations which Lt.-Col. O'Gorman cites, I felt that, though not in any way discounting them, I should point out that some of our most eminent entomologists have put forward strong evidence supporting contrary, and much less intriguing, explanations of the " assembling " of moths, such as scent scales, etc. There does, however, seem to be considerable doubt as to how the " assembling " *is* actually brought about, neither side having, I consider, adequately proved their case.

The Rev. S. Runsie Craig Memorial was founded on June 30th, 1938, by a donation to the Victoria Institute of £400, from MRS. CLARA MILDRED CRAIG, of 59, David Place, Jersey, C.I., in memory of her late husband, the REV. S. RUNSIE CRAIG, B.A., LL.B., F.R.A.S., to be utilized under, *inter alia*, the following general terms and conditions.

(*a*) The Fund to be held in Trust as the Rev. S. Runsie Craig Memorial, for production, printing and publishing of Papers (and the discussions thereon), written with the object of maintaining the integrity of the Holy Scriptures of the Old and New Testaments and contending earnestly for the Faith once delivered unto the Saints, as embodied in the Apostles' and Nicene Creeds as ordinarily understood; and/or of refuting philosophies and theories opposed thereto.

. . . . . .

(*e*) All papers and discussions thus produced, in the "Transactions" and in the form of "separates," will be shown as "Under the Rev. S. Runsie Craig Trust." They will not be chosen in advance, but will be selected by the Council at the end of the session as, in their judgment, best fulfilling the objects of the Trust from among all the papers read during the session.

In accordance with the terms of the Trust, the Council have selected for the 1939 Memorial the paper on "Survival of Old Testament Forms of Religion on the Western Frontier of Modern China," read before the Institute on March 20th, 1939, by the Rev. T. TORRANCE, F.R.G.S., as embodying the results of an original investigation of unique evidential value in confirmation of the Old Testament Scriptures.