# ESSAYS ON UN-NATURAL HISTORY

Rev. John Gerard, S.J.

# ESSAYS ON UN-NATURAL HISTORY

# ESSAYS

ON

# UN-NATURAL HISTORY

BY THE

REV. JOHN GERARD, S.J.

LONDON

CATHOLIC TRUTH SOCIETY

69 SOUTHWARK BRIDGE ROAD, S.E.

1900

# PREFACE

The papers here collected have already severally appeared, originally in the pages of the *Month*, afterwards in three separate volumes published by the C. T. S. under the titles *Science and Scientists*, *Science or Romance? Evolutionary Philosophy and Common Sense*. Although the topics of which they treat are very various, and, it may seem, diverse, they have this in common, that all deal with points raised by the more prominent and dogmatic Evolutionists, whose writings are familiar to the public; whilst the object of all is to show that we have the means of judging for ourselves concerning much which we are commonly bidden to accept on the authority of experts.

The facts of Nature, upon which all sound speculations regarding her must be based, are, to a far greater extent than we commonly realize, within the ken of all who will use their eyes; and in spite of the imposing guise in which they are usually presented, the theories of our modern philosophers will furnish abundant food for healthy scepticism to anyone who will insist on ascertaining exactly what they mean. It is because the accounts given by such writers as I have indicated—whether of the ways of Nature in the present, or her processes in the past—appear to me to break down when thus handled, that I suggest for them the title of "Un-natural History."

J. G.

31 Farm Street, W.,
*April 9th*, 1900.

# CONTENTS

## I.—SCIENCE AND SCIENTISTS.



## II.—SCIENCE OR ROMANCE?



## III.—EVOLUTIONARY PHILOSOPHY AND COMMON SENSE.

# Mr. Grant Allen's Botanical Fables

"Every one of these English plants and weeds has a long and eventful story of its own. In the days before the illuminating doctrine of evolution had been preached, all we could say about them was that they possessed such and such a shape, and size, and colour: and if we had been asked why they were not rounder or bigger or bluer than they actually are, we could give no sufficient reason, except that they were made so. But since the great principle of descent with modification has reduced the science of life from chaos to rational order, we are able to do much more than that. We can now answer confidently, Such and such a plant is what it is in virtue of such and such ancestral conditions, and it has been altered thus and thus by these and those variations in habit or environment" (Grant Allen, *Flowers and their Pedigrees*, p. 2).

"The relation of our existing vegetation to preceding floras is beyond the scope of our present inquiry: it has been frequently made the subject of exposition, but to handle it requires a more lively imagination than I can lay claim to, or perhaps than it is desirable to employ in any strictly scientific investigation" (*Address to Biological Section, British Association*, 1886. By William Carruthers, F.R.S., F.G.S., President of the Section).

THERE is a very active and very influential school of philosophers at the present day who could invent for themselves no better designation than "peripatetics." Not Peripatetics, be it observed, in the traditional and transferred sense: Aristotle they repudiate; and if he had the opportunity, the repudiation would probably be mutual. But, according to the original and literal meaning of the word, they are "walking" sages. They stroll out to the fields, or the moors, or the sea-shore, and every object they meet—beast, bird, insect, or weed—furnishes them with a text wherewith to enforce the great creed formulated by exact science and exact thought concerning the origin of the heavens and the earth. The late Laureate familiarized us with the truth that in the lowliest of living things there is something that must remain incomprehensible until we shall have fathomed the whole mystery of being:—

> Flower in the crannied wall,
> I pluck you out of the crannies;
> Hold you here, root and all, in my hand,
> Little flower; but if I could understand
> What you are, root and all, and all in all,
> I should know what God and man is.

Our peripatetics quite agree with the poet, that the key to all truth is needed in order to unlock the riddle of the flower's life; but they differ from him altogether in this, that for them there is no mystery: they have the key, and therefore are they able to compel the blossom to display to us all that we should know, about ourselves, and about the forces which brought us into being.

The writers with whom at present I am concerned, though they are not scientific men, yet claim to speak in the name of Science. They have not themselves engaged in original research, but they profess to expound the discoveries of specialists for the benefit of the general public, a large proportion of whom firmly believe that in them they are listening to the accredited agents of scientific thought. This is not strictly speaking the case, and yet scientific men have in great measure only themselves to thank for the confusion. Writers who publicly profess to popularize the new philosophy, should be publicly disowned if they misrepresent it. Men of science are quick enough to assail the exponents of the old belief when they seem to trench on their own ground: they ought, one would think, to be even more solicitous that the sacred name of science should not lightly be invoked on behalf of unsound doctrine.

It must be remembered too that, whether scientific or not, these writers are eminently popular. They claim for their method, and claim justly, that they can be understanded of the people to a degree which is impossible for those who treat subjects in a more technical fashion. Men who are quite incapable of even following an argument based on the structure of a tendon, or on the peculiarities of the "hippocampus major," can pick up a buttercup or a snail-shell and follow with intelligence and interest the lesson which the object is made to illustrate. The great doctrine of evolution can thus alone, it is said, be brought home to the general public; thus alone can be satisfied the yearning, natural to men, for information as to how things came to be as they are.

Now it is perfectly true that things are thus brought home to most of us as they could not otherwise be brought, and an opportunity is given us of forming a judgment on the subject, far more substantial than we could otherwise form. But it may be that this judgment will be adverse to the theories set before us, and that the insight imparted to us into the ways of nature will furnish us with arguments, not for, but against, the exhibitor's creed. The many must needs be mute when the question is referred to niceties of anatomy, but may feel themselves quite as competent to speak as any specialist, when the facts employed as data for discussion demand only a plain pair of eyes to examine them.

Mr. Grant Allen is a notable specimen of the neo-peripatetic school. He has applied himself of set purpose to popularize the doctrine of evolution,—a doctrine which he follows to the extremity of determinationism,—by taking simple and well-known natural objects, and giving such an explanation as evolutionary principles afford of their more striking external features. He claims to have at least suggested the right way to go to work in the matter, even though he has not gone very deep. As I have said, I agree with him thus far. He has given plain people an opportunity of forming for themselves a judgment worth something on the subject before them, instead of feeling themselves forced to bow to the *ipse dixit* of a man who knows how to use a microscope or a scalpel. It may be worth while, therefore, to take his various writings as a sort of running text on which to base some remarks concerning the figure made by evolutionary argument, not to say by the doctrine of evolution itself, when thus brought within the scope of ordinary vision.[1] Apart from science, too, the objects to which he leads us may serve to enliven many a summer ramble, and his method, though we may differ widely from his conclusions, will, at least, teach us to use both our eyes and our brains. Which, being premised, let us stroll out with him into the country.

One of his first texts is afforded by a Strawberry—a wild Strawberry growing by a lane side.[2] He undertakes to tell us in this, as in all his other instances, how such a product of nature came to its present form. No one, I suppose, in these days of popular lectures and elementary hand-books, needs to be told that what we call the fruit of the Strawberry is not the fruit, but the receptacle or cushion on which the fruit is placed, the fruit being in reality the hard little brown nuts which, if we condescend to notice them at all, we usually call *seeds*. But while the fruit remains—to ordinary ideas—unfruitlike the receptacle becomes fleshy and juicy and red, and, acquires the flavour which induced old Isaac Walton to say, or at least to endorse the saying, that God could without doubt have made a better berry, but equally without doubt God never did. Now how comes it, asks Mr. Allen, that the Strawberry has developed the habit of producing this succulent and conspicuous cushion? It was not so from the beginning: this was not the "primitive form." The primeval Strawberry fruits were crowded together on a green, dry, inedible receptacle. Whence the change? "Why does the Strawberry develop this large mass of apparently useless matter?"

The answer follows unhesitatingly. For a plant with

[1] The works I shall chiefly refer to are *The Evolutionist at Large* (Chatto and Windus, 1881); *Vignettes from Nature* (Chatto and Windus, 1881); *lowers and their Pedigrees* (Longmans, 1883); and certain articles in *Knowledge*, incorporated in *Nature Studies* (Longmans).

[2] *Evolutionist at Large*, p. 16.

indigestible fruits, like these little nuts, it was a clear gain in the struggle for life to be eaten by birds, and, consequently, to have something to tempt birds to eat. Some of the ancestral Strawberries chanced to have a receptacle a trifle more juicy than their chaffy brethren, and by virtue of this piece of luck gave birth to more than the usual number of seedlings, all reproducing and some farther developing the maternal characteristic. The most developed were throughout the most fortunate, till the present state of affairs was reached; while the Strawberry plants which had not chanced so to develop were utterly beaten in the race of life, to the extent of becoming altogether extinct. By a like process the berries (if we may so call them,—for botanists will reprovingly tell us they are no such thing) became red, the colour serving as an advertising medium to let the fowls of the air know where the now luscious morsels were to be found.

Now I am far from saying that this is an impossible account of the growth of Strawberries—I will not even say that it is very improbable. But Mr. Grant Allen gives it simply as matter of fact, as categorically as he would tell us that Columbus discovered the New World. Is it a certain matter of fact? Are there no difficulties in the way of accepting his piece of history?

A very notable difficulty is sure to grow in the same hedgerow in the shape of a little plant,[1] a Potentilla, first cousin of the Strawberry, and with a blossom so similar that it has been said, by some botanists,[2] to be undistinguishable. This Potentilla differs from the Strawberry, we may say, only in this, that it has *not* developed in the course of its history any juiciness or edibility of receptacle. Its fruitlets—hard and indigestible as those of its cousin—remain crowded together upon a scaly and uninviting green receptacle, which no living thing finds it worth while to eat. And, strange to say, in spite of this circumstance, the plant has been

[1] *Potentilla Fragariastrum*, or Barren Strawberry.

[2] Lindley makes this assertion, which is, however, incorrect

nowise beaten in the race of life; it is just as prolific and as numerous as the Strawberry itself. Now, how is this, if the history above recounted be so indubitably the true one?

Mr. Allen sees the difficulty and undertakes to solve it. And this is his solution:[1] "Science cannot answer as yet. After all, these questions are still in their infancy, and we can scarcely yet do more than discover a single stray interpretation here and there. In the present case a botanist can only suggest either that the Potentilla finds its own mode of dispersion equally well adapted to its own peculiar circumstances, or else that the lucky accident, the casual combination of circumstances, which produced the first elongation of the receptacle in the Strawberry has never happened to befall its more modest kinsfolk."

But if this be true, how can the history given above be assumed as certain? If we know so little about the matter, how can we be sure that the interpretation put upon the Strawberry's characteristics is the true one? Can we be positive that it has benefited by becoming eatable, if it is not equally plain that the Potentilla has been handicapped by not becoming so? To explain away difficulties by pleading our ignorance is very well, so far as those difficulties go, but the bearings of the plea will not stop there; if we plead ignorance, we cannot claim to be heard on the score of knowledge.

In plain language, therefore, the explanation we have heard comes to this, that we *know* nothing about either the one plant or the other, and have to be satisfied with guess-work, more or less ingenious. It is all very good to talk about *discovering* an interpretation, but more accurately the process should be termed *imagining*.

Close to the Strawberry there will probably be found another plant which likewise furnishes Mr. Allen with a theme—the curious plant which the learned call *Arum maculatum*, and the unlearned "Lords and Ladies" or "Cuckoo-pint." By these names most

[1] *Evolutionist*, p. 23.

people will recognize the large hooded blossom with a pink or pale-green knob in its midst, which Mr. Allen tells us is now known to be one of the earliest flower-forms still surviving upon earth.[1] Certainly, if this be so, the history which he proceeds to give of it goes to show that much development has not served to make more modern creatures a match for this crafty and malignant antediluvian vegetable.

But before we trace the grimmer features of its character, there is a question as to its fertilization on which popular writers seem now agreed, but which may afford some profitable study. Sir John Lubbock[2] tells us, at great length, that it is of advantage for a blossom to have the stigmas of its pistil fertilized by pollen from another plant, and he cites the Arum as an illustration of the way in which this is brought about. This plant is *monœcious*, that is, it has stamens and pistils in different flowers, but on the same plant. These are arranged on the lower part of the knob already mentioned, the large green hood being no part of the flower proper, but a sort of envelope and protection. On this central knobbed column are arranged, beginning from the bottom, first the pistillate, then the staminate flowers, and then a number of threadlike stalks, of which botanists a short time ago did not profess to know the meaning. Now, however, we are told—by both Mr. Grant Allen and Sir J. Lubbock—that they act as a *chevaux de frise* to close up the entrance of the cup in which the flowers below are placed, for these hairs point downwards, and the envelope is much contracted just about their position. Consequently, says Mr. Allen, they serve as the spikes in an eel-trap or lobster-pot.

This being so, what happens in the case of the Arum, we are told, is this. The pistillate blossoms flower first, in consequence of which the first Arum of the season must go without pollen, and therefore

[1] *Evolutionist*, p. 84.
[2] *British Wild Flowers in relation to Insects*, p. 28.

without seed for that year. But there is something in the envelope that attracts small flies, which crowd into the hood in great numbers. Getting in is easy enough, for, as has been said, the hairs in the neck bend downwards; but getting out is another matter, and the adventurous insects must wait till the opposing hairs wither. By this time the staminate flowers have bloomed, and the pollen therefrom falls on the flies and dusts their backs and legs, and when on being released they proceed to plunge straightway—despite experience—into another Arum hood, they find the pistillate flowers mature and ready to be dusted with this pollen, thus securing cross-fertilization.

This is a very pretty and interesting history: and to look at the picture of the Arum which Sir J. Lubbock engraves we should judge it to be very probable. But flowers do not always grow in the fields as they are drawn in books, and if the observer will go out for himself and find an Arum and slice it open with his penknife, he will probably find that there is nothing whatever in the *chevaux de frise* to hinder any fly from walking out when he likes. The threads are by no means thick set, they twist about and do not run straight, and there is generally plenty of room between their extremities and some portion of the walls. Flies there are generally in plenty, little black flies, so small that it would seem to be a matter of no consequence which way the spikes point, for they could pass between them. The real obstacle to egress is a condition which looks very much like being drunk and incapable. They lie, often many deep, at the bottom, some without any sign of life, many in a limp and languid condition, much like rioters who have broken into a wine-vault. Whether, when they come forth from their confinement, the fresh air, to which they have been so long unaccustomed, gives them strength and energy to hunt up another Arum before they get rid of their coat of pollen—and Arums do not generally grow very near one another—is a question requiring a great deal of very close and clever observation for its solution.[1]

But this is somewhat of a digression. The Arum is made to tell us a story which bears remarkably on that already related by the Strawberry. The former plant is not merely "one of the earliest flower-forms now existing on the earth," but probably *the* most virulent specimen of plant life that exists, at least on English ground, so virulent indeed that I hope none of my readers will ever dare to masticate even a small portion of its large glossy arrow-shaped leaves. The fruits are of the quality of the plant, and these fruits turn when ripe to a rich red colour, till they form "a beautiful cluster of living coral."[2] When speaking of the Strawberry fruit, Mr. Allen tells us that "birds have quick eyes for colour, especially for red and white; and, therefore, almost all edible berries have assumed one or other of these hues."[3] But, if this be true, how comes it that so very *in*edible a berry comes to appear in the favoured hue? Mr. Allen is at once ready with the answer. Its object, he tells us, is to attract the animal world in the shape of field-mice, squirrels, and small birds, but with treacherous intent: "For though these berries be beautiful and palatable enough, they are deadly poison. The robins and small rodents which eat them, attracted by their bright colour and pleasant taste, not only aid in dispersing them, but also die after swallowing them, and become huge manure heaps for the growth of the young plant."[4]

As to which, in the first place, if this be so, how have the robins and field-mice got on in the race of life if they have developed this insensate habit of rushing like so many bulls at everything scarlet?

[1] Since writing the above in 1882, I have convinced myself that the Arum kills the flies which visit it, and absorbs their more succulent portions into its own substance.

[2] *Evolutionist*, p. 86. [3] *Ibid.* p. 22. [4] *Ibid.* p. 86.

The Arum is a very old-world and primitive growth. How did it so early in the history of the earth pick up what Captain Costigan would call this "aisy stratagem," which long subsequent ages of development in higher creatures have not sufficed to elude? But in the second place, is this a piece of fact or a piece of fancy? Are Arums usually, or ever, found to grow out from among the skeletons of robins or of shrews? I commend the question to the experimental zeal of my readers; the research requires only a strong knife or a small spud.[1]

From fruits and flowers let us turn to the leaves of plants, of which Mr. Allen speaks in connexion with Buttercups.[2] Holding up one of these familiar flowers for our perusal, he thus directs attention to the leaves: "These, one notices at once, are raised on long stalks and deeply divided into several segments. . . . Now such a complex leaf as this shows by its very nature that it must be the product of considerable previous development. All very early leaves are quite simple and rounded; it is only by slow steps that a leaf thus gets broken up into many divided segments. . . There are some other Buttercups, such as the Ivy-leaved Crowfoot, which creeps along the mud of ditches, or the Lesser Celandine, which springs in the meadows in early April, whose leaves are entire and undivided; . . . but both these plants, having plenty of room to spread in the unoccupied fields of spring or the unappropriated ditches, have never felt the necessity for subdivision into minute segments. They have free access to the air and sunlight, and so they can assimilate to their hearts' content the carbon of which their tissues are built up. It is otherwise, however, when similar plants push out into new situations less fully supplied. . . . The Buttercups have taken to growing in the open

[1] See more on this subject in the Essay, *How Theories are Manufactured*.

[2] *Nature Studies*, p. 99.

meadow where the competition for vegetable food-stuffs is keen and the struggle for existence bitter. Hence they have been compelled to divide their leaves into many finger-like segments; and only those which have succeeded in doing so have managed to hold their own in the struggle, and so to hand down their peculiarities to future generations. As a rule, just in proportion as vegetation is thick and matted, do the plants of which it is composed tend to develop minutely divided and attenuated foliage."

After reading a passage like this it would seem as though, in evolutionary argument, instead of the theory being extracted from the facts, the facts are evolved from the theory. Here is a string of assertions fit to take away the breath of any one who will but go out walking and use his eyes.

Firstly. "All very early leaves are quite simple and *rounded*." What is meant by *early*? Does it mean "the earliest forms on the earth," or those which appear earliest in the year? If the first, how about grasses, which certainly are amongst the oldest forms of vegetation, but whose leaves though simple are very much the reverse of round? Or for those other forms which men of science are never weary of indicating to us as the primitive vegetation of all—the Mosses and Horse-tails—where shall we find more subdivided fronds than theirs? If, on the other hand, it be meant that early flowering plants have round leaves, where shall we find earlier flowers than the Shepherd's Purse and the Groundsel? while the Spring Crocus, which certainly has the field pretty much to itself, reduces its foliage almost to the limits of tenuity.

Next, as to the theory on which the whole argument is based. "They have been compelled to divide their leaves, . . . and only those which have succeeded in so doing have managed to hold their own." How so? How does the subdivision of leaves help a plant to obtain a larger share of "vegetable food-stuffs"? It is not the *edges*, but the *surfaces* of the leaves, which suck in carbonic acid through the *stomata*, or breathing pores, situated chiefly on the under side. It is, therefore, amount of surface that should most assist a plant to gain a livelihood in a populous and competitive neighbourhood. But, *cæteris paribus*, surface must be proportionally greater in a simple than in a divided leaf; it should, therefore, follow that plants growing where vegetation is dense are distinguished by having their leaves *not* divided. Mr. Grant Allen may perhaps find in a consideration of this point an answer to the complaint he makes in another place,[1] that "the problem of the shape of leaves, . . . a most important one, . . . has hardly been even recognized by our scientific pastors and masters."

So much for theory. Now, thirdly, for facts. "Just in proportion as vegetation is thick and matted do the plants of which it is composed tend to develop minutely divided and attenuated foliage." The Buttercup being the concrete instance in hand, apropos of which this is laid down, we may take for granted that the vegetation amidst which it is found is of the thick and matted order, and therefore let us go and view in any meadow that may be at hand the plants which press around it, and observe how far they can, as a body, be said to have divided and attenuated foliage. First there are the Sorrel and the Dock, concerning the shape of whose leaves it is hardly necessary to say anything. There is the Lady's Mantle, which by its name sufficiently indicates the form of its foliage. There are the three Plantains, all with leaves broad and entire. There is the White Saxifrage, leaves slightly lobed, the Cat's-ear and the Knap-weed, neither of them divided or attenuated. These are flowers sure to be found in any English meadow; could an equal number be named equally certain to be present which would in any degree bear out Mr. Allen's assertion about the form of leaves in such a situation?

[1] *Evolutionist at Large*, p. 37.

If these criticisms be true, it may perhaps be thought that I am simply setting up a man of straw to contend with, and endeavouring to make a point against evolution by fastening on an unfavourable representative of its doctrines. But it must be remembered that Mr. Allen's sermons are delivered in somewhat high places. The papers which we are mainly considering first appeared in the *St. James's Gazette*, or in the rival *Pall Mall.* Like utterances were given forth in the journal called *Knowledge* — which claimed to be the newest organ of science "plainly worded, exactly described." In face of all this we cannot but take Mr. Allen as an authorized exponent of his creed, the only difference between him and others being that he treats of matters which we can more practically understand.

Enough has perhaps been given in the way of examination, more or less minute, of his various theories. It will be worth while, however briefly, to collect some specimens of the easy way in which stepping-stones are found in the deepest places to help the historian forward to the desired conclusions. Thus we are airily told — apropos of Water Crowfoot—that one of the Buttercup tribe[1] "*took once*, under stress of circumstances, *to living pretty permanently in the water.*" As to the migration of Salmon:[2] "The ancestral fish, only a hundredth fraction in weight of its huge descendant, *must have somehow acquired the habit of going seaward.*" The Cyclostoma[3] "is a gill-breathing pond snail which *has taken to living on dry land.*" In these and numberless other instances, what is the greatest difficulty in the matter is simply set down as a fact, and then used as a basis by means of which to explain the rest. In the last quoted instance it is frankly declared that it is "the light cast upon the question by Darwinism" which vouches for the fact being as stated. In other words Darwinism, which by way of being proved, or at least demonstrated, is taken

[1] *Evolutionist at Large*, p. 42. Italics mine throughout.
[2] *Ibid.* p. 118. [3] *Ibid.* p. 177.

for granted to start with, and, as I have already said, instead of the theory being educed from the facts, the facts are made to square with the theory.

Some very curious principles are likewise introduced which assist in the fashion of a *deus ex machina* over many an awkward stile. Thus, talking of the plumage of birds, we are told[1] that "it is probable that an æsthetic taste for pure and dazzling hues [in the plumage of their mates] is almost confined to those creatures which, like butterflies, humming-birds, and parrots, seek their livelihood amongst beautiful fruits and flowers." Indeed! Do bees fall short of butterflies in this respect? The most beautiful beetles feed on filth; the goldfinch on thistle-seeds; the kingfisher on minnows and bull-heads.

But another question arises. If there be the alleged connexion between the colours admired in mates and those which are found in articles of food, should it not follow that those creatures which admire any particular colours in the world outside should likewise consider them additions to the beauty of their own race? And if so, how about men? Mr. Grant Allen tells us whence they acquire their appreciation of the various hues which meet their eyes:[2] "The reason why we consider these colours pretty seems to me obvious. We are the descendants of ancient arboreal ancestors, who sought their food among bright orange and blue and crimson fruits in tropical forests;[3] and those fruits were specially coloured to allure their eyes, just as the speedwells and primroses and buttercups are specially coloured to allure the eyes of bee or butterfly. And further, as the eyes of the bees are so developed that these colours attract them, the eyes of our pre-human ancestors must have been so developed as to be attracted by the similar colours of oranges and mangoes, and tertiary plums or peaches."

[1] *Evolutionist at Large*, p. 194. [2] *Vignettes*, p. 86.

[3] See more on this subject in the Essay, *How Theories are Manufactured*.

Now if all this be meant for sober fact, should it not also be maintained that the arboreal race which was happy enough to live in a climate where such fruits hung on the trees all the year round, and in such profusion as to afford a staple article of food, should have come to regard plum colour, or black and blue, as the most becoming hue, and the most conducive to good looks among their own kind? And should not the "mulberry-faced Dictator's" have been an enviable complexion? A still more pertinent question is whether there be the slighest tittle of evidence to show that there ever was a race so sustained, except the necessity of supposing it in order to find an explanation for the colour-sense.

There is likewise a very curious piece of philosophy introduced under the ægis of Mr. Herbert Spencer, apropos of a donkey.[1] This much misunderstood animal is in reality, we are told, quite an aristocrat among brutes, "one of the final developments of one of the most successful branches of the great progressive ungulate tribe." Being so high up in the social scale, he "really cannot well avoid being an extremely clever brute." But his cleverness is limited by physical conditions, and here comes in the latest addition to our philosophy on this subject: "He is not so clever to be sure as the higher monkeys and the elephants; for, as Mr. Herbert Spencer has pointed out, the opposable thumb and the highly mobile trunk with its tactile appendage give these creatures an exceptional chance of grasping an object all round, and so of thoroughly learning its physical properties, which has put them intellectually in the very front rank of the animal world."

