PROTECTIVE CHARACTERS AND NATURAL SELECTION.

PROTECTIVE characters have proved an attractive field of investigation to the modern zoologist. The idea that such characters have arisen—like the courage which "mounteth with occasion"—in response to the need thereof, is a fascinating one. Thus a species of animal exposed to the attacks of many enemies is in danger of extermination. But *natural selection steps in*—to put it in the usual picturesque but illogical phraseology—and throws a protecting mantle over it: it becomes clothed in protective characters. Thus nature, "red in tooth and claw" towards the INDIVIDUAL, becomes, *in consequence*, an *alma mater* to the SPECIES. The idea is, indeed, a fascinating one; the sword which threatens to destroy is changed by *its own action* into a protecting shield. And then the—*sometimes misleading*—argument from analogy is not wanting. For do we not see the bird rising in the air *by means* of the *opposing* current; the muscle growing *stronger* with the *exercise* which *wastes* it; and the tree becoming more *firmly rooted* in response to the wind which *tends to overthrow it?*

There is, then, some excuse for the great band of enthusiastic naturalists who, carried away by the fascination of the idea, have flooded biological literature with their explanations of how *protective characters* have been developed.

What, then, are protective characters? In looking round the animal kingdom we see, for example, that many of the animals living among the snows of Greenland are white, while those living in desert regions are often of a sandy hue; in other cases we see animals armed with offensive weapons, as the stings of insects; or we see certain families of animals *resembling* certain others, which latter are for some reason or other supposed to be free from the attacks of the usual enemies—as in the so-called *mimicry* among butterflies and other insects. Among plants, again, we see some provided with spines, thorns, stings or bristles. All these are examples of *protective characters.*

In the following remarks it is intended to inquire whether such characters can logically be supposed to owe their evolution to the Darwinian principles of natural selection.

In the first place, then, while in many cases these characters are of protective value, in others they are very doubtfully so, or even obviously otherwise.

This would appear to be the case as regards the *whiteness* of certain polar animals. The following extracts from *In Arctic Seas, or the Voyage of the Kite*, refer to the Polar bear:

"The fur was very thick, long, and of a yellowish-white colour, *in marked contrast to the pure whiteness of the snow*" (p. 107).

"A she-bear and her two cubs were *seen* at a *considerable distance* from the ship, their yellowish fur making them *clearly distinguishable* against the icy background" (p. 108).

As further examples, let us take the lemming and the musk ox. In summer the former is described as of a *yellowish-brown*, and in winter as of a *greyish-white*. The musk ox has long *dark brown* hair, with fine *yellow* fur beneath. There is, moreover, evidence to show that the white colour is partly due to the direct action of the cold.

Among insects, protective characters are extremely common, and may in many cases serve to protect them from insect-eating animals and other enemies. But if it be admitted that they have a certain protective value, it must also be insisted that this has been greatly exaggerated by those who trace their origin to the action of natural selection. Many of the examples brought forward, indeed, are too far-fetched and fanciful to be seriously considered. And even admitting the full protective value claimed for such characters, it would still be a far cry to the possibility of their evolution by natural selection. When the attempt is made to trace in detail the development of the protective characters of any particular species many difficulties are met with. Such a protected species is supposed to have arisen from one freely devoured by insectivorous animals, and by reason of being so persecuted. Among the individuals of such a species—let us suppose they were caterpillars—some would be a *little* more like their surroundings than the rest. The question is, would the keen-sighted insect-eater fail to detect them because of their *slightly* greater resemblance to their surroundings? Are there any grounds for supposing that those *left* by the birds would not contain a *large majority* of the normal type? And, if this were so, the few individuals a little more like their surroundings than the normal type would have their variations swamped by inter-crossing, even if *none* of them were eaten. But that they would escape being eaten, under the supposed circumstances, seems unlikely. Under normal conditions insects are so prolific that even those species most devoured by birds, &c., remain sufficiently abundant to continue the species. But the evolution of a new "protected" species is supposed to have arisen from a time of *special* persecution: individuals were so eagerly sought after by their enemies that *only* those escaped which were *slightly more like* their surroundings than the rest. We must suppose that individual A, which was normal, was devoured, while B, which was feeding in close proximity, escaped *because* it was *slightly* more like its surroundings. It must be remembered that birds feeding on caterpillars are in the habit of coming to the bushes where they are wont to find them, and searching at pretty close quarters. How, then, can a *slight* difference in individual caterpillars be supposed to deceive them? But the caterpillars have other enemies besides birds, and these can scarcely be supposed, even by the most enthusiastic, to be discriminators of minute individual differences. These enemies are ichneumon flies. Professor Poulton found that out of 533 larvæ collected by him, no less than 422, or about four out of five, died from the presence of ichneumon grubs. Now it can scarcely be supposed that the *one* of the five which survived did so by reason of any slight individual peculiarity by which it differed from the other four, or by anything but what we usually call *chance.*

