

LITTLE BLUE BOOK NO. **53**
Edited by E. Haldeman-Julius

**Insects and Men:
Instinct and
Reason**

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INSECTS AND MEN; INSTINCT AND REASON

Reflections on the Observations and Discoveries of the Late Henri Fabre, Naturalist.

By Clarence S. Darrow.

[Stenographic report by Ethel M. MacIskey of an address before the Rationalist Society of Chicago. Revised by the author.]

Henri Fabre has been very little known. He is coming to be known better every day. He was not a reformer or even a Freethinker, or a business man, but he was just a simple student who spent all of his lifetime finding out about bees, ants, caterpillars and other brethren of his. He found out more about them than any other living man. I do not know what good it did him to find this out, or what good it is for the world to learn about them. For me, it is interesting, that is all. And if what I may say can induce some of you to study him I think you will find a great deal of pleasure in it, which is the most you get out of anything. If a man can become so interested in an ant or any other bug that he forgets himself, it is almost as good as not living at all.

Henri Fabre was born of poor parents—about the poorest one could have and live. He was one of a large family. His parents were ignorant, they could neither read nor write,

nor could his grandparents before him. Henri Fabre said: "It is hard to find in any of my ancestors an excuse for me." He had scarcely any schooling to mention. As a boy, he worked hard. Early in life, he became interested in the little things about him. He earned his way by doing manual work. At one time he secured a professorship in a school. Outside of his work he studied bugs. People thought he was crazy, and they tried to have him dismissed from the school. Then he went back to manual work again. At another time he discovered a new kind of a dye that could be made from animals and was nearly on the verge of making a fortune out of his discovery when somebody found a mineral dye which could be made much cheaper, so he lost this.

For twenty or thirty years he worked on his bugs before anyone ever heard of him. He was probably sixty or more years old before the world knew anything about him. All of his life he longed for a little patch of ground that would be inhabited by wasps and bees and beetles and grasshoppers, and no men or women excepting his own family. He had a large family, eight or ten children, and his father lived with him until he was nearly a hundred years old—and after he was sixty-five years, Henri Fabre managed to secure a little plot of ground, a few acres, sterile and fruitless. It was not good enough to raise anything and had been given back to nature. This land was filled with all of the creeping things that Henri Fabre liked, and he spent the last thirty years of his life on it—a few miles

from a little hamlet in Southern France—and never went away from it. After he was about eighty years old, the world gave him the first formal recognition at a reception in the little town where he lived. Maeterlinck and some other famous people of the world came to pay their respects to him, and have told the world who and what Henri Fabre really was.

While Henri Fabre was making his discoveries, he was writing books that were not published until later. These were on the fly, the bee, the grasshopper, the caterpillar, the spider and all sorts of other bugs—ten volumes in all, that have but recently been published. Fabre was not a great reader of books, unless they were along the line of his work. But, I have nowhere found more delightful literature than these sketches of Fabre's. They are plain, simple stories. He tells of the most profound things in the easiest possible way, so that even a child can understand them. For studying style one could not do better than to get Fabre's books and read them.

Henri Fabre was a poor man all of his life. At one time, while he was living on his little abandoned plantation, he was so near starvation that he applied to John Stuart Mill for a loan. John Stuart Mill had a little place near Fabre's, and, contrary to custom, when Fabre asked for a loan of two or three hundred dollars, John Stuart Mill sent him seven or eight hundred dollars. He was one man who recognized Fabre's greatness. Later in his life, Henri Fabre received a small pension that allowed him to finish his work, that is. so far

as anybody finishes any work in this world, and lived until he was over ninety years of age. He died after the world war began.

Any discussion of his work is naturally fragmentary. It is much better read from his books. Man has the habit of thinking that he is the only creature in the universe. I presume the fly thinks the same thing, and with just as good reason. So far as we know, flies cannot write books, so they cannot have them printed. But no doubt that is what they are talking about when they are buzzing around the ceiling. They doubtless think that "man was made to make pies for flies." There is no reason why he was not. There is just as much reason to think so as to think that fishes were made for man to eat.

The insects are just as marvelous as man. Their actions sometimes seem more reasonable than man's. They are more reasonable because they do not reason; they just do things automatically, yet they work perfectly; while man, with his reason, gets all "balled up." I did not get that expression out of Fabre. It is one of my own. Animals do nearly all the things man does and generally more perfectly. Many of the unnecessary things man does, animals do not do, as far as I can tell, which is not very far. Man does not have the intelligence to understand the animal language, so we cannot be quite sure of these things.

Fabre tells his story and raises questions about life. He was honest, and did not try to answer questions that could not be answered. If he did not know he would say he did not

and was not ashamed to confess ignorance of any question. It is only ignorant people who are ashamed to confess it. They do not like to, because everybody knows it without. Fabre took up the question of reason and instinct, and while he did not answer it, he threw much light on it. But, as to the cause of it all, he gives no answer.

Fabre was born a Catholic, and, in a sort of way, remained one all his life, that is, he considered the question was not one for him to bother with, so he let it alone. He was not orthodox and could not be. He did not fully accept the doctrine of evolution as it is generally taught. He was not so much a philosopher as he was an examiner in the special field where he worked. Naturally he asked a great many questions as to the meaning, the purpose, and the end of life; but most of these he left unanswered.

One of his most interesting books is "The Mason Bee." I would commend it to you to read. It will tell you what a bee can do and what it cannot do. The ordinary bee, building its home, erects something more wonderful than man can build. A man puts up a home, while a bee will put up a city, suited to the bee, where everyone works in perfect order. No one knows how they do it, but they just do, that is all, and they make no mistakes as they do it, every step is taken perfectly and automatically. Man cannot work in that way. The Mason Bee is a little animal that does not live like our honey bee. It generally lives alone or with two or three other bees. It builds a

mud house on a flat stone or on the side of a wall. As you study its life and pay some attention to it, all kinds of questions come to your mind. Here is a bee going about in a dusty road, picking up little pieces of flint and mixing it with mud to make mortar out of it; then flying to the eaves of some house or rock and there building for itself, not exactly a home, but what serves the purpose—a place to raise more bees. The bee builds a little hut, probably four or five inches high and an inch or two in diameter. At the certain time of the year when it is seen picking up these pieces of mud or dry dust, it flies with them to the place selected for the home. In some ways insects have a very rational view of life, for it is usually the female who does most of the work and raises the family; the male performs his work in some other way, ordinarily. The female bee goes back and forth until the mud hut is built. When it is all finished but a little place in the top, she goes to the flowers to make honey which is placed in the bottom of the hut. Then she lays her eggs. The little space left in the top of the hut she seals up with the mud left in her mandibles. When this is done, she goes away, leaves it and never sees it again—never sees the young bee that will come out of it, and knows nothing of it. But she invariably builds the hut, lays in her store of honey, lays her eggs, seals up the hut, and goes away about her business.

Bees have wonderful instinct. If they are taken a long distance from their hut and released in the air, they will fly directly up and

go back in a straight line. It makes no difference whether you carry them in a certain way, in the dark or in a sack, or make them drunk or dizzy by whirling them around in the air, when they are released, any distance within reason, they go up in the air, and straight back to their home. Man cannot do it; and few animals can. The animals have this instinct stronger than man, some animals stronger than others. The ant perhaps has no such instinct, or very little. The dog, the cat, or the mud turtle, has it to a very high degree. But the bee has it unerringly.