Here we have a prime example of the fatal facility with which theories may be invented and presented for acceptance, theories which the most ordinary observation should serve to discredit. We are asked to believe that the power of "grasping an object all round"

[1] *Vignettes*, p. 197.

begets intelligence. Yet what creature succeeds so thoroughly in getting round an object as that stupid brute the Boa-constrictor? And how about the sagacious Dog and the cunning Fox? Neither of them embraces its prey like the slow-witted Bear. The Parrot is said by some writers, improving on Mr. Spencer, to get the intelligence displayed in its talking, because it has a prehensile foot and bill. But the Crossbill has both, yet does not learn to talk; and the Magpie, Jay, and Jackdaw have neither, yet talk not so much worse than a Parrot, and display intelligence, in other ways, far beyond his.

It would in fact be just as reasonable to maintain that animals with big tails are cleverer than those scantily furnished in that respect, citing, on the one side, the Beaver, Fox, Magpie, and Collie Dog, and on the other the Guinea-pig, the Mole, and the Bat.

Mr. Allen sets his face with much determination against the idea that there is any intentional beauty in the universe; there is, in fact, no beauty in anything at all till it is "read in by the fancy of the human race."[1] In a sense we need not very much quarrel with this, but evidently that sense is not his. What he means is that there is no sort of relation between the beauty we find in nature and the faculty by which we recognize it; that the thing which we feel to be beautiful, and the perception of its beauty within ourselves, equally come to exist in a blundering haphazard fashion quite independently the one of the other. The subject is too large and too deep a one to be attempted here in any fulness; it will suffice to set forth one of Mr. Allen's notices of it, leaving it to speak for itself. He is talking of the flower of the Lesser Bindweed:[2] "Nothing could be prettier than this alternation of dark and light belts; but how was it produced? Merely thus: The Convolvulus blossom in the bud is twisted, and the bits of the blossom which are

[1] *Evolutionist*, p. 199.
[2] *Evolutionist*, p. 200. The italics are mine.

outermost become more deeply oxidized than the other parts, and acquire a russet-red hue. The belted appearance which thus results is really as accidental, if I may use that unphilosophical expression, as the belted appearance of an old umbrella. The flower *happened to be folded so* and got coloured, or discoloured, accordingly. . . . Four or five petals radially arranged in themselves produce that kind of symmetry which man, *with his intellectual love for order and definite patterns*, always finds beautiful. But the symmetry in the flower *simply results* from the fact that a single whorl of leaves *has grown into this particular shape*, while other whorls *have grown into other shapes*, and every such whorl *always and necessarily* presents us with an example of the kind of symmetry which we so much admire. . . . Thus the whole loveliness of flowers is in the last resort dependent upon all kinds of *accidental* causes—causes, that is to say, into which the deliberate design of the production of beautiful effects does not enter."

Here is surely a key to many difficulties, and an antidote to much misplaced admiration. Let the reader remember next time he may chance to visit a print-works that the figures impressed on the calico are but a necessary result of the machinery: given that the rollers rotate, and that the stuff passes under them, the distribution of reds and blacks and yellows in the forms we see, follows as a matter of course. It is moreover to be remarked that the Bindweed is frequently destitute of these dark bands, though in bud it has been folded as described.

There are many tempting themes to which Mr. Allen invites us, and not least when he decides concerning the Butterfly that it is "*mainly* an animated puppet," but yet "a puppet which, after its vague little fashion, *thinks and feels* very much as we do."[1] Into these themes, however, I cannot now follow him, but before parting company I would try a specimen of his method on my own account, and, going out into the fields, look to see

[1] *Evolutionist*, p. 160. Italics mine.

whether there be not evolutionary difficulties as well as evolutionary arguments to be found there.

First, let us look up to the tops of the elms, where the Rooks are as I write so busy with their nests. How came they to develop their nest-building faculty? These large conspicuous structures must be placed on the tops of trees to be safe. The first building of them must have been in such a position. But if the ancestral rook had tried the experiment of establishing his household gods there before he had acquired the present architectural skill—would any young rook have survived to carry his dusky race down to the present day? To build dry unbendable sticks into a nest on a windy tree-top would seem to be but to prepare for it the fate of the historic cradle placed in a like position. I much doubt if, without the aid of twine, the cleverest man living, although in possession of an opposable thumb—as to which gift alone Mr. Grant Allen seems to say[1] have his ancestors behaved better to him than those of a donkey—could with such materials construct a nest which should withstand the gentlest breeze, let alone a south-western gale.

This is, at least, something of a problem. If from the tree-tops we turn our eyes down to the waters under the earth, we shall meet with another. How come the backs of fishes so closely to resemble the surface above which these fish live? How, to take particular examples, does the Loach come so exactly to mimic the stones at the bottom of the brook, or the Skate and Flounder, as we see in aquariums, the gravel or sand on which they respectively dwell? It is not enough to say that "nature" enables them for protective purposes thus to hide themselves. Take a dozen, or a score, or a hundred fish, and in no two are the markings the same; there is every variety of detail, but one general effect of resemblance to the common object, just as in a long gallery of deal doors which a skilful

[1] *Vignettes from Nature*, p. 90.

grainer has converted into the semblance of oak. Now, how can there be implanted in a nature, by any blind and accidental forces, a tendency simply to *resemble* gravel or mud? We might possibly conceive every fish being so provided with a black or red spot in one unvarying position, but where there is this strange evidence of an indefinite and yet artistic purpose do we not come face to face with what Mr. Grant Allen would deny, "the deliberate design of the production of effects?"

I have said that here I will conclude, at least for the present. A large and tempting field yet remains unvisited—the question of the colour of flowers, concerning which Mr. Allen says something and Sir John Lubbock much. But this subject, if attempted at all, would demand an entire paper to itself,[1] and should be treated with an amount of detail which, at present, I wish to avoid. My object is but to show how evolutionary argument looks when it condescends to come down to a field in which we can experiment for ourselves, and of what texture are the argumentative products of that modern exact thought which we are daily told to regard as putting to shame the loose reasonings of our undeveloped ancestors.

Theories and hypotheses have their place, and a most valuable place it is, in the field of scientific knowledge, and undoubtedly we do well to feel our way by means of them to the solution of problems which older generations never attempted. But we outrage science and bar the road to sound knowledge if we take as proved and certain what is as yet but hypothetical and speculative; and if, through a natural partiality for a system of our own, we get ourselves into the way of forcing facts to fit into it, whether they will or no, or neglect those which tell against it, having no eyes to see anything but what seems to bear witness in its favour.

Of all this there seems to be only too much danger. We are in such desperate haste to assure ourselves

[1] See the Essay, *Who painted the Flowers?*

that we have sounded the bottom of all knowledge, that we cannot be content to acknowledge our ignorance, even when our ignorance is the truth. Hence, instead of patiently and dispassionately garnering the facts and sifting them, to see what they will yield, writers too frequently start with an assurance that they know the issue before they examine the record, and with an indignation against those who deny their theory which would be righteous if that theory were already demonstrated, but which is thoroughly unscientific if Darwinism is still beset by a multitude of scientific difficulties. Is it not far more wise to say that we do not yet know, as in fact we do not, than to amuse ourselves with imaginary histories, and giving them to the world as contributions to its knowledge?

# Who painted the Flowers?

It may, I suppose, be without question assumed that flowers are beautiful. Whatever else the caprice of taste may command us or forbid us to admire, there is one fashion which, though every season repeated, is yet found to be ever fresh—the fashion of the Violet and the Rose; and there is no truth to which the common observation and the common-sense of mankind have given a readier assent, than they have to the declaration that the most splendid of monarchs in all his glory was not arrayed as are the lilies of the field.

So far there is agreement. But in these days of ours it will not do to rest satisfied with the fact: it must needs be asked how the fact came to be. That these beautiful flowers were made beautiful, simply as they are, that their gracefulness came to them as it comes to a copy of themselves on a Christmas card or in an artificial bouquet, directly from the hand of an artist, is not the sort of explanation of which contemporary science will take account. But as the fact has to be somehow explained, science is ready to explain it, and that particular school of science for which there are no puzzles, for which the making of an apple is an operation nowise more mysterious than the making of an apple-dumpling, is here, as everywhere, ready with a full, true, and particular account of the process of their adornment and of every step and stage in the same. As usual, too, the explanation offered is not likely to err through any morbid deference towards the ideas of previous generations. It has hitherto been supposed that flowers are not only the most beautiful but also the least utilitarian of the products of the earth; that their chief function is not in any way to toil or to spin, but to adorn our fields and woods with the brightness of their hues and the fragrance of their breath, and that in the need of some such adornment to save the face of nature from too dull a monotony, is somehow to be sought the reason of their being.

This, we now learn, is all wrong. The colours on the petals of a Rose are no more to be attributed to a purely artistic motive than those on the sign-board of an enterprising publican. Flowers are in fact like nothing so much as sign-boards, which let the passing insect know where good cheer, in the shape of honey, is to be had; and the blossoms which we see at the present day are what they are simply because they have managed their advertising business better than others, which they have consequently trampled out of the world in the keen competition for existence.

This is no overstatement of the theory in vogue. Flowers, it is said, need the service of insects to assist in their propagation, and therefore must attract insects, and those which have best succeeded in so doing have best succeeded in the race of life. And consequently the various hues and their various arrangements which we see in blossoms have come to be there because their casual presence helped in the great work of attraction, and therefore they were, by natural selection, "developed." Hear Sir John Lubbock:[1] "To them [the bees] we owe the beauty of our gardens, the sweetness of our fields. To them flowers are indebted for their scent and colour; nay, for their very existence, in its present form. Not only have the present shape and outlines, the brilliant colours, the sweet scent, and the honey of flowers, been gradually developed through the unconscious selection exercised by insects; but the very arrangement of the colours, the circular bands and radiating lines, the form, size, and position of the petals,

[1] *British Wild Flowers in Relation to Insects*, p. 45.

the relative situations of the stamen and pistil, are all arranged with reference to the visits of insects, and in such a manner as to ensure the grand object which these visits are destined to effect."

The expression "unconscious selection" here employed suggests a question which Sir John Lubbock does not explicitly propose, and which, though I do not purpose to treat it, should at least be indicated. Of course the selection, whatever it be, exercised by insects must, so far as they are concerned, be "unconscious." But when that is allowed the question of design remains in its entirety. Are these unconscious workers, or are they not, the instruments of conscious intelligence? Many, especially among the lesser lights, of the modern school are very peremptory in their denial of any consciousness, or intelligence, or æsthetic intention, anywhere in the process of evolution. Mr. Grant Allen, for example, tells us [1] that "the whole loveliness of flowers is . . . dependent upon all kinds of *accidental* causes —causes, that is to say, into which the deliberate design of the production of beautiful effects did not enter as a distinct factor." The question so raised I do not now wish to treat. It appears to me that to institute an argument on this point would be very like insisting that we could not get a finished picture of the Venetian school by shaking a kaleidoscope; nor produce a poem of Tennyson's, say the *In Memoriam*, from the letters which designate the divisions of our police, by arranging the men who compose the force along Regent Street, according to their height or their weight or their length of service. It is true that an eminent leader of fashionable thought [2] finds the existence of a Providence a less satisfactory and scientific explanation of the phenomena we observe than an "unconscious effort to the good and the true which exists in the universe, and throws a cast of the dice through each of us." But such phrases are,

[1] *Evolutionist at Large*, p. 205.
[2] M. Renan, *Souvenirs d'Enfance et de Jeunesse.*

at least to the majority of minds, to say nothing of their authors, simply phrases, and mean nothing. "Some people," says Dr. Asa Gray,[1] "conceive of unconscious purpose. This to most minds seems like conceiving of white blackness." It must needs be a hyper-metaphysical disquisition which has such a concept for a theme, and I wish to deal not with speculative, but with observed fact. Supposing the production of beauty to be like everything else in nature, the result of law,[2] I wish to ask how far the facts that we can see bear out the theory that insects have been even the sole instruments for the production of beauty in our gardens and our fields. This is a pure question of natural science, which can be discussed without any *a priori* prepossessions. To allow the insects all that is claimed for them would not be to deny that there is a law: it would be to make the law inconceivably more wonderful. The checks and counter-checks of the system must be indeed of marvellous complexity, if insects working directly for food, and indirectly serving to the propagation of species, and being allured by colour as an indication of food, and so serving more indirectly to propagate colour,—should under the guidance of one unvarying taste have produced, in respect of colour, such bewildering variety, and through all variety have in every direction hit upon the beautiful: wonderful indeed would it be that not only they should have dyed different blossoms with all the different colours of the rainbow, but that they should have managed these different materials with such exquisite diversity; spotting the Foxglove, and streaking the Iris, and yet refraining from painting the Lily,—while yet in each case the result has been such that we can conceive none fitter.

As a plain matter of fact then, how does the observa-

[1] *Contemporary Review*, April, 1882, p. 609.

[2] "Lawless, or really random variation, would be a strange anomaly in this world of law, and a singular conclusion to be reached by those who insist upon the universality of natural law" (Dr. Asa Gray, *loc. cit.*).

tion which is within the reach of all bear out the assertion that all which there is in flowers is "arranged with reference to the visits of insects, and in such a manner as to ensure the grand object which these visits are destined to effect"?[1]

The theory, I repeat, is that every variation which has been perpetuated has been so perpetuated because it served to attract insects, which have in their turn served to propagate the variety. But, in the first place, if this be true of colour, how about *form*? This is a most important factor in the beauty of flowers. "Everybody knows," writes Mr. Grant Allen,[2] "that flowers are rendered beautiful by their shapes, by their perfumes, and above all by their colours." And Sir John Lubbock, in the passage already cited, includes "the shape and outlines" among the features which have been developed through the selection of insects. But how can the form conduce, or be imagined to conduce, to the advertisement of honey-stores within? In a broad way, certain shapes of blossoms may help a bee or a butterfly to find where the honey is more readily, or to get at it more easily. But, to say nothing of such fantastic growths as the Butterfly Orchis or the Monk'shood, how can the artistic finish of the edge of a petal or the curve of grace and beauty introduced in the outline of a cup do anything to allure honey-seekers? Or, letting the flowers alone, how can this agency account for the graceful shapes of leaves?

Moreover, there is a large class of plants which admittedly owe nothing to insects,—the *anemophilous* or wind-fertilized flowers, and the large order of Cryptogams, —ferns, mosses, and the like. It is generally assumed on the utilitarian hypothesis that where colour can do no positive good it cannot exist, and that its absence, in the case of the plants indicated, is a proof of the general

[1] Dr. Asa Gray pertinently remarks that all writers have to agree in speaking of "arrangements," "adaptations," "contrivances," and the like, in this connexion.

[2] *The Colours of Flowers*, p. 1.

theory. But firstly, it is by no means true that colour is absent. The hues of our autumnal fungi are at least as vivid as those of any spring or summer blossoms, and in the large wind-fertilized tribe of the grasses there is great variety and great beauty of colouring, as one may see in any meadow in May or June. But beyond that, and granting for the sake of argument the absence of colour, who can deny the exceeding great beauty of the fronds of a maiden-hair fern or the head of a feather-grass? Mr Ruskin's exquisite little engraving of "foreground leafage" in *Modern Painters* fills many with wonder and delight, and yet, as he himself tells us, it represents only what any one may see who chooses to lie down on his face in a field in summer; while in any square yard of vegetation there are more delicate variations on the same theme than any artist but the sun can faithfully reproduce.

Here then is, at the outset, a difficulty which seems fatal to the theory under examination; for if there be undoubted facts which the agency of insects can nowise have affected, how can it be assumed that such agency is the only possible explanation of other facts analogous to these?

Leaving this question suggested by the shape, I come to the colour itself. How far is the theory of insect agency supported by a mere examination of this element of flower beauty prescinding from aught else? That insects, bees especially, can produce very marked variegation in the colour of blossoms, no one will deny who has seen the growth of a zebra-like variety of garden Nasturtium (*Tropæolum majus*) after the bees have been busily working alternately at a bed of maroon-brown and of sulphur-yellow flowers. But how far are we justified in assuming that this has been the sole means of producing the colours that we see? Those who defend such a position assert, as is indeed necessary for their case, that all flowers with conspicuous petals must depend on insects for their well-being, otherwise they would but waste so much of their vital energy on an unremunerative product. So assured are they of this, that Mr. Grant Allen, relying on an *a priori* method of reasoning which would seem rather out of harmony with modern scientific canons, unhesitatingly pronounces on the past history of plants from this feature alone. There is, for instance, a well-known plant, the Ribwort Plantain (*Plantago lanceolata*), with which children play at "soldiers"—if indeed there still be children who care to play games which cost no money. It is wind-fertilized and unvisited by insects. At the same time it has a perfectly-formed corolla—inconspicuous indeed, dark-coloured and dry, but as symmetrical in form as a corolla need be. A wind-fertilized plant has no need of a corolla at all, and can gain nothing by turning out on every one of its flower-heads a multitude of these shapely little cups. *Therefore*, says Mr. Allen, the Plantain is a degraded plant; it was once fertilized by insects, but has for some reason or other reverted to the "older and more wasteful process" of wind-fertilization, retaining, however, in its little corolla a testimony against itself. "Once upon a time it was a sort of distant cousin to the Speedwell. But these particular Speedwells gave up devoting themselves to insects, and became adapted to wind-fertilization. . . . Thus every plant bears upon its very face the history of its whole previous development."[1] We are accordingly asked to take it for granted with the same authority,[2] that the bright pigments of flowers have for their main, if not their only function, the attraction of insects — from which it would follow that a bright flower with no honey, or a bright flower, at which, from any circumstance, insects could not get, would be a monstrosity in nature, and would as such be necessarily and speedily trampled out. It is at least remarkable that what is probably the most conspicuously-coloured of English flowers, the Poppy, secretes no honey at all, although it is true that its abundant pollen offers some reward to the bees

[1] *Evolutionist at Large*, pp. 137–141. [2] *Colours oj Flowers*, p. 7.

which take the trouble to visit it, which special source of attraction will suggest another question presently. But a far more puzzling problem is presented by Wordsworth's pet flower, the Lesser Celandine (*Ranunculus Ficaria*). Appearing in early spring, when insects have hardly begun to stir, this little plant indulges in a luxuriance of blossomhood not inferior to that of its cousins, the summer Buttercups. That from a decorative and æsthetic point of view such display is worth making, no one will deny who looks forward, as one of the chief charms of spring, to see the Celandines "take the winds of March with beauty." But as a mere matter of business, where does the plant find its account for all this expenditure? Not certainly in its fertilization by insects, which is sufficiently evidenced by the fact that Celandines are seldom fertilized at all. The examination of a whole field after flowering will hardly result in the discovery of a single ripened head. Yet the Celandine contrives to increase and multiply, and that by a process which not only emphasizes the difficulty already started, but seems to strike a blow at the very root of the whole insect theory.

The main principle on which the need of insect agency is supposed to rest is the necessity for *cross*-fertilization. The ovules of a plant, it is said, should for full development be impregnated by pollen from another plant of the same species, and insects afford the surest means of securing this. Now, without doubt, cross-fertilization is often highly advantageous. But is it universally, or quasi-universally, necessary? To judge by the utterances of some men of science, we should suppose so. "Nature," says Mr. Darwin, "abhors perpetual self-fertilization."[1] "I will not enter," says Sir John Lubbock,[2] "into the large question why cross-fertilization should be an advantage, but that it is so has been clearly proved." And the whole gist of the

[1] Quoted by Asa Gray, *l. c.* p. 600. [2] *Flowers and Insects*, p. 6.

literature on this side of the question is summed up by Dr. Asa Gray[1] in the proposition "that all the various adaptations of flowers to insects are in view of intercrossing." It is assumed, in fact, that by a timely deference to nature's "abhorrence," those plants which have secured cross-fertilization have produced a vigorous progeny which has stamped out the effete rivals which failed to avoid a contradiction of the fundamental law. "No continuously self-fertilized species would continue to exist," is an aphorism of the school. But the Celandine is a vigorous growth, making fields yellow with its useless cups, and with no mark of approaching extinction upon it. And how, failing its blossoms, does it contrive to propagate? Simply thus. In the axils of its leaves there form little proliferous bulbs, which in due season, dropping off, become the parents of new plants. This is the very contrary of crossing. For a cross, such as is postulated, two distinct plants should contribute to produce a new one, and here there is not the contribution even of two distinct organs. And this is by no means a solitary case: propagation on the same principle is adopted by very large classes of plants. Sometimes it is by runners rooting at the joints (of which the Strawberry affords a familiar instance), sometimes by suckers, sometimes by buds, or by slips and shoots. And such plants are propagated in endless abundance. It has, for example, been said that all the Weeping Willows we see have probably been produced by slips from one common ancestor, for the willow is *diœcious* (bearing stamens and pistils on different trees), and there is no staminate Weeping Willow known in Britain, and consequently the tree never fruits;[2] while, as is well known, all our cultivated Apples are propagated by grafting, each variety carrying on through all its members the life of one individual ancestor. Some of these varieties (for instance, the Herefordshire "Red

[1] *Ibid.* p. 600.

[2] A large number of the trees of this species have been propagated from Napoleon's Willow at St. Helena.

streak" and "Fox whelp") are known to have existed for nearly three centuries. Indeed, so far from being unduly handicapped in the race by their utter neglect of the fundamental law, these self-propagating plants are precisely the most rampant and aggressive of all, and the most difficult to get rid of.

For instance, the Creeping Buttercup (*Ranunculus repens*) is designated "a troublesome weed" *because* it increases by creeping roots or *scions*, which take root wherever a leaf is produced; the Coltsfoot (*Tussilago Farfara*) is almost ineradicable, *because* any fragment of its long and brittle roots serves to produce a new plant; and a variety of the Lady's Smock (*Cardamine pratensis*) merits the designation "remarkably proliferous" *because*, while its flowers become incapable of fertilization, owing to doubling, the leaflets as they come to the ground produce fresh plants.

There seem, therefore, to be facts, on the very threshold of the inquiry, which may at least justify us in pausing before we accept the doctrine which is so unhesitatingly laid down.

But the most interesting portion of my task will consist in an examination of the case made out by the advocates for the insects. Before undertaking such examination of some facts of this case, which will raise some new points as well as some of those already noticed, it will be well to state precisely once again what is my contention. I do not at all wish to deny that insects are of service to flowers, nor, this being so, that there are many "arrangements" on both sides to secure that the service be effectually rendered. But given a fact, many modern writers are far too prone to found on it an hypothesis which depends far more on an *a priori* conception of the fitness of things than on the fact with which it is thought to square. The hypothesis once stated is then far too often itself treated as a fact, and it is sought to make out a case for it by quoting other facts which seem to bear it out. The making out of such a case is not difficult, and is apt, quite unintentionally, to become a mere piece of special pleading. It is very easy to collect all the instances that tell one way, and to forget those which tell the other way: it is easy for a man who has too hastily assumed the truth of his hypothesis to see all facts through its medium, and to make them mean something which on more critical examination would be seen not to be their meaning. It seems to me that a conspicuous example of such a process is afforded here, when from the undoubted usefulness of insects to some flowers it has been inferred that all flowers have been entirely modified by insects in all those respects which bring them into connexion. It seems also that even so earnest and so painstaking an investigator as Sir John Lubbock has not escaped the danger above indicated, and has in many instances seen his facts with pre-determined eyes.

In his work, *British Wild Flowers in their Relation to Insects*, from which I have already quoted the general conclusion which he seeks to draw, he runs through the whole British flora, and endeavours in the case of each family to establish the truth of his hypothesis. It seems truer to say that we need go no further than his book to find convincing proof that insects can *not* do all that is claimed for them. It is not easy to arrange in very logical order the points which arise from the examination of many separate examples. Having indicated my general drift, I shall consider it enough to arrange my strictures very much in the order which his work suggests.

He tells us,[1] with regard to *anemophilous*, or wind-fertilized flowers, that "it is an advantage to these plants to flower before the leaves are out, because the latter would greatly interfere with the access of the pollen to the female flower." Now it is true that Hazels, Poplars, and the like, flower before the leaves appear, and that they are wind-fertilized; but no less so

[1] *Op. cit.* p. 8.

do the Wild Cherry and other *entomophilous*, or insect-fertilized, trees. Again, the large class of the *Coniferæ*, the Fir tribe, are *evergreen*, with one exception, the Larch. The Larch is also the one which is not wind-fertilized. In the case of all the others, Scotch Fir, Yew, Spruce, for instance, the flowers cannot possibly appear before the foliage.

"Again," says Sir John, "in such [wind-fertilized] flowers, the filaments of the stamens are generally long;" but again, I would remark, in the Scotch Fir and the Yew there are no filaments at all.

Some woodcuts are given by Sir John to show how the stigma[1] in wind-fertilized flowers is more branched and hairy than in those fertilized by insects. No doubt, it is obvious that such an arrangement is but natural and to be expected; but it is dangerous to deduce general rules from particular facts, and if the examples were somewhat differently selected, the conclusion would not be so clear. If, for example, the Apple or the Water-Plantain (*Alisma Plantago*) were chosen to represent the entomophilous, and the Ash the anemophilous plants, it might seem that the rule was reversed.