It seems a fallacy, indeed, to suppose that a hard-pressed race will tend by reason of the persecution to form a new one by the survival of *slight variations.* Pressed themselves by hunger, the persecuting race will not be able to respect slight differences—they will be forced to search so diligently that a *slight* resemblance to their surroundings will not avail the insects. Those which do escape will owe their safety to chance, rather than to slight individual differences. And none of the species which have been hard pressed in recent times have, as far as we know, formed new species. The much persecuted bison and rhea of America do not seem to be doing so. The extinct dodo and sea-cow have not left new races behind them. Possibly, however, where human agency comes in, the case may be considered different. But there is also the case of the rat. The brown rat has persecuted and almost exterminated the black rat, yet the latter has not developed a new species. On the island of St. Helena, again, the goat is said to have practically exterminated the trees and shrubs by its depredations. Yet no *new species* of plants has been thereby produced, although the peculiarities of certain existing species are attributed to similar depredations by cattle in the far past.

When we consider the case of what are called *warning* colours in insects the difficulty seems even greater. A species of insect is much eaten by birds, and among its spontaneous variations some show more brilliant and conspicuous colours than the rest. This colour is supposed to be arranged so that in the course of further development it will resemble that of a species which birds for some reason avoid. Can we reasonably suppose that a bird will be deceived by the *beginning* of such a resemblance, especially when hard pressed by hunger? The varying insect must at first be far more like the *normal* members of its own species, which are *freely eaten,* than like those of the other species, which is *avoided.* And if the bird is not deceived by the beginning of the resemblance, this will not be further developed, but will be swamped by inter-crossing. It is, perhaps, doubtful whether the most perfect example of mimicry known to naturalists can deceive the keen eye of the insect-eating bird; it is *quite certain* that the *beginning* of such a resemblance cannot do so. These considerations show that Mr. Bates's explanation of mimicry, though generally received, is insufficient. The case of insects protected by nauseous or poisonous qualities is equally difficult. There can be no doubt here as to the protection—at any rate, as far as concerns the latter quality—but how has it been developed? According to the principles of natural selection the property must have been acquired gradually. But even if individuals suddenly appeared perfectly poisonous, or exceedingly nauseous, the difficulty remains. A bird might eat a poisonous insect and die, or a highly nauseous one and avoid the whole species in future; in neither case would anything have been done towards the evolution of a poisonous or nauseous species. For the poisonous insect is *killed* as well as the bird; and the sickened bird would avoid in future the perfectly wholesome and normal insects. Again, let us suppose that the acquisition of poisonous or nauseous qualities was gradual. Insect-eating animals are probably, as a rule, not very sensitive in the matter of taste; but, supposing one of them were to get an insect of not quite so good a flavour as usual, what would be the effect? There would be nothing to distinguish the nauseous insect from the rest—nothing, at least, so striking as to enable the bird to notice and remember. It would have learned nothing to enable it to distinguish and avoid other nauseous individuals. Either it must now avoid the species entirely, or go on eating as usual, and take its chance of getting a nauseous mouthful occasionally. *In neither case would it assist in the evolution of nauseous characters.* And we must remember that the nauseous or poisonous quality was at first something very little different from the normal wholesomeness, and would therefore *very* slightly affect the insect-eater. We must, moreover, be careful in our assumptions as to the protective value of nauseous, or even poisonous, qualities. That "one man's meat is another's poison" has probably its application here, and the avoidance of nauseous insects has only been proved for a few species of insect-eaters. In any case, the fact that such nauseous species are not increasing greatly in numbers almost necessitates the assumption that they are freely eaten by something; *possibly* on account of the very property which renders them "*caviare* to the general."