The Mason Bee seals up her hut. The egg hatches into a grub. The grub eats the honey and grows into a bee and gets strength enough to break through the hut and fly away. Nobody tells the young bee what to do or how to fly. It never saw its mother, much less its father. It never received instruction from anyone. The bee does not learn it, nor get it from its environment. The young bee just grows in the mud hut by feeding on the honey, then breaks the shell open and goes away. And, when the time comes in her life, she comes back once more and builds another mud hut for her own young bees, and flies away, and so on, with the endless procession of bees, to the end of time.

Now, it seems almost as though a bee knew what it was doing. Yet Fabre has experimented with that, too. He has taken the hut of a bee, moved it six feet away, when the bee was off gathering honey. It comes back to the exact spot where the hut was before. It

may go close to its own hut and never know it or see it. It may come back a dozen times and fly away, utterly unable to find its own hut. It may fly over it and around it without knowing it, and is utterly unable to locate the hut.

Fabre has tried other experiments. He has taken two huts, one of them half completed, where the bee was still building, the other one where the hut has been placed in readiness for the egg. He has changed places with them. The bee comes back to the exact spot. The bee whose hut was but half finished, finds the one that is completed and ready for the egg. She goes on and adds another story to it, beginning on the completed hut where she left off on her own. The bee who has completed her hut is ready to lay her egg, goes into the unfinished hut, and lays the egg, although it is impossible for anything ever to come from it. But just because the time has come in the life of that bee to do this particular thing, she lays her egg in the unfinished hut and the egg is lost.

Apparently the bee uses no reason, or faculties of any sort. What is it then? The bee is alive. It has a brain. The brain is very small—not enough to do it any harm, and not large enough to think with—and it does not seem to use it. But it gets along very well. It seems to work exactly like a machine. At a certain time in the life of the Mason Bee the urge of nature comes to it and it builds a nest. It seems impossible that it ever thinks about why this is built. When this is com-

pleted, the urge comes to put honey in it. There can be no more building or repairing after the honey is put in. If a hole is made in the side of the hut, the bee pays no attention to it, but plugs up the top perfectly. After the urge has come to lay the egg, she must have a piece of mud in her mandibles to close up the opening. Then she does some more work, plasters up the side to make it stronger, after which she flies away and is never heard of again. It must be purely instinctive.

How do they do it? Mark Twain in his book "What is Man?" discusses this question. He says: "Instinct is petrified reason"; that the things men and animals do instinctively have been once thought out. But that can hardly be the case. It is impossible to conceive that the bee ever reasoned it out. It just does it. It seems impossible to conceive that the first bee did not build her nest, put in her honey, and lay her eggs just the same as the last bee that ever comes into the world will do. Nobody can see that they improve or that they change or can think or imagine how they came to be bees. They do not understand it, but they do it perfectly. It is impossible to think it is petrified reason. It seems to me almost equally impossible to think that they ever came up as the survival of the fittest—that an innumerable number of bees tried to do it and failed, and only those that got along survived until they performed their task in this way. Those are things we can only speculate on. We cannot help speculating when we see the wonderful facts before us.

To my mind, it has been so since the first bee; but this is not an explanation. The question is still here. It merely means it could not have come about in some of the ways that some thinkers and naturalists believe it came about.

Other insects are as curious and wonderful as the bee. Fabre tells us the story of the red ant. It fills volumes covering interesting details of the ordinary ant and its hill, in the garden. It seems to be an intelligent being. Man is patterned very much after the red ant; he is a little bigger, but perhaps there is no sense in his being so large, for he takes up more room than the ants do. Some of the ants do not work; there is a sort of an I. W. W. amongst the ants, or capitalists—whichever way you want to put it—anyhow, they do not work. They are larger than the rest and use the rest as slaves. These ants start on an excursion to the home of the black ants. They do not know where they are going. They march in long columns. They go exploring this way and that way. Those ants in the front part of the column are used as an exploration party. They go out and come back. They find a hill of black ants. A terrible battle ensues. The red ants always win; the black ants are destroyed. The red ants take away the young black ants, hold them in their mandibles, which serve for hands, to their home. No matter how far away or how rough has been their path, they always go back over the same path over which they came, although it may be ten times as far around as it would

be if they went in a straight line. The ants evidently have no sense of direction. If they cross a street on their way, they recross it on their return; if they went in a dangerous place where they lost a good many of their ants, they will go back that way and lose some more. But, whatever befalls them, they always hold the captive grub in their hands and not even death can remove it. The captive black ant is made a slave by the red ant and does its work, very much like human beings. I suppose we are weak imitations of the red ant. We do it more indirectly than they. The red ant captures certain animals that give it honey and work for it. It also captures little microscopic animals from whom it gets milk. "They toil not, neither do they spin"—in fact, they act very much like human beings. And it seems as if they were.

How they find their way back is not easy to understand. They do not do it instinctively like bees, for they do not go straight back. Some people think the ant follows the old road by sense of smell. Fabre has tried this out by placing substances with a similar odor in the road, but it makes no difference with them, they find the path again as they go over it. Perhaps it is by the sense of sight, if it is strong enough. Or they do it by some instinct more subtle and sensitive than man possesses. They act methodically, always in the same way, with a purpose. That is substantially what man does.

Fabre has a book on spiders. They are rather human, too. They are much handsomer

than humans, but most people do not understand their beauty. Their motives are very much like the human in many ways, but more simple and direct. Still they accomplish the same thing.

There are many varieties of spider, each having different habits and modes of life. One large spider he calls the banded *Epeira*. Perhaps Fabre calls it that on account of the color of the band that runs around its body. This spider is a large one that spins its web to catch flies or any other sort of insect that comes its way. The web is spun with the same skill that a hunter spreads a snare to catch birds, or department stores spin advertisements to catch the human birds. Watching the spider as it performs this work on the branch of a tree, you would notice that it spins the web out of itself. It lowers its body down to within two or three inches of the ground, spinning as it goes, going back by the web already spun, spinning another web, making two, and a loop below, finally reaching its original place. As the lower part of the web is waved around by the wind or air, or some motion of the spider, it launches itself upon another branch which makes a bridge across for the spider to walk on. Then backwards and forwards it spins until it gets enough strands and the web is finished.

The web is woven with almost perfect geometrical precision, infinite almost in its number of strands. All rotate from a common center. The geometrician can figure it out, but no human being could build it; it is too

fine a work for man. A man can no more make a spider's web than an elephant could a watch. If the web is examined under a microscope, it seems to be twisted like a wire and made up of an infinite number of small strands which are hollow, and although they are microscopic and hardly can be seen with the naked eye, they contain a fluid inside which is sticky like glue. It is by means of this substance the spider descends upon the limb of another tree where it continues weaving its web. First it spins a strand which is hollow and sticky, like glue, so as to protect the web, and at the same time takes care of any prey that comes in the path of the web, which is more important still.

The axle and many of the strands that run from the center are not sticky. In the center of this web, the spider places a trap, which is a flat substance about as large as a hand, but is not sticky. The spider weaves this from the same place in its body as the strands. On this area, the spider sits, waiting. While some of the strands are sticky, others are not, and the spider can go backward and forth over them for the reason, as Fabre has found out, of some fatty substance in the feet or legs of the spider which prevents its sticking, unless it stopped too long in one place and the fat disappeared.