But these are minor matters, and are valuable only as showing how easy and how unsafe it is to generalize. To come now to the main point at issue, which resolves itself into two questions. (1) How far does it appear proved that the sole function of colour in flowers is to attract insects? (2) How far, that the service of insects is the main advantage to plants in the struggle for existence?

As to the first question, Sir John Lubbock implies[2] that even in the case of two species of the same genus, the larger or more showy flower will attract the more numerous insects. But how does the theory so implied agree with the fact that many of the most insect-

[1] The summit of the pistil on which pollen from the stamens has to be deposited for fertilization.

[2] P. 41.

frequented flowers are the least conspicuous? Mignonette, for example: it is hard to conceive a flower offering less in the way of show, and certainly none is a greater favourite with bees. Again, many intelligent people might be in the habit of seeing trees all their lives, and yet never advert to the fact that the Sycamore and the Lime bear flowers at all — so unobtrusive are they. Yet these flowers are prime favourites with bees. If it be said that the size of the trees renders coloration unnecessary, how, I would ask, can such a position be maintained? Amid so many other trees which produce no honey, surely a guiding mark ought to be as essential as in the case of blossoms in a field. How, again, account for the fact that so many large trees *do* produce conspicuous flowers — for example, the Horse-Chestnut and the Hawthorn? Again, though it be true that the Lime and the Mignonette bear sweet-smelling flowers, yet the Sycamore, whose flowers are the least conspicuous, is comparatively scentless, while the Lily, for example, and the Violet, are both showy and odoriferous.

Moreover, as there are colourless flowers that attract insects, so there are brilliant flowers which contain no honey. An instance has been already quoted, namely, the Poppy; which, however, we are told insects visit for the sake of the pollen. But how, in such a case, can their visits produce *cross*-fertilization? Either in such a flower the stamen and the pistil mature simultaneously, or they do not. If simultaneously, the flower can fertilize itself, and an insect visiting it is as likely to dust the stigma with pollen from its own stamens as with that from others. If, on the other hand, the stamens are mature when the pistil is closed, insects will visit the flowers (seeking the pollen of the stamens) only when the pistil is incapable of fertilization.

But Sir J. Lubbock tells us that in some such instances the colours serve as a sort of *ignis fatuus* to lure insects on a bootless errand. Thus, of the St. John's

Worts[1] he says: "They secrete no honey, but are frequently visited by insects, partly for the sake of the pollen, partly, perhaps, *in a vain search for honey*." And of the Restharrow, "*Ononis* does not secrete honey, . . . [it] is exclusively fertilized by bees, and H. Müller has repeatedly seen male bees visiting this species *in a vain search for honey*."[2]

Now on development principles this should not be. Not only have flowers been so modified as to get the best service from bees, but bees have in their turn been made fit to drive the best possible bargain with flowers. "If flowers," says Sir John Lubbock,[3] "have been modified with reference to the visits of insects, insects also have in some cases been gradually modified, so as to profit by their visits to flowers. This is specially the case with reference to . . . bees and butterflies." And Mr. Grant Allen[4] lays down that "the eyes of the bees are so developed" as to be attracted by the colour which flowers display. But if they are so developed it surely should follow that they have by this time come to know the colours which signify "no honey" as well as those which give token of much. The Restharrow, for example, is a flower of very peculiar hue, one that can be distinguished by a human eye at a considerable distance. Bees should have by this time learnt that this particular colour means "Honey-seekers, apply elsewhere!"

But not satisfied with the general assertion that colour serves only to advertise and attract, Sir John Lubbock goes to declare that the actual disposition of the colours is obviously regulated by the same conditions: "the very arrangement of the colours, the circular bands and radiating lines . . . are all arranged with reference to the visits of insects." In other words, we are asked to believe that the varieties of colour are always only nature's finger-posts indicating to the visitor where is the store of which he is in quest.

[1] P. 69. [2] P. 84. [3] P. 12.
[4] *Vignettes from Nature*, p. 86.

But how can such an explanation meet the case of colours on the *outside* of a flower? And many flowers are painted on the back of their petals as well as on the face, while some, as the Apple-blossom, are painted on the back and *not* on the front. Mr. Grant Allen gets out of this last difficulty by quietly remarking that the colour has not yet developed to the other side.[1] But if it is useless where it is, how does it survive to develop at all?

Again, the same author points out that it is *irregular* flowers which are variegated,[2] while regular forms (in the case, at least, of wild flowers) are almost always of uniform hue. But if honey-clues were necessary in the case of any flowers, it would be precisely in these latter and not in the former. The difference between a regular and irregular blossom is that between a saucer and cream-jug. In the first there might be some possible difficulty in finding a patch of honey, but in the latter the shape tells the story; it must be at the bottom. As Sir J. Lubbock himself says,[3] "The advantage of the irregularity [of shape] is that it compels the insects to visit the nectary in one particular manner." An insect which does not know that it has to crawl down a Foxglove-bell to get what it wants is hardly likely to be conducted to it by an observation of the faint and irregular spots which are scattered beneath its feet. It should be noted, too, that in some flowers (as in the Pinks) the colour-bands run transversely to the course of honey-seeker, and so can do nothing in the way of guidance, while in others, as in Milkwort (*Polygala*), where the sepals are the conspicuous part, and are quite as clearly veined as the petals of a Geranium, a pursuit of the colour indications would lead to the place where the honey is *not*.

With regard to these honey-clues, has the experiment ever been tried of painting false ones on a flower? If so, has any insect ever been misled? If not, does any

[1] *Colours of Flowers*, p. 25. [2] P. 61. [3] P. 80.

observer conceive that there would be the smallest hope of misleading it? For it must ever be remembered that insects show in the plainest manner that they are dependent on no such adventitious guidance. In many cases (as for example, Columbine, Tufted-Vetch (*Vicia Cracca*), and Oxlip), bees find it most convenient to get at the honey by biting a hole through the corolla from the outside, without troubling themselves to thrust their trunks down the tube. Now, if they can thus tell the position of the store when an opaque veil intervenes, what possible reason is there for supposing they need the guidance of spots and lines when advancing down a tube?

So much for the idea that the colours of flowers are designed solely for the allurement and guidance of insects. Next, how far does their service, even when secured, appear to be the great benefit which it is assumed to be? Here, again, I limit myself to facts for which Sir John Lubbock speaks.

In the first place, the great order of the *Cruciferæ*, a remarkably vigorous and thriving tribe of plants, is thus described by him:[1] "But although the colour, honey, and scent of the *Cruciferæ* have evident reference to the visits of insects, this order does not offer so many special and specific adaptations as we shall meet with in other groups; *and the majority of species, at any rate, appear to have retained the power of self-fertilization;*" whence it appears that the retention of such power is, after all, no great hindrance in the struggle for life.

Again, the Lime-tree, as I have said, is a prime favourite with bees. Yet what is the result? Sir John Lubbock[2] again tells us: "The visits of insects are very numerous, and yet in this country the Lime seldom produces ripe seed." What argument do we therefore find to warrant us in declaring that the only object of all its pomp of blossom is to attract visitors which benefit it nothing?

[1] P. 58. [2] P. 71.

Finally, not to multiply instances, I take the case of the Violet. This produces two kinds of flowers; one, in spring, the well-known odoriferous and handsome blossom which is visited by bees: the other in late summer, minute, inconspicuous, with neither scent nor show, and unvisited by insects. Yet it is the latter kind and not the former which produces the bulk of seed; "in fact," says Sir John Lubbock, "the Pansy is the only one of our English species [out of five] in which the showy flowers generally produce seed."[1] The fact speaks for itself. Sir John can only suggest that the showy flowers are useful "in securing an occasional cross."

Such theoretical suggestions are one thing: the laying down of a dogmatic proposition, like that quoted at starting, is quite another: and enough has, I think, been by this time said to show that the facts in our possession do not by any means warrant such dogmatism.[2]

If this be so, and if even so careful and observant an author has allowed himself to be hurried too fast by the exigencies of theory, it is scarcely necessary to dwell on the more extreme views of less scientific writers. Mr. Grant Allen, for instance, draws out a chromatic scale of the likings of bees. Their favourite colour, he tells us,[3] is blue. "Blue flowers are, as a rule, specialized for fertilization by bees, and bees therefore prefer this colour; while conversely the flowers have at the same time become blue because that was the colour which the bees prefer." This, if it means anything, means that blue flowers contain more honey than others; otherwise the bees would be credited with a taste in colours for their own sake, which would at once destroy the utilitarian theory and bring the coloration question back to the

[1] P. 58.

[2] Plants growing in meadows where they are liable to be cut down, as the Lady's Mantle and Mouse-ear Chickweed, have likewise adopted this device of producing *cleistogamous*, or inconspicuous, blossoms.

[3] *Colours of Flowers*, p. 19.

ground of æstheticism. Can it then be said that blue flowers are pre-eminently honey-bearing? It would be hard to know what blue flowers could be meant. In a rolling sea of blue Hyacinths we shall not find as many bees at work as in the inconspicuous green tassels of the Sycamore overhead; while the Heather and Mignonette will certainly compare not unfavourably with the Speedwell and Harebell, and even with the Sage and other labiates, "perhaps the most specialized of any flowers so far as regards insect fertilization."[1]

In view of these instances, therefore, and of many others such as these, I maintain that the insect theory is, to say the least, not proven. And if we turn to some considerations of a more general nature, its position will certainly not be improved.

In the first place, even supposing, for the sake of argument, that all development in flowers of colour and form and nectaries has been produced by the agency of insects, yet for development we need the thing to be developed: and whence came that? Granted that the bees painted the flowers, who supplied the paints? A pink blush, it is said, appearing on the petal of a rose made it more attractive than it was when pure white, and so the pink blush was gradually developed to crimson. But whence the pink blush? The bees did not make *that*. And whence its power of developing to crimson? All the bees in the world could not develop an agate into a ruby. And therefore there must be something for which they are not responsible, and that something the

[1] It is remarkable to what length the imperious demands of theory will go, and how far one theory will prove inconvenient to another. In his essay on the colour of flowers, wherein he traces the process of development according to this indication alone, or at any rate chiefly, Mr. Allen comes to the conclusion (p. 32) that the *Ranunculaceæ*, or Buttercup family, are the most primitive of all dicotyledons and "perhaps best of all, preserve for us the original features of the early dicotyledonous flowers." Yet it is precisely the *Ranunculaceæ* which botanists who judge by structure have unanimously set down as the most developed of all dicotyledons, that is as the furthest removed from monocotyledons.

most important of all. As Dr. Asa Gray well says,[1] "The origination is the essential thing. . . . To be a scientific explanation [the theory] should show, or enable us to conceive, how insect-visitation operates or in any way tends to develop colours, and originate apparatus. . . . Thus far it does not appear how the visits of bees to a blossom can make one hair white or black. For all that yet appears, we may be indebted to bees for the beauty of our gardens and the sweetness of our fields, much as we are indebted to the postman for our letters. Correspondence would flag and fail without him; but the instrument is not the author of the correspondence."

It seems obvious, then, that if flowers had been developed by bees, it is because it was their nature to be so developed: and that nature was theirs before the bees came. What development there has been must have been along lines already laid down when the flowers were made. The beauty which has resulted cannot be attributed to the labourers who educed it, unless we are prepared to credit the masons and carpenters with the artistic merit of a cathedral.

Another question which suggests itself refers to the doctrine of development itself upon which the whole argument depends. With regard to that doctrine, I must for my own part say that in the observation of facts within reach I meet with more apparently insoluble difficulties than with fragments of proof. It is generally assumed that the alternative to the development theory, the supposition, namely, that all members of one species are descended from one common ancestor originally created in that form, is too violent to be entertained, and that on development principles the difficulty disappears. But, I would ask, must not developists suppose that all these individuals are descended from one common ancestor originally *developed* to this form? Otherwise, if there had been independent developments, how account for the marvellous identity of results? How, at least

[1] *Contemporary Review, ut supra*, p. 606.

without allowing the reality of an energetic law which would put accident out of the question. Take, for example, so familiar a weed as the common Dandelion.[1] This is a composite flower, and as such must have been much developed. Its individuals, as in the case of all species, agree one with another in a number of most delicate particulars, as all may see by reading the description I append.[2] Is it to be said that all the Dandelions now growing are descended from one original that had changed into the present form? If so, the difficulty is practically as great as under the non-development supposition. If not,—if different lines of individuals have all developed into agreement in all these particulars—the difficulty seems much greater: and greatest of all on the insect theory. The Dandelion has an enormous geographical range: it is found in the Arctic regions, in all north temperate regions, and, moreover, in the temperate regions of the southern hemisphere. The insect visitors in Greenland, in China, in Italy, and in Patagonia can hardly be alike; how, then, is there such complete, I will not say similarity, but identity of result? How indeed, except by allowing that the insects were, at the very most, but instruments, and that the Dandelion, as we see it, was designed from the beginning?

Another remarkable point in the same connexion is, that flowers nearly allied often differ very much in some one particular. Thus Sir J. Lubbock tells us,[3] with regard to two equally common species of Mallow: "In *Malva sylvestris*, where the branches of the stigma are so arranged that the plant cannot fertilize itself, the

[1] *Taraxacum officinale.*

[2] "Glabrous, or cottony at the crown and involucre. *Root* long, stout, black. *Leaves* oblong-obovate or spathulate, lobes usually toothed. *Scapes* one or more, ascending or erect. *Head* $\frac{1}{3}-2$ in. broad, bud erect; involucre campanulate, outer bracts more or less recurved, inner erect. *Corollas* bright yellow, outer often brown on the back. *Fruit* brown, with a beak of equal length" (Sir J. Hooker, *Student's Flora*, ed. 3, p. 240).

[3] P. 41.

petals are large and conspicuous, so that the plant is visited by numerous insects; while in *Malva rotundifolia* the flowers of which are comparatively small and rarely visited by insects, the branches of the stigma are elongated and twine themselves among the stamens, so that the flower can hardly fail to fertilize itself."

Here, then, are two species which have both contrived to develop into mallowhood, which are constructed so exactly alike that in any systematic catalogue they must stand side by side, and yet which differ in the one particular which we are told rules all development. Insects have worked for generations at the one, and have done nothing for the other, and yet they have both arrived at the same point, and both agree exactly in their complex generic peculiarities.[1] And here again it is not in one or two individuals that this strange diversity and stranger agreement are found. These two mallows are each distributed over Europe, North Africa, Siberia, and Western Asia, even as far as India. Such development in all the varying circumstances of this area would certainly seem to be beset by unsurmountable difficulties.

It seems, then, that our knowledge of the mystery of flower life is still far from sufficient to justify us in undertaking to explain the secrets of their inner history, and that the explanation which we have seen offered is insufficient. As already said, nothing is so dangerous as to champion theories when they are but theories, and to allow our natural sympathy for the offspring of our own brain to mislead us as to facts. That our knowledge on the subject of flowers is insufficient, Sir John Lubbock appears in one chapter frankly to avow. He says:

[1] How complex these are may be judged from Sir J. Hooker's description of the genus: "*Leaves* angled, lobed or cut. *Flowers* axillary. *Calyx* 5-fid, 3-bracteolate. *Staminal column* long, filaments distinct at its top only. *Ovary* many-celled; styles stigmatose on the inner surface. *Fruit* a whorl of indehiscent 1-celled carpels separating from a short conical axis. *Seed* ascending, albumen scantly mucilaginous" (*Student's Flora*, p. 75).

"Our knowledge of the subject is as yet in its infancy. . . . Most elementary treatises unfortunately, though perhaps unavoidably, give the impression that our knowledge is far more complete and exact than really is the case. . . . Few, I believe, of those who are not specially devoted to zoology and botany have any idea how much still remains to be ascertained with reference to even the commonest and most abundant species."[1]

But although incomplete and insufficient for full explanation, the knowledge gained through observation may well suffice to point in one direction, and I shall be much surprised if, on calm consideration, that direction is found to be the blind and fortuitous work of unreasoning agents. As Sir John, in yet another passage, parenthetically remarks,[2] "It is difficult to account for the relations which exist between flowers and insects, by the hypothesis of a mere blind instinct on the part of the latter."

This brings us back to the consideration with which I started. I do not believe that insects, as a matter of fact, have done all for flowers which is claimed for them; but were it proved to the full that no colour exists in our fields and gardens which has not been developed by their agency, the ultimate solution of the question which heads this paper would be as far from us as ever. To prove all that I have supposed would be to prove no more than that our bees and butterflies are the paint-brushes of nature: we should still have to ask who is her artist? It is needful to dwell emphatically on this point, for when once we have traced effects to a mechanical cause, there are many who bid us rest satisfied as with a final explanation. But such is not the verdict of true science. "We now believe," says Professor Weismann, "that organic nature must be conceived as mechanical. But does it thereby follow that we must totally deny a First Universal Cause? Certainly not; it would be a great delusion if any one

[1] P. 178. [2] P. 19.

were to believe that he has arrived at a comprehension of the universe by tracing the phenomena of nature to mechanical principles. He would thereby forget that the assumption of eternal matter, with its eternal laws, by no means satisfies our intellectual need for causality. We require before everything an explanation of the fact that *relationships* everywhere exist between the parts of the universe."[1] And the same author, than whom it would be impossible to find a higher authority, quotes with approbation the words of Von Baer: "The laws of nature are the permanent expressions of the Will of the Creative Principle."

Briefly to recapitulate. It is maintained, on the one hand, that all the beauty of flowers can be explained on Darwinian principles, as being of advantage to them in the struggle for existence by attracting the visits of honey-seeking insects, which assist the process of fertilization. It appears, on the other hand, however, that there are many difficulties in the way of such a theory, to be found by ordinary observation in the fields around us. The problem of beauty of form remains untouched by such an explanation. There are conspicuous and highly-coloured flowers which contain no honey, and others which produce no seed; while some of the least noticeable of blossoms are richest in honey and the greatest favourites of bees. Some of the most successful tribes of plants do without insect agency, and prosper better than those which employ it most, and some which largely employ it, never being fertilized, obtain no benefit in return. Plants of the same genus may differ absolutely in their attitude as to insects, and yet their development be so little affected that they bear their affinity to one another stamped upon every feature, and no diversity of insect workers can alter any one minutest character in individuals of one species.

[1] *Studies in the Theories of Descent.* English translation, with Preface by Darwin. London, 1882, vol. ii., "On the Mechanical Conception of Nature," p. 716.

In view of all this, is it scientific to flatter ourselves that we have probed the whole mystery to the bottom, and to lay down that to insects alone do we owe the beauty of our gardens and the sweetness of our fields?

*Felix qui potuit rerum cognoscere causas*, says the Roman poet, but it is no part of true happiness, nor of true science, to boast of knowledge which we do not possess and to become so enamoured of theories as to lose the power of rightly estimating facts.

# Some Wayside Problems

It is generally assumed nowadays, that science has spoken the last word on the subject of life and its developments. He that would not be considered a mere Philistine must profess to hold the great creed of Evolution, and must do so, not because he himself understands the proofs on which it is supposed to rest, but because it has been worked out by experts in laboratories and dissecting-rooms, because it comes to him on the authority of men better than himself, men who can talk familiarly of cellular tissues and protoplasm, of ganglia and nerve centres, and the supra-condyloid-foramen.

The creed which comes to us thus authenticated is this. That in the struggle for life, ceaselessly going on upon the earth, those qualities or habits or attributes are perpetuated and developed which enable their possessors to survive, while others perish, so that not only do we see in the creatures now existing the "winners in life's race," but we also learn from examination of their constitutions, manners, customs, and tastes, what it was that enabled them to win. Here, we are told, is the explanation of all we see. The Squirrels in our oak woods have survived to be there, because they could crack nuts impervious to their rivals. The acorns are there, and therefore the Oak-trees too, because these nuts baffled enemies to which other nuts yielded. If Crows are black and Flamingoes are scarlet, it is only because these uniforms enabled their several ancestors to march respectively more triumphantly to victory. Nightingales sing because the practice has proved useful to Nightingales, and Strawberries develop their misnamed fruit because in commercial phrase the article has been a paying one. Nay, more than this; the ideas which we are apt to consider the most deeply rooted in our own nature are but evidences of what has helped to pull our own forefathers through their primeval difficulties. What we call the true, the good, or the beautiful, is but what has proved advantageous in the long run towards winning the aforesaid race. If men agree to stamp dishonesty as bad, it is because in a very strict sense honesty has been the best policy, and if we instinctively admire the hue of a rose, a glacier, or a rainbow, it is because a keen eye for such colours was once upon a time a useful thing to have, when fruits so tinted formed the food of our distant kindred.

The last-mentioned articles of the evolutionary creed are held, it is true, or at least are preached, only by the more extreme of its disciples: still preached they are, and they should not therefore be omitted from a review of its features. At present, however, my business is not with them. The relation between evolution and the soul of man is a subject too vast to be treated conjointly with any other, and I am just now concerned with the more primary and simpler question as to how far the doctrine so incessantly and so confidently propounded is to be admitted by us as proved in regard of the external world of which our senses tell us.

In approaching this inquiry, there are two points which I hold to be clear, though one of them at least may not generally be much regarded. Firstly, the evolutionary doctrine is after all but a theory—and like other theories should be judged by its accordance or non-accordance with facts. And it must fit *all* facts. It is not sufficient that of some here and some there it should seem to afford a plausible explanation; nor on the strength of its so sufficing may we assume that in other cases where no such explanation is forthcoming it nevertheless exists. We are dealing with that which claims to be the key to unlock all the riddles of nature, and every riddle which it can make no attempt to unlock is a stronger argument against it, than those which it seems to fit are for it, since there may obviously be more explanations that one of the same phenomenon. At least until an overwhelming majority of observed facts declares unmistakably for the theory it is hardly scientific to adopt it as a basis of argument and to call it even "a working theory."

Secondly, the facts which demand consideration are not those only which present themselves to the initiated few. It is not needful that a man should know how to work with a microscope or a scalpel in order to be capable of doing at least something towards the formation of his own opinions. As I have said, all the facts of nature have a bearing on the question under consideration, and every wood and heath and hedgerow presents facts enough and to spare for the study of any one who will use instruments no more recondite than his own eyes and brains.

Any one who will do so will not improbably come speedily to the conclusion that things are not, to say the least of it, so plain and obvious as the books and lectures of his would-be teachers might incline him to suppose. No doubt with some of the facts of nature the evolutionary hypothesis does seem to square well enough, as a plausible or possible explanation. But amidst the endless multitude of phenomena which meet us at every turn, what proportion suggest such an explanation or even seem to admit it? Is it not possible that those who are interested in the theory set too much store by the instances which favour their pet doctrine, and too little by all besides? Is it not at least the more scientific course to go to nature oneself and ask oneself such questions in her presence?

We certainly shall not have far to go for cases in which the accepted scientific account is not too obvious. Is it, for example, quite evident that Moths have in the long run benefited by their inveterate habit of flying into candles? or that it has been a good thing for Linnets and Salmon to be so fascinated by a light as to make possible the operations of bat-fowling and "burning the water"? Might not May-flies and Spinners have discovered a method of depositing their eggs in water without the preliminary evolutions on its surface which are so convenient for the Trout? Have Wheatears been proved to be any the better for their propensity to drop into the first hollow they come across, a propensity on which the shepherds of the southern downs trade so largely? Have Wild Ducks any substantial advantage to show for that readiness of theirs to follow a red dog which leads them in hundreds into the decoys of the fens? or have Sheep improved their position in the world by the practice of huddling together at the sight of a dog and impotently stamping? When a Blackbird flies screaming out of a bush, does he do himself any particular good to compensate the advertisement of himself which he gives to those who do not wish him well? Though it may probably be a valuable assistance to the hen Nightingale that her mate should sing to her when sitting on her eggs in spring, does the same explanation equally apply to the autumn song of the Robin? Is it so very certain that the Strawberry has been signally aided in the struggle for life by its edible fruit, seeing that its cousins the Potentillas have thriven even better without one? How has the Little Celandine found a return for the cost lavished on its blossom, which scarcely ever performs the proper work of a blossom by producing seeds.

These are a few specimens, taken at random, from among the multitude which thrust themselves upon the notice of any one who gives any attention to the facts of nature. And any explanation of the methods of nature which claims to be accepted as final must easily fit itself to such. All I am at present concerned to argue is that as yet we are not in possession of any account so obviously satisfactory as to justify us in dogmatizing or in pluming ourselves on having attained the felicity promised to him *qui potuit rerum cognoscere causas.*

And even in those instances which the champions of the evolutionary dogma cite on its behalf, may it not sometimes be that the explanations offered are more apparent than real? To take, for example, the case of the acorns. They, we are told, have survived because they by their increasing hardness beat off various tribes of enemies that had lived by opening them; something in the same fashion that ironclad ships have lived down the ordnance of the days of Nelson. But, firstly, would not a small development of poison in their kernel, of strychnine or prussic acid, have proved more easily effectual than a great deal of external armour? And might we not therefore most naturally have expected all threatened fruits of this sort to have by this time become deadly? And, secondly, is it quite certain that acorns have really benefited by having killed off all other enemies but Squirrels, if Squirrels remain? It is not the number of species, but of individuals that is important, and there may easily be as many individual Squirrels in the woods now as there were individual acorn-eating animals fifty centuries ago, though recruited from a dozen different tribes.

