WHAT MAKES A SPECIES?

THIS is a question to which many of our readers would probably be disposed to give a theological answer. But an answer of that kind is one which, for reasons, we above all things wish to avoid. It appears to us, as a result of much intercourse for many years with men of science and with persons of both sexes who really love science for its own sake, that very many of them are beset with an abiding fear of being caught hold of by theology, as by the arms of an octopus, and dragged into a sea of dogma from which they can find no escape. To them (*mirabile dictu*) it seems clear that dogmatic authoritative Christianity is a great evil, if not *the* great evil, and they deem it to be a power which can close men's eyes to the evidence of fact, and which can pervert the volition of men into devious paths, to practice superstitious ceremonies in order to obtain what they desire in another world, to the great detriment of the progress of the human race in the present one.

Therefore they become, as it were, "color blind" and "tone-deaf" by an unconscious process of averting their mental gaze from facts and deductions which seem to them necessarily to conflict with the theology they favor. Such facts and deductions, therefore, run off from their intelligence, as water from a duck's back. Nothing will induce persons so prejudiced to consider them fairly, unless they can first be convinced that the results they so greatly dread would not necessarily follow did they accept the scientific facts and admit the deductions offered to them.

Similarly no positive Christian writer, above all, no man of science who is a Catholic apologist, can hope to obtain a fair hearing. He must not hope it, because those whom he addresses not only dread and detest his creed, but can never persuade themselves that he is even honest; that he really cares for the science he teaches for its own sake; or that his one only object is not to make "Romanists," or at least "Christians," of them, willy nilly. The specious arguments of such a man, they think, are not to be listened to, or, if listened to, then listened to with a mind firmly closed against conviction, and only keenly alive to detect the sophistries and fallacies which *must* be latent in his teaching, because his teaching, if accepted, would bring them under a bondage from which their whole being recoils.

It seems to us that the only way of dealing with such people is to say: "Well, let us assume that no supernatural revelation has been made, that no Church legitimately claiming authority exists, and that no anthropomorphic deity once created and now sustains the universe." Let us, then, for argument's sake, make abstraction of all such doctrines, and take for granted that the abandonment of a mechanical explanation of nature need not carry with it, as a consequence, the Divinity of Christ, the Doctrine of the Trinity, Transubstantiation and Papal Infallibility.

Let us say further to the inquirer: "Admit, if your intelligence is convinced that such is the case, that the universe manifests a reason, latent within it, which is not the reason of man; that there is something which, for want of a better term, we may call with Oersted, 'a soul in nature.' All that does not force you to be a Christian.

"As to the nature of this 'latent reason' you are quite free to remain an 'agnostic,' for, in some respects, we all are and want to be 'agnostics' with respect to it. Adore, if you wish to, the great god Pan, or rehabilitate, if it helps you, the whole heathen Pantheon. Do not, however, shut your eyes, blunt your senses, or paralyze your reason when you look out upon nature, but study and try to apprehend its deeper, if not its deepest, lessons.

"Shake off the paralyzing fears which beset you, be honest, be earnest, and try to view nature with an unprejudiced mind. We, on our part, promise you, in turn, to be absolutely sincere and honest while advocating the truths which we believe nature teaches. We will keep back not only all roundabout attempts to influence your religious belief, but (for the time) all mental reference thereto in our own minds, studiously avoiding anything of the kind, lest we should thereby unconsciously become theological proselytizers, when our one only aim is to be sincere students of nature, willing to follow wherever natural truth leads us."

Only by such a course of conduct can we, we think, induce these mistaken but morally well-meaning persons to put aside their prejudices and consider our arguments dispassionately. Moreover, it must be admitted that some distrust on their part is not altogether unreasonable or unwarranted; for, obviously, the scientific writings and arguments of many among us are evidently undertaken for the sake of edification, and are much more directed (as is, of course, very laudable from the supernatural standpoint) to secure converts to the Church than to advance science purely for its own sake.

Thus it is we have instituted "Catholic Scientific Congresses"

which cannot but give offence as well as edification, since they imply that there is such a thing as "Catholic Science," apart from all theology.

Yet it is impossible to deny that there really is a neutral region of scientific truths which may be apprehended alike by believers and unbelievers, by Christians, pagans, agnostics and dogmatic antitheists.