Professor Poulton has pointed out in certain caterpillars what he calls a "terrifying attitude." Thus the caterpillar of the *Puss moth* has certain markings which give it the appearance of a caricature of a vertebrate face, and when threatened with danger it presents these markings to its foes. This is supposed to be a protective character, and "*probably alarming to its vertebrate foes.*" By means of careful experiments Professor Poulton has shown that lizards and marmosets are, *to a certain extent, alarmed* by the appearance of such caterpillars. They approach them with caution, and examine them carefully before eating them. But they *do eat them.* If, then, the fully developed "terrifying attitude" does not save the caterpillar from animals, which are, perhaps, not in the habit of seeing that particular species, how can we suppose that the animals which fed on the ancestral form of the same were deterred from eating those in which the *germs* of the *terrifying attitude* first appeared? The entire experimental evidence, indeed, on which the assumption that warning colours and terrifying attitudes confer immunity is based is eminently unsatisfactory. This is shown by an examination of Professor Poulton's experiments.[1] The general result of these experiments was that the insect with the warning colour, or the terrifying attitude, was received at *first with suspicion*, but finally *eaten.* *Obviously* it reaped no benefit from its colours or attitude. Yet, strangely enough, Professor Poulton considers his experimental evidence confirmatory of his theory.

Among our most notable native examples of mimicry are certain bee-like and wasp-like flies. Their resemblance to bees and wasps is supposed to be of protective value, and to confer immunity from insect-eating animals. In the usual phraseology, for a long series of generations in the past, only those individuals survived which were increasingly like bees. And they survived because their enemies avoided them on account of this resemblance. Two points require to be noted here: first, how far the resemblance can be supposed to deceive the interested individuals; and second, how far true bees and wasps are avoided by insectivorous animals.

The resemblance of the flies in question to bees and wasps is doubtless very striking.

Even such a skilled and experienced naturalist as Réaumur tells us, in his *Memoirs* on certain of these flies, that he hesitated to take them in his hand on account of their likeness to bees. But a little familiarity soon enables one to detect the deception readily enough. Such, at least, is my experience. I have been in the habit of observing bees pretty closely for a number of years, and can easily detect the sham at a few yards' distance. Mr. Bates had a similar experience with the humming-bird hawk-moth. "Several times," he says, "I shot by mistake a humming-bird hawk-moth instead of a bird. This moth (*Macroglossa Titan*) is somewhat smaller than humming-birds generally are, but its manner of flight, and the way it poises itself before a flower whilst probing it with its proboscis, are

[1] *Colours of Animals*, pp. 247, 261, 280, &c.

precisely like the same actions of humming-birds. It was only after many days' experience that I learnt to distinguish one from another when on the wing." [1]

Seeing, then, that the human eye may be trained to detect the difference readily, may we not infer that the keen and practised eye of an insect-eater, which depends for its existence on its powers of sight, will as readily learn to recognise the sham? Réaumur's experience, indeed, was different, for even after long practice he could not easily detect the bee-like fly at first sight. But, then, even a Réaumur can scarcely be supposed to have the trained eye of an insectivorous bird, or the same keen interest in judging which might be eaten. It seems, then, that the sham insect should be readily recognised by its enemies.

The second point is, do birds and other insect-eaters *avoid* bees and wasps as food? The answer is, They are *rather partial* to them than otherwise. Thus, a writer in the *Naturalist* (November 1889) relates how a wasps' nest, having been discovered and exposed in front, was in a few days completely destroyed by great tits, *both wasps and grubs being devoured*. Toads, again, have been observed to feed willingly on both bees and wasps. The blue tit, the great tit, the fly-catcher, the chaffinch, and the sparrow are noted by bee-keepers as devourers of their stock. Virgil, it is well known, accuses the swallow. And yet Dr. Wallace [2] observes of a certain wasp-like beetle that its disguise had no doubt often saved it "from the beak of hungry birds!" Nor does the sting of the bee or wasp save it from some of the larger spiders.

Certain birds, again, have been observed to extract the stings before eating the insects. The bear philosophically takes the stings along with the honey.

Thus, on the one hand, the resemblance is probably insufficient to deceive; and, on the other hand, if it were perfect it would not save the flies, since their enemies do not avoid either bees or wasps. And if this is so, it is scarcely worth while to go back to the time when the resemblance was, so to speak, in its infancy, and say that individual flies a *little* more like bees than the rest would not on that account escape.