When a fly reaches the web, by some involuntary movement, the spider ascends the web, which terrorizes the fly and paralyzes it so that the spider grabs it. When a larger animal, like a Praying Mantis or a locust, gets

near, the spider touches it and paralyzes it. Then it begins spinning a web around it until it completely ties up the insect. It seems to be wound in a shroud and cannot move. If the spider did not do this the larger insect would kill the spider. In this way the spider brings the insect, entirely helpless, sewed up in a shroud, as it were, into his trap. He has a wonderful feast. The spider is a great anatomist. He understands anatomy better than a doctor. He knows just where and how deep to bite and in such a way that a microscope can scarcely discern an injury. The spider does not kill its prey, but captures it.

The spider has another trick which the doctors have imitated in another way. You have heard of trepanning the human skull so as to stun the person while an operation is being performed. The spider trepans its victim and does not kill it; he does not want to; probably he does not know why. The spider has a way of compressing the head of its victim that always works. He does not eat the Praying Mantis and locust; they are not good enough for him. But he feasts himself on them in their helpless condition, by sucking the blood and eating the tender parts that the blood flows through. Perhaps it will take a day to finish the meal. To all appearances the insect still remains, but all that is left is an empty shell, with everything that is edible and best, with all of the sirloin steak gone. What remains would not even be fit for a working spider.

There are more questions to answer regard-

ing the grasshopper. The spider sometimes lies for days on the trapdoor, catching and devouring its prey. Its net is still there and it is sleeping or watching for victims. It does not do it by sense of sight. Sometimes, in the case of the grasshopper, the spider weaves another net, a smaller one, which has a strand of the web connected to the leg of the spider so that when it goes back to lie in wait for its prey, it will get a telephonic signal through this strand from the other web and know when to come out and get its victim.

Who taught the spider to telephone? It hardly learned by reason. If one strand of the spider's perfectly automatic web is broken, it does not know how to repair it. It builds an entirely new one. Some spiders spin but one web. You might as well say that the earth has learned by reason just how near the sun it shall go, or how fast it shall turn on its axis or how near it should go to the moon. It just is that way, and no man can get any further—at least I cannot, so I assume nobody can.

The insect world furnishes wonderful examples of surgeons that have beaten our doctors, except in charges. There is a little wasp called the Sphex, which digs a tunnel in the ground. The main business of animals, like the human animal, is to get more animals. Some human beings do not attend to their business, but all activities get back to the one thing—which is that life shall be preserved on the earth. Some animals and people have to live to feed others, those others have to live to feed still others, and so on. But the main busi-

ness of life is to create more life. What it is done for no one knows. I suppose it is because the sun shines part of the time, because the rain falls—it is the law of the universe. There is no answer to it. It is simply a fact. You can trace all the activities of the insects, whether little ones or big ones, or human ones, back to the question of getting more of them, for fear they will run out.

The SpheX digs a hole in the ground, a sort of a tunnel. It is for the purpose of raising more wasps, for it is its job to provide that kind of wasps. Then it finds a caterpillar. The caterpillar is a great deal bigger than the SpheX and much stronger, but the caterpillar has certain nerve centers, seven I believe. Some insects do not have as many and some have more. The SpheX paralyzes the caterpillar by stinging it in these nerve centers. How it found the location of these nerve centers, I do not know. Maybe God told the SpheX, but then who told God? But, with unerring aim, the SpheX stings the caterpillar in seven different places and the caterpillar does not die. The SpheX does not want it to die for if it died it would not be of use. The SpheX seems to know its purpose although it probably does not know it at all. But this makes the caterpillar helpless.

Then the SpheX drags the caterpillar, or cricket—it does not need to be a caterpillar, but I take it for an illustration—into its tunnel. The SpheX then lays her eggs on the back of the caterpillar; not in front where its mandibles might destroy the egg. The grub then hatches

and begins to eat its way out from the back to the front of the caterpillar. By the time the grub has reached the front, the caterpillar is no longer alive—there is just the shell of the caterpillar and the grub of a SpheX, so that there may be more SpheX. Of course, the caterpillars are taken care of in another way, but I will not go into it this time, for there is so much else. However, the matter is always taken care of, because it takes more caterpillars to feed more SpheX and so on around. For the grub eats its way out, grows stronger, flies away, gets ready to tackle a caterpillar itself, digs a hole, lays another egg, and so on, world without end.

Fabre does not know why; I do not know and nobody does. We know it is true, that is all. We know the life of insects is as mysterious as ours. We know their actions are as unfathomable as man's, and that their work is as wonderful and as interesting, if one cares to study them.

The insects have parasites, too, like human beings—parasites who will not work—lawyers and preachers. Some of them seem to know better, or they may not know, but just do not do it. Let us go back to the Mason Bee for a moment. The Mason Bee carefully lays her eggs so as to make another Mason Bee. Along comes a little grub, microscopic almost, with a tiny drill. Man could not make one so small and well adapted to the work. This parasite bores in and lays her eggs on the grub of the Mason Bee, and as it grows stronger, the grub from the egg of the parasite eats the grub of

the Mason Bee, or, in the case of the Sphex, the caterpillar. So that when the resurrection comes, it is not the resurrection of the Mason Bee, but the birth of the parasite that fastened itself on the grub of the Mason Bee. So after all the Mason Bee did not build its nest for its own but for a parasite that took the result of it for herself.

Other kinds of parasites may crawl into the nest while it is being filled, and still others go in while the egg is deposited, feeding on them, and a parasite instead of a bee is born. In the same way the parasite of the Sphex works. There is a tiny wingless wasp that digs into the ground and finds the place. How I do not know. But it must have some sort of a divining rod that tells it that of all the rest of the world, here is the place. In about the same manner as in the case of the Mason Bee's parasite, this tiny wasp lays its egg on the top of the Sphex's egg which in turns eats its way out through the caterpillar. The insect world is filled with parasites as is the human world. Fabre says that he has searched all the notebooks he has ever made, and that he has never found any species that made a parasite of the same species, excepting man. I suppose that is the reason we are the highest animal in the universe; I do not know what other reason there is.

Fabre in describing all these wonderful things says, "Matter is only kept alive by passing from one form to another. It is true with animals and with man." Fabre says that "at the banquet of life, each is in turn a guest

and a dish." We all sit at the table of life and eat to our fill; then we are a dish for the next who comes after, whether it be man or any other insect. Everything lives on what has lived.

Fabre gives us no religious platform for Nature. Nature with him is not good; Nature is fang and tooth; Nature is merciless and cruel. He says that "in the fierce riot of empty bellies, the parasite takes what it can with its tools." That is what life is—a fierce riot of empty bellies, each seeking to be filled, and using its own tools to fill itself with. He says that life is made up of two things—getting food and perpetuating itself, so that you can get more food and perpetuate more life. That is all we can find anywhere in Nature. In referring to the ant, Fabre compares it with man. He says: "We build towns, but she builds cities; we have servants, but she has slaves; we have domestic animals, but she has animals that furnish her with sugar; we have cattle, but the ant has milch cows. In fact, ants have everything we have excepting clothes, and they do not need clothes."

Fabre describes one little bee called the *Osmia* which seems to have solved a problem that man has failed so far to solve—for this insect knows how to control sex. It lays at will an egg that produces a male and another a female. It is the only species known that can do it. In the place where it lays its eggs, there are certain narrow chambers for the male eggs and wide ones for the female, for she needs more support also with the insects.

This insect determines sex when the egg is laid and it comes out invariably right. Man cannot do it although he has studied and philosophized about it.