It is, I hold, a wholesome and useful practice to check the dicta of books in such fashion as this by observation of facts and by independent reasoning upon them. It is far more scientific thus to use one's own means of knowledge, however limited, than to resign oneself helplessly into the hands of a teacher, however eminent. And assuredly, as I have said, though limited the means of knowledge presented to all who will use them are ample enough, and increase with the using. It is my present object to point out a few common and easily verified examples.

In the first place, let us take the case of our common twining plants. As is well known of those plants which avail themselves of strength other than their own to raise them upwards, some, as the Vine, the Pea, and the Clematis, make use of tendrils wherewith to clutch the support of which they take advantage. Others, like the Ivy, develop for the same purpose what are called aerial roots. Others again, as the Convolvulus, the Honeysuckle, and the Hop, being furnished with instruments of neither sort, mount by twining, like snakes, with their whole growth round and round their prop. It is quite conceivable that this habit has been a benefit to them, or any habit which helps them upwards towards the light and air, *quo cuncta gignentium natura fert.* But is it equally comprehensible that it should make any serious difference to a plant whether it turns to the right or to the left?[1] Yet each species adopts one course or the other, and keeps to it pertinaciously. The Convolvulus and the Scarlet Runner, for example, always go to the right: the Honeysuckle, the Hop, the Black Bryony, the Climbing Persicaria,

[1] These terms are, if unexplained, in danger of being highly ambiguous. Indeed, it is said to be a sure method of starting a conversation in any company to turn some object round and round one way, and ask whether it is turning to the right or to the left. Should this by some chance fail to produce the desired effect, all present agreeing, it is only necessary to inquire further *why* such motion should be so described, and discord must inevitably follow. It is indeed curious to note how hard it is to describe an absolute difference in relative terms such as these, and how utterly different modes of reasoning will commend themselves to different minds. Take, for example, the case of a plant twining like the thread of an ordinary corkscrew. Should it be said to twine to the right or to the left? To the right, says one, because its course is the same as that of a boy swarming up a pole, and always following his right hand. To the left, says another, for it is like a spiral staircase, in mounting which one must turn on his left. To the right, says a third, because looking at it from without the part nearest the eye goes upward to the right. To the left, argues a fourth, for fancy yourself to be the prop in the middle, and the plant will cross your breast towards the left. These various explanations are in fact found in print. As it seems impossible to settle such a question on its merits, it will be convenient to define the sense in which the terms are used here. If a man clasping a tree-trunk preparatory to climbing were suddenly, after the manner of Daphne, to be changed to a plant, his arms becoming twining shoots, his right arm would be said to twine to the right and his left to the left.

always to the left. It is useless to attempt to make them reverse their practice. They will untwine and fall from their support rather than do so. It is not, I repeat, a little difficult to understand what particular advantage they have gained by such pertinacity? It will perhaps be said that the first plant of each species which developed the twining faculty adopted that mode of twining which has been perpetuated in its descendants. But such an explanation does but land us in a region of mystery lower still than that from which it seeks to extricate us. It would mean that all individual Convolvulus plants, for instance, are descended from one original progenitor. Yet this is precisely what evolutionists, when arguing against the fixity of species, assume to be impossible. The idea which they are never weary of inculcating is that like circumstances have in countless different instances produced like results, different individuals of one form being forced by their surroundings into another. But can the circumstances have been so absolutely identical as this? And it must not be forgotten, keeping still to the instance I have taken, that there are a multitude of species of Convolvulus differing widely in many respects, but agreeing in their mode of turning. Does the evolutionary hypothesis afford any very satisfactory mode of accounting for such agreement coupled with such difference.

This topic suggests another remark in confirmation of my contention that there is a large field for the most ordinary observer to work in. One of the few books in which I have found any notice of this singular feature in the habits of such plants, after enumerating examples of those which adopt a determined course, goes on to say, that others vary their practice, some individuals of the species twining one way and some the other, and as an instance of this cites the Bittersweet, or Woody Nightshade (*Solanum Dulcamara*). Now, if true, this is singular, so singular as to deserve verification. Luckily the Bittersweet is a common enough plant, and a very short hunt down a hedgerow any time in summer will suffice for the discovery of its purple and orange blossoms, in form so like the flowers of the potato as at once to mark their relationship. In autumn its brilliant red berries will be still more conspicuous. A very brief examination will show that the plant cannot properly be said to twine at all, not at least in the same sense as those already named. It straggles and clambers up through a bush, elbowing itself up chiefly by means of its leaves, which do the work of exceedingly rude tendrils, the upper leaves being furnished with ears at the base to facilitate the process. But in particular it will be observed that though the stem, more from force of circumstances than from any natural instinct of its own, does occasionally make a coil round some object, it has no sort of attachment to one or the other direction. It is not that some plants go one way and some the other, the same shoot of the same plant will occasionally do both. This fact, though of no particular value for the general purpose of my remarks, is yet valuable as showing the need there is for individual observation even of those facts which would seem to be the best attested.[1]

Another matter which suggests difficulties of a similar kind is the practice of most flowers to close at night. It is said that to be open during the day is a clear advantage, because then insects are astir which help to fertilize them, and so to propagate their race; and that to be shut at night is equally advantageous as preventing rain or dew from spoiling the delicate machinery of stamens and pistil. So far so good. But what of plants which close just at the

[1] With regard to the plants which truly twine it has been suggested that their course may have some relation to the motion of the sun. It would be interesting to know how they behave in the southern hemisphere where, according to this idea, their motions should be reversed.

time when, according to this theory, it would be best to open? A notable instance of this is the Goat's Beard (*Tragopogon pratensis*), known from its practice in this respect as "Jack-go-to-bed-at-noon." This flower, one of the multitudinous tribe which many compendiously set down as "dandelions," is wide open in the early morning. By the time that the sun is half way to the meridian it has begun to put up its shutters, as if to warn intending visitors that its business hours are over, and by twelve o'clock it is fast shut, just when the insect world is appearing in fullest force. Yet notwithstanding its go-to-bed habits the somnolent plant seems to get on in the world quite as well as most of its more wakeful and harder working neighbours. It ripens its fruit in abundance, and is very tolerably plentiful through the length and breadth of the land. Paying no attention to the law which we are told to regard as governing plant life, and exhibiting no sign of suffering for its negligence, it certainly suggests a query as to whether the said law be absolutely established.

If the Goat's Beard contradicts the law in one way, the Globe Flower (*Trollius europæus*), also a fairly common species, does so in another. The former shuts itself up at noonday, the latter never opens at all. Instead of regarding insects as the most precious of all visitors, to be allured at any price, that in their comings and goings they may carry pollen to and fro and secure cross-fertilization, the globe flower constructs with its petals a covering, something after the manner of a Roman *testudo*, which so effectually shuts in its stamens and pistils as to make it morally impossible for anything but self-fertilization to take place. So grevious an offender against vegetable economics ought assuredly to come to speedy ruin, yet in its favourite soils it flourishes exceedingly, and up the moist valley of many a Highland stream its flowers are thick as are Buttercups elsewhere.

So much for instances wherein the laws which we are told govern development seem to be ignored, or even contradicted. There are other cases in which the processes of change from one form to another exhibit themselves as considerably different from what we are told to expect. In theory the processes should be exceedingly slow. An animal, or plant, so to say, gropes its way in the dark towards a better form. A flower, for example, produces seeds, and the seedlings which grow therefrom are none of them the exact facsimile of the parent, nor of one another, but differ, infinitesimally it may be, in various particulars. Those whose differences are in a profitable direction are the most likely to survive, and from them will spring others in which the useful features are developed still further, and so on in ever succeeding generations. It is the external circumstances which rule the changes of growth, not any motive force internal to the plant itself. Yet here again it is not hard to find tongues in trees which seem to tell a very different story.

There is a plant exceedingly abundant in spring beside water or in the damp places of woods, known in botanical English as the Water Avens (*Geum rivale*). Bearing a very dusky and inconspicuous flower, it is likely to escape common notice, though mediæval architects were so smitten with the form of its leaves as to model on them much of their foliage. It is a little singular that a plant thus selected for the purposes of ornament should seem to have a decided taste for self-beautification. Its common form, as has been said, is not striking to the common eye. But among plants of the ordinary type there are sure to be found some which altogether change their habit of growth, and do so not in the tentative and gradual fashion which evolutionists describe, but with surprising thoroughness.

The two plants bear commonly drooping flowers of dusky red or purple hue, almost brown. On the stem are three or four leaves of unequal size, and three other leaves springing from the root down below. These various appendages are the raw material to which the plant is confined for its purposes of adornment, and it uses them thus. In place of two flowers on each stalk, the exceptional specimens develop one only, of far greater size. This one flower is made double. The doubling of flowers, as is well known, is effected by changing stamens into petals, and a flower that does this dooms itself to sterility. The Avens, however, seems resolved that if it makes this sacrifice it will have a *quid pro quo* in the way of beauty, and it accordingly colours its now abundant petals far more brilliantly than seems to be their nature, so brilliantly that they are often as ruddy as a Rose. Not content with this, it draws its leaves together, bringing up not only those on the stalk, but some from the root, to make up the orthodox number of five,[1] and bringing them approximately to the same size and form, arranges them something in the fashion of an Elizabethan ruff round its altered flower. The effect is most artistic, and few who are not botanists would imagine that the quaint prim little plant with delicately-tinted blossom could be of the same species as the lax and straggling growths, with dusky nodding flowers, which surround it. Here then is an instance in which development takes place in a given direction at a bound, and apparently on a plan. Moreover, the individuals which exhibit such development being sterile, can do nothing towards handing on the tendency. Yet every season fresh examples of it occur. In some cases the development goes still further, the pistil, whose proper function is to be a seed vessel, changing into a stalk and growing up through the transformed flower, with leaves upon it, and another attempt at a blossom up aloft.

[1] Such a plant as the Geum has 5 petals and 5 sepals. As a general law, exogenous plants adopt the numbers 5 or 4 for their various parts, and endogenous plants the number 3.

Another common plant, the Lady's Smock (*Cardamine pratensis*), frequently exhibits the same sort of change.

A less frequent instance of a striking change of habit suddenly occurring is afforded by the little scentless Dog-Violet (*Viola sylvatica*), which is so common everywhere in April and May. To look at the lowly prostrate plant, whose family has been taken as the emblem of humility, nothing could seem further removed from the rampant climbers with which I began, plants that employ every parasitical device to thrust themselves into prominence. Yet I have known the Violet do just the same. It was on the borders of the little Welsh river Aled, late in October, many years ago, that an unusual-looking blue flower half way up a hedge caught my attention. Examination showed this to belong to a long straggling stem, two and a half feet long, but an indubitable Violet. Instead of staying its growing operations at the usual season, this specimen had, to gain its private ends, continued to develop its main shoot, from which sprang off laterally alternate leaves, with flowers in their axils, and it had multiplied these leaves to the number of sixteen. Of flowers there had presumably been an equal number. That which caught my eye was the only one still blooming, but below it were several seed-pods. Altogether, except for the circumstance that it was a Violet, nothing could less have resembled that plant.

It would be easy to extend the list of such phenomena, but the catalogue might not improbably grow wearisome, and those which I have mentioned are sufficient for my object. It is quite clear that there is abundant matter for observation within reach of all, and it seems to me no less so, that we shall find reiterated to us in many ways the lesson of our own ignorance. The making of theories is a fascinating pursuit, and nothing is more attractive than to find facts tally with a theory we have made. There is therefore no little danger lest convenient facts should be taken and inconvenient facts left, and that hypotheses should therefore be held as proved which we have taken no real step towards demonstrating, and that whilst we are priding ourselves on having sounded the bottom of all knowledge, we should in reality be all the time, like Newton, children on the sea-shore picking up a shell or a pebble here and there, while the limitless ocean with all its treasures rolls before us unexplored.

It may be said that the facts I have instanced and others like them must admit of some explanation, and that the arguments here used would, in some cases at least, appear to suggest that no explanation is possible. What, for instance, about the self-immolation of moths and other insects when they see a light? But such examples tell only against any blind operation of merely mechanical laws. Once admit a design in the processes of nature, and there is no phenomenon but may well be part of that design. Not only the propagation of a species, but its confinement within suitable limits, or even its extinction in favour of other forms, may be in the plan of the Designer. "Foumarts,"[1] said a veteran north-country gamekeeper, "are the clumsiest things about a trap. They'll go into anything, a box or a cage, it doesn't matter; and they'll walk on to a trap that's hardly tried to be hidden: they seem never to look under their feet." Clearly this gives them no great assistance towards multiplication—but their multiplication may possibly not be intended.

So too their cousins the weasels are cursed with a curiosity which goes far to neutralize the benefit of the proverbial fact that they are not to be caught asleep. If one escapes the gunner by reaching the security of a hole, his enemy has only to wait patiently in sight of it, and he will not have to wait long. Infallibly the creature will pop out its head again to have a look at the stranger, and in so doing will give the stranger a sight in return.

[1] Polecats.

The primary fact whereof we have to take account in our investigation of the world of life is that it is a machine which works. Its actual efficiency is far more manifest to us than are any of the hypothetical explanations which we hear, as to how that efficiency is secured. Looking at the universe in its separate parts only, and conceiving of the various tribes which make up the organic kingdom, as separate and independent one of another, fighting each for itself alone, we obtain no key to the mystery that the outcome of this chaotic antagonism, should be that orderly Cosmos which it is the pride of science to contemplate. Looked at, for instance, from the point of view of the vegetables, what advantage had any plant to gain by producing a digestible seed? All that comes of such a quality is to secure, that, the seed being consumed by bird or beast, the propagation of the plant, so far as that seed is concerned, should come to nought. Yet without such seeds—our wheat, barley, oats, rye, rice, peas, beans, and nuts,—what would become of us men, who are yearly within measurable distance of starvation if the harvests of the world fall short of their due amount? In like manner we may ask what advantage has accrued to our cattle and sheep from their latent capacity of producing beef and mutton,—to the horse from his powers of traction,—to the dog from his aptitude to be trained to herd a flock, or point at a covey, or turn a spit. Yet all these various qualities—and a hundred thousand others—fit in with the complex requirements of the world as we know it, and make its operation possible. Not the independence of each factor, but their interdependence is the great fact whereof evidence stares us in the face at every turn, a fact demanding an explanation, and explained, at least more simply than in any other manner, by supposing it to be the result of design.

But here we touch the crucial point of the whole matter. This admission of design is what the most vehement preachers of evolution are chiefly anxious to avoid. Indeed, they make little secret of the fact that their zeal on behalf of the forces of nature is in large measure owing to their belief that the machinery of those forces is sufficient to account for the construction of the universe without an Architect. The blind action of natural laws, the struggle for existence, the survival of the fittest, are sufficient to account for everything; that which it requires mind to explain, required nevertheless no mind to form.[1] It is against this doctrine that the foregoing arguments, and other such, have weight, and he who will in any degree attempt to read nature for himself, will doubtless in no long time come to two conclusions: the first that in every direction mystery bounds our knowledge; the second that where our minds do contrive to penetrate, there has been Mind before them, and that to read the purposes of that mind must be the highest ambition of ours. And this it is that constitutes the true charm of scientific investigation. An historian once contemptuously dismissed the chronicles of the Heptarchy as no more worthy of attention than the battles of kites and crows. Natural history would be something still worse if it dealt but with the aimless and random workings of blind forces. How different the view of such a discoverer as Kepler, exclaiming: "O God! I think Thy thoughts after Thee!" This frame of mind is not devout only, but alone rational and scientific. *Dieu explique le monde, et le monde le prouve.*[2]

In attempting to explain the origin of all things by mechanical forces alone we are attempting a task which is, and must ever remain, impossible. Granting all that our scientists assert, the question of the ultimate cause remains still unanswered. "I believe," says Professor Weismann,[3] "that the theory of selection by no means leads—as is always assumed—to the denial of a teleo-

[1] "Quoi! le monde formé prouverait moins une intelligence que le monde expliqué!" (*Diderot*).

[2] Rivarol.

[3] *Studies in the Theory of Descent.* English translation, p. 716.

logical Universal Cause and to materialism, and I hope thereby to have cleared the way for this doctrine, the importance of which it is scarcely possible to over-estimate. Many, and not the most ill-formed, do not get so far as to make an unbiassed examination into the facts, because they are at the outset alarmed by the, to them, inevitable consequences of the materialistic conception of the universe. *Mechanism and teleology do not exclude one another, they are rather in mutual agreement.* Without teleology there would be no mechanism, but only a confusion of crude forces; and without mechanism there would be no teleology, for how could the latter otherwise effect its purpose.

It is well to insist on this truth, obvious though it be. Scientists too often are so overcome by the wonders they meet in nature as to make the mechanism itself the object of their homage. But this, under the style and title of science, is thinly disguised Fetishism. The idea of mechanism is altogether unmeaning, without that of the end which it subserves, and of the Designer who contrived it, and it is to Him that the universe bears witness.

> These are Thy glorious works, Parent of good,
> Almighty ; Thine this universal frame
> Thus wondrous fair. Thyself how wondrous then !

# "Behold the Birds of the Air"

THE Oxford tutor[1] who has made the public his debtor by his *Year with the Birds*, confesses to an experience at which some at least of his readers are likely to stand aghast. He began life as an angler, and not only has forsaken his art, but considers that he, as well as the Trout, is a gainer by the renunciation. That an ignorant Philistine should speak disrespectfully of the gentle craft, is only what every fisherman pityingly expects; but that any of the initiated should cut himself adrift from the brotherhood of anglers, is what probably none of that brotherhood ever deemed conceivable. Do not fishermen boast that, quite apart from the question of mere success in killing, their pursuit is essentially that of the contemplative man, the most idyllic of all out-door pastimes? that it not only leads its votaries into the most beautiful corners of the land, but likewise puts them in a frame of mind to appreciate their beauties? that, as an American writer has it, no one is in a condition to enjoy scenery to the full, unless he have a fly-rod in his hand and a fly-book in his pocket?

The instance is therefore phenomenal enough to suggest inquiry as to what charm it is, that has availed to break a spell usually so potent, and what master so seductive as to allure a disciple away from the school of Izaak Walton,—and the answer which this query evokes presents us with an interesting specimen of those re-

[1] The Rev. W. Warde Fowler.

venges which it is the habit of Time to bring. It is the man of birds, routed in the dialogue with which the *Compleat Angler* opens, who has got the better of the fisherman, though the man of birds is in this case *Auspex* the Ornithologist, not *Auceps* the Fowler. In other words, the fishing-rod has been resigned in favour of a binocular, and an object has been found for country walks, in the observation of the manners and customs of Wag-tails and Willow-wrens, instead of attempts to allure the wary and suspicious Trout.

Fishermen, as I have said, are members of a craft which is indeed a mystery to outsiders, the charm of which can never be understood by any with whom the sacred fire is not inborn. But it is probable that to a still larger multitude this substitute for angling will seem even less delectable. The man who goes roaming about the country, poring with his glasses into tree-tops and hedge-rows, must look to having his pursuits as irreverently described as were those of his brethren the geologists, by worthy Meg Dods, "And some ran up hill and down dale, knapping the stones to pieces with hammers, like so many stone-breakers run mad; they say it's to see how the world was made."

This is inevitable; but it is to be doubted whether those who can speak from their own experience will join in the outcry. It is the peculiar charm of field observation that it puts a point on that which otherwise is pointless, and by making us note variety, creates interest. Botany accentuates a multitude of shades in the seasons of the year, not only the Primrose, the Violet, the Rose, and the Heather, but every obscure waif and stray of the vegetable kingdom making its mark on the calendar, each as it comes hanging out its own private signal, and claiming welcome as an old friend. Ornithology deals with places rather than with times. It does not, to be sure, omit the latter; the autumnal appearance of the Fieldfare and the Woodcock is an event to it as interesting as the appearance in spring of the Cuckoo or the Swallow; but it is by quartering a district out into habitats for different species, that it adds chiefly to the interest of a country walk. There is the upland moor, where may be sought the Snow-bunting in winter, and the Ring-ousel in summer; the fir-woods, which are sure to exhibit a nomadic company of Gold-crests, Red-polls, and Cole-tits, perhaps a family caravan of Long-tailed Tits; the swampy bits down below, which the Sedge-warbler enlivens with his petulant chatter and comical mimicries; the sheltered spot where far into the winter the Grey Wagtail *sera moratur*. Sometimes there is one spot, and one only, in a whole country side, where a Wood-wren or a Chiff-chaff may be heard, or a Dab-chick seen.

Nor will the observer be long at work before he discovers, as in other branches of natural investigation, what marvels lie hid behind the veil which hitherto he has been contented not to lift. Before we begin to train our eyes by using them, we are vaguely conscious that there are birds of various species in our woodlands and our fields, and that of these species some come and go at their appointed times. It turns out in fact that, except during the comparatively brief period when they are anchored to one spot by the all-absorbing solicitude of nesting, the tide of bird-life is in a continual ebb and flow. In winter, with every spell of frost, numbers move away seawards, and with every promise of open weather return inland. In the later summer, migration of individuals, and even of larger bodies, sets in long before the season when a whole species disappears. Many birds, which we suppose to be always with us, are reported by observers at sea or along the coast as furnishing their quota to the army of migrants—Jackdaws for instance, and Rooks, and even the familiar Robin. Our home-bred Larks, we are told, dwell in their native fallows only until others of foreign origin come in and dispossess them, and then move off to do the same, presumably, by others. Nor are their routes of travel less remarkable than their seasons. From certain definite points of the coast do they start their long flight across the sea, and not from others; and to the same do they return. An observer, for example, on the Norfolk coast may catch scarce a glimpse of the spring immigrants, while at the same time sailors and light-ship men, a few miles off, report dense converging streams pouring towards the estuaries of the Trent and the Humber.

Migration is the broadest and most striking feature of bird-life, but it is one feature only out of many which will reveal themselves to eyes that care to look. The manners and customs, the associations and antipathies, of various species are each a subject of study and of marvel;

> The modes of life
> Native to each, and what, among themselves
> Their feuds, affections, and confederacies.[1]

Whence for example, to take but a few obvious examples, do the Crow tribe get their proclivity for running away with shining objects? Do they indulge the practice in the wild state? or is it a taste developed only by domestication? The Oxeye-tit too, when at large, is not known to batter out other birds' brains and devour them, but this he will certainly do if confined in an aviary. Why do small birds mob the Cuckoo? Is it because they recognize in him a disturber of their homes? And if they so recognize the parent bird, how are they so inconceivably obtuse as not to detect the nature of his enormous brute of a son, hatched in their own nests, which they will sometimes go on feeding even when he has grown so far beyond themselves that they must perch on his back to reach his mouth? Why do Titlarks assault Missel Thrushes? and why do the latter, large and not sweet-tempered birds, submit to be so

[1] δίαιταν ἥντινα
ἔχουσ' ἕκαστοι, καὶ πρὸς ἀλλήλους τίνες
ἔχθραι τε καὶ στέργηθρα καὶ ξυνεδρίαι (Æsch. *Prom.* 498).

bullied? Why does the cock Wren employ his spare time during the breeding season in making fictitious nests, wherein no egg is ever laid? What governs birds in their choice of building materials? A Chaffinch for instance will as a general rule pick his moss and feathers, and make of them a nest most artistically toned to its surroundings. But only this last spring,[1] one such bird, at least, gathered from a decayed stump a mass of white touch-wood, and built it up plain for all passers-by to see, conspicuous against the black bole of a fir-tree. Was this departure from usage induced by the fact that the builder's lot was cast where no nest, however secreted, could remain undiscovered, and where every nest, however unconcealed, was safe?

It seems not wonderful, therefore, that those, in whom a love of nature is inborn, should find that animals can afford them entertainment otherwise than as objects of slaughter; and that an addition to one's stock of facts about them should be held as great a prize as a full creel or heavy game-bag.

It was in observations such as these that Gilbert White and many a follower since his time have spent blameless days, finding, no less than Isaak Walton himself, the longest summer day too short for all the uses they would fain have put it to. *Fortunatos nimium!* Their days and their ways are not ours, and the pursuits they loved cannot be for us what it was for them. A new presence—that of science—has made itself conspicuous in this as in other fields, and not for the first time the fruit of the tree of knowledge has served to bring to an end the placid peace that reigned, before it was tasted, in the paradise of Nature. Gilbert White was satisfied to note the birds without any questionings except those which his eyes could answer, to discriminate a new species of Petty-chaps, and speculate on the hibernation of Swallows. But now the schoolmaster is abroad and has turned

[1] 1887.

every object into a text for deep philosophisings, and do what we will we cannot bear ourselves as if we had not his teachings in our ears. Whether we agree with those teachings or disagree, we cannot but recur to them in our observations, nor avoid asking ourselves how they square with the facts falling under our eyes. Such collation of facts and theories is just what modern science impresses on us as a duty; but, as I have had to confess before, the examination of the simple phenomena which it is in my power to observe, does not serve to impress on my mind the truth of the conclusions most in vogue; but suggests doubts and disquietudes as to their soundness, almost as much as the arbitrary assumptions and dogmatic declamations of the most positive and intolerant of their upholders.