In such a region lies the multiplication table, the whole of algebra and Euclid, the facts of the world's past history as revealed by geology, and of the annals of mankind as made known by the most recent advances in historical research.

No true man of science, and no true lover of science, Catholic any more than non-Catholic, can avoid a feeling of distrust with respect to the scientific teaching of anyone whose direct and main aim is not the utilization of science for its own sake, but for some ulterior purpose.

Having, then, done my best to make clear that here and now I write purely and simply as a man of science and from the scientific standpoint only, I invite the attention of readers, from whatever bench of the "Parliament of Religions," to the consideration of certain biological facts bearing upon our initial question, "What Makes a Species?"

The disciples of Mr. Darwin and that eminent naturalist, Dr. Alfred R. Wallace (who propounded the theory of "Natural Selection," in the rooms of the Linnæan Society, on the same evening[1] as his *confrere* of wider repute), do not for a moment hesitate to answer my initial question very positively.

The joint enunciation of the Darwin-Wallace theory took place nearly forty years ago, and we have lamented the loss of Charles Darwin now for fifteen years; but at the last meeting of the Linnæan Society's last summer session the survivor of the great biological twins read a highly interesting paper which clearly and unmistakably expressed his answer to the question. The maker of a species—of all species of all and every kind—is and must always be, he said, "utility" and nothing but "utility." The title of his paper was: "The Problem of Utility—Are Specific Characters Always or Generally Useful?"

One most remarkable feature of this paper was its extreme dogmatism! Dr. Wallace affirmed that, *even in the absence of all evidence* of the utility of specific characters, we MUST none the less affirm their necessary utility, and that it is only through such utility that they *could* have ever come into existence!

[1] On the 30th of June, 1858.

It was very interesting to listen to the venerable zoologist who, after the lapse of more than a generation, was thus able to return to the scene of the promulgation of his theory, amidst wonder and opposition, in order to reassert it to an audience almost entirely acquiescent. And it was a "reassertion," because a declaration that all specific characters have been produced by "utility" is simply the reassertion of his original theory. For, if any specific characters are not useful ones, either for saving life or gaining a mate, then the species constituted by such characters can never have been produced by "Natural Selection." But the author, in treating the question, took for granted, as he might naturally be expected to do, the truth of the doctrine common to him and the late Mr. Darwin. So the question was implicitly answered at once; since, if species arise by "Natural Selection," then those characters which serve to characterize any kind of animal *as* a species must be due to the same cause, *i.e.*, to utility.

Thus the question which was really raised by Dr. Wallace in asking, "Are specific characters always or generally useful?" was really but a repetition of the old one, of thirty-nine years ago, "Do species arise through 'Natural Selection'?"

To do our best to answer this question from the pure standpoint of physical science, we have the advantage of citing some novel and interesting facts, though we must not on this account lose sight of important arguments which we have before brought forward—arguments which have never been replied to or duly noticed, owing, probably, to that very prejudice to which we referred in the opening passage of this article.

That there really is such a thing as "Natural Selection" (*i.e.*, that the destructive forces of nature eliminate individuals least able to endure them), and that it acts to a certain extent, is, for us, an obvious fact, and it was evident long ago to the Greek predecessors of Aristotle. Nevertheless, there are a number of biological facts, too often and generally ignored, which demonstrate that many specific characters are due not to "Natural Selection," *i.e.*, to "Utility," but to what for us is evident, an innate tendency towards variation in a definite direction. If, however, amongst our readers are any minds prejudiced against the very idea of anything "innate," it will suffice to affirm that such specific characters are due not to the "utility" of them, but to an X power.

In that great and wonderful island, New Guinea, and in a few adjacent to it, there are to be found a number of kinds of very remarkable birds, not to be found anywhere else in the world. In

fact, the 100-fathom line round New Guinea accurately marks out the range of the birds we refer to. One curious fact is that the birds in question are near allies, zoologically speaking, of a group with which we are not accustomed to associate ideas of "beauty" any more than of melody, in spite of the fact that their throats contain apparently as perfect an apparatus of song as is to be found in that of the Nightingale or the Mocking-bird. They are, in fact, close allies of the Rooks and Crows, Jackdaws and Ravens; and yet, after those unrivalled living gems, the Humming-birds, I know none more beautiful than these transfigured Rooks and Crows, the Birds of Paradise. New species of them have been found quite lately—new forms which even exceed in the singularity of their beauty.