Just a few words on the love affairs of the insects, that I will put as delicately as I can, for they are great lovers. They have to be to keep the insect world going. The purpose of all the activities of insects is more insects, and it is impossible to see where they do anything except for this result. I presume if someone could look at man the same thing would be said; but luckily he cannot see himself, or he would die laughing—which would be a happy death. But the insects really love. One of the spider family hauls her eggs fastened to her legs and wherever she goes, she trails the eggs with her; she is never separated from them until they are finally hatched and the infant spiders fall on her back. Then she carries them around with her until they are able to spin webs of their own, which they know how to do when the time comes, afterwards run off to be gone forever. Another species develops its eggs in an egg pouch which keeps growing larger and larger with more eggs until the time for hatching comes, when the spider seems to be just one big pouch of eggs. She dies then, for her part in the grand business of keeping life on the earth is finished.

All the wasps seem to know where to sting. There is a certain wasp that lives on the honey bee. As the bee is sipping the honey from the flower, this wasp slips up to it and kills it with a single sting. Some insects sting

on the neck and others in several places over the body to paralyze their victim. Then the wasp takes the bee in its great hairy arms and presses it close. The tongue of the bee protrudes and it is dead. The wasp has squeezed its throat in order to extract all of the honey from the throat, thorax, and the honey sacs of the bee. Then the wasp takes the dead bee to its nest and on it lays its eggs. The reason the honey is squeezed out of the bee by the wasp is that the honey is poisonous to the grub; if it touches it, death ensues. It is a matter of unconsciousness to the wasp when she takes the bee and squeezes out the honey, but it is done simply that her grub can live, nothing else. It is not cruelty, it is just nature. In one way there is no cruelty in nature; it is just life—life and death. It is hard and terrible, but it is the law.

The bee gives his life in the conjugal embrace. He does his part once in preserving the species, and then dies. It is not likely that he stops to wonder if it is worth while or that he knows that he will die. But that is his part in the great job of keeping life on the earth, and he does it and dies. It is finished, and that is all there is to it.

The female scorpion is an intense lover. After she gets through with the love scene she eats the male—loves him to death. Many species of the spider do the same thing—that is, the female eats the male. The female seems to be the most ardent in the insect world. In still another species, during the nuptial embrace, the female eats the stomach of the

male; another eats out her partner's brains. Fabre has experimented with a number of "Praying Mantis," by putting them in a cage. At a certain season, when their duty to preserve the species comes upon them, they enter the conjugal embrace, and the female begins by eating out the brains of the male, and after five or six hours, she eats the entire male, for she still loves him. Then if another male is fed to her for a husband, she eats him, and sometimes as high as seven of them, one after the other, have been fed to a loving spouse. Thus they do the service nature has called upon them to perform. It is a weird story but it is true.

Nature, after all, is strongest. It is life. Man wants life without paying the penalty for it. But, Nature has provided the way life shall come and the penalty that must be paid.

If any one can find any meaning in all of it, they do better than I can. To say that back of all is a Supreme Power which fashioned it for some purpose, is idle, without evidence, or logic, or reason to support it. And, if it is true, it explains nothing, because man immediately asks the question: What is back of that? The honest way is to take the facts that we have, use what reason we have, and when we cannot answer questions, say that we do not know.

Why it is, and how, man cannot tell. There is probably no "why" except that a certain mixture produces life, and everything follows it, and life preserves itself. In any sense that man understands it, the world is not good.

Nature is not good. The poet may say that God is in heaven and all is well with the world, but the poet is "seeing things," that is all; he is mistaken. There is no god in his heaven, so far as man can see. The truth is, Nature is a slaughter house. There are some pleasant sensations, some pleasures, which many would deprive us of, and, scattered along the path is trouble and misery, and in the end, tragedy. It is all a nightmare, if you think. The animals have the advantage of us—they do not think, they simply live.

AN ANSWER TO MR. DARROW.

No more interesting and entertaining article has appeared for many a month than the article of Clarence Darrow under the title of "Insects and Men; Instinct and Reason."

After giving a brief and interesting biography of a most remarkable man—Henri Fabre—Mr. Darrow proceeds in his own easy and lucid way to outline to us some of his observations in the insect world.

He tells us about the mason bee, how she builds her mud hut, stores it with honey, deposits her egg, seals up the aperture and flies away and never returns; how the egg so deposited germinates, consumes the honey so deposited, develops into a bee and emerges from the hut and flies away without instruction or guidance from any source; how the young bee in turn repeats the same process as the mother bee, and so on from the first bee to the end of time.

He shows that this is all done mechanically, since, if there be substituted for the half-completed hut of one bee the completed hut of another bee, the bee with the half-completed hut will proceed to add a half hut to the completed one, while the bee that had a half-completed hut substituted in the place of her completed hut will proceed to deposit her honey and eggs in this half-completed hut, which will not suffice to develop the grub.

From these facts Mr. Darrow, I think,

reasons correctly that the mason bee has no reason, that what it does it does from a certain urge or instinct; but when he comes to consider what instinct is I think he gets befogged.

He takes exception to Mark Twain's apt and pithy definition of instinct as being petrified reason, which I am inclined to think, is exactly what it is.

Mr. Darrow says: "It seems impossible to conceive that the first bee did not build her nest, put in her honey, and lay her eggs just as the last bee that ever comes into the world will do. Nobody can see that they improve or that they can change or can think or imagine how they came to be bees. It is impossible to think it is petrified reason. It seems to me almost equally impossible to think that they ever came up as the survival of the fittest—that an innumerable number of bees tried to do it and failed and only those that got along survived until they performed their task in this way."

A man by the name of William Paley wrote a book on "Natural Theology," in which the whole burden of his argument is in the above strain, and to my mind Mr. Darrow's is the strongest, not to say the only, argument in favor of a design in creation and the existence of a designer or Deity.

According to Fabre, the mason bee must be closely related to the honey bee; the difference being that it builds its own hive instead of selecting one provided ready-made in the hollow of a tree or the cleft of a rock, or one provided for it by man. Perhaps at one time they

were both alike and environment caused the different habits.

Now, let us consider the honey bees briefly: In Southern California, where the climate will allow, they hive among the limbs of a tree without any exterior covering of any kind. In more rigorous climes they seek some cavity or other that affords them protection, and it is possible that if Fabre had been able to extend his researches over a wider area he would have found the mason bee where environment would permit, availing itself of some ready-made receptacle for the deposit of its honey and eggs.

Nature is infinite in its completeness and opportunities. In infinite time, space and numbers everything that in the nature of things is possible, is liable to happen.

At first glance it might seem impossible that anyone should ever have conceived the idea of utilizing the electric current as a means of communication, as Professor Morse did, or that some one would think of utilizing the explosive force of gasoline by means of a gas engine.

It appears highly improbable that a poor French peasant boy would have a craving to devote his life to the observation of the habits of the insect world as Fabre did; yet among the infinite number of men that have appeared on the world, nature in her prodigality has made a proper provision.

This petrified instinct advanced by Twain and rejected by Mr. Darrow is to a certain extent observable in man.

No doubt Mr. Darrow has a certain way of getting into his trousers on arising from bed, and could not well get in any other way. He invariably puts on the same shoe first every morning.

The time was, perhaps, when honey bees all hived in the open as they do yet in Southern California and other subtropical countries, but some bee driven by the struggle for existence into a more rigorous climate, strayed into a hollow tree and found a congenial place for her habitation, and this habit has become fixed, or "petrified" with them; and no doubt if taken into Southern California where a hive or natural cavity could not be found, they would perish for want of the habited assembling-place.