But there is another view as to the meaning of this resemblance of certain species of flies to bees. Some of them are parasitic on bees—that is, they lay their eggs in the bees' nests—and it has been observed that they resemble the particular species in whose nests they thus place their eggs. This resemblance is supposed to protect them from the bees, which take them for their own kind. If this likeness is thus supposed to be the result of the protection afforded by deceiving the bee, we must believe something of this sort to have taken place:

[1] *The Naturalist on the Amazon*, p. 187. [2] *Natural Selection*, p. 96.

A race of flies, not like bees, took to laying their eggs in bees' nests. Presently the bees, in revenge, began to kill the flies. But among the numerous spontaneous variations occurring among the flies were some *remotely like* bees. The bees were taken in by this *distant resemblance*, and did not kill these flies. In every succeeding generation those flies which were most like bees survived most frequently, while the others were killed by the bees. It is difficult to understand how the *slight resemblance* in its initial stages could deceive the bees. Even with the perfected resemblance of the present day there is a suspicion that, if it cannot deceive a practised observer at a few yards, neither can it deceive a bee at a few inches. And if such an explanation—the killing off of all flies not sufficiently like bees—is correct, it ought to be shown that bees at the present day *do kill* the flies hovering round their nests. Indeed, to keep the mimicking flies up to the mark of their present attainments, it should be shown that all showing retrogression—and there ought to be such—are killed off by the bees. If this were not so, then, according to the principle of panmixia, there should be degeneration back to the normal type.

A notable special objection which has been urged against the general theory of protective resemblances is that "protected" species are usually rare. And it is a remarkable fact that in certain families a species protected by mimicry may be *rare*, while others of the normal family type and inhabiting the same country are *common*. Among the butterflies of the family *Pieridæ*, for example, certain species which mimic *Papilionidæ* are scarce, while normal species of the same family are common. Now, it seems a reasonable supposition that a specially protected species should be able to multiply and become more numerous than an unprotected one. In fact, to fulfil the conditions of evolution by natural selection, we must suppose that each step in the perfecting of the likeness to the mimicked species was of special advantage to the mimicking, and enabled larger numbers to survive than of the unmodified. By the time the likeness reached its present stage of perfection the mimicking branch of the race ought to be the more numerous—if, indeed, we ought not to suppose the unmodified branch to have become extinct. If this were so, and the normal *Pieridæ* now inhabiting the same region be assumed to have migrated thither from a region where the strugggle for existence did not induce mimetic modification, a new difficulty is introduced; for, if the unmodified form can *now* exist, what is there to hinder the variation of the mimicking species which tend to revert to the normal type from doing likewise? Such reverting forms will not be weeded out, and there will be, in consequence, a rapid going back of the whole race to its original form. For an example of the unsatisfactory nature of the answers usually given to these objections I must refer to p. 233 of Professor Poulton's

Colours of Animals. And we must suppose that every mimicking species was brought to its present state of perfection by the constant weeding out of those not varying in the direction of more and more perfect resemblance. This weeding out must have been accomplished by birds and other insect-eating animals, which constantly destroyed all *slight departures* from perfect likeness. But there does not appear to be any evidence that this is so, nor does it seem likely that a bird so keenly interested as to devour all the *slight* departures from the type would be deceived by the perfect form. The fact that mimicked and mimicking species have not been shown to be rapidly *increasing* again points to the conclusion that they, like others, must be largely destroyed in the adult state, and that probably by insectivorous animals.

Mr. Wallace, it is true, takes the fact of a species being abundant as a proof that it is protected. Thus, writing of the butterfly *Kallima Paralekta*, which resembles a withered leaf, he says: "We thus have size, colour, form, markings, and habits all combining together to produce a disguise which may be said to be absolutely perfect; and the protection which it affords is sufficiently indicated by the abundance of the individuals that possess it."[1]

But, unless such an abundant species is *rapidly increasing*, there must be in it a *vastly larger annual* destruction than in a *rare species.* Expression is given by the same writer to a similar fallacy in connection with the genus *Drusilla*, which is mimicked by three different genera, *Melanites*, *Hyantis*, and *Papilio*:

"These insects, like the *Danaidæ*, are abundant in individuals, have a very weak and slow flight, and do not seek concealment, or appear to have any means of protection from insectivorous enemies. It is natural to conclude that they have some hidden property which saves them from attack."[2]

It is not, however, mere *abundance* of individuals in a species, but *increasing numbers* which would indicate immunity from attack. And if we compare in a given district a rare with a very common species, which are both, on the average, just maintaining their numbers, we must admit that the latter were destroyed in *greater* numbers—in other words, that they are *more*, and not *less*, subject to attack.