The Great Bird of Paradise (the species longest known) possesses a dense tuft of delicate plumes, sometimes two feet long, which come forth on each side of the body from beneath the wings. These tufts have for a very long time been made use of as an ornament for ladies' head-dresses. It is an inhabitant of the Aru Islands. A similar but smaller species is found in New Guinea, Mysol, and Salwatty.

The Red Bird of Paradise has its two middle tail-feathers charged with two stiff black riband-like structures a quarter of an inch wide. It is found nowhere but in Waigiou, a small island off the northwest end of New Guinea.

The King Bird of Paradise has an altogether differently developed plumage to that of the three foregoing birds. Its tail is short, save two feathers, while on each side of the breast are some short, broad, brightly-tipped feathers which can be spread out like a fan over either shoulder. The two middle tail-feathers are nearly six inches long and like delicate wires, save toward their ends, where they have on the inner side a most singular web in the form of a spiral disc. This species is widely distributed over New Guinea and the adjacent islands.

Quite different again is the form of the plumage of the other small bird known as the Magnificent Bird of Paradise.

Another bird, the Republican Bird of Paradise, a skin of which is in the Museum of the Academy of Natural Sciences of Philadelphia, has the top of its head bald and (when fresh) of a rich blue color.

One of the rarer Birds of Paradise is called "the Superb." It has over its breast a sort of shield formed of narrow and rather stiff feathers, and another much more extraordinary one, which springs from the back of the neck, the outer sides of which shield are actually larger than the wing.

Another anomaly is presented us by the Six-shafted Bird of Paradise, which has six wonderful feathers, six inches long, which spring from the sides of the head and are like delicate wires with a small oval disc at the extremity of each. It has also a great tuft of soft feathers on either side of the breast.

Yet another kind named after Dr. Wallace, who discovered it in the island of Batchian, has a quite unique structure in the form of a pair of long narrow white feathers which spring from the bend of each wing—a structure unlike any other known to us in the whole class of birds. The Twelve-wired Bird of Paradise is so called because on either side of the body it has six feathers, each like a slender black wire, bent almost at right angles about its middle and ending in a point without any web—a most extraordinary and fantastic ornament amongst those of this singularly polymorphic group of birds.

Lastly it will suffice for the present purpose to refer to the Long-tailed Bird of Paradise which by the structure of its tail, even more by its upstanding lateral plumes, exhibits a special structure of its own.

In this remarkable group of birds we find their exceptional abnormalities of plumage so different in different species that they could never have sprung from a common origin—from one parent abnormality—but they must have arisen independently in different modes in different species. Evidently in the whole of the individual organisms which together compose the group of Birds of Paradise there must have been an innate, latent tendency to develop a special abundance of plumage, different in both form and locality in different species.

Dr. Wallace said: "Accessory plumes and other ornaments originate at points of great nervous and muscular excitation." But the points of origin of abnormalities of plumage in these birds are so numerous and diverse that such local excitations seem a very inadequate cause to account for them. Yet even if they were adequate, what would account for such varied localities of excitation in this particular group of birds alone?

But Dr. Wallace affirmed that such characters were utilized "for purposes of recognition, ... each ornament being really a 'recognition mark,' and therefore essential to both the first production and subsequent well-being of every species."

Let us suppose that a certain group of birds (A) have begun to vary in such a way that the males have acquired incipient secondary sexual markings or growths in their plumage, and that another group of birds (B) have begun to vary so that new tints, or

plumage growths, appear equally in both sexes. The change must be small at first, and, indeed, Dr. Wallace said "the transition" is an "almost imperceptible process." But that influence can, at the same time, induce the males of the group (A) to seek for females, freshly modified but different from themselves, and the males of the group (B) to seek for females freshly modified but like themselves.

And why should individuals with only incipient modifications object to mate with individuals of the hardly different parent stock? Yet if they did not so object in a majority of cases the new variety would soon disappear. Dr. Wallace declared that such marks must have been specially needed during the earlier stages of differentiation. Yet at such "earlier stages" the much-needed (according to Dr. Wallace) "recognition marks" must have been at their minimum. An innate spontaneous impulse of this kind—an impulse on the part of individuals *incipiently* varying to breed together *exclusively*, is surely a very mysterious impulse. The causation of such a mysterious *quasi* voluntary mode of action must be a *sine qua non* for the origin of species. But the origin of this impulse is as mysterious as the origin of species itself! To explain a mystery by another mystery not less mysterious than the first is a proceeding as unscientific as it is unsatisfactory.