Man himself furnishes a good illustration. In the South Sea Islands and torrid Africa and Australia, where nature has been kind and necessity did not require any of man's devices to overcome environment, man remains in his primitive savage state; and he has remained in such a state so long that his faculties have become dwarfed and "petrified," and it would be impossible to ever develop him to the state attained by the European.

So the civilized man develops, but the savage remains; and so all along down the scale of life. The fish remains, but the reptile developed; the reptile remains, but the mammal developed. The fish became petrified, but certain fish have the ability to fly in a rudimentary kind of way, and, perhaps the bird developed. Certain fish became a fixed type,

but in the plastic youth of the fish's existence a frog, which in infancy is a fish, but in later life develops into a reptile, by some chance of environment was evolved and the reptile was ushered into the world.

I believe if Mr. Darrow will read a little more extensively the great works on evolution, his doubts will be dispelled and his difficulties removed.

HUGH H. MARTIN.

"INSTINCT AND REASON."**Mr. Darrow Finds No Explanation of Them in
Either Evolution or Theology.**

Permit me to state my views a little clearer on the origin of "Instinct and Reason" and also to make some suggestions in reply to Mr. Martin's interesting article.

I cannot see why one who does not believe that "instinct is petrified reason" and confesses himself unable to explain its origin, should be put down with Paley, who argues from the Evidence of Order in Nature that there must be a God. Paley seems to me to take the position in theology which is taken by Mr. Martin in evolution, who argues that because there is no other way to explain instinct, excepting through evolution, therefore evolution must be its cause, and still stranger, that the insects have lost their reason and gone down until they have only one instinct left. Really, it seems to me that whether one is a scientist or a theologian, when he comes up to a fact which he cannot explain, it is just as well to say that he does not know.

Another thing, neither theology nor evolution explains anything. I could ask Mr. Paley "Who made God?" and he would tell me I have asked him one question too many. I can ask you "What is the cause of evolution?" and I fancy you would say the same thing. I simply stop one step before Mr. Martin or Mr. Paley—that is, I stop with the known and con-

fess to ignorance beyond it. Neither one can explain instinct.

I am quite sure Mr. Martin is a more thorough student of Darwin than I have been, but in spite of this he seems to have fallen into what I regard as a very common error—that evolution accounts for something, whereas, in fact it is little more than showing a common pattern through all life. Man and the bee were made on a common pattern. Evolution cannot go much further, or at least it has not yet been able to. Probably a number of the efforts of Mr. Darwin to explain things are not now considered sound by scientists, but still this has in no wise affected the fundamentals of his work or disturbed his position as being the foremost of the scientists of the world.

To be a little more specific, let us see whether Mark Twain was right, or was I right. No one has a higher regard for Mark Twain than I have. As a literary man and original thinker, he was without a peer, but his discussion of instinct and the doings of animals, especially as found in his very important work, "What is Man?" does not show marks of investigation or familiarity with the latest of what is known of animal life. His story of a horse who managed to get from the pasture to the meadow by thinking out the way to pull a pin that fastened the gate, is simply nonsense. The horse never thought out anything in any such sense. What the horse did was to fumble around and accidentally knock out a pin. The second time he did it a little easier, until after a while it became a habit. Late observations

of animals show this is the mode of action.

Mark Twain's explanation of instinct I believe is not upheld by any scientist. If instinct is petrified reason, it must follow that reason came before instinct; that at one time the bee was possessed of a remarkable intellect and wonderful reasoning faculties in many respects far beyond man but in some way he lost these and his reasoning power became petrified and he acted instinctively like a machine. This view does not correspond with Mr. Martin's idea of evolution, nor the popular idea of evolution that life is gradually going upward, which proposition to my mind is also absurd. Is there any question but that instinct came first? The nature of instinct is fairly well understood. It is little more than mechanical action. Under the law of mechanics, a lever, for instance, acts on an object that is to be lifted. If material is properly adjusted, the second object may act on a third and the third on a fourth, and there may be even an infinite number of actions and reactions started by the operation of the lever.

Instinct is about this. It is reaction from a perfectly mechanical origin. Reason is something more. It implies memory and the power of relating facts to each other and the ability to select the facts. It cannot exist in unconscious things, or conscious things acting unconsciously. That the lowest order of animal may have a modicum of reason is no doubt true; but that it is sufficient in any animal to affect his life seriously, is most likely not

true. It certainly is not true of the lower species.

Take, for instance, the bee. In order to provide fresh meat for an unborn bee, it stings a caterpillar in six or seven places, paralyzing it so that it cannot move, but still keeping it alive until the egg becomes a grub and is able to eat the caterpillar and later grows to be a bee. Can anyone imagine that there was a time when the bee by experiment and reason found out the six or seven motor nerve centers of the caterpillar; learned to do what no surgeon on earth could do, and then lost this reason, but retained the power to do it because the reason was petrified to instinct? It seems to me impossible to imagine such a thing, and even if you cannot imagine its opposite, it is an assumption with nothing to sustain it. To hold that the animal who uses his instinct ever acted in any other way; that all the animals, and especially the lowest of them, act entirely through instinct, seems to me, with what light we have, to be beyond dispute. I have no doubt that most of man's actions are instinctive. Pretty much all that he does, especially those things important to life, are purely instinctive. Reason came as one of the latest developments in life, and of course it is vastly more prominent in man than in any other of the animal creation. Animals no doubt acted automatically and unconsciously for ages before consciousness was born, and most likely consciousness grew out of some great stress which required it for the preservation of life. Consciousness is a late thing in

the history of the world, and reason is much later still. I can see no support in science for any idea that reason came first, or any possibility that instinct is "petrified reason." I cannot even see it in theology, with which I am even less familiar than science.

I fancy that the illustrations given by Mr. Martin in his criticism came nearer proving my case than his. Doubtless a hive of bees may live in a warm climate without resorting to a hollow in a tree and doubtless they may instinctively find the hollow of a tree where the climate makes protection necessary, but it does not follow that either one precedes the other, or that reason is in any way connected with the one or the other, or that one is ahead of the other in the time or degree of evolution. No doubt "trial and error" and "trial and success" may have much to do with the actions of animals through long periods of time, but this has no necessary connection with reason.

Mr. Martin's illustration of habits of dressing, as a proof of instinct in man, is also quite aside from the question. No doubt one puts on or takes off his clothes in a certain way without much or any thought of how he is doing it; but this does not come from instinct. It is a matter of habit, and whatever one does, if he does it often enough, he comes to do almost automatically.

The illustration of the South Sea Islands and African and Australian savages seems to me in no wise to support Mr. Martin's contention. Is the South Sea Islander or the Bushman of Australia less intelligent than he

once was? Did his reason petrify? I doubt if Mr. Martin would say so on reflection. The savage is as wise as he ever was. Possibly a little wiser, although this I doubt. By some action of nature, perhaps a mutation, he reached a certain point and stopped, as I am convinced the so-called civilized man has done, but he did not go back—he only stopped.

Neither do I read evolution in animal life as Mr. Martin reads it. That the civilized man developed and the savage remained, I very much doubt. That the fish petrified and the reptile developed, I do not believe; nor that the reptile remained and the mammal developed. As I read it, life, starting very low, reaches a certain point—assume to the fish, which as a matter of fact is quite well along. Then, through some mutation or unfolding, the reptile came from that stock. It became a reptile, but the fish remained. Through some further mutation, some higher form of mammal was born, but the reptile remained, and so on, up or down to man, whichever way you see fit to look at it.