The cardinal doctrine, as everybody knows, of the new evolutionary creed is that there are no such things in the organic world as *species* properly so called. That is to say, the various types of animals and plants, which we see around us, are but various modifications of one original, the descendants from which have variously developed into dissimilarity according to the various circumstances in which they have had to struggle for existence. The host of birds, for example, is not a regular army, designedly portioned off into divisions and regiments, but a multitude fortuitously gathered round certain standards upon which in the march of life they have chanced to come; and those who have been led in the same direction, as if stained by the variation of the same soils, present to our eyes what we mistake for a uniform. They are all, to change the metaphor, carved out of the same block; but the carving has been done by blind forces, not by an artist's hand; it is the heat and the cold, the drought and the deluge, the accidents of climate, of companionship, or of soil, that have determined the forms and features and habits which present themselves to our observation. The Swallow would have been a Sparrow had his ancestors gone through experiences precisely similar to the other's, and on like conditions the Sparrow would have been a Sparrow-hawk.

With the general fact of development I am not concerned. The arguments in its favour are held by professed men of science to be too strong to gainsay, and indeed there seems no more difficulty in understanding how the divisions of animals and plants have been brought about by its agency than by any other. But if there has been development it has been upon a plan. It has been along lines laid down and intended, and in obedience to laws intelligently framed and artfully contrived. To say that Nature as we see it is organized by blind forces without a guiding hand, that the dice have fallen so regularly without being previously loaded, appears so incredible, as to make me wonder with Newton that any man "with a competent faculty of thinking" can fall into such an absurdity.

Sir John Herschel's observation is well known. "When we see a great number of things precisely alike, we do not believe this similarity to have originated except from a common principle independent of them: a line of spinning jennies or a regiment of soldiers, dressed exactly alike and going through precisely the same evolutions, gives us no idea of independent existence."[1] Now coming back to observations of the class whereof I have been speaking, is there anything more absolutely uniform, more obviously fashioned to a plan, than the various tribes of birds? What can be more absolutely identical than the deportment in similar circumstances of different individuals of one race? This is indeed a point which must soon impress an observer with a sense of weirdness and mystery. Looked at apart from his fellows, each individual would appear to be a perfectly spontaneous agent going through his tricks and devices at his own sweet will, with a thousand eccentricities of his own. But when we find the myriads of his fellows so faithful in their imitation that the books

[1] *Discourse on the Study of Natural Philosophy*, § 29.

on our shelves can tell us beforehand what we shall see them do, down to the most minute particular, can the thought fail to arise, that for manœuvres so complicated there must be a word of command? Every Blackbird, for example, flies at our approach from his bush with precisely the same cackle; every Black-cap we try to watch will persistently manage to be behind a tuft of leaves; every Water-ousel settling on a stone sits there curtseying to things in general; a flock of Golden Plover will always turn with a simultaneous precision to which no battalion was ever drilled; Rooks, which appear to go about their affairs so deliberately, will always come back some time in autumn to sit lugubriously beside their nests; a flock of Bullfinches will always fly down a hedge in the same follow-my-leader fashion, making them impossible to mistake for any other species; a flock of Greenfinches can be no less easily distinguished, even at a distance, from other small birds, by their inveterate habit of wheeling about several times with such absolute precision before they alight as to appear and disappear to the eye according as the lighter portion of their plumage or the darker is turned towards the observer; while Siskins may be known by the occasional evolutionary excursions they simultaneously make to interrupt their feeding, and by their unselfish habit of inviting by general acclamation passers-by of their own kind to come and share their banquet; no Jackdaw has ever yet learnt the futility of trying to bring a stick crosswise through a crevice; the Tree-pipit's song is always delivered in precisely the same fashion, while with quivering wings and expanded tail he floats down in a semicircle to the spot he has but a moment left; and the Stone-chat will always be at the top of anything he settles on, be it a furze-bush or only a tussock of grass.

Examples of this sort might be multiplied *ad infinitum* and drawn from every one of the species we see around us. So absolute is the uniformity of their conduct, as to force upon us a conviction of their unity, as is shown by the way in which we are accustomed to speak of species and assign them a character as if to individuals. Thus an eminent naturalist[1] writes of one of our commonest little birds, the Hedge-sparrow: "It is unobtrusive and harmless, of an amiable disposition, and deserves protection and support." The Long-tailed Tit is set down by another writer[2] as a model of all the family virtues, though with just a tinge of eccentricity; while the common experience of mankind has prepared them to set down every Magpie they meet as a rogue, every Sparrow as a *gamin*, and every Robin as an old friend. The Wren will always persist in the seemingly purposeless labour of constructing several nests, before deciding which to use, and the astute egg-collector, when he sees little tufts of grass, as of the foundations of a nest, in the bushes, will conclude that there is probably a Blackcap's or a Garden-warbler's nest in the neighbourhood. The Starling, apparently to beguile the monotony of the long winter, will begin fussing about the place where he intends to build, weeks and weeks before he takes up the business in earnest; the Tomtit will inspect and survey all manner of eligible situations, and suddenly make up his mind to select what seems a most unsuitable one; while the Fly-catcher will have his site chosen and his house built within four days of his return from the south. Nothing, to our notions, is so fatal to hatching eggs as cold water, but every mother Grebe has a natural philosophy of her own, teaching her to bring damp weeds from the bottom of the water, and cover with them the eggs in her nest, when she wishes for a time to leave it. When walking across a moor, if we observe a bird flitting, in half-friendly, half-timid fashion, on our track, taking up a position somewhat in front of us, and as we approach advancing yet farther, again to await us, and so on perhaps for a mile or more from the spot we first observed him, we may be as certain as if we held him

[1] Yarrell. [2] Johns.

in our hand that he is a Wheatear. We know that a tame Swan will drive away Water-fowl, and that a wild Swan will not, while Coots will attract them to the water they inhabit. The Nut-hatch will run up and down trees; the Creeper upwards only; the Goatsucker will never perch across a branch but only sit along it, and so markedly distinguish himself from the Cuckoo and the Hawk for which on the wing he might easily be mistaken. Still as of yore the temple-haunting Martlet will prove himself the guest of summer, and to-day, as in the reign of King Duncan, we may observe that where these birds most heed and haunt the air is delicate; while the Ptarmigan, on the other hand, will not only frequent bleak mountain-tops, but shun their sunny side: and though the hens and young birds will come far into England in winter the male Snow-bunting after he acquires mature plumage, scorning such effeminacy, will brave out the cold in more northern climes.

Not so mysterious as this similarity of character, but equally wonderful, is that of the outward form. This is a matter more easily demonstrated to the eye than the other, and yet it is doubtful whether many even amongst those that see birds every day, have ever noticed how marvellous it is. As an instance, I will take a bird which every one must know—the Chaffinch. Every cock Chaffinch has a black forehead,[1] and a bluish-grey head and nape, with a narrow half-collar of oil-green, between this and the chestnut of his back: the quill feathers of his wing have each a narrow edging of greyish-white; of the wing-coverts, some are always black, and some white, and one row is black at the base with a white tip to each feather: the inner primaries have each a white patch at the base of the outer web, while the

[1] That is to say, in summer. In winter, the plumage of the head and upper part will with equal certainty be found obscured by the long brown margins of the feathers; the edging of the wing-tertials will be tinged with ochre; and the white of the wings with lighter yellow.

pair of tail feathers next to the outer ones have each a narrow white outer margin and a triangular white patch on the inner web. Many other variations of colour would need to be described to give a complete picture, but these items will serve to show how intricate and seemingly arbitrary is the pattern according to which an array so multitudinous is yet uniformly clad. Surely never was a garb so complicated designed for a human battalion, not even that which Michael Angelo devised for the Pope's Swiss Guard; and never assuredly did human skill more accurately reproduce the simplest of designs. It makes the matter not less, but more astonishing, that the bird exhibits unmistakable tendencies to vary. A tinge of yellow is often, but not always, found on the greater wing-coverts, while instances of downright "sports," piebald and buff-coloured varieties, are not unfrequent. What is it that holds such tendencies in check, and instead of motley confusion, produces such practically persistent unity of type, that the next Chaffinch we chance to catch will be sure to agree with it down to the last particular?

How much labour it requires to keep any race up to a model of our own making, we know by experience; how much of the *vis humana* is required if we are not to see our carefully-produced varieties of animals or plants *in pejus ruere, ac retro sublapsa referri*. And yet with all our conscious efforts we cannot obtain such absolute unity of type as nature offers. The short-horns of two herds, the cinerarias from two nurseries, are never precisely the same, whereas not only from John O'Groat's house to Land's End, but from Greenland to Beloochistan, and from Siberia to Algiers, we shall find our friend the Chaffinch, undistinguishable in his dress, unaltered in his manner, and everywhere of the same sprightly carriage which has suggested to our friends across the Channel the happy phrase, *gai comme pinson*.

Can it be seriously maintained that all this is the work of chance, in the sense that it has been wrought out by mechanical forces apart from a plan? I think not: for to set aside all other considerations, such a supposition would require us to believe that the circumstances which have operated to produce development have been as absolutely identical in all cases as are their results. Every bird precisely similar to another should be descended from a line of ancestors which had lived through just the same series of experiences as that other's. Yet it is almost impossible that in the case of any two broods can this be true; it is abundantly evident that, speaking of the race in general, it is the reverse of the truth. In no two of our own English parishes are the conditions of weather or of food-supply precisely identical; and if these had been the efficient causes, they should have availed to manifest their influence by varying at least the breadth of an edging or the shape of a spot. What differences of type might we then expect to find in Norway and in Palestine?

The example chosen is that of a bird so common that its observation is within the reach of all, but it is by no means either solitary or singular. The description of many others furnishes us with minutiæ of variations still more remarkable. Let the reader, the first time he has the opportunity, take a good look with a field glass at a Red-start, and observe the colouring of his head. He will find a narrow black band above the bill, a white patch on the forehead, the chin and cheeks jet black, the top of the head lead-grey. Again, to choose a subject which there will probably be more opportunity of handling, he may test upon the first Woodcock he falls in with, the following description of the bird by Yarrell:

"The beak is dark brown at the point, pale reddish brown at the base. From the beak to the eye a dark brown streak. The colour of the plumage is a mixture, principally of three shades of brown, pale wood-brown, chestnut-brown, and dark umber-brown; each feather on the upper surface of the body contains the three shades, but so disposed as to produce a beautifully variegated appearance. The cheeks pale wood-brown, spotted with dark brown; the forehead, to the top of the head, greyish brown; occiput and nape, rich dark brown, transversely divided into three nearly equal patches by two bands of yellow wood-brown; each feather of the neck below, pale brown, edged with dark brown; the back, greyish brown, varied with reddish brown and dark umber-brown; all the wing-coverts, reddish brown, with open oval rings of dark brown; primary quill feathers, blackish brown, with triangular spots of pale reddish brown along the margin of each web; secondaries and tertials of the same ground colour, blackish brown, but the light coloured marks are more elongated, and extend from the margin of the web to the shaft of the feather; rump and tail-coverts, chestnut-brown, tinged with grey, and barred transversely with dark brown; tail-feathers, black above, tipped with pure dark grey; neck in front, breast, and all the under surface of the body, wood-brown, transversely barred with dark brown; both shades of brown on the under surface becoming lighter in old birds; under wing-coverts, pale brown, barred with dark brown; under surface of the quill feathers, day-slate grey, the triangular markings, yellowish grey; under surface of the tail-feathers, nearly black, tipped with delicate snow-white."

This I think is a very wonderful picture of a species to be drawn from one individual bought in Leadenhall Market; yet the Woodcock has a large geographical range, and must have been familiar with most diverse experiences, being found in Lapland within the Arctic circle, in Japan, in Cashmere, in Greece, in Barbary, everywhere the same, down to each triangular spot and open oval ring; arguing a permanence of type most strange in such variety of circumstances, and assuredly inexplicable by them.

Another question here naturally suggests itself upon which, important and obvious though it be, evolutionist writers do not sufficiently enlighten us. Are we to say that all the Woodcocks now existing have descended from one pair of Woodcocks, the first birds that ever attained that form; or that through different and totally independent lines of descent precisely the same terminus has been reached? One or other it must be, but each answer would appear to involve grave difficulties. If, on the one hand, we say that all the members of the species are descended from one pair of ancestors, there is an end of the favourite Darwinian argument against the hypothesis of special creation, which rests on nothing more firmly than on the assumed impossibility of such descent. If, on the other hand, we adopt the supposition that Woodcocks have been the result of distinct developments, how account for the fact that the results are indistinguishable? As we have already seen, while, on Darwinian principles, it is circumstances alone which mould a species, the circumstances of no two breeds can be so exactly similar as are all the members of a species. How then shall we hold the circumstances to be the creative agency to which the species is traced? It is the fundamental article of Darwinism that there is no tendency implanted in organic nature ruling its development according to a definite plan: there is but a tendency to vary equally in all directions, as the steam in a boiler presses out equally at every point. What gives form to this shapeless force is the repressive action of Natural Selection, preventing development in all but a few directions; that is to say, external circumstances, not innate power, makes a plant or animal what it is. But if we say this we attribute to the one what we deny to the other. Grant that there was no tendency in the developing creature to become a Woodcock, and we must allow a tendency in the world around to make one, if it be indeed a fact that this complex pattern and no other will suit Nature's requirements, and avail for survival when those differing but a hair's breadth from it have been everywhere ruthlessly discarded. It is as easy as it is futile to amuse ourselves with vague general statements of the problem and airily to assume its solution. As we attempt to look more closely, we find, inadequate as our knowledge must be of the difficulties which in fact exist.

that a swarm of fresh complications throw all our imagined machinery out of gear. The first developed Woodcock, for instance, must have had a host of kindred developed within one degree of himself. On Darwinian principles these must either have subsequently exactly followed his example, having hitherto failed exactly to follow it, or, failing to do so, must have been absolutely exterminated by competition with him and his progeny. Can we imagine that each and all of the minute artistic touches already described are so important to the bird's well-being, that their absence means a sentence of death? And if it does not, how comes it that this, and every other family of birds and beasts and plants, is not surrounded with a fringe of poor relations who have not succeeded in acquiring all its minor characteristics? Yet each species stands apart, as sharply defined as if struck from one mint. "Sports" there indeed may be within a species—albinoes or negroes or what not—but these do not perpetuate their peculiarities. Albino birds, it is said, never find mates, and the same is probably true of those tending to exceptional blackness. What we do not find is perpetuation of divergences from the exact specific type, and it is the absence of this which, on Darwinian principles, seems inexplicable.

In scientific investigations, as we are often told, the only sound mode of procedure is to see what hypothesis will fit the facts, and to prefer that which appears best to satisfy this requirement. If this be really done, can there be any doubt as to the nature of that force to which the phenomena we meet must ultimately be attributed? Has any answer but one been ever given to the straightforward question of Bishop Butler: "Will any man in his senses say that it is less difficult to conceive how the world came to be, and to continue as it is, without, than with, an intelligent author and governor of it?" I am much mistaken if the science whereof I have been speaking shall not lead him who studies it by methods truly scientific to bid the objects of his study to join with him in the glory of their Maker, recognizing, as he cannot fail to do, that whatever was the nature of the process, it was He who made them according to their kinds: and that if those kinds stand firmly established, in such bewildering variety, it is because He has blessed them, seeing that they are good.

# How Theories are Manufactured

WHEN the theatrical company commanded by Peter Quince took a hawthorn brake for their tiring-house, they put it to no unaccustomed use. Under its cover another band of performers, at least equal in merit, had, time out of mind, been wont to assume their liveries, before presenting themselves to the public eye. In the boughs above, or the brushwood and herbage below, the birds of the woodland had exchanged the callow deformity of nestlings for the elaborate costumes appropriated to the parts they were respectively to bear in the great drama of the seasons—the Redbreast and the Redpoll, the Black-cap and the White-throat, the Gold-crest and the Fire-tail,

> The Ousel-cock so black of hue,
>   With orange tawny bill,
> The Throstle with his note so true,
>   The Wren with little quill,
> The Finch, the Sparrow, and the Lark,
>   The plain-song Cuckoo grey,

and all the rest of the tuneful choir. Each of these has, not only his special character, but a special dress to distinguish it, and to apprize us what to expect when he enters upon the scene; just as Duke Theseus and his court were to know that a man with plaster about him was going to do the work of a wall, and that another with a bush of thorns and a lanthorn was to "disfigure or present" the person of Moonshine. The piece in which these actors perform has had the longest run on record, yet is it ever new and full of novel interest to those who care to watch it. When that most delightful of books, *Alice in Wonderland*, was put upon the stage, the juvenile audience, who thronged to see it, joyously recognized for old friends each of the actors as they came on: "There's the White Rabbit, the Duchess, the Dormouse," was their cry; and the peculiarity of their pleasure was in seeing that done which before they had read about. In something of the same fashion we know the actors in Nature's serial story, and we know what they will do, yet always find it new in the doing. The Blackbird will, throughout the season, at evening, sound the curfew of the woods which the Hedge-Sparrow will echo with a modest accompaniment. The Robin, though his voice be drowned in the richer harmonies of spring, will make his mark as a musician, singing sweetly in the falling of the year. The Nightingale, "the liquid voice beloved of men, come flying over many a windy wave in days of budding April," will hold unchallenged supremacy amongst all choristers for about a month, and will then sink to the bottom of the scale, and be capable of nothing but an unmusical croak; while the diminutive Chiff-chaff, with his poor little ditty of two notes, will be in the field a full month earlier, and will go unwearied on three or four months later. The White-throat will babble and jar by the sides of hedges, every now and then darting vociferous up and down in the air, like a singing sky-rocket. The Sedge-warbler will chatter and prattle as he bounces about among the reeds and bushes of the water-side, and throw in mimicries of his feathered acquaintances. The Goat-sucker will purr the summer nights through on the moorlands, while the Corncrake complacently rehearses his interminable lay in the meadows, and the Snipe drums circling in the sky above. The Chaffinch will in winter be true to the ungallant habit that has gained him the specific name of "bachelor,"[1] cocks and hens consorting in separate flocks. The Rooks will leave their nesting-trees between

[1] *Fringilla cœlebs.*

the autumnal and vernal equinox to roost in large companies elsewhere, though for a short period ere the winter thoroughly sets in, they will come back and occupy themselves for some days in doing nothing about their properties. The Cuckoo will open his lay in April, and alter it in June, as the old rhyme promises, and will play his singular rôle up and down the woodlands and meadows, giving Hedge-Sparrows and Pipits the charge of his offspring, which they will, as a matter of course, fatuously accept. The Gold-crest will weave his pendent nest with the same superlative art as he has ever done. The Bottle-tit will elaborate his poke-pudding of a structure, and contrive to bring his dozen or more of youngsters out of it with their long tails all unruffled. The Willow-wren will build a domed nest on the ground, and the Jenny-wren a domed nest above it. The Thrush will plaster the inside of his, while Blackcaps will entrust eggs to so loose and light a structure as to make it seem inevitable that they will fall through, which, however, they will not. Swallows and Wagtails will mob approaching Hawks. Wild-ducks will be fascinated by the sight of a dog. All this and indefinitely more may be set down beforehand, and set down in the confident expectation of finding it performed. It is quite clear that the actors are cast for their various parts, and that somehow or other they have got those parts by heart, and have no notion of anything but duly going through them. And as it is clear that they do not improvise for themselves as the piece goes on, any more than they pick and choose, like Æsop's Jackdaw, what plumes they are to wear, men naturally set themselves to ask who or what it is that pulls the strings to which these multitudinous figures move.

This question scientific writers of the present day, or rather, perhaps, writers on scientific subjects, undertake with effusion to answer; and some of them are never weary of telling us how exceedingly simple a thing an answer is, since what they call the "illuminating" doctrine of evolution has been given to the world. But concerning the said doctrine, it seems high time that a clear understanding should be arrived at, and that we should be plainly told what it really does for us, and what it does not.

"Evolution," taking the word to stand for a scientific doctrine, signifies the theory that different kinds of creatures have developed from the same original, and that they have severally passed through sundry and various modifications in the process; that, for instance, the birds of to-day are descended from birds of other habits, whether we take the word to mean dress or conduct, and these again from animals, not birds at all, but lizards and fishes, and before these again something on a par with sand-eels and slugs, and so on down to "primitive Protozoa." Be it so, as perhaps it may be; for evolution does undoubtedly go on in the history, not of species only, but of individuals. Any one of the birds we see came into existence not as a bird at all, but as an egg, in which were contained none of those parts—muscle, nerve, or feather—which we now behold. The change from a Jelly-fish to an Eagle would not be one whit more wonderful than that from the yolk of an Eagle's egg. But what then? Evolution, at best, is but a fact; and what we want is not a fact but a force, which ten thousand facts will not supply, but only demand the more as their explanation. The locomotives which race to Edinburgh, and the marine engines which drive the greyhounds of the Atlantic, are both, no doubt, developments of the primitive machine which James Watt was called in to repair; yet we should hardly give an adequate account of the history of the steam-engine by merely stating this to be the case. What we want to know, and what evolutionists claim to tell us, is the active agent working through all the modifications that have been made, and in the development which has been the result. In the steam-engine, the improving agent has been found in the brains of various men: in the modifications of organic life it has been, according to evolutionists, the force of Natural Selection.

This is undoubtedly the case; or else how are we to account for the position claimed for Mr. Darwin, as the Newton of organic science? Darwin did not originate the doctrine of evolution. Lamarck and others had championed it as stoutly as he. What he did was to offer explanation of a means by which evolution might have been governed and effected; to present what seemed a workable hypothesis to explain the process; and to state certain arguments in its favour. In other words, he professed to find the force responsible for the facts, and this force was Natural Selection. This it was that brought him into such prominence, for in this department preceding evolutionists had obviously failed to satisfy the laws of probability; while his inexhaustible patience in research, and his ingenuity in linking conditions and consequences, enabled him to present a sketch of Nature's method of procedure, which, within certain limits, might well be correct. It is true that it was only within certain limits, and that at best those limits were not wide. On the origin of life he could throw no light; while his very theory postulated a tendency in organic beings to reproduce their own likeness, with yet a certain tendency to variation, and variation in directions capable of advantageous development, and moreover of development towards a "higher" type. Given life, however, to start with, and such tendency to work upon, and it was hard to say, on first sight at any rate, that his system would not work; and it was speedily adopted as doing a great deal more. The limitations above indicated being tacitly ignored, it was speedily assumed that we had now, not as hypothesis, but as undoubted truth, the whole philosophy of the world of life, and that evolution was at last proved, because Natural Selection would explain it.

But what is the case now? Evolution continues to sail under Darwinian colours, and to trade upon the approval which Darwin's great work gained for it, while meanwhile the vital principle of that work may be said to be already dead; for the explanation so ingeniously offered has, by further inquiry, been discredited. The Natural Selection theory of the origin of things has lately been described, and so far as I am aware, without contradiction, as being no less extinct than the Dodo. An eminent man of science[1] stigmatized the proposition that Natural Selection has originated species as "the most absurd of all absurd propositions." More than this, the case seems to be allowed to go by default against the theory, through the silence of its friends. A few years back, when, on occasion of the twenty-first anniversary of the publication of Mr. Darwin's book, a celebration was held to commemorate the coming of age of Darwinism, it was remarked as significant that not a word was said about Natural Selection. It would, in fact, appear that this theory is considered as a mere scaffolding, useful in running up the building, which may be quietly removed when that is completed. But so far as Mr. Darwin's contribution to science is concerned, and, moreover, so far as scientific explanation of evolution is concerned, it is not a scaffolding, but the central pillar upon which all the superstructure rests; and to talk of the system remaining unshaken aloft, though this has crumbled beneath, is like expecting the ball at the top of the Monument to hang suspended in the air should the shaft subside into a heap of broken stones.