Dr. Wallace stoutly maintains that the action of no other agency than "Natural Selection" is credible, because it is imaginable that specific characters which are now useless may have once been useful in unknown ways to unknown ancestors of existing species.

It is difficult to tackle such an assumption, and yet we are sure it can be tackled, and successfully tackled, could we only obtain an unprejudiced hearing for facts we have to bring forward and will bring forward very shortly.

Dr. Wallace, in his paper here referred to, affirmed that "no other agency" than "Natural Selection" has been brought distinctly forward and shown to be a probable cause of specific characters—and therefore of species. Possibly not. But if an asserted cause (X) has been shown to be incapable of producing a certain effect, it is no use to say: "It must be (X) because you have not brought forward any definite (not X) as efficient to produce that effect." Surely it amply suffices to reply: "The cause you assert is insufficient; we must therefore still remain in an attitude of doubt and expectancy with respect to the phenomena in question."

There is, however, another group of birds besides the Birds of

Paradise to which attention has recently been called.[1] This is a considerable group of small-sized Fruit-Pigeons, which range from the Malay Peninsula, through the Malay Archipelago, to Australia and Polynesia. The group is so large that it is subdivided, and one of these (named *Ptilopus*, in the most restricted sense of that term, which in a wide sense is also applied to the whole group) contains twenty-two species, of which no less than thirteen are found isolated from other species each on its own island or small groups of islands.

Thus the species *P. pelewensis* is found only in the Pelew Islands. *P. roseicapillus* is confined to the Ladrones. *P. ponapensis* and *P. herusheimi* are both found in the Caroline Islands, and yet only in different ones; the former only in Rock Island and the latter in Kushai. *P. parpuratus* and *P. chrysogaites* both belong to the Society Islands, but to different ones; while other species belong respectively to the Solomon Islands, New Caledonia, the New Hebrides, the Marquesas, and so on.

Now, as Captain Hutton says (p. 333), it is highly improbable that all these thirteen species were first developed on other islands where now they are not to be found. It is no less improbable that other species of this section of the Fruit-Pigeons formerly lived on each of these thirteen islands, and have become extinct on all of them. If it had been a single case only, we might have had some doubt; but when it comes to having to apply the same explanation to more than half of the whole number of species, the process surely becomes absurd. Consequently, it appears almost certain that most of these species were developed each on its own island; and, this being allowed, we have the problem of the origin of their specific characters reduced to its simplest form.

If these species originated in the islands in which they are found, the colors which distinguish them cannot be recognition marks, because there is no other species in each island with which they could be confounded. The colors cannot be due to correlation, because they are the only characters which have changed. They cannot have been useful to ancestors, because they have only lately been developed. And we cannot suppose that they give any special advantage in each island, because all the islands have, for practical purposes, the same flora and fauna. This exhausts the resources of the principle of utility, and we are driven to the conclusion that these specific characters have a non-utilitarian origin; and yet they are found "in every individual constituting the

[1] By Captain F. W. Hutton, F.R.S. See the *Journal of the Linnæan Society* (Zoology), vol. xxvi., No. 168 (November 1, 1897), p. 330.

species, neither more nor less." In these opinions we are entirely at one with Captain Hutton; and we further agree with him in affirming that whether we can discover the cause of these developments or not, there is an overwhelming probability in favor of the statement that these truly specific characters have had a non-utilitarian origin.

But the colors and markings which constitute the specific characters of these Fruit-Pigeons have not had a utilitarian origin; surely it is quite probable that the specific characters of many, most or all other species have not had a utilitarian origin either!

It therefore follows, as an absolute certainty, that recognition marks and specific characters are not necessarily developed through utility; therefore, that utility does not make a species, or, in other words, that the origin of species is not and cannot be due to "Natural Selection," however much the destructive agencies of nature may facilitate or hasten that origin.

There is yet a third group of birds to which I will here refer, and to which I would specially invite the reader's attention, because it is a group of beautiful species of which I myself have made a very special study.[1]

The group in question is made up of the Parrots which compose the family *Loriidæ* (seventy-five species), which have mostly brilliant plumage, and which vary in size from about that of a Turtle Dove down to about that of a Sparrow. They form rather less than one-sixth of the whole order of Parrots. They are very choice feeders, living on the nectar and pollen of flowers, and very largely on the blossoms of *Eucalypti* and coral trees.