In speaking of the peculiar shape of wing which is found in so many different genera of butterflies in the island of Celebes, Dr. Wallace gives expression to what appears to me another fallacy. This special form of wing is supposed to give greater facility in making sudden turnings, and thus baffling a pursuer. And the only species of Celebesian *Papilio* whose wings are not thus modified, "being already guarded against attack, have no need of increased power of wing; and natural selection would have no tendency to produce it."

[1] *Natural Selection*, pp. 61, 62. [2] *Ibid.* pp. 181-82.

But it is difficult to conceive of a butterfly so *absolutely protected* that such increased powers of wing would be of *no advantage*, and so long as it was of the *slightest benefit* it would tend to be preserved and perfected according to the principles of natural selection. It is, indeed, absurd thus to speak as though natural selection were an *intelligent* agent which could *stop* the evolution of protective characters as soon as a species was *sufficiently protected* to maintain itself. For seeing that variations in the direction of protection occur *irrespective* of the *need* for the same, and that if these are *advantageous*—and further protection from enemies must always be so—natural selection must preserve them, the process cannot be supposed to *stop short of absolute immunity from attack.*

Another writer makes a similarly illogical statement regarding the dying out of very large species of animals. He speaks of their great size as " a final and tremendous effort to secure survival, but a despairing and unsuccessful one ! "

Is it not obvious, however, that the size could only be obtained *because* it was an *advantage*, and the cause of survival? And what is supposed to make the effort? Not the animals themselves—emulating the frog in the fable—that would be ultra-Lamarckism. Nor can natural selection be logically said to *make an effort*, for it merely *allows* favourable variations to survive. The "gigantic stature" is supposed to be the result of the effort, but the context does not indicate what is supposed to make the effort. Both cases in fact are examples of that *illogical* attribution to natural selection of *intelligent purpose* which is so common to the literature of the subject, and by which difficulties are often *slurred* over and so unnoticed by the reader.

If any species were *absolutely* free from attack they would increase inordinately and live down the others. But since even the most protected species are not so increasing they must perish in the struggle for existence as freely as the less protected. A similar argument is applied by Dr. Wallace to bees and wasps. They have not developed protective colours *because* they were already protected by their stings. But neither bees nor wasps are absolutely protected; they are, in fact, eagerly devoured by birds and other insect-eaters. Thus, when Von Siebold was studying parthenogenesis in the wasp *Pollistes gallica*, the birds destroyed such numbers of the nests that he was obliged to protect those he wished to observe with nets!

We know also that not a few species of bees have no sting. If, then, protective colouring enables an insect to escape its bird foes, there is every reason for its development in bees and wasps according to the principles of natural selection.

As a special example of protection, Dr. Wallace mentions certain comparatively soft and eatable beetles, which he thinks are protected by their resemblance to other species, which are so hard as to turn the point of the entomologist's pin when he tries to transfix them. But it must be remembered that many birds swallow even *stones;* surely, then, *no beetle* could be too hard for them! Others again are able to break *nut-shells,* which would also turn the point of the average entomologist's pin. It might also be suggested that a hungry bird would at least *try* the *hard-looking* beetle with its beak.

As an example of what may be called the more far-fetched cases of supposed protective characters, I will quote Dr. Wallace's example of an American caterpillar, *Bombyx regia :*

> "But perhaps the most perfect example of this kind of protection is exhibited by the large caterpillar of the Royal Persimmon moth (*Bombyx regia*), a native of the Southern States of North America, and known there as the 'hickory-horned devil.' It is a large green caterpillar, often six inches long, ornamented with an immense crown of orange-red tubercles, which, if disturbed, it erects and shakes from side to side in a very alarming manner. In its native country the negroes believe it to be as deadly as a rattlesnake, whereas it is perfectly innocuous. The green colour of the body suggests that its ancestors were once protectively coloured; but, growing too large to be effectually concealed, it acquired the habit of shaking its head about to frighten away its enemies, and ultimately developed the crown of tentacles as an addition to its terrifying powers." [1]