But there is another point with which at present I am more directly concerned. While the Natural Selection theory is subject to attacks which its champions do not care to meet, it is still by a host of writers presented to the public as if in undisputed possession of the field. Those who deal only with what is known as popular science, will probably be surprised to hear any doubt cast on the sacred dogma, or on those romantic histories which are constantly written to glorify its cult. While scientific men of the first rank, who do not care to repudiate Natural Selection, are content to let it discreetly alone, there are many of a lower grade who

[1] Mr. St George Mivart in *The Tablet*, June 2, 1888.

cannot bring themselves to discard the weapon with which it seems to furnish them in their endeavour to demonstrate that the world is a clock which needs no winding, and that the potencies of matter are all-sufficient to explain the phenomena of life. Writers of this stamp are always ready to tell us all about it: to point a moral and adorn a tale from any object they meet in nature; the tale being the old one of development by Natural Selection, and the moral, that there is no Mind at work in the ordering of the world, and no controlling force except that Juggernaut-like engine, the struggle for existence, ever securing that the fittest only should survive while the weakliest go to the wall. It would be hard to match the calm assumption and serene self-confidence of some of these writers, undertaking to unlock the secrets of nature, while in blank unconsciousness of the very existence of problems that stare them in the face. But even more than the mental attitude of individuals, a study of their productions illustrates the fatal facility with which fact and theory may be made to tally. It is with the common objects around us that such writers as Mr. Grant Allen—to take once more a conspicuous example—are wont to deal; and what I now propose is to observe in a few instances the method in which the work is done, and to ask a few questions as to the soundness of the result.

To come back to our birds, which I may seem in danger of forgetting. They, we are told, have acquired their present form, their plumage, and their habits, because these have partly helped to find their ancestors food, and partly to find them mates; and because, by the principle of heredity, the qualities, which have helped one generation to survive, have been perpetuated and made habitual in their descendants. Shape of beak and claw, development of muscle and of nerve, have served the one purpose; beauty of form and feather, sweetness of voice, and other æsthetic qualities, have served the other. But here at the first step a difficulty must needs crop up. Of what avail is external beauty of any sort, or rather how can such beauty be conceived as possible, unless there be somewhere a sense of beauty to recognize it? Of what possible advantage can it be to a Wren to develop a golden crest, unless other Wrens think the feature pretty, when they see it? And whence came their taste in this regard, a taste that must have been antecedent to the first development, which would otherwise have been useless? On this point we are not likely to obtain any very clear information, the nearest thing to it which I have succeeded in finding being an assurance that tastes of this sort are due to the creature's "environment," and that, in particular, bright colours in the food on which a species lives, are apt to be as it were reflected, through its tastes, in its plumage. Without diving deeper into the philosophy of the subject, let us see how far facts bear out this theory, and how far it is like the lamp in Christabel—all made out of the maker's brain.

"It is probable," we read in an evolutionary work,[1] "that an æsthetic taste for pure and dazzling hues is almost confined to those creatures which like Butterflies, Humming-birds, and Parrots, seek their livelihood amongst beautiful fruits and flowers." Such an assertion raises many questionings in a mind whose mood is philosophic doubt. Do not Bees frequent flowers as much as Butterflies? and the sad-coloured Humming-bird Hawk-moth as much as the Humming-bird? Are the seeding heads of thistles and knap-weeds so very brilliant as to account for the plumage of the Goldfinch? Is not the most lustrous of our British birds, without question, the Kingfisher, whose diet of minnows and loaches is as unlike as possible to that assigned to the tropical birds whom he so closely approaches? The Gold-crest, living in dull-coloured fir-trees, and feeding on insects, is robed in green and orange, while the Creeper, amid the same trees and hunting the same quarry, wears the soberest of sober garbs; the Woodpeckers live much like the Creeper, but dress in the fashion of Parrots, while

[1] Grant Allen, *The Evolutionist at Large*, p. 195.

the Grebes, which skulk among reeds and spend much of their life beneath the water, have a strong tendency for brilliant decorations, orange-red horns, chestnut crests, rose-tinted beaks, and green feet.

It would also be a not uninteresting subject of inquiry whether the colours displayed by fruit and flower in tropical forests, be really so pre-eminently brilliant as to account for the hues of the birds and butterflies whose lot is cast amongst them. Mr. Wallace, who so thoroughly explored the Malay Archipelago with its "gorgeous fruits and flowers,"[1] tells a different story. "The reader familiar with tropical nature only through the medium of books and botanical gardens, will picture to himself many other natural beauties. He will think that I have unaccountably forgotten to mention the brilliant flowers, in masses of crimson, gold, or azure. But what is the reality? Not one single spot of bright colour could be seen, not one single tree or bush or creeper bore a flower sufficiently conspicuous to form an object in the landscape: there was no brilliancy of colour, none of those bright flowers and gorgeous masses of blossom so generally considered to be everywhere present in the tropics. I have given an accurate sketch of a luxuriant tropical scene, as noted down on the spot, and its general characteristics as regards colour have been so often repeated, both in South America and over many thousand miles in the Eastern tropics, that I am driven to conclude that it represents the general aspect of nature in the equatorial (that is, the most tropical) parts of the tropical regions."[2]

Mr. Wallace goes on to ask and answer a significant question. "How is it, then, that the descriptions of travellers generally give a very different idea? and where, it may be asked, are the glorious flowers that we know to exist in the tropics? These questions can be easily answered. The fine tropical flowering-plants cultivated in our hot-houses have been culled from the most varied

[1] *Evolutionist at Large*, p. 191.
[2] *Malay Archipelago*, vol. i. p. 371.

regions, and therefore give a most erroneous idea of their abundance in any one region. Many of them are very rare, others extremely local, while a considerable number of them inhabit the arid regions of Africa and India, in which tropical vegetation does not exhibit itself in its usual luxuriance. It has been the custom of travellers to describe and group together all the fine plants they have met with during a long journey, and thus produce the effect of a gay and flower-painted landscape. During twelve years spent amid the grandest tropical vegetation I have seen nothing comparable to the effect produced on our landscape by gorse, broom heather, wild hyacinths, hawthorn, purple orchises, and buttercups."

The splendid fruits fare no better at Mr. Wallace's hands than the gorgeous flowers. "Many persons in Europe are under the impression that fruits of delicious flavour abound in the tropical forests, and they will no doubt be surprised to learn that the truly wild fruits of this grand and luxuriant archipelago are in almost every island inferior in abundance and quality to those of Britain. Wild strawberries and raspberries are found in some places, but they are such poor tasteless things as to be hardly worth eating, and there is nothing to compare with our blackberries and whortleberries. The kanary-nut may be considered equal to a hazel-nut, but I have met with nothing else superior to our crabs, our haws, beech-nuts, wild plums, and acorns; fruits which would be highly esteemed by the natives of these islands, and would form an important part of their sustenance. All the fine tropical fruits are as much cultivated productions as our apples, peaches, and plums, and their wild prototypes, when found, are generally either tasteless or uneatable."[1]

Evidence to the same effect, and directed to the precise point under consideration, is contributed by a correspondent of my own, from the Western tropics. Writing from the West Indian island of St. Vincent, he says: "A

[1] *Malay Archipelago*, vol. ii. p. 103.

few days ago I went up into the high woods; there are primæval forests, with all the luxuriance of vegetation one expects to meet in a tropical forest. I can safely say that in the course of many hours' walking I did not see one spot of bright colour. The tall trees, which exclude all sunshine, and the vegetation below, are of every possible shade of green, but that is all. Up to the edge of the forest, in the 'bush,' many wild flowers are now in bloom; but none of them are brilliant in colour—much less so than our English wild flowers: most of them are of a pale yellow, or washed-out lilac, almost grey. Every day I see Humming-birds feeding from flowers of a dull colour; up in the woods I saw many Parrots of a species peculiar to the island; their plumage is very bright, of the gaudy order of parrotdom, and at no time of the year can their surroundings help them to keep up their style of plumage. These are almost the only bright-coloured birds, except perhaps the Golding, a sort of heron, which is found in dark marshy bits by the rivers. The birds in the cultivated parts, where there are gardens and more show of colour, are almost all of dull hue."

From all this, it would appear, that our safest method will be to stick to our own landscape, about which we know something, and not wander off into tropical forests in quest of data for our hypotheses; though, as we shall presently see, no object is so common and homely but that it may, in the interests of theory, be made the subject of a fairy tale. To pursue our researches, therefore, at home. After what Mr. Wallace has told us, we may, I think, conclude that in spite of the "bright orange and blue and crimson fruits in tropical forests"[1] nothing to be found there can compare with a Rowan-tree[2] in September, ladened with masses of coral-red berries. Yet what has been made of this glorious opportunity for colour education by the birds we find there—the Blackbird, the Ring-ousel, and the Missel-thrush?

[1] *Vignettes from Nature*, p. 86.
[2] Or Mountain Ash.

Not one of them shows the smallest tendency towards "pure and dazzling hues." One is glossy black, another rusty black with a white gorget, the third speckled with various shades of buff and brown. Again, how is it that the various birds which devastate our cherries and currants should be of so dull hue compared with the Crossbill who, living on fir seeds, goes bravely in red and green? What again but the exigencies of theory could tempt a writer to say that the key to the comparative dinginess of the Blackcock is that he "does not feed upon brilliant food-stuffs, but upon small bog berries, hard seeds, and young shoots of heather," while "our naturalized oriental Pheasants still delight in feeding upon blackberries, sloes, haws, and the pretty fruit of the honeysuckle and the holly."[1] Any one who has walked a moor must know that cranberries and cowberries are quite as beautiful as those of the honeysuckle or holly, while the whortleberry is a fair match for the blackberry, which by the way also grows on hills, to say nothing of haws and sloes; and these various mountain fruits are supplied to the Grouse and Blackcock in far greater abundance than any æsthetic food to the Pheasant, which as a matter of fact, as farmers will sadly bear witness, prefers to anything else the grain of a wheat-field.

Again we are told that wading birds have had their æsthetic tastes turned into a "sculpturesque" line,[2] and that they care for beauty of form, not for beauty of tint.

In support of this thesis, we are referred to "the Herons, the Cranes, the Bitterns, the Plovers, and the Snipes," with their various devices of crest and gorget and wing plume. But, even within the limits of the list furnished us, the Lapwing, a Plover, is surely a great deal more remarkable for his colour than for any exceptional grace of outline; while to go a little beyond it, the Woodcock is in shape comparatively clumsy, and

[1] *Evolutionist at Large*, pp. 191, 194.
[2] *Vignettes from Nature*, p. 105.

the Flamingo is anything but an instance of quiet coloration.

Again, take the large family of the Ducks. The habits and food of all are much the same, yet how extraordinary are the varieties of their colouring! The Mallard's head is green, the Pochard's chestnut, the Teal's chestnut with a peculiar green patch, the Sheldrake's is black, the Gadwall's grey. The Scoter wears a nearly uniform suit of sable, the Harlequin is spotted and striped, in accordance with his name. One duck is long-tailed, another is pin-tailed, a third is tufted. Most have a green speculum on the wing, in some it is white, others have none at all. How construct an explanation to reconcile all these varieties with the fitness of things? Who standing on the Bass, and seeing the myriad flocks of Gannets sailing above, around, and beneath, can imagine that the delicate shade of buff with which their heads are tinged is a consequence of their acquaintance with herrings and gurnets? The Jackdaw lives a life much like that of Rooks. How has his family and not theirs picked up a taste for a grey hood? The brilliant Yellow-hammer, bright as a Canary, is first cousin to the dingy Bunting, and lives in the same cornfields. The Pied Wagtail differs little in its habits from those whose prevailing hue is yellow. The Swallow has a red patch on the throat, and the House Martin a white patch on the back, though both lead the same life, and hawk after the same flies—in fact, so endless are the vagaries of plumage, that it would seem as feasible an undertaking to construct a philosophy of Paris fashions by computation of the planets, as to find an explanation of those of birds merely from the circumstances of their life. No one will, of course, deny that the circumstances in which they live have something, or rather very much, to do with their style of dress. We should not, on any theory, expect those who breed in open fields to be so brilliantly coloured as to attract the attention of every marauding Hawk or Stoat. No doubt Natural Selection would come into play to stamp out any development of colour which in this way was objectionable and would thus affect colour *negatively*. The question is, whence comes the *positive* tendency towards coloration so abundantly manifested? To say that it is the result of "selective preference," on the part of other individuals, is to say nothing, till that preference be itself explained; for it needs explanation as much as the colour which it evokes. And what is true of colour is true of all other kinds of ornament.

In fact, in order to work their plan with any show of effectiveness, the writers of whom I speak have to beg the whole question. They are by way of demonstrating the truth of the Darwinian theory, and as a first step they assume its indisputable truth. This done, they proceed in a particular case to excogitate another theory as to how on Darwinian principles the organism could have come to its present form. This product of their fancy they set down as fact, and from this fact they invite us to confirm our faith in the great "illuminating" doctrine. That this is a fair account of the method of procedure no one will, I think, deny who has taken the trouble to sift the matter for himself; but to establish my assertion, I will take an example. What is true of colour in birds is true of it in flowers; the only difference being that the case of plants, the selective agency invoked is that of animals, benefiting those which please their eye, and thus aiding them in the struggle for existence. Sometimes it is insects which visit by preference a blossom of brighter hue, and so help to fertilize it: sometimes it is birds which, attracted by a conspicuous berry, help to disseminate its seeds. Amongst other plants with a conspicuous fruit is the Arum or Cuckoo-pint, known also as Lords and Ladies, a common and very noticeable growth along hedgerows in spring, which in autumn produces a bunch of brilliant red berries, like the rest of the plant deadly poison. The history of this plant's economy is cheerfully told by Mr. Grant Allen. "The Robins and small Rodents which eat the berries, attracted by their bright colour and pleasant taste, not only aid in dispersing them, but also die after swallowing them, and become huge manure heaps for the growth of the young plant." This gruesome little romance I have had occasion to notice in a former paper,[1] wherein I ventured to propose two obvious questions: first, whether this remarkable arrangement has ever been verified in fact; second, how it comes, on principles of Natural Selection, that creatures so stupid, as the Robins would thus appear to be, have managed to survive in the struggle for existence. The author, since he first told the Arum's story in his *Evolutionist at Large*,[2] has somewhere been confronted by questions to the same effect, which, in a later work, *Flowers and their Pedigrees*, he notices.[3]

After recounting the murderous tale substantially as before, he proceeds thus to qualify his former categorical account. "I will not positively assert that it is for this reason the Cuckoo-pint has acquired its poisonous juices; *but I cannot help seeing* that *if* any berry happened to show a tendency in such a direction, and so occasionally poisoned the creatures which eat it, it would thereby obtain an advantage in the struggle for existence, and would tend to increase the poisonous habit so far as it continued to obtain any further advantage by so doing. . . . Poisonous berries are unquestionably useful to the plants which bear them. . . . It is impossible, in fact, that a plant should not benefit by having its berries poisonous, *and so* some plants *must necessarily*, in the infinite variability of nature, acquire the property of killing their friendly allies."

Here, then, *habemus confitentem reum*: the pathetic story Mr. Grant Allen has told us as to who killed Cock Robin is exactly on a par with the veracious

[1] See Essay on *Mr. Grant Allen's Botanical Fables.*
[2] P. 86.
[3] P. 263. The italics are mine.

ballad of our childhood, neither more nor less:[1] it is an evolution of Darwinian fancy, not a sober record of observed fact. Such are the feats which we are able to perform in the fields of science, who have the good luck to live "since the great principle of descent with modification has reduced the science of life from chaos to rational order;" we who "can now answer *confidently*: Such and such a plant is what it is in virtue of such and such ancestral conditions, and it has been altered thus and thus by these and those variations in habit or environment."[2] Confidence there assuredly is, enough and to spare, in the story told us, but whether, all things considered, such confidence constitutes scientific merit is quite another thing.

The answer elicited to the other question is no less wonderful though in another way. "It has been asked why the birds have not on their side learnt that the Arum is poisonous. The very question shows at once an ingrained inability to understand the working of Natural Selection. Every bird that eats Arum-berries gets poisoned: but the other birds don't hold a coroner's inquest upon its body, or inquire into the cause of death. Naturally the same bird never eats the berries twice, and so experience has nothing more to do in the matter than in the famous illogicality about the skinning of eels."[3] No doubt this reply is in true philosophic vein; and unquestionably "ingrained inability" is good. But,

[1] This nursery rhyme might be re-written in the scientific spirit for the benefit of children of the future; thus—

Who killed Cock Robin?
  I, says the Arum,
  My fruits ensnare him:
I killed Cock Robin.

Who saw him die?
  I, says Darwinian:
  It's my opinion:
I saw him die.

[2] *Flowers and their Pedigrees*, p. 2.
[3] *Ibid.* p. 264.

with all due deference to a passed master of the craft, it may be asked whether he himself has in this instance quite understood the action of Natural Selection. The question is not what the birds think, but what nature does: not of a coroner's inquest, but of the survival of the fittest. Naturally the birds which gobble down poison for food will die, and as a necessary consequence will have no more children; while those they have already had, if they imitate their parents, will perish like them, and bring their race to naught: or if they do not imitate their parents, will produce a new and circumspect generation, in face of which the malign vegetable will, like the Moor of Venice, find its occupation gone. To argue according to the model we have already seen: it is impossible that a bird should not suffer by a habit of eating poison, and some birds must necessarily have been exterminated by their treacherous entertainers.

The plain fact is that the whole thing is too absurd for serious discussion, were it not that so large a number of readers would appear to take such histories for serious contributions to science. The writer with whom I have been engaged produces book after book and article after article, in a fashion which bears witness to his popularity: he is enthusiastically praised by such men as Mr. Clodd,[1] and if report speaks truly, patronized by Mr. Herbert Spencer: he is chosen to write the sketch of Darwin in the *English Worthies* series, and there he proclaims, as he everywhere indicates, his championship of the crudest and baldest materialism, and his devotion to the creed of "evolution as a cosmical process, one and continuous from nebula to man, from star to soul, from atom to society."[2] In view of all this it becomes imperative to examine thoroughly the real claim of his works to the position they affect to fill.

But it is not only in this fatal facility of imagining,

[1] "As Grant Allen shows in his delightful and exhaustive book on the colour sense," &c. &c. &c. (Clodd, *Story of Creation*, p. 90).

[2] *English Worthies: Darwin*, p. 191.

that such guides are apt to prove misleading: grant all their facts and the processes of what they call their reasoning are still more extravagant. To come back to the matter which has so long detained us. Suppose it be a fact that birds acquire their taste for bright colours by feeding on bright fruits: whence, then, did the fruits get their brightness? Strange to say, from the same birds! So at least, most emphatically, does Mr. Grant Allen inform us: "These fruits were specially coloured to allure their eyes, just as Speedwells and Primroses and Buttercups are specially coloured to allure the eyes of Bee or Butterfly."[1] "Birds have a quick eye for colour, especially for red and white: and *therefore* almost all edible berries have assumed one or other of these two hues."[2] "For this end, just as so many flowers have bright-coloured petals to attract the eyes of insects, we *know* that fruits have bright-coloured pulpy coverings to attract the eyes of birds or mammals."[3] Surely for a system that undertakes "to reduce the science of life from chaos to rational order," this is the most admired confusion that ever was. The birds acquire from bright fruits that taste, which they must have, to make the fruits bright; and wherever we shall conclude that beauty of hue first appeared, sense of such beauty must, on Darwinian principles, have preceded it. Everywhere in fact *apparent diræ facies:* the Absolute looms before us. Once grant that there are things beautiful, and we must come to a canon of beauty, which they did not make: just as from the acknowledgment of truth, as such, we must come to Truth that is eternal, and by talking of creatures "higher" and "lower" in the scale, we implicitly confess to a type of perfection.

It is all very well embarking with a light heart on an uncomprehended enterprise, to tell us that no conscious purpose has been at work to produce what we admire, but that man, recognizing in the work of Nature those

[1] *Vignettes from Nature*, p. 86.
[2] *Evolutionist at Large*, p. 22.
[3] *Flowers and their Pedigrees*, p. 263.

elements of beauty with which he is familiar, in the handicraft of his own kind, proceeds to "read in" an intention, and to fancy that Nature, or whatever that word represents, had an artistic end in view. If man recognizes beauty when he sees it, no matter where, and if his recognition corresponds to a reality, then he has a sense, which, till it first met with a beautiful thing, could in no way be accounted for by circumstances. Just as the idea of colour must have been existent to evoke coloration, so the idea of beauty must be in the mind that picks out one object or one arrangement as more beautiful than another, and selects it for reproduction. It might seem therefore that judgment in this matter goes by default. On the one hand we have no experience of artistic work as the product of anything but artistic purpose. On the other hand we find artistic work in Nature, vastly superior in merit to our own, and we find no possible motive to explain it in any blind mechanical machinery. Is it unreasonable to trace in it a purpose like in kind to that of which we are conscious in ourselves?

But this is not all. We have not to go far in the records of observation to find distinct evidence of an *immanent* purposive tendency, working in nature in definite directions. It is certainly not from what we see, that we learn to describe the tendency to variations in plants and animals as being merely centrifugal, like the expansion of a gas. On the contrary there are clear indications of a something in the organism itself guiding definitely in one direction. To illustrate this by examples It has been said that the tribe of Birds of Paradise seem to have an innate tendency to vary in the direction of beauty, a tendency satisfied in such diverse modes as to preclude the notion that they have all been hit upon, within the limits of the same family, by blind accident. Now one set of feathers and now another are wonderfully developed and coloured. In the Six-shafted Bird it is those of the head that form its peculiar ornament, being lengthened into slender wires with a small oval web at their extremities: the Great Bird has a dense tuft of golden-orange plumes beneath the wings, two feet in length: the Red Bird has the two middle tail feathers transformed into stiff black ribands twenty-two inches long, forming a graceful double curve: the Magnificent Bird has a mantle of straw yellow springing from the nape of the neck: the Superb Bird a bluish green shield on the breast and a large shield of velvety black from the back of the head. These are but a few; but as Birds of Paradise frequent tropical forests I prefer to seek for traces of the same sort of thing among the denizens of our own woods. The nearest akin of these to the Paradise group are the Starlings and Crow tribe, and amongst them we find a distant reflection of the brilliant metallic colours which their far off relatives affect, and a modest imitation of their variety of decorative device. The Starling itself is one of the handsomest of our British birds, its dark plumage glossy with purple and green reflections; its rose-coloured cousin, the Pastor, has the neck and throat violet-black, the wings and tail metallic greenish black, while the back and breast are tinted with the hue whence it takes its name. The Crows, closely allied to the Starlings, in spite of the deep mourning into which their best-known representatives have permanently gone, exhibit the same tendency, in the lustrous reflections of their feathers; the Magpie has developed a long tail iridescent with greenish bronze, and has glossed the dark portion of its remaining plumage with green and violet: while its next of kin the Jay, discarding metallic lustres altogether, supplies their place by the elegant crest of the head, the delicate wine-brown of the nape and back, the beautiful arrangement in black, white, and blue on the winglet and greater coverts.

Something of the same sort is to be seen amongst the Woodpeckers. They again as a family have a taste for splendour, but it is a splendour quite distinct in kind from that of the *Corvidæ*, and quite distinct in its developments among Woodpeckers themselves. The

Green Woodpecker, "the garnet-headed Yaffingale," adorns his head and nape and the corners of the mouth with crimson. The Great Spotted Woodpecker is chiefly black and white, but crimson on the nape and under tail coverts; the Lesser Spotted Woodpecker has a crimson crown; and the Great Black Woodpecker, though otherwise sable as a crow, reveals the family taste in his blood-red cap. Another well-marked family, with decided proclivities, are the Titmice, their plumage brightly painted according to a chromatic scheme of their own, eschewing gaudy hues. The Great Tit is in blue and yellow, with a black cap and white cheeks, and a narrow black stomacher. The Tomtit, too well known to need description, with his cobalt coloured crown, and blue, green, and yellow tints of back, breast, and wing, shades off our British species into the ultramarine and azure tits of the Continent. The Cole Tit on the other hand discards the blues and yellows altogether, but is artistic in his treatment of black and white. One Tit develops a crest; another a pointed black moustache. To the Grebes I have already alluded. The Loon has a crest and ruff of dark brown and chestnut; the Sclavonian Grebe has a bushy black ruff and two orange-red horns; the Eared Grebe has, above and behind each ear, a tuft of loose reddish chestnut feathers. Even the modest and retiring little Dab-chick, Shakespeare's

> Didapper peering through a wave
> Who, being looked on, dives as quickly in,

cannot forego the scrap of finery supplied by a lurid red tint about the throat. What has been already said about the Duck tribe may serve in this connection for them likewise. No one who has made personal acquaintance with the family of the Chats and their kindred, Stonechats, Whinchats, Wheatears, and Redstarts, can fail to note the unity of decorative idea which they exhibit in their diversities; and the same may be said, in greater or less degree, of the Wagtails, the Linnets.

and the Doves, and still more markedly of the Herons and Cranes.

In face of all these examples, it seems hard to conceive that there is not an internal directive force guiding development, if development there be, along predetermined lines, and not leaving it to find its way, fortuitously, like a butterfly in a hailstorm, between the blows of destructive forces.

It is likewise perhaps worthy of remark that although brilliancy of colour is as a rule most conspicuous in the breeding plumage, it sometimes manifests itself at a season when the selective preference of a mate cannot account for its genesis. The Redpoll, for instance, in spring, has but a faint tinge of crimson on its forehead, which develops in richer tints as the season advances to the time of the great moult which follows; being thus at its best when the breeding season is done. A phenomenon of similar import is presented by the autumn song of the Robin, which cannot be accounted for, like spring melodies, by the advantage which it gives the singer in securing a partner.