If I may make a general criticism, which I do with all modesty, stating again that I am conscious that I am not a thorough scientist—that I have only grabbed what I could here and there without having the time to make original investigations, or even become familiar with all the best literature on the subject; but with these admissions, if I were to pass a general criticism, it would be this: that almost all men who have a theory, whether they are theologians or evolutionists, seem to feel the

necessity of accounting for everything. They seem unwilling to take a fact and ask after its origin and confess that they do not know. This was one of the great points with Fabre. He laid the fact clearly before you, then asked himself the fundamental question, What is its origin? and answered that he did not know. Theologians seem bound to explain everything by assuming a God. It is not necessary to ask if everything naturally follows from that. They simply say it must follow. The tendency of the evolutionist is to accept evolution unqualifiedly, which is still a theory, and then to say that it must explain everything in life.

In the first place, there are all kinds of questions as to what evolution means, and even though as a general theory it may be true, still this theory is constantly modified and explained by facts; and if ever fully accepted, it only widens the realm of the unknown and gives no ultimate explanation of anything.

Herbert Spencer in his "First Principles" has shown how impossible it is to find the ultimate explanation. The theologian, the evolutionist and the one who views life as I do, must sooner or later say, "I do not know."

CLARENCE DARROW.

INSTINCT, REASON, DESIGN.

The second half of Clarence Darrow's article on the observations and discoveries of Henri Fabre in the insect world, while equally excellent and interesting as the first, is somewhat a repetition of it, in that the same questions are asked and queries raised.

After telling us how the wasp, called the sphex, paralyzes a caterpillar by stinging it in the nerve centers, rendering it helpless, and then inserts its (the sphex's) egg and thereby perpetuates its species, he asks the question, "Who told the sphex where the caterpillar's nerve centers were?" answers "Maybe God did," and then asks "Who told God?"

No doubt the contemplation of phenomena like the above is the cause of the acceptance of the god and design idea by a great many men of learning and strong understandings, and it would appear that it leaves even Mr. Darrow in a quandary.

The great question whether the operations of the laws of nature as displayed by the actions of the insect world indicates design or a mere sequence of cause and effect, is brought before us.

To my mind the design idea is a kind of a mental mirage. It is very delusive. It is one of those cases where things are not what they seem, and we must proceed warily or we shall be misled.

Looking at it from the view-point given us

by Mr. Darrow, we are liable to get the impression of a design.

Yet the design argument gets you nowhere. No matter what conditions or phenomena nature might exhibit, and no matter how different things might be from what they are, the design idea would present itself.

The fact that the mosquito has a long, penetrating bill, by which it secures its sustenance might be taken as an evidence of design, and if man were given a protective covering of some kind by nature, rendering him immune to the mosquitoes' annoyances, that would perhaps be taken by the careless thinker as an evidence also of design; but the fact that protection has not been supplied us must be evidence of a lack of design.

If there be design, there perforce must be a designer; and if this designer was capable of implanting the kind of instinct he did in insects and animals, it would follow that he could have arranged things differently to avoid so much pain and suffering.

Fabre says all nature is merciless and cruel and a great slaughter-house—that at the banquet of life each is in turn a guest and a dish.

Nature has its mysteries and wonders, and perhaps the facts gleaned by Fabre from the insect world are as perplexing as any; the possession of instinct by animals is difficult of explanation, and the idea suggested by Twain's meaty term, "petrified reason," is probably the true solution.

According to Fabre, the mason bee has but a tiny brain; yet he it ever so small, that

brain must have a function. If the bee is a mere machine, it need have no brain, since machines have none.

All living things have had their genesis, and in the plastic youth of the mason bee species, and before its faculties became petrified, the mason bee's brain, small as it may have been, was perhaps capable of devising a mud hut, but in doing so it exhausted its faculties, so that its present brain has become a kind of a reservoir of past achievements, or something in the nature of an impulse transmitted from its ancestry. Have we not a kind of analogy to this in man? Is it not an accepted fact that certain mental traits are transmitted from sire to son? Man has his instincts, and they are perhaps a sort of petrified reason.

Most individuals shudder at the sight of a snake; they do this involuntarily and instinctively; and why? Perchance some primitive man was bitten by a venomous snake; his fellows beheld him writhing with pain, and reasoned hence that all snakes were dangerous; the impression thus received was so burned upon the human mind that it has become a constitutional habit of thought "petrified," and is transmitted to posterity, for no doubt if a child were taken in early infancy to some uninhabited island and away from human intercourse it would have the same repugnance to snakes.

Human instincts are so modified and obscured by reason that a comparison with the brute creation cannot safely be made, but still

resembling traces may be discerned.

The sense or instinct of direction appears much stronger in some men than others. I have traveled with men through forests, over mountains and across streams, turning hundreds of times; yet though unacquainted with the locality, they would keep in mind the direction of the starting-point.

And it would seem that the lower the scale of life and the smaller the brain, the narrower the range of instinct—showing it to be a mental faculty.

The mason bee appears to have exhausted the resources of its genius in the construction of its mud hut and storing the honey and eggs; its brain could go no further. All brains, even those of men, have their limitations, sad to say.

The bird has instincts, the same as the mason bee, and perhaps, like the mason bee, what it does it does from instinct; but its instincts take a much wider range than those of the mason bee, showing that the brain of the primitive bird was much larger than that of the bee; that its faculties were much greater and its processes of reasoning much more complex before it became petrified; for the bird builds its nest, lays its eggs, hatches them, feeds and cares for its young, and in case the young are threatened with danger, the mother bird will pretend injury to divert pursuit to herself.

And suppose Fabre had experimented with the bird as he did with the mason bee, would he have got the same results? Suppose he

had substituted a completed nest of one bird for the half-completed nest of another bird. Would the bird for whose half-completed nest a completed nest had been substituted have proceeded just where she left off and added another half nest to the completed one, as the mason bee did?

Fabre, no doubt, was a patient observer, but, as Mr. Darrow says, he was not a philosopher. He was too much of a Catholic to give up the God and design idea. He could not overcome his religious instincts. As with nearly all creedists, his reason had petrified along that line; and a pity it was, too, for an acceptance of the evolutionary idea would no doubt have brought him larger truths and much more useful discoveries to the storehouse of knowledge.

Instincts may be fallacious, vicious and inutile, as well as needful and correct. Men's instinctive fear of serpents makes them kill a great many harmless and useful animals, and I can see no reason why the mason bee might not utilize some ready-made crevice in stone or wood as a receptacle for her honey and eggs, as a great many other insects do, unless and except in the beginning she went through some fallacious processes of reasoning. Why does the dog sleep with his head to the fire, or turn around a number of times before lying down?

As the different forms of organic life have evolved from the simpler forms, individuals of all forms appear to have been arrested at the advances attained and became a fixed type A

like evolutionary principle is discernible in the development of mind, although it is much more obscure and harder to follow up and trace than in the material forms.

If the burden of years did not lie so heavily on the venerable John Burroughs, he might, out of his illumined mind and with his fund of first-hand knowledge, send us some additional light. Could Professor Eccles help us out?

HUGH H. MARTIN.

The Source of Animal Instincts

BY DAVID ECCLES.