But to suppose that natural selection could thus evolve a species *too large* for safety seems illogical from the point of view of the writer of the above extract. For the *larger* individuals must have *survived only* because, and when, increased size was *an advantage.* And this must have gone on for countless generations, the *smaller* individuals perishing in the struggle for life. But perhaps Dr. Wallace would contend that size, having *once* been an advantage, *ceased* to be so under changed conditions. In such a case, however, we might naturally suppose that the *small* would then survive and the race become rapidly dwarfed again. Dr. Wallace, however, does not believe this. He thinks that these larger caterpillars being in danger of extermination, some of them took to shaking their heads. This frightened their enemies, and those that shook their heads escaped, while those that did not do so perished. Now why these caterpillars should shake their heads, or why the birds about to eat them should refrain from doing so in consequence, is not very obvious. But letting this pass, we are next asked to believe that among these head-shaking caterpillars some developed a fringe of tentacles round the head. These we are to suppose were still more efficiently preserved, because still more terrifying to their enemies. Thus by slow degrees they became what they are, each step in the development being *more terrifying* to their enemies. As an argument in favour of his view, Wallace brings forward the fact that the natives are afraid to touch the caterpillar. But it is possible they

[1] *Darwinism*, p. 210.

may have other reasons than its supposed terrifying appearance. This is a fair sample of the way such protective characters are supposed to have been evolved.

Against the theory of the evolution of protective characters in insects by natural selection, then, the following objections must be urged:

(1) The difficulty of understanding how a *slight* departure from the normal colour in a freely-eaten form could deceive the keen and trained eye of an insectivorous animal.

(2) The small amount of experimental evidence that "protected species" are avoided, and the inconclusiveness of what is brought forward.

(3) It has not been shown that reversions to the "unprotected" type among mimicking species are weeded out by their enemies. And it seems unlikely that minute variations from the type of perfect mimicry would be noticed by insect-eaters. But without such weeding out there would be reversion.

(4) If any species were *really* protected from those destructive agencies which keep others *in statu quo* as regards numbers, such a species ought to be *rapidly increasing.* But the greater the protection the greater the rate of increase. But protected species have not been shown to be increasing; some of them, indeed, are rare. And the mere fact of a species not increasing implies the annual destruction of immense numbers of individuals.

Protective characters also occur among plants. Thorny and spiny plants, and plants with stinging hairs, are supposed to have been evolved in the same manner as protected insects. Thus, those plants which tended to produce spines and stinging hairs were preserved in each generation, while those not doing so were destroyed. The first difficulty here is that of understanding how an animal in the habit of browsing on a certain kind of plant could be supposed to *avoid* a plant here and there *because* it was—as we must suppose it was at first—*very slightly spiny*, or had *embryonic stinging hairs.*

The second difficulty is that browsing animals *do not avoid* the perfected thorny or spiny plant, or even the stinging nettle. Sea-holly is one of our most spiny plants, and yet on the Norfolk coast, where it grows abundantly, the horses browse on it freely. The donkey's fondness for thistles is proverbial, and many browsing animals eat furze; while the nettle is eaten by snails, several species of caterpillar, as well as by cattle. And it cannot be supposed that browsing animals have been evolved *pari passu* with the plants, so as to enable them to feed on the same, for the staple of their food is grass, and they do not need the others. When we think of *grass*, again, we feel another difficulty. For the grasses are the plants most browsed on by animals, and in which, most of all, anything in the way of spininess ought to have been developed. Yet these same grasses have, according to some, developed a remarkable series of contrivances to protect their pollen from ants! The grasses, then, show us clearly that plants browsed on by animals do not need either thorns or spines to enable them to increase and multiply—to maintain and extend their place in nature.

We have seen that the protective value of stings in nettles and in bees is a doubtful quantity. Here is another example pointing the same moral, viz., that whatever be the real use of stings, or reason of their development, it is not that they protect their owners from the animals which prey upon them. This interesting case of really formidable stings being no protection is from the *Journal of Sir Joseph Banks.* Shooting an albatross on one occasion, he relates how the bird ejected from its stomach quantities of a species of jelly-fish which is armed with really powerful stings. The bird was evidently wont to feed on them.

Thus, to bring these remarks to an end, there seems to be no substantial foundation, either theoretical or experimental, for the view that "protective characters" have been evolved by the process of natural selection. But if not true, it may at least be claimed for it that it is paradoxical; for it is by the ruthless destruction of individuals that the race is supposed to be protected.

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