But this threatens to lead me to the question of manners and customs, another branch of my subject, of even wider and deeper interest, which I had intended to treat in this paper, but which, *spatiis exclusus iniquis*, I must leave for another.

Before passing from the question of colour, however, some mention should be made of the solution recently proposed by Mr. Wallace. In his opinion the Darwinian explanation of the origin of decorative coloration, through the selective agency of mates, is not the true one;[1] and in its place he suggests another, which, truth to tell, is still less comprehensible; here, in fact, as elsewhere, his argument is not merely hard to follow, but absolutely eludes perception. He calls attention[2] to the fact that diversified coloration follows the chief lines of structure, and changes at points, such as the joints, where function changes. Thus among mammals

[1] *Darwinism*, pp. 274-288. [2] P. 288.

stripes often follow the lines of the spine and ribs, the shoulders and hips are marked by curved lines, and emphatic coloration picks out the extremities of ears, feet, and tail. Among insects the same sort of thing is noticeable. In butterflies, the spots and bands usually have reference to the form of the wing and the arrangement of the nervures. Even in birds the distribution of colour and markings follows generally the same law. The crown of the head, the throat, the ear-coverts, and the eyes have usually distinct tints in all highly-coloured birds, and distinct patches of colour are frequently situated on special centres of muscular action, as on the breast and the root of the tail. Mr. Wallace also points out that special brilliance of coloration often accompanies other symptoms of more than ordinary vigour. "Brilliant colours," he says,[1] "usually appear just in proportion to the development of tegumentary appendages. Among birds the most brilliant colours are possessed by those which have developed frills, crests, elongated tails, expanded wings, or plumes," like the Humming-birds, Peacock, Argus Pheasant, or Birds of Paradise respectively. So, too, among insects the most gaudy are those which have the most expanded wings, as Butterflies, Moths, and Dragon-flies.

Here is an interesting collection of facts—if, indeed, the general proposition itself be a fact[2]—but what then? Where is the "explanation" of coloration which these facts afford? Apparently we are to understand that vital vigour produces colour, and that where the former

[1] P. 290.

[2] The fact for which Mr. Wallace contends seems to require large deductions. Among birds the ornamental bars of the wings and tail generally run across the line of their structure and do not follow it. Moreover, the most beautiful effects are produced by differences of hue in each individual feather. Our brightest British Birds, as the Kingfisher and the Goldfinch, develop no crests or appendages. The Pheasant develops a long tail, but it is sombre in colour in comparison of the neck and back. Moreover, the theory seems to deal only with brilliant coloration and to afford no explanation of the not less beautiful effects produced by delicate shading, as in the Woodcock or Partridge.

has a free hand the latter will appear. But is this more than to say that animals clothe themselves in colour because, in the much criticized words, "it is their nature to"? Because Homer and Milton showed their strength of constitution by living to be old men, shall we say that the production of the *Iliad* and *Paradise Lost* is by that fact sufficiently explained? It would seem to be much the same sort of an argument to say that because a Peacock develops so stately a train we understand how that train comes by its complicated spangles.

Here I must stop, but enough has, I think, been said to show that, as Mr Balfour has it,[1] "although Evolutionists also find themselves occasionally amongst the prophets, some of their theories are conceived in the spirit of prophecy, rather than in that of natural philosophy."

[1] Address to Church Congress, 1888.

# Instinct and its Lessons

Who taught the nations of the field and wood
To shun their poison and to choose their food?
Prescient, the tides or tempests to withstand,
Build on the wave, or arch beneath the sand?
Who made the Spider parallels design,
Sure as De Moivre, without rule or line?
Who bid the Stork, Columbus-like, explore
Heavens not his own, and worlds unknown before?
Who calls the council, states the certain day,
Who forms the phalanx, and who points the way?
(*Essay on Man*, iii.)

MR. POPE was, clearly, in no doubt as to the answer, when he framed his question in such terms as these. The Darwinian bard, supposing him to be evolved, will ask, not *who*, but *what* has ordered Nature thus; and will call on science to reply that the blind selection of unconscious force has framed all laws we trace in Nature's course. What does Nature herself say? On which side does she give evidence?

If through any of her phenomena she bears witness to a plan consciously designed for definite ends, her voice would appear to be most clear and emphatic in the phenomena of instinct. There we find abundant traces of a force acting with a purpose, which yet is not the purpose of the immediate agents: we find creatures obviously deficient in the very elements of that power, by which we have to solve every problem of our life, yet solving some determined problem, it may be of extraordinary intricacy, with a facile precision, to us wholly incomprehensible; powerless to originate the least shred of fresh design, but striking out that which is native to them, with the unhesitating accuracy of a planet describing an ellipse. The force guiding such operations is what we describe as instinct. Round this term many controversies have raged, and rage still, and not least as to its definition. For present purposes it may be sufficiently described as a guiding light directed to a practical conclusion, but not by means of premisses: telling the *what*, but not the *why:* guiding correctly, but not supplying the knowledge on which alone could a correct judgment rationally be based.

That there is such a guide can hardly be denied. What man could do only with much elaborate training, animals do unhesitatingly and at once; and while it is simply out of the question to suppose that they have the conscious knowledge by which he would have to steer, they arrive at the goal by a straighter and surer path:

> Sure never to o'ershoot, but just to hit,
> While still too wide or short is human wit;
> This, too, serves always; Reason, never long;
> One must go right; the other may go wrong.[1]

To give in illustration an oft-quoted example. Wasps of the genus called *Sphex* lay up with their eggs a store of animal food for the benefit of their young when hatched. It is desirable, from their point of view, that the victim chosen for this unhappy function, should be rendered helpless, but at the same time not killed, that so the provisions may keep fresh. This is effected by stinging him in one or more nerve centres, thus paralyzing him for motion, but not immediately affecting his life. One species of Sphex, for instance, preys upon Crickets, in which three nerve centres have to be thus dealt with, to reach one of which the neck has to be stretched back, while the others are minute spots in other parts of the body. For a man to do this would require the nicest knowledge of anatomy. Yet the Sphex performs the operation with unhesitating accuracy.

[1] Pope, *Essay on Man*, iii.

and a young mother doing so for the first time cannot be guided by experience, while she certainly has not an elder instructor at her elbow.

From examples such as this, which is but one out of thousands, it would seem, as I have said, to be quite clear, that the actions of animals exhibit a purpose, which is not their own. The Wasp cannot deliberately intend to pierce a nerve she has never seen, and of the functions of which she has no knowledge: but her action accurately serves to attain the end of propagating her race. For Darwinism, however, this is a matter of life and death: if there is purpose in Nature, it is all over with the supremacy of Natural Selection. It is not, therefore, to be supposed that the point will be tamely yielded, and as a matter of fact, great pains have been taken to show that purpose is not a necessary part of Nature's machinery.

It is contended that in this department also, as well as in bodily outfit, Natural Selection has been sufficient to produce and to perpetuate those habits which are beneficial to the race. As Mr. Darwin himself puts it,[1] his restrained and scientific tone contrasting agreeably with that of many among his disciples: "It may not be a logical deduction, but to my imagination it is far more satisfactory to look at such instincts not as specially endowed or created instincts, but as small consequences of one general law, leading to the advancement of all organic beings, namely, multiply, vary, let the strongest live and the weakest die."

How this idea is worked out is not very easy to explain, for, with all desire to understand the expositions of its advocates, I have found them hard to grasp. I think, however, that the following is a fair description.

Whatever in the way of instinct is beneficial to the race, enabling its representatives to survive in the struggle for existence, has been handed on, and developed in the handing, by the hereditary principle, from parents to offspring. Given that a beneficial habit was once

[1] *Origin of Species*, p. 244.

acquired, there is no difficulty in its perpetuation. And just as sharper claws or a longer beak may have been produced by the survival of individuals whose organs chanced to vary in such direction, so the migratory instinct of the Swallow, the architectural skill of the Chaffinch, or the surgical accuracy of the Sphex, may be accounted for.

It is obvious that whatever truth be conceded to this statement of the matter, it does not take us very far on the road to an absolute explanation. Just as the Natural Selection theory requires life to begin with, and capability of variation to work upon, so this hypothesis by which instincts are to be explained demands instinct to start with, and instinct, moreover, capable of development. It is of no avail putting an egg into an incubator, unless that egg contains a germ which the fitting conditions of ventilation, moisture, and warmth, will develop into a chick; nor can an instinct be hatched by any combination of circumstances except from an instinctive principle. Yet on the origin of such principle Mr. Darwin emphatically assures us, he can throw no light. "I must premise, that I have nothing to do with the origin of the primary mental powers, any more than I have with that of life itself."[1] At this point therefore we are, on any theory, stopped short by a great gulf, which our reasonings cannot pass, and in our explanation of what seems mysterious we must perforce leave untouched the greatest mystery of all. This only is allowed us, striking the track on the verge of this infinite void to follow it through the fields of nature, and to search out the conclusion to which it leads. "We are concerned," Mr. Darwin tells us, "only with the diversities of instinct and of the other mental qualities of animals within the same class.

Without at present stopping to examine this most important limitation of the field, let us see what there is left for us to explore. Prescinding from the question of their origin, does Natural Selection sufficiently explain

[1] *Origin of Species*, p. 207

the production of such instincts as we find actually in operation? Can we suppose that the multiform habits we find among the brutes, have all been beaten out of the primordial instinctive germ by no agent of more directive tendency than the sledge-hammer of destructive forces? This question resolves itself into two. Is it conceivable that the habits now instinctive, originated in fortuitous acts;[1] acts which proving advantageous have by Natural Selection been perpetuated as habits? In the next place, granting it possible that blind forces should have elaborated machinery so complicated as some habits exhibit, could those habits descend from one generation to another, unless there were in a creature's very nature something inducing the descent?

Both these questions Darwinians answer in the affirmative. To employ again the example already brought, they say that the instinct of the Sphex is sufficiently accounted for by the possibility that one of its ancestors had the luck to hit upon just the proper nerve to sting,[2]

[1] Objection will probably be taken to this term *fortuitous.* It will be said that there is no such thing as chance; that if a stone cast at random hits a Swallow, given the path of stone and bird, their impact is not fortuitous but necessary. Of course it is; but that does not eliminate the fortuitous coincidence of the paths, creating the necessity. Chance is the coincidence of *independent* phenomena; phenomena not co-ordinated to an end. The action of rain and frost, weathering the surface of a stone, must produce in it some shape or other; but should a bust of Napoleon result, the *likeness* would be due to chance. If the phenomena of development and external force be not determined towards the survival of certain forms, their survival is fortuitous. If the phenomena be so determined, then chance vanishes; but so does, likewise, the Darwinian hypothesis.

[2] There is indeed another explanation offered: that of "lapsed intelligence," thus stated by Mr. Romanes (*Mental Evolution in Animals*, p. 301): "I can see no alternative but to conclude that these wasp-like animals owe their present instincts to the high intelligence of their ancestors, who found from experience the effects of stinging thus, and consequently practised the art of stinging till it became an instinct." In spite, however, of the high scientific authority of its advocates, it will seem to most readers that such a theory does not demand to be seriously discussed.

thereby scoring a point in the game of life; and that this act, grown into a habit, has been handed on by Natural Selection, improving as it went, to the Sphex of to-day.

Now it is quite evident that so far as the ultimate treatment of the matter is concerned this theory does not strictly touch the question of purpose at all. Purpose may well lie hid in that first embryo of instinct of which we have perforce to take no account, but in which so much was obviously contained. To say that we could find no working of purposive design in all after developments, would be only on a par with saying that we could find no vital principle in a tree but only in its roots. This is sufficiently obvious, yet it appears sometimes to be forgotten. It seems to be not unfrequently assumed, that granting the possibility of such habits having fortuitously originated, and having been handed down by descent, the whole question is solved. But surely not. Everything else being surrendered there remains that first spark of instinct with which we all must start, and that spark must be capable of development, or we could none of us proceed. This very capacity of development though it were only vaguely and equally in all directions, would still be inexplicable without a design which its development should accomplish. We do not therefore completely explain instinct by calling it inherited habit; it is not an explanation merely to give a thing a name. A habit, by its very essence, demands something whereof it may be a habit; it is of necessity a parasite, growing upon something else, and upon something else from which it can draw its vitality. Let all instinct now existent be inherited habit, that does not take away the need of a first instinct that was not a habit but was capable of forming habits. If there be not such an original to build habit upon, habit there could not be; we might as well expect to get fruit by grafting an apple upon a milestone.

It is a still more obvious consideration that the number of instances in which instinct has been handed down, in form of habit, does not in the least impair the necessity of a basis wherefrom the first impulse might start. Archimedes might have moved the world could he but have found a fulcrum, and Nature's machinery, however complex it be, and however remote its ramifications, must, no less than his, depend for its power of doing work upon the basis, whereby it is upheld. Once get habit solidly mounted and no doubt it may transmit its forces, but being habit it cannot be its own foundation.

Thus much premised, let us explore the narrower territory in which Darwinism claims to reign. And first we have to inquire whether it be a tenable hypothesis that the instinctive habits, which we witness amongst the brutes, had their origin in what we describe as fortuitous acts. On this question there is no need to dwell at length. Darwinians assert that this hypothesis is conceivable. Let us take a few instances, and ask ourselves to conceive it.

Without again recounting the story of the Sphex we may refer to it once more in this connection. The instinct here manifested is by no means without a parallel, it is not even the most wonderful of its kind. Another species of the same genus uses Caterpillars instead of Crickets, and to paralyze them from six to nine stings are needed, one between each of the segments of the body, the brain being also partially crushed by a bite with the mandibles. Another species of Wasp, *Tachytes*, uses Grasshoppers in a similar fashion, and to reach the desired nerve has to bend forward the victim's head and bite through a membrane, but if Grasshoppers fail it will take a Caterpillar. The *Ampulex* prefers Cockroaches, but will make a shift with other insects: the *Stethorectus* chooses Spiders by preference, even the huge Bird-spider which devours Humming-birds, but can do with Grasshoppers and Caterpillars. An instinct fundamentally the same is occasionally found in animals altogether different. Thus there have been found in a Polecat's nest as many as forty

Frogs and Toads, all alive and able to sprawl helplessly, but each bitten accurately through the brain, so as to incapacitate them for locomotion.[1] The devices of the Wasps I have mentioned are paralleled by those insects on which they practise. Thus a Spider in whose web a Beetle had been entangled, and who was in trouble with so boisterous and unruly a prey, has been observed to bite through one of the fore-legs; the Beetle then bending its head to soothe the injured limb, the Spider quickly passed a thread round its head, and bound it down in a position that made further struggle hopeless.

Insects that live in community, as Bees, Wasps, and Ants, need the most complicated machinery of instinct, that their polity should stand. The individual members must be willing not only to work, but to work for others, and not for themselves, and they must be respectively ready for the diverse functions assigned to them. To quote Réaumur, "Hardly are all the parts of the young Bee dried, hardly are its wings in a state to be moved, than it knows all it will have to do for the rest of its life. It seems to know that it is born for society. Like the others it leaves the common habitation, and goes in search of flowers. It goes to them alone, and is not embarrassed to find its way back to the hive. If it goes to draw honey, it is less to feed itself than to commence its labours for the common weal, for, from its first journey, it sometimes makes a collection of wax. M. Maraldi assures us that he has seen Bees return to the hive loaded with large balls of this substance the same day they were born."[2] To estimate the practical skill which a wax-worker Bee requires we must remember that the form of his cell is exactly what it should be, to give a maximum of strength and capacity with a minimum of material, and that to calculate this form mathematicians have to propose to themselves the

[1] *Magazine of Natural History*, vol. vi. p. 206. Quoted by Mivart, *Lessons from Nature*.

[2] Réaumur, *Hist. des Insectes*, t. v. mem. xi.

following problem: "To find the construction of a hexagonal prism terminated by a pyramid composed of three equal and similar rhombs, such that the solid may be made of the least quantity of materials."[1] This problem resolves itself into another, namely, what should be the angles of the rhombs that cut the hexagonal prism, so as to form with it the figure of least possible surface. The value of the angles as found by the Bees, and correctly found, are 109° 28′ and 70° 32′. Also the working Bee must have the power, by whatever process acquired, of striking perfect circles from centres, the distance of which from each other must be accurately adjusted, and the centre of the circle drawn on one side of the comb must be equi-distant from the centres of the three adjacent circles on the other side: a problem which man would find not altogether easy, even though armed with compass and rule. It has been confidently argued, against the obvious inference to be drawn from these facts, that the form and arrangement of the Bees' cells naturally result from the manner in which they set about their work. But the answer is obvious; how did they learn so to set about it? On the whole it is not, I think, an unfair statement of the case, that, either a most delicate mathematical problem is solved by every Bee that makes a cell, or the problem has been solved, once for all, for every Bee before it was born.

Bees and Wasps perform from their own resources the various operations necessary for the public weal, wax-working, honey-storing, cell-construction, and nursing of the larvæ. It is not so with all social insects. Some Ants have another instinct that prompts them to engage in the slave-trade. One of our English species (*Formica sanguinea*) does this at the expense of another (*Formica*

[1] The problem was proposed in this form by Réaumur to König, who calculated the angles as 109° 26′ and 70° 34′. Further calculation has shown that the trifling error was on the side of the mathematician, or rather on the table of logarithms he used. See the *Encyclopædia Britannica* (last edition), article "Bees."

*fusca*). The slaves, as Mr. Darwin tells us, "habitually work with their masters in making the nest, and they alone open and close the doors in the morning and evening." They also search for Aphides. A continental Ant (*Formica rufescens*), which likewise makes slaves, has lost all power of any work except slave-making. The males and females of this species do no work at all; the neuters, or workers, though most energetic and courageous in capturing slaves, do nothing else. The slaves have to make the cells, tend the larvæ, feed their masters, and, in case of migration, also to carry them. The slave Ants are thus possessed of an instinct altogether unselfish, one which does not in any way tend to the good of their own kind, for it is most noteworthy that the slaves are all neuters, which can do nothing to hand down instinct of any sort: while the dusky race, of which slaves are made, show their sense of the blessings of slavery by fierce battles to avoid it, when a party comes marauding.

Creatures such as insects are in some respects the best in which to study instinct, as in them we find it most remote from reason. While such animals are obviously incapable of framing a judgment, their operations yet exhibit a minute accuracy which we do not meet elsewhere. We find examples, however, of much the same import, among brutes of higher development. The architectural work of the Bee may to some extent be matched by that of the much-abused Mole. This underground engineer has played a part in English history, and for his share in bringing about the death of Dutch William he used to be toasted by Jacobites as "the little gentleman in black velvet." This, however, is not his earthwork's only claim to admiration. Though endowed with eyes so imperfectly developed as to make it doubtful whether he can really see, and though his whole life is spent in laborious search for food, a fast of six hours being said to be fatal, this animal exhibits in its engineering operations the most consummate skill. In the centre of his estate, for each Mole claims a certain district as his own, he constructs his fortress, thus described by Mr. Bell: "The fortress is formed under a large hillock. It contains a circular gallery within the base, which communicates with a smaller one above by five nearly equi-distant passages; and the domicile or chamber is placed within the lower and beneath the upper circular gallery, to which it has access by three similar passages. From the chamber extends another road, the direction of which is at first downwards for several inches; it then rises to open into the high-road of the encampment. From the external circular gallery open about nine other passages, the orifices of which are never found opposite to those which connect the inner and upper gallery; these extend to a greater or less distance, and return into the high-road at various distances from the fortress."[1] Thus the chamber communicates downwards directly with the higher road and upwards with the upper gallery, which again communicates by five passages with the lower, and this again with the road by no less than nine, affording an elaborate system of escape. The high-road, so often mentioned, extends from the fortress to the extremity of the domain, and from it run on each side the alleys which lead to the hunting-ground. The architectural craft of the Beaver has been so often described that I need do no more than allude to it in this connection.

An instinct of quite another kind, but in which it is equally difficult to trace a fortuitous origin, is that exhibited by the Wild Duck in her efforts to decoy an intruder from her young. So well is the game played as to deceive a person who is familiar with it in books. An angler, for instance, is wading up stream among the hills, when suddenly, as he turns a corner, out flops from under his feet a Duck, one wing dragging helpless, while she impotently beats the water with the other. If young and inexperienced, he will be sure, unthinkingly, to make a dash at the bird which, flapping and quacking, just out of his reach, leads him floundering on, and

[1] *British Quadrupeds*, p. 93.

water-logging his water-proofs, only to find her presently, on a sudden, recover her powers and be off: while, if he had waited quietly, and looked about him, he would have seen a brood of ducklings paddling in all directions to seek for cover. "Is it conceivable," asks Mr. Mivart, "that such an act was first done by pure accident, so that the descendants of the first Duck which so acted, having inherited the tendency, have alone been selected and preserved?"[1]

This supposition appears, if possible, yet more improbable, when we find different species of birds adepts in acting the same part. Partridges will constantly tumble along as if with a broken wing, when their covey is in danger. I have seen a Willow-wren delude, in this manner, that most dangerous of animals, a school-boy, leading him thirty yards from her nest, and then quietly popping over the neighbouring hedge. This same year the same trick has been tried, within my knowledge, by a Reed-bunting. The common Sandpiper plays the game elaborately, pretending that both wing and leg are injured, so that it can neither fly nor run; his cousin the Snipe acts his part in much the same fashion, while the Tree Pipit and White-throat exhibit a less finished performance, fluttering along the ground as though too weak to escape. Are we to believe that these birds, and others, have all independently struck out, by accident, this histrionic talent? The dramatic touches thrown in, according to circumstances, are in the highest style of art. Walking into the midst of a brood of Partridges suddenly, with a dog, I have seen both old birds, in face of so imminent a danger, tumble demonstratively about, screaming as if in severe pain. That a Partridge will go through the performance of dying is attested by Mr. Harrison Weir, the well-known artist: "A little way in front a Partridge was struggling on the ground, sometimes on her back, and then rolling over and over, till, after one or two apparently exhaustive efforts, she fell, and lay as if dead."[2] The whole thing being a deliberate

[1] *Tablet*, May 26, 1888. [2] *Bird Stories*, p. 21.

imposture. Father Robert Ross, S.J., gives me the following description of what he himself witnessed, in former days, on the part of a Norwegian Ptarmigan, or Ryper: "I was after deer on one of the shoulders of Snaehatten, when I put up a few Ryper. Their flight attracted the attention of an Eagle, who immediately swooped down in pursuit. One of the birds pursued turned sharp round towards me, the Eagle close after it, and dashed itself in among the rocks within twenty yards from where I stood. The Eagle could not get into the crevice, but by the flapping of its wings, and general features, could, I thought, just reach the bird with its talons, and was tearing it to pieces. I did not wish to shoot the Eagle, for fear of frightening the Deer, but was anxious to get the Ryper as an addition to my larder. Accordingly, with my stalker I made a rush and frightened the Eagle off, and on reaching the spot we found the Ryper lying, as we thought, dead, with a handful of its feathers around. The Norwegian thought I had better tap it hard on the head with his stick, before he put in his hand to reach it, but thinking it quite dead I gave the bird only two slight taps, one on the head and the other on the body, just enough to convince the man, as I was convinced, that the Ryper had given its last kick. The bird all this time never moved, but the instant the stalker put in his hand to bag it, there was a sudden quick flutter, and the next instant out rushed the Ryper through another crevice, as strong and well as ever."

Sundry insects will likewise sham death, to escape threatened death. But it is evident, as we see in the above case, that unless the deception were quite perfect, such a proceeding would only ensure destruction by awaiting it. But on the Natural Selection theory the imitation must have been very far from perfect to begin with.

The instincts called into play by birds in defence of their young, where a species has not strength sufficient to show fight, are often pervaded by the same idea, though it takes a different form. Approach a Blackcap's nest too closely, and down come the old birds, within arms' length, amongst the leaves around, rustling and chattering, so that you cannot but attend to them, and perhaps fancy you can catch them; while meantime, amid all their antics, they contrive to have some foliage ever between your eye and them, making it difficult even to get a full view. On the other hand, just as some tribes of birds have a style of plumage distinctively their own, so their conduct in such circumstances reveals a character equally distinct. The Titmice, amongst the smallest of our birds, will defy an intruder with a recklessness that has in it an element of the ludicrous. Nothing will induce a sitting bird to come off her eggs. A lighted match may be introduced into the hole where they lie, and the mother will only peck at the flame. I have known an instance where a collector, wishing for a Tomtit's egg and utterly unable to persuade the parent to evacuate the position, fished her out with a spoon, but before he could get his limed stick ready to procure the egg, she was in again.

An animal, moreover, exhibits sometimes an instinct in particular circumstances, to which nothing can lead up. Take for example the case of the Ringdove, witnessed by Waterton,[1] which elected to build in a tree already occupied by that depredator of nests, a Magpie. The Pigeon's eggs and young escaped untouched, and as the great naturalist remarks, the bird somehow instinctively knew that it would be so, for she settled there with the danger staring her in the face.