Agnosticism, in certain departments of thought, has its uses; but when it intrudes into biology and writes "Ignoramibus" all over organic nature it acts as an opiate on the mental faculties and should be resisted. "Fabre does not know why, I do not know why, and nobody does," says Mr. Clarence Darrow, speaking of certain mysterious instincts discovered by Henri Fabre in spiders, bees, wasps and other insects. Many of these discoveries were made before Darwin wrote his "Origin of Species," and much illumination has been thrown on the problem since that date, even if Mr. Darrow does not know and Mr. Fabre never cared to know. The good old explanation, "miraculously endowed by God," satisfied him. The mind that can rest on these unsolved problems without even an effort to guess at a solution, having rejected the design theory as unproved and inadequate, presents a peculiar apathy in itself.

In marshaling facts for explanation, any kind of theory, even if it fails of a complete explanation, is better than none. The theory of natural selection, by slow accretion, has explained much of natural adaptation, and gives promise of eventually explaining it all. But if we suppose things have always been as they are then Nature is a standing miracle,

and no explanation, save the theological one, is possible. The apparent malignity of Nature can be brushed aside by the faith that "behind a frowning Providence he hides a smiling face." What are the feeble and separate instincts of spiders, bees, wasps and ants, compared to the wonderful coordination found in the human system itself? Can anything in these parallel the marvelous complexity of sensations evolved by cells modified through the ages into special organs, nerves, veins, capillaries, muscles, connective tissue, fluid circulation, secretive glands, bones, etc., all depending for their harmonious working on ten thousand instincts specialized in the primal amoeboid units? The spider's web is simplicity itself compared to this grand arborescence, reticulation, and anastomoses. The white blood cells, following instinct, sacrifice themselves daily to save our bodies from poisonous bacterial invasion, and each unit in the total, following its own sensational promptings, is building higher than it ever knows. Their actions are not reasoned out at all. They are the mere expression of feeling, and the feelings are there because all that failed to vary in this direction have been exterminated through ages of organic selection. Most of the cells have carried their first endowment of respiration through every change as an abiding index of their individuality. They do their own assimilation and breathing, as the needs of each are peculiar and specialized.

Instinct is the simplest and crudest form of

mind. It begins in mere mechanical tropisms. When the roots of a plant turn to water in whatever direction it is, or the leaves turn to sunlight they obey an instinct. Professor Loeb, from the physical side, will explain the chemistry that compels them to turn, nevertheless it is an adaptation to help the development of a living system. All matter does not respond in this way, only that matter specially constituted to react to water or sunlight. We are not in the habit of calling the plant's movements an instinct, but where shall we draw the line? When a *Drosera* or a Venus Fly-trap closes its cilia or leaves on an insect and holds it till digested, then slowly opens, in what respect is its action different from an amoeba? They are both brainless and respond to nothing but a stimulant. For years I have tried to impress the important truth that evolution can create nothing. It can only bring into more unity and cooperation powers already present. "If matter starts as a beggar," says Tyndall, "it is because the Jacobs of theology have robbed it of its birthright." When a crab is taken from a pond and thrown over a hill fifty yards away it will immediately start back in an ambling way for the pond. Like the camel it has a sense that tells it exactly where the water is. Tropisms are organic tendencies to mechanically execute movements that in the main are beneficial to the system. We have chemical tropisms (chemotaxis), phototropisms, or heliotropisms (reactions to or from light); geotropisms, obedience

to gravity; thigmotropisms, responding to surface contact, etc. The sense of direction in some animals may be originally derived from a magnetotropism.

Take the case of newly-hatched loggerhead turtles. The babes invariably move away from red, orange green, etc., but turn toward opaque or transparent blue. By following this tropism they are enabled to reach the deep sea, though born on land. As a case of geotropism, Professor Bohn has shown that the *Convolutas* (a sea worm) in a quiet aquarium rises and falls with the tides—they ascend when the tides go down and descend when it arises, though they may be miles away from its influence. That it is not merely periodical is seen in the fact that they keep time with its irregularities. Being a sea-worm, natural selection built up this tropism to preserve the race. Chemotropism is seen in the action of ciliated larva of the liver-fluke. This is a parasite that causes liver-rot in sheep. They swim round and round in the pond, coming in contact with many forms of vegetation and living things to which they pay no attention, for they do not eat, having no mouth. If no water snails are in the pond they eventually die, as millions of the egg-germs had done before that had been deposited on the upland and never reached water. When they find by touch a water-snail they immediately show excitement and make for its breathing apparatus, the only aperture it can enter. Here they go through three stages of metamorphosis

till transformed into an animal with a bilobed food canal. They feed on the snail till it dies, and leave the water, wiggle up blades of grass, become encrusted thereon, till a sheep comes along, eats the grass and starts it anew on its old life permutations. How many millions of failures and readaptations did it take for this creature, with merely a chemical sense, to fit itself to such changes? Remember, most of this lower parasitic life multiply at a rate that if supplied with food and living conditions would fill the bounds of the earth within a few years. I have no doubt at first it found an abode in other animals, but at last it specialized on the sheep as its surest protector. Now the extinction of the sheep means its own extinction. A little higher up in the scale of life we find that the larvae of fresh-water mussels exhibit the same chemotaxis. If a piece of fresh fish is put into an aquarium where they are they will jump and snap at it, just as they do at the minnows in the ocean, who carry them around till they complete their metamorphosis, when they fall back into the mud.

The easiest error the human mind falls into is the belief that an adaptation is a device. It fills a certain end; therefore it must have been designed for such an end, is the common thought. It is the adaptation of the sphex to feed its larvae by stinging the caterpillar that leads to the belief that either the sphex foresees the larvae's wants and provides for it, or that some higher intelligence implanted

instincts in it that meet the end. Through careless observation, or to fill the craving for wonder, the adaptation is generally exaggerated. Professor Marchal has shown that the instinct of the sphex wasp to sting at a precise point is neither as fixed nor as accurate as Fabre represented. Many blows have often to be given and mistakes are made. The crickets or caterpillars frequently recover and get away after being stung. Even Fabre has shown that if a fresh cricket is placed in the hole as a substitute for the one just stung it is dragged out and the battle renewed, showing that it is not pure routine, and that the wasp is prepared by experience for such an emergency. If the doctrine of Natural Selection is true, some time in the distant past sphex wasps stung their victims at random and had many more kinds to select from. Even now the varieties of wasps choose different kinds of food. This led to the failure of the eggs to hatch in adequate numbers. Those survived best that were best preserved; and those were best preserved where the tendency was to select the most adapted subject and to sting most effectually. In this way natural selection perpetuated those that paralyzed by stinging nearest to the nerve center. By degrees the limbs, sting, and organs were selected to bring each stinging feat nearer perfection, and thus was the perpetuation of the race assured. The crickets themselves may at first have furnished the holes by burrowing after worms. The only instinct the wasp had primarily was to

eat and to deposit its eggs. This was an old inheritance. Eggs are deposited in millions of ways, under millions of conditions all over this earth. Some are merely dropped at random and left to the hatching power of the sun, and the range of resistance extends from 250 degrees below to 210 degrees above zero.