When such trees are in flower, Lories may be seen in large flocks clinging to the smaller branches in every attitude possible to them, and when they have exhausted the supply to be obtained at one spot they will fly off rapidly with shrill screams to other trees as yet unrifled of their nectar. So intent are they, while feeding, on their occupation that they may then be closely approached, and even the firing of a gun from beneath, though fatal to individuals, has been known not to disturb their uninjured neighbors.

Their plumage is almost always a mixture of green, purple (or

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[1] See my work, *A Monograph of the Lories or Brush-tongued Parrots Composing the Family Loriidæ*, London, R. H. Porter, 7 Princes Street, Cavendish Square, W., 1896. With LXI. plates, drawn and colored from nature, representing 22 typical specimens, and 16 species, represented for the first time, an anatomical introduction with 19 figures, and 4 plates of geographical distribution.

blue) and red, often of all three, while yellow is frequently also present. Sometimes the whole body is green of one or more shades, while the plumage may be all red, or, in two instances only, blue and white. The tail is generally short, and may be nearly square, but in rare instances the two middle tail-feathers may be very prolonged.

The tongue is very remarkable, the papillæ on its upper surface laterally and towards the apex being much elongated and bent more or less backwards, so as to form a kind of brush, which must be useful in extracting the nectar and pollen of flowers. Such is the structure of the tongue in all these species the tongue of which has been examined.

It is the geographical distribution of certain species, however, which is of special interest to us. The Lories do not extend beyond 10° N. and 45° S. latitude or west of 115° E. longitude or east of 145° W. longitude (English reckoning). Their extreme northern habitats consist of the Caroline, Washington and Fanning Islands; their furthest extension south is to Tasmania; their most western dwelling-place is the island of Sumbawa; while their extreme limit eastward is formed by the Marquesas Islands.

New Guinea, with the islands of Geelvink Bay, is the region richest in Lories, having no less than thirty-one species.

Of a small section of the group—the Black-billed Lories (*Chalcospittacus*)—one species, almost entirely black, is found in New Guinea, but a closely-allied form, known as Berstem's Lory, which (so far as yet known) is confined to the island of Mysol, has there acquired a red edge to its otherwise black forehead. The utility of this specific character may indeed be deemed problematical. Certainly it can be no recognition mark, since the general blackness of the body alone constitutes a complete and ample distinction from the three other Lories which alone inhabit Mysol. Another species, however—the "Red-quilled Lory"—which has so far only been found in the small island Amberpon, has the under surface of the wings and tail with bright red or red and yellow tints. This is the more remarkable because we have up to this time no evidence that any other Lory is an inhabitant of Amberpon Island.

The islands in Geelvink Bay seem to be the only home of the Black-winged Lory, a very distinctly-marked species with its black shoulders and bright blue spot at the side of the head. Similarly the Blue-streaked Lory hails from the Tenunber Islands and Timor Laut, while in the former no other Lory is to be found save the one (termed "plain"), the simple green plumage of which

renders the elaborate markings of the Blue-streaked Lory quite needless as recognition signs.

Very much more striking, however, is the fact that the very exceptional species, named "the Cherry-red Lory," is confined to the small island Puyuepet, one of the Caroline Islands. Its remarkable coloration cannot be needed to enable the sexes to recognize each other, for no other species of Lory exists (so far as yet known) in this group of islands.

Similarly the two species of Notched-winged Lories each dwells in a habitat which no other kind of Lory shares. One of these, the "Fringilline Lory," is found in Samoa and the Friendly Islands, and the other, "Kuhl's Lory," as exclusively in the Washington and Fanning Islands.

Most remarkable of all, however, is the extremely exceptional distribution of the most exceptionally colored of all Lories, namely, the "Blue Lories."

The first of these, of a beautiful azure tint, which was known and described by Buffon in 1779, is called the "Tahiti Lory." As its name implies, it is found in the Society Islands, and is the only Lory there found. The other species, the "Ultramarine Lory," is the only one inhabiting the Marquesas Islands, which is also the only portion of the globe where it is to be found.

The blue coloration of both, the white throat of the Tahiti Lory and the white spots of the other, cannot be "recognition marks." Neither is it conceivable that the surrounding conditions of environment in either the Society or Marquesas can have educed the blue color of these species, or that those of the Caroline Islands can have elicited the uniform tint of the cherry-red Lory.

As Captain Hutton well observes in the paper hereinbefore referred to, recognition marks can be useful only among those animals which are capable of recognizing them by their senses. But in some blind animals color constitutes a specific character, as in bivalve shell-fish (Lamellibranchus). Even with animals possessing eyes there are some specific characters which cannot be regarded as recognition marks, for they cannot be seen, as the teeth of the so-called "tongue" of snail-like creatures (Gasteropods). The venation, *i.e.*, the arrangement of the so-called "veins," of the wings of Butterflies and Moths is hidden by the scales which clothe them, and yet it often furnishes good generic and sometimes specific characters; occasionally even the venation differs in the two sexes. Some crabs are always covered with sea-weeds, and the species cannot be ascertained till these sea-weeds have been removed.

Many species of orthopterous insects (such as cockroaches, grasshoppers and locusts) differ from each other in the number or position of the spines on the legs, and no one will suppose that the male of one of these insects stops to count the number of spines on the legs of a female before making love to her, or that the female does so as to his spines before accepting him.

Can we suppose that the colors which distinguish the shells of the different species of *Tellina*, which live in sand, have been developed by "utility"? Can we suppose that a spine more or less, or a different arrangement of the tubercles, on the carapace of a crab has been so formed either? Can it matter in the struggle for life whether a vein in the wing of an insect branches once or twice; or can slight differences in the number or position of the spines on the legs give an individual insect an advantage over another? Can we, again, suppose that the slight differences in the number and shape of the teeth of snail-like animals, or whether they have ten or twenty ribs to the tenth of an inch on their shells, are important for life? Yet they are often good and constant specific characters. Let us consider the shape of the spicules of sponges, or the skeletons of Rudiolarians, or the small differences in the leaves of ferns and mosses, or the various ornamentations on the frontales of Diatoms. Can all or any of these characters—which are certainly as stable as specific characters which are acknowledged to be useful—can any of them be explained by the principle of utility? If such is the case, which, among two or more species living together, is best adapted to the conditions, and which the worst? And why has not the worst died out? Take, for example, the different colors and shapes of the shells of Mussels (*Mytilus*), two or more species of which often live together under exactly the same conditions; if one color or shape is more advantageous than the others, why are the others there? We cannot plead want of time, for many of these species date back to the Pliocene period. Suggestions that it might be this or might be that are not worth consideration when we find that effects which, according to them, ought to have been produced have not been produced, and when species are equally abundant which have and which have not some character thus hypothetically deemed useful.

As examples of the gratuitous hypotheses which men like Dr. Wallace are ever ready to suggest, we may take the following. On its being suggested that a rabbit's white tail, instead of a useful appendage, must be a dangerous one as attracting the eyes of an enemy, he replied, "It has been created by utility because, in

cases of danger, it serves to guide the young to their dam and therefore to their burrow." The spots over dogs' eyes are also, according to him, due to utility, because, he tells us, they delude onlookers into the belief that a dog is awake when, in fact, he is fast asleep.

But the fact seems to us to be simply undeniable that different groups of creatures have different innate tendencies to develop in certain definite directions, as we have seen reason to believe that the groups of Birds of Paradise have a tendency to develop redundant plumage now in one region of the body and now in another region.

In the great group of Marsupial or pouched animals, whereof the Virginian Opossum may be taken as a type, we find a series of species in which a certain portion of the bodily frame becomes more and more diminished. These species constitute a section of the Marsupials which inhabit Australia. One of them has a squat body, somewhat like that of a Marmot, and is a burrowing animal. Each hind foot has five toes, whereof the second and third are very slightly shorter than the others and somewhat further bound together by the skin. But this minute difference cannot be supposed to be of very vital importance to the Wombat. In another group of Australian Marsupials, however, the Phalangers, this difference is a little more marked, and when we examine the structure of the foot in a third group, that of the Bandicoots, it becomes much more so. In the Kangaroos we find this character present in an extremely marked degree. Each hind foot has two large and conspicuous toes of unequal size, the inner one being very large, with a very big and sharp claw. On the inner side of this large toe is what at first sight appears to be a very minute one, furnished with two claws placed side by side. An examination of the bones of the foot, however, shows that this apparently two-clawed toe really consists of two very slender toes bound together in a common fold of skin, and these answer to those two toes which are very slightly shorter than the others in the Wombat.