All stinging insects draw fluids from the bodies of their victims. Food is their prime pursuit; the rest is cumulative or incidental. If they deposit eggs or germs—as many of them do—it is because it is a mechanical accompaniment of the suction. When the sphex wasp stings a caterpillar it simply wants to satisfy its appetite. The kind of food selected stimulates it to get rid of its eggs. Burying its victim may be the rudiment of an instinct derived from a remote ancestor who stored its food. Storing of food is common among insects and higher animals. The abundance of food the sphex found renders this instinct useless to itself, but the salvation of the larvae. If we do not contemplate these instincts from a cumulative point of view they are beyond all understanding. The mole provides worms for its winter use. To keep its prey in readiness it bites its head off. In the summer time the worm's head would be renewed by growth and it would crawl away. In the winter the biting renders it inert and a new head does not grow. The mole thus, far underground, has fresh meat on tap. The animal itself is as much a degenerate as the whale or porpoise. Its original limbs and eyes

are aborted or distorted. Probably it began by scratching after worms like a hen, but its small frame enabled it to go deeper underground, and the deeper it went the more it was subject to disease conditions. These acted on its germ cells and compelled change. The hand became a shovel, its nose a snout, new bones were supplied to strengthen muscular action. The eyes diminished and became covered with hair to protect them from dirt and friction, the lens aborted and sight became imperfect, the ear lost its external drum, etc. Viewed just as it is, it is a wonder; viewed from the point of natural selection, the slow change is simplicity itself. All the magic and miracle and sterile astonishment that Mr. Darwin likes to cultivate is gone.

There is no "petrified reason" about these habits. It is blind mechanical selection, as much so as the pocket the boulder wears in the bed-rock of a stream when the current tries ineffectually to move it on. The hole and the boulder become mutually adapted to resist the current; and if they were sentient things, benefited thereby, we would see God's providence in the act, as the old lady did in noting that large rivers ran near great cities. These instincts started before reason as the first expression of sentiency. Reason only comes in when a large brain treasures complex memories. The relation between the phenomenon and the fact is unknowable. Ultimate explanations as to why things exist at all are beyond science and beyond reason.

Looking for a purpose answers nothing; for the everlasting question still remains: "What is the purpose of the purpose?" The earliest endowment or instinct of life is to get food. It took millions of years before an organ was made that could move and seek for it. Life always presses on the boundary of its food supply, so that there is a constant struggle for existence. This has led to universal slaughter and parasitism. Mr. Darrow asserts that Fabre says that he has never found any species save man that acts as a parasite to its own kind. Whenever a man wants to conceal a falsehood he resorts to metaphor. It is only metaphorically that man is a parasite on his kind. A parasite is by scientific definition a smaller plant or animal of another species that lives on the abundance of a larger one. But almost all animals steal from each other and many prey upon their own kind. Most of the fishes prey upon their own young. Mr. Darrow himself has given illustrations of such preying. The females of spiders, scorpions, "praying Mantis," etc., as he has shown, eat the males in the nuptial act. The controlling desire of the female is to eat; it is different with the male. And here we see how instincts are mechanically limited. If males had shown a tendency to eat the females in the sexual act they would have wiped their kind from the earth. After the act of impregnation the male can be spared. The death of the female would mean the death of the possible progeny. Wrong variations often occur, but they correct them-

selves by their own extermination. Personally I think that accompanying every adapted tropism there is a sense of comfort or discomfort—perhaps too elementary for us properly to conceive with our higher and more acute sensations. A Mantis that allows itself to be eaten without resistance cannot have much pain, nor a wasp after it has been cut in two at the waist that keeps on sucking the juice or syrup it was indulging in before being severed.

The facts of adaptation are universal and apparent. Their causes are more concealed; but when discovered are usually so simple as to cause us to be astonished at our previous astonishment. Take the adaptation that enables the chameleon to change its color with its environment. For millions of years coloration has been a subject of natural selection. Half of Nature is a camouflage. Butterflies, moths, Mantis, etc., mimic to perfection the leaves, flowers and branches on which they generally abide. As to the cause a simple experiment tells the story. Professor Cesnola tethered 45 green praying Mantises to green herbage and 65 brown ones (both colors being changeable with the season) to withered herbage and found that not one of them was taken by a bird in 17 days. He reversed the order and found all the green ones were taken in 11 days, while only ten of the brown ones on green herbage escaped the vigilant birds in 17 days. Does anyone doubt the mechanical cause of this adaptation? The selection not

only extends to color but to shape and habit. The praying habit of the Mantis is its method of mimicking a dead branch. Has design or "petrified reason" anything to do with this? To believe so one must be very credulous. Coloration has numerous causes. It may be chemical or mechanical. In the evolution of organic substances a colorless matter has been found, called chromogen, that takes on different colors according to the amount of oxidation. Nature made millions of futile experiments before she developed this substance. These experiments, as Dr. R. G. Eccles has shown, as well as others in the building up of the organism, were mainly the side product of parasitism. It is all a battle of chemical solvents and resistants to these solvents. Not a metazoan creature on earth is free from parasites. In the years ago I have shown how this parasitic battle has been the cause of the imperviousness of the skin to microbes, the heat and coagulation of the blood, the poisonousness of all organic substances when injected into the system without being first broken down by the solvents of the stomach into their respective amino acids, the retirement of the germ cells to secluded parts of the body and their gradual decrease in numbers, the separation of the sexes, the close chemical connection of all consanguineous species, as proved by anaphylaxis, etc., etc. All this differentiation is the work of blind natural selection. Neither the parasites nor the cells have brains. A chemical change that

will dissolve or resist is all that Nature needs to build on, and these changes by the aid of sentiency are continually being forced. The greatest marvel is the power the organic molecules have to change from acids to bases, and vice versa, by mere rearrangement of radicals, but this, to be understood, requires more knowledge of chemistry than the average reader possesses.

The parasites select the food they need by solvent powers of their own juices. A million different kinds of food may be touched without awakening response, but when they touch the right kind, like the liver-fluke with the snail, they show excitement. A certain kind of mosquito—the anophele—unerringly selects the blood of man. Another kind of mosquito selects bird's blood. In this selection each carries to the host the germ of a parasite. If the first kind bites a bird it swallows with the the bird's blood a parasite. When it does so it digests both blood and parasite. If the second kind bites a man, it also takes in a parasite, but digests it. Thus both parasites are killed. But when they attack their preferential food, and the parasite is taken in, neither of them can digest it. It has a stage of development in their own system and is transferred again to the host. If both of these mosquitoes should vary so as to digest both parasites, malaria would depart from both bird and man.

I have made this excursion into biology at the call of my friend, Hugh Martin. I hope it will clarify his judgment. He plainly saw that

Mr. Darrow's treatment led nowhere, but was too much tinctured with Lamarckism to furnish the proper reason. No proof has ever been advanced that a habit becomes an instinct. Some of the most perfect instincts could not arise by habit, for they are executed only once in a life time. Almost all people reverse the order of Nature and try to make structure a product of intelligence. The very opposite is true. Man is intelligent because of his brain structure, made by natural selection, and some people are no more competent to become philosophers than I am competent to become a Caruso. My vocal cords are defective and no training could change them beyond inherent capacity. We all have a reserve power that training can improve, but it is limited by the structure. Only the survival of favorable variations can improve a voice or improve a brain. The higher animals have an intelligence that enables them through experience to add to and build on their instincts. A bird does this. The first brood of ducks a hen raises causes her endless alarm, when they approach water, but after she has raised several broods, she will actually call her own chickens to go into the water. Fear is instinctive where fear is a protection. The fear of snakes goes beyond man to the monkeys, and even lower than that, as I have seen my turkeys crane their necks and chatter like magpies at one. A pig has no such fear, because a pig is immune. The habit of the dog to turn around before lying down promoted his comfort, when

as a wolf he camped where the night found him and lay down in the grass, stubble or weeds. How structure and instincts are correlated is the unknowable. No one knows it all, but it is not safe for a man to assert that because he and his self-selected instructors have not an explanation of a fact, no one else has.

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