Thus we have here a characteristic and progressive determination of a part which must have been due to an innate tendency, since its incipient stage, as we find it in the Wombat, could not have been developed through utility and the struggle for life.

There is another interesting group of animals which exhibit an analogous condition with regard to the hand, a condition which culminates in a structure which no one has, or can pretend, to have been due to either natural or sexual selection.

There is a group (*genus*) of animals which inhabit Madagascar which are known as "Lemurs." They are creatures mostly about the size of a cat, with sharp-pointed muzzles and long tails, which, like their bodies, are well clothed with hair. Their legs are not much longer than their arms, while each extremity is modified to serve as a hand, the great toe as well as the thumb being opposite to the other digits. Their hands and feet are thus like those of monkeys, with which they were long associated in zoological classification, though in reality they seem to have no special affinity whatever with the monkey tribe. There are a number of groups (*genera*) of animals which more or less closely resemble these Madagascar Lemurs, and they have, therefore, become known as Lemur-like[1] animals. Some of the genera thus allied to the genus *Lemur* are also found in Madagascar, but a few exist in Africa, and also in Southeastern Asia.

Among the Lemur-like animals there are four genera which we may distinguish from the others as slow-lemuroids, because they are rather sluggish animals and singularly deliberate in their movements. They are all about the size of a squirrel or a little larger, their limbs are of equal length, and their tail is, at most, but a short one. None of them are found in Madagascar, but two are Asiatic and two African. Of the two inhabiting Asia (in the India region) one is known as the Slender Loris, for it is exceedingly slender in build, and has not even a rudiment of a tail. It inhabits Southern India and Ceylon, and is regarded by the natives as a remedy for ophthalmia, on which account it is sold in the bazaars of Madras. The second Indian kind is a stouter animal, and is found in Cochin China, Sumatra and Borneo.

Of the two African kinds one is known as the Angwautibo, and inhabits Old Calabar, and was first described in 1863. The other African kind was discovered by the traveller Bosman during his voyage to Guinea, and was first made know in 1705. After that, it was not again seen by a European for twenty years, nor was it ever fully described till 1830.

Now the special point to which we desire to direct the reader's attention is the structure of the joints, or index finger of the hand. In the true Lemurs of Madagascar that finger is already slightly shorter than the others, and this is a common feature in Lemur-like animals. When, however, we come to the Slow-lemurs this

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[1] The author of the present paper was the first to propose this arrangement in a paper read before the Zoological Society of London on November 22, 1864, pp. 635–637.

shrinking of the index becomes progressively more marked, until, in the Angwautibo, the first finger is reduced to a mere rudiment. In the Potto, however, the reduction is most complete, for it has no index finger at all.

This peculiarity of the Potto appears to us to afford nothing less than an absolute demonstration that it is not "utility" which "makes species." For who can believe that the circumstance of not having an index finger ever saved the life of a single Potto? As to sexual selection, who again can believe that even one male Potto ever gained a mate through such a defect? Is it credible that when a male Potto makes an offer of his hand to the female of his choice, she habitually looks carefully to see if her suitor has a rudiment of an index finger, and would certainly reject him with scorn and disgust, could he not proffer a hand entirely devoid of a feature so offensive to her susceptibilities?

But what other reason can possibly be assigned by the school of Dr. Wallace as a cause for this progressive atrophy of the index amongst Lemuroids, and for the special distinguishing character of the species Potto?

"Oh!" some will reply, "It is not due to natural or sexual selection directly, but only indirectly; it is a character correlated with some other character which *is* due to one or other of these kinds of selection."

But certainly no one can even pretend to be aware of any useful character thus varying concomitantly with the development of the index finger. As for any unknown character, anatomical or physiological, it would surely be nothing less than monstrous to assume that some unascertained anatomical condition of the liver or kidney, or some diminished or increased function, *e.g.*, of secretion—was the real cause of such a specific character, wherewith the size of the first finger was correlated in some quite unknown and quite unimaginable manner.

A survey of the organic world cannot be a complete or scientific one, if the characteristics of the highest of animals (man) be left out of the account, nor can man be said to be treated scientifically if his highest characteristics, his mental endowments, are not taken into consideration as well as his mere animal faculties and organization.

Now as to the latter, man's body shows a curious analogy (when taken into consideration together with the structure of apes) with the Potto as becoming the vanishing points of a progressively decreasing structure. In many mammals there is a well-developed penial bone, and such a structure is well developed

in the ordinary Apes. When we come to the man-like or Anthropoid Apes, we find it becomes smaller and smaller, till it was, for a time, believed to be entirely absent in the Chimpanzee. It exists, however, at least in a rudimentary condition, in all the Anthropoids. Yet in man it has, at least normally, entirely disappeared, and yet it is impossible to suppose that its progressive disappearance has been progressively useful as regards any form of "Natural Selection." This absence is, as in the case of the Potto, merely the culmination of a tendency latent in the group which comprises men and apes—in the order Primates.

But it is not the body but the mind of man which constitutes his essentially distinctive character. We have so frequently and fully urged the impossibility of his highest mental faculties having been formed by "Natural Selection" that we forbear to repeat our arguments here, which is the less necessary as they have been never answered, still less refuted.

But we desire in this connection to call attention to one very curious fact. *Mirabile dictu*, Dr. Wallace himself holds that these most important characters of the human species are the results of "Natural Selection," but are due to the intervention of some conscious intelligence or intelligencies (for Dr. Wallace remains a Spiritualist) who, according to him, have acted on man much as the celebrated Sir John Sibright acted on the development of pigeons.

Therefore against Dr. Wallace we have a triumphant *argumentum ad hominem*. But as I have not here entered upon the distinctiveness of the human intellect, I am content to rest my opposition to the doctrine that "utility makes species" on the various facts I have brought forward about birds and beasts, and especially on the specific characters of that small beast, the Potto. Other instances, not here set down, could also be brought forward, but logically one suffices: "*Falsus in uno, falsus in omnibus.*"

In one instance (our own) we see that Dr. Wallace gives up the matter. But therein he really concedes the whole question, for if one species is the outcome of such intelligence, why not all? And surely nature abounds, on every side, with phenomena which "Natural Selection" is impotent to account for. The colors and markings of flowers have been attributed to insect agency, yet no such agency will serve to account for the markings on foliage-leaves.

But, however, flower streaks can never be so accounted for. It suffices to contemplate the delicate divergent streaks on the lowest petal of some pansies—so beautifully symmetrical in their

dichotomous divisions—to be sure that the cause thus assigned is ludicrously inadequate. It is as inadequate as such a cause can be for the minute markings on shells and the pustules of Diatoms.

Moreover, can anything be more unreasonable than to judge as to the cause that has produced the various species which constitute the *organic* world without taking account of the various mineral species belonging to the inorganic world? This is the more remarkable since, but for the powers and processes of inorganic substances, no living creature could ever have existed! But what has "Natural Selection" had to do with the symmetry, no less definite than multiform, of crystals? Did "sexual selection" or any kind of "utility" produce the glorious tints (rivalling those of the breasts and heads of humming-birds) which mineralogical galleries have to show? Yet the mystery of these phenomena is essentially the same as those to be found amongst animals and plants. If the former are due to an agency which is unknown and unimaginable, why may not that agency also be the cause of such of the latter as "Natural Selection" has been called in to explain?

But here some of those we are addressing will feel themselves unable to accord an impartial consideration to the arguments here advanced, because they fear that our arguments imply a theological explanation as to "what makes a species." But if they will with candor examine our words they will see that they accord with any explanation which may commend itself to their minds so long as it is not a mechanical one. If they are really pagans and will have nothing but Pan, or if they can accept nothing more than "a soul in nature," we have nothing here to say on such a subject. All we say, and say most earnestly, is: "Consider and weigh the *facts*. Do not allow, as many do, your intellect to be fettered by your imagination. Do not, because, if the all-sufficiency of mechanism be denied, anthropomorphic images arise in your mind which your intellect tells you are absurd, do not on that account shrink from decrying the sufficiency of mechanism. Such images are not at all necessarily connected with the intellectual perception of the inadequacy of a mechanical idea of nature. Indeed, with the perceptions and conceptions here advocated, such mental images have really as little to do as have the signs of the zodiac with the origin of the solar system. In studying science be really scientific, and do not allow yourselves to disregard facts, being blinded to their reality by a sort of "anti-theological ophthalmia!"

ST. GEORGE MIVART.