Of the bringing of examples there threatens to be no end, so I shall limit myself to one more. The Cuckoo, as every one knows, lays her eggs in the nests of other birds. This instinct is a very singular one, and it is hard to see how, on Darwinian principles, it could have originated. Mr. Darwin tells us,[2] "It is now commonly

[1] *Essays:* the Ringdove.
[2] *Origin of Species*, p. 216.

admitted, that the more immediate and final[1] cause of the Cuckoo's instinct, is that she lays her eggs, not daily, but at intervals of two or three days, so that if she were to make her own nest, and sit upon her own eggs, those first laid would have to be left for some time unincubated, or there would be eggs and young birds of different ages in the same nest. If this were the case, the process of laying and hatching might be inconveniently long, more especially as she has to migrate at a very early period; and the first hatched young would probably have to be fed by the male alone."

It is hard to see how this reasoning should on its own merits gain common acceptance. Other birds, Owls for instance, lay their eggs at intervals, as long, or longer, and the owlets first hatched help to hatch the other eggs; so that we find in an Owl's nest "eggs and young birds of very different ages." Again, the Cuckoo's stay with us is not very much briefer than that of the Swallow, which yet contrives to rear two broods or perhaps more. That the Cuckoo could easily acquire the habit of staying a little longer is evidenced by the fact that young birds linger not uncommonly till September.

But supposing that all the circumstances enumerated rendered it hard for the Cuckoo to make its family arrangements: what then? The natural consequence should be that the Cuckoo race would perish, too heavily handicapped to struggle for survival. How could its weaknesses in this regard have suggested their own remedy?[2] Here there is no question of a series of acts graduated towards the completed habit. Either an egg was laid inside another nest or outside. No egg laid outside would benefit the bird at all. An egg laid inside requires the instinct which it is supposed to originate.

[1] The term *final cause* is, of course, not used here in its philosophical sense.

[2] It might, moreover, be suggested that cuckoos should have learnt to lay their eggs at shorter intervals, those which did so obtaining a marked advantage over the others.

Good observers, moreover, are of opnion that the Cuckoo lays her eggs on the ground, and then taking them in her mouth, so introduces them into the selected nursery.[1] This, if a fact, makes the economy of the Cuckoo more singular, and distinguishes it more sharply from that of other birds. It would appear, besides, that the parent can, in the interests of its offspring, take account of circumstances. It is no hard matter for the young Cuckoo to obtain sole possession of a Hedge-sparrow's or Pipit's nest, and a monopoly of the food-supply to feed its greater bulk. It might not be so plain sailing for it amid a brood of Blackbirds. It is accordingly a significant circumstance to find, as was found this spring,[2] all the Blackbirds' eggs pierced so as to prevent them from hatching.

Another strange feature in the history of this remarkable bird, is the fascination it exercises upon its adopted parents. These seem to develop a passion for its welfare more intense than in the case of their own offspring. Not only will they go on feeding it, when it is so much larger than themselves, that they have to get on its back to reach its mouth, but if their bantling happens to be taken from them, they will follow the robber to a great distance, crying piteously. Nothing is more ridiculous than to see a Meadow Pipit laboriously endeavouring to keep up with a young Cuckoo, who having great power of wing which he has not yet learned fully to control, goes ducking and dipping through the air, like a kite escaped from its string. Nay, according to Mr. Harrison Weir,[3] this fascination

[1] Since the above was written, I have met with conclusive evidence on the point. Mr. Hart, of Christchurch, in his interesting museum, exhibits a hen-Cuckoo and her egg which he himself watched her deposit with her bill in the nest of a Wagtail. I have also been told of a Cuckoo being shot, its mouth being found to be full of the yolk of an egg. This the keeper who shot it took to be proof positive that the bird sucks eggs, an accusation often made; but, while it does not accord with this theory, it gives clear support to the other.

[2] 1888.

[3] *Bird Stories*, p. 17.

is not confined to the foster-parents. In the case of a young Cuckoo, which he watched, not only did the Hedge-sparrows responsible for it attend to its requirements, but a Greenfinch, which had nothing to do with the business, came to help them. He tells us that in another case, when a young Cuckoo was hung up in a garden in a parrot cage, two Wrens, which were building near, came, and, getting through the bars, commenced to feed him: being presently joined in the office by a pair of Hedge-sparrows. Even when they had finished their own nest, one of the Wrens continued to feed the young monster. Such an instinct can clearly do nothing to serve the fortunes of the race which exhibits it, for the young Cuckoo commences his career by the destruction of the young birds in the nest he occupies: being therefore taken by the greatest of observers as the type of a thankless usurper's treatment of his dupes;

> And being fed by us, you used us so,
> As that ungentle gull the Cuckoo's bird,
> Useth the Sparrow: did oppress our nest:
> Grew by our feeding to so great a bulk,
> That even our love durst not come near your sight.

Now, leaving the question of their origin, we have to examine the other question as to the transmission of instincts. Is it conceivable that they should descend from one generation to another unless there were in the creature's nature something tending to induce the descent? Can that something be anything but the machinery of purpose to secure an end?

Some of the examples already cited, under the first head of our inquiry, will serve to introduce us to the second. Most remarkable of these is the care of neuter insects, which, doing nothing to propagate their race, can do nothing to transmit instinct or anything else. Yet these neuters do all the work of the community, and require the most complicated instincts to do it. To fit them for their object, even their bodily form has often to be entirely different from that of the males and females, and in some species the neuters destined for different branches of work differ entirely from one another: thus in one kind of ant there are working neuters and soldier neuters, with jaws and instincts extraordinarily different; and in another kind, the workers of one caste, and one alone, have a wonderful sort of shield on their heads, the use of which, it may be observed, is quite unknown. Yet these neuters are the offsprings of males and females, none of whom, and none of whose ancestors, ever did a stroke of work in their lives. How then can their instinct, or its instruments, have possibly been developed by Natural Selection only? Mr. Darwin is, of course, too acute not to see the difficulty, and too honest to dissimulate it. He calls it the most formidable he has to meet, but proceeds to meet it by an elaborate explanation. Selection, he says, may be applied not to the individual only, but to the race, in order to gain the required end. The good of the race requiring the production of neuters, thus variously modified in form and instinct, those fertile instincts may alone survive, which tend to produce neuters so modified: and thus may Natural Selection suffice for the production. The realms of imagination are, no doubt, infinite, and within their sphere such ramifications of fortuity are perhaps conceivable: but have we not reached the bursting strain of improbability? That direct descent should develop the geometrical instinct of the Working Bee is hard enough to believe, but here the difficulty is raised to the square. And even if the sum of improbabilities thus piled up be not overwhelming, still the explanation so suggested does not avail so much as to touch the case of slave ants. They exhibit an instinct beneficial, not to their own race, but to another: it can be of no advantage to the tribe from which they are taken, that so many of its members should be dragged away to bondage, or, at any rate, if it were so, why should that tribe fight to prevent it, and suffer mutilation and death in the struggle? By what possible process can it have been brought about, that black queens and drones should have been so selected as to produce neuter insects, which will make good slaves for red ants, at the same time handing on to their progeny an instinct that makes them perish in the attempt to avoid that very service for which they have been so laboriously prepared? Here, then, we are clearly beyond the sphere of possibility itself, and I cannot see how in this case, at any rate, the Darwinian explanation is even "to the imagination far more satisfactory."

The case of neuter instincts would then seem to be final, as against the theory, but there are many others, which, to some minds at least, will appear equally conclusive. Such, for example, are the actions performed by many animals and by many human infants, absolutely without instruction or previously acquired knowledge. We know from the experience of our own minds that our reason is not self-sufficient, that it requires a premiss on which to build a conclusion, and can judge how to act, only by drawing upon the teachings of authority or of experience. We all know how to proceed to eat our dinner, but we do not know how we learnt to take our first sustenance. What taught us that the lips and not the hands were the proper organs to employ? Obviously not reason, which would have been utterly powerless in such a case. Yet there was a guide which directed us, and directed us rightly, the voice of instinct.

This, Mr. Wallace[1] seems inclined to deny, on the ground that "this is one of the *simple* acts depending on organization." Most unquestionably; but instinct is precisely a part of the organization, and for animals the most essential part of all. Nor, as we have seen, can it be explained away, by calling it inherited habit,

[1] *On Natural Selection*, p. 206.

for that by its very idea requires an instinctive principle which is not habit.

In such a case as this, we are therefore in presence of instinct utterly divorced from those conditions in which knowledge can be imparted. Yet how much do creatures in such circumstances practically understand. The Chicken will chip the shell, which to animals stronger and more experienced than itself would be a hopeless dungeon. Emerged from the shell, it knows how to peck and run. I think it is White, of Selborne, who says that if held up to a window it will eagerly devour flies, but refuse a Wasp. That young ducks will take to the water, in spite of all teaching, many a perturbed foster-mother of a hen can witness. Young cocks will spar before their spurs are grown; and young adders raise themselves to strike, when, as yet, they have no fangs. A young Water-ousel taken from the nest and brought to the water will dive and find hiding-places to crouch in, as though familiar with the work. Young wild-fowl hatched in captivity, as we may see in the London parks, descrying a large bird in the air, will at once take the alarm, hiding in the grass or skulking in broken ground, so as to make themselves as inconspicuous as possible to a Hawk; providing against a danger which they have not experienced, by a device which they never have been taught. Young Gold-crests, frightened suddenly from the nest they have never yet left, will show themselves equally at home amongst the foliage of a fir-tree, fluttering from twig to twig, and running along branches with extreme dexterity. As the Dipper in the water, and the Gold-crest among the firs, so the young Swallow finds himself at home in the air. Only two days ago an experience to this effect befell me with a House-martin. A nest with young ones, being found in the first week of October,[1] I observed it daily to see whether, as in some cases, the migratory instinct would overcome the parental, and induce the old birds

[1] 1888.

to abandon their brood to their fate.[1] On the 8th of the month the young were still in the nest, two of them perpetually having their heads at the door, and the old birds were assiduously feeding them. On the 9th there was no trace of birds, either in the air or at the door, but something could be seen moving inside. This, on examination, proved to be a solitary young one, crouching forlorn upon the floor. It was brought down and given the chance to fly, when, like the young Bee described by Réaumur, it knew all about it, going off as though it had done nothing else all its life, soaring and circling high in the air, and apparently hawking after insects. I watched it for about a quarter of an hour, and left it so occupied.

If with Mr. Wallace we define instinct to be "the performance by an animal of complex acts, absolutely without instruction or previously acquired knowledge,"[2] cases like this would certainly appear to be included. There are, however, acts still more complex, which seem equally instinctive: so complex as to preclude the idea that they can be governed by anything but an inbred guiding power, a part of the creature's self. To this Mr Wallace appears to demur. He inclines to believe that even the song of birds and the construction of their nests, are not instinctive to them, but learnt by experience. As to the nests, he holds that we shall have no satisfactory evidence of instinct till eggs shall have been hatched by steam and the young birds placed in a covered garden, with plenty of building materials, to see what kind of nest they will construct. I do not know

[1] While observing the nest, I remarked that though the young birds appear to fight selfishly for the foremost place at the door, to secure food, yet just before a visit of the parent, one that held the position, who had been fed on the previous visit, drew suddenly back and another came forward. This looked very like another case of self-denying instinct. Were there not some such provision, a weak nestling might easily be starved in the background, as the parents stay but a moment at the opening, and feed the bird before them.

[2] *Natural Selection*, p. 204.

that this experiment has been tried,[1] but naturalists of an experimental turn have often put the eggs of one bird in the nest of another. Thus Waterton writes to Mr. Ord, July 4, 1833: "This season I have made Jackdaws hatch Magpies, and Magpies Jackdaws; Carrion Crows have brought up Rooks, and Rooks Carrion Crows. It is quite laughable to see a brood of young Jackdaws following an old Magpie, and *vice versa*." Does any one for a moment suppose that when mature these birds would not instinctively know their own kind, and next season build their nests after its fashion, though, in the case, for instance, of the Jackdaw and Magpie, totally different from that in which they have been reared?

It must also be allowed that even supposing a young bird to occupy his leisure with inspection of the domicile in which he lies, he will need something like instinct, and plenty of it, to compose a similar one, when his own time comes. Mr. Wallace[2] implies that the instinctive character of birds' architecture is discredited by the observation that they severally employ the materials that naturally lie in their way: thus the thicket-dwelling Wren uses moss; Kingfishers, fish bones; Carrion Crows, fur or wool; the earth-grubbing Rook, fibrous roots; and the pool-haunting Swallow, mud and clay. But is this quite a fair account of the matter? To say nothing of the Tailor birds and Weaver birds of other climes, we find most remarkable instances amongst our own species, of materials both carefully chosen and artistically used. The Bottle-tit, besides moss for the walls of his structure, and feathers for the lining, weaves the whole together with fine threads of wool, felts the dome, and makes it rain-proof, with moss and lichens, wool, and the web of spiders' eggs; and coats the outer surface with white

[1] Since writing the above, I have been informed that bird-fanciers are in the habit of substituting an artificial nest for that built by Canaries; and that the young so reared nevertheless build after the manner of their species.

[2] *Natural Selection*, p. 216.

lichen so as to resemble tree bark. The Gold-crest hangs his nest, of moss lichen and wool, from the boughs of a fir-tree, in such a manner as to be partially suspended from one and supported by another. The Chaffinch uses spiders' webs to produce what Waterton calls his paragon of perfection. The Thrush manufactures a varnish of mud or cow-dung and rotten wood, wherewith to line his nest, and the arboreal Nuthatch plasters up the approach to his, except one opening, very neatly, with clay. In the choice of materials, too, birds will exhibit a power of discrimination which man could rival only by a laborious process. Martins, for example, seeking clay for their nests, will unanimously select one puddle out of fifty equally convenient, their diagnosis of the quality of its contents being seemingly instantaneous, while we, to come to a sound conclusion, should have to institute a long and tedious comparison.

As to song, Mr. Wallace tells us that Linnets, educated in captivity under Larks, and Goldfinches under Wrens, learn the notes of their instructors instead of their own. But captivity, as is well known, alters habits in an extraordinary degree; though even in captivity a young Skylark, without any instruction at all, will acquire his native song. But in a wild state, is it probable that Waterton's young Jackdaws learnt to chatter like Magpies, or his Magpies to yelp like Jackdaws? If we were, on a large scale, to interchange the eggs of Blackbirds and Thrushes, or of Nightingales and White-throats, should we expect any notable results to be apparent in the minstrelsy of the district? One argument to the contrary nature has exhibited in the Cuckoo, which reared in the society of strangers, and with their notes in his ear, yet sticks unfalteringly to the tune, which only by instinct can he recognize for his own. Again, how should a young bird learn from its parents the art of mocking whatever sounds it hears? Our common Sedge Warbler, for instance, will not only mimic the Sparrows, Chaffinches, and Blackbirds around it, but should it chance to hear the peculiar cry of a Guineafowl, will add this also to its repertory. Obviously it cannot be parental training which enables it to do so.

None of these instances, however, brings such weighty testimony to bear upon the matter, as do the phenomena of migration. These have ever been a marvel to the mind of man, and, to explain the mystery they offer, he has been prompt to believe that if the Stork knoweth his way in the air, and the Turtle, and Swallow, and Crane, the time of their coming, it has been because they are in the leading strings of a power he cannot see.

The broader features of these phenomena are known to everybody. We are all aware that the Swallow and the Nightingale, the Cuckoo and the Corncrake, come to us in spring and leave us in autumn, and that the Woodcock, the Snow-bunting, and the Fieldfare reverse the process, coming for the winter months and wandering away to northern lands to breed. The journeys they undertake, in their oft-repeated change of quarters, are prodigious. The Stork, who spends his summer season in close acquaintance with civilized men, his next erected on the housetop of a Dutch or German village, is to be found in winter by the great African lakes, amid Crocodiles and Hippopotami; the Warblers travel to and fro between our woodlands and Morocco, or Asia Minor, while our Wild Ducks and Fieldfares betake themselves for the nesting time to Lapland or Siberia, even within the Arctic circle. Why our summer visitors should ever come to us, or our winter visitors ever depart, we cannot tell. It is not food, it is not warmth, we know not what it is, that they gain by the exchange. Yet year after year they unhesitatingly embark on the voyage, which we cannot understand how some of them accomplish. The Corncrake, during his stay with us, seems hardly able to fly the length of a field; how does he ever get across the seas? How do the tiny Gold-crests, five full-grown specimens of which weigh less than an ounce, come, earning their title of the Woodcock's pilots, across the German Ocean?

What prompts them to start on such an enterprise? and what teaches them to know how to set about it? Yet this is not all the wonder. Recent observation has established the fact that the routes followed in migration are well defined, the sea voyage being by no means reduced to a minimum.[1] Whence comes the knowledge which makes it possible to steer such a course?[2]

It has been attempted to maintain that here too, as well as in music and architecture, the experience of the old is communicated to the young, and that it is a matter, accordingly, not of instinct, but of education. The teachings of observation, however, are all the other way. In the first place, to say that any bird, old or

[1] We are told that these routes follow the lines of least depth of water, and it is inferred, that the birds having grown accustomed to these lines, while they were dry land, have been unable to forget them ever since. Of course, if the fact be correctly established it must be accepted; but otherwise grave and obvious objections present themselves. In flying over land, the birds, I believe, follow the river basins,—the valleys, not the hills. The track of what once were hills, the shallower waters, cannot therefore be the oldest memory of the race. If that older memory has been supplanted by a newer why not that again by a third? It would seem that it should have been so most emphatically on principles of Natural Selection. Enormous numbers of birds perish in the sea passage. Tens of thousands, we are told by Dr. Robert Brown, are drowned yearly. Here is a case where Natural Selection should work at high pressure. Birds accidentally taking a shorter route should have been so favoured in the struggle for existence as, by this time, to have produced a race following a mathematical straight line betwixt the nearest points, from shore to shore.

[2] An extraordinary explanation has been imagined by an observer quoted by Mr. Romanes. He is of opinion that birds always start their migration when the wind is from the south, and that the instinct is fully accounted for by the pleasurable sensation they experience in flying against the warm breeze. This appears to be an excellent example of the theoretical manufacture of facts. On the 9th of October, when the Martins before mentioned took their departure, the wind was all day N.N.E., except for a short period when it got round to N.N.W., as shown by its self-registration in our Observatory.

young, has the minute geographical memory which would be required to steer by between Lancashire and Morocco, seems no more in accordance with what we know of them, than to say that worms have a sense of humour. What possible co-ordinates would serve them out of sight of land, over the tracts of the unfruitful sea? Migration, moreover, is performed more by night than by day, and to judge by the mad way in which the birds then dash up against lighthouses, it would seem as though they were hurried irresistibly on with far less power of self-control than they ordinarily exhibit; as young Salmon confined in a pond will throw themselves on the bank when the season for going to the sea arrives. For it must be remembered that birds are not the only migrants: the wanderings of the Herring and the Salmon are still more extraordinary, and of them it is a still less hopeful task to attempt any explanation. What guiding lines can be found in the waste of waters, even if it be true, as has gravely been asserted, that Salmon-smolts go down their native river tail first in order to observe what should be their way up again?

Turtles, also, which at other times spread themselves far abroad in the ocean, manage to hit off at the breeding season the little island of Ascension, a tiny speck in the midst of boundless waters, which many mariners with the aid of chart and sextant have not been able to find.

But the most extraordinary and inexplicable of all migratory instincts, is afforded by a quadruped, the Lemming. This little animal, a member of the Mouse family and a close relative of the Water-rat, lives habitually in the east of Norway, but at irregular periods, varying from three years to ten, a large portion of them set forth on the most mysterious of pilgrimages. Their course is directed due west, and thus does not lead them to the regions where more plentiful food might be obtained, in the south. They spend more than a year moving resolutely on, turning neither to the right nor to the left for any obstacle, swimming lakes and climbing houses which lie in their path. They winter beneath several feet of snow, and rear families on their journey. All the way along they are accompanied by another crowd of travellers for whose movements their migration is the signal. The Fox, the Stoat, and the Hawk find a ready livelihood provided for them in the ranks of the caravan; the Great Snowy Owl is on these occasions alone to be found in its best condition: even such pacific animals as Reindeer and Goats develop ferocity in presence of the Lemming, stamping them to death, and, according to some authorities, actually devouring them. All this makes it hard enough to understand what benefit this migration brings to the migrants, but it is all as nothing with the final issue. Steering ever due west the Lemmings arrive at last at the shore of the Atlantic. This obstacle they treat like all the others. On the first calm day they plunge into the sea and the whole multitude perishes to its last member, the front of the host still pointing to the west. As Mr. Romanes tells us,[1] "No faint heart lingers on the way, and no survivor returns to the mountains." So vast are the number thus immolated, that in November, 1868, a ship sailed for fifteen hours through a swarm of swimming Lemmings. To explain this instinct has baffled, as well it might, the ingenuity even of theory. Mr. Wallace suggests that Natural Selection has played an important part in causing migration, by giving an advantage to those animals, which enlarge their breeding area by travel. Mr. Crotch, however, pertinently remarks that, "if none return or survive, it is difficult to say what becomes of the fittest." Having disposed of Mr. Wallace's explanation, Mr. Crotch proceeds to give his own, which is even more remarkable. He finds in the instinct of the Lemming an argument for the existence of the island of Atlantis, that vague and shadowy land spoken of by Plato

[1] *Mental Evolution in Animals*, p. 283.

and Diodorus. To this, when it was land, the Lemmings, according to Mr. Crotch, acquired the habit of migrating, and the habit has persisted though the land has sunk fathoms deep in the ocean. To this theory, which is adopted likewise by a writer in the *Encyclopædia Britannica*, there is the obvious objection that the Lemmings, which do not migrate, alone perpetuate the race, and must therefore be supposed to hand on the instinct, which in their own persons they do not exhibit. Is it not more truly scientific to acknowledge that we know nothing at all of the matter, and cannot even conceive a satisfactory hypothesis? This suicidal instinct is no doubt mightily convenient to the world at large, in so effectually checking the unlimited increase of these prolific rodents, but within the limits of their race it cannot be said to have any advantages to recommend it for Natural Selection.

But we need not weigh these improbabilities, however grave they be, in discussing the question as to whether the knowledge required for migration be acquired by education or implanted as instinct, for, as a matter of fact, the young birds of the year, in the case of the great majority of species, migrate before the old ones, and perform their first journey with no guide but that which they can themselves supply. As if to leave no doubt upon the subject, there is one notable exception. The Cuckoo, reared, in almost every case, in a non-migrant's nest,[1] having no converse with its own parents, leaves the country a month after they have gone, and when every possibility of a personally-conducted voyage has vanished.

Still more hopeless would be his task who should maintain that in the case of fish, "the voiceless children of the incorruptible," instruction of any sort is imparted by the older to the younger generation. Salmon are of

[1] Far most commonly in that of the Meadow-pipit, and after that of the Hedge-sparrow, or Wagtail.

all migratory fish those whose history we know best, and though, to tell the truth, we know next to nothing about them, it is yet quite evident that the fry not only do not know their own parents, but keep sedulously out of the way of every member of their kind which is large enough to eat them; for fish are sad cannibals, and when there is question of a dinner the claims of relationship are apt to be little regarded. The Smolts go down to the sea in "schools" on their own account, quite apart from the full-grown fish, waiting for a flood to take them over obstacles which they have never had an opportunity of observing. Should the water remain too low for travelling, they are consumed with a fever of restlessness, causing them continually to throw themselves out of the water; and if confined in a pond they will, as already mentioned, throw themselves on to the bank, in obedience to their irresistible yearning to be off. In the case of a fish, therefore, the idea of guidance is out of the question: to suggest it in connexion with the Turtle, would partake of the ludicrous. As we have seen, no Lemming ever makes the journey twice, and none can therefore serve as a guide to the company.

Such are a few items out of the mass of evidence, that the phenomena of instinct affords us in our investigation of nature. It is, I think, undeniable that even assuming an instinctive principle to start with, there are many difficulties in the way of the theory which would trace all the forms of instinct now existent to the perpetuation, through Natural Selection, of accidental variations happening to be serviceable. It seems impossible to conceive that means so nicely adjusted, were elaborated by any power not having the end in view which they so accurately attain; in some cases their transmission appears to be physically impossible; in all which I have cited there seems to be conspicuous absence of any medium whereby knowledge may be imparted.

Yet of these instincts each and all serve an end.

They play their part, and a supremely important part, in sustaining those laws of nature, the investigation of which is the whole object of science, as their harmony is her boast. Was such a work achieved without a plan? Did Nature grope her way blindfold to its accomplishment, unconscious of the reign of law she was herself establishing? That order of the universe which, when recognized, overpowers our minds with admiration, was it no more esteemed than chaos till our minds recognized it? As in a looking-glass there can be no image till there be an eye to see it, was the idea of harmony unsuggested by the facts of Nature till the natural philosopher arose upon the world? So must it have been unless there was a purpose that saw itself reflected in their accomplishment: it would appear to be as imaginable a proposition that two and two did not make four till the first multiplication table was constructed, or that the properties of triangles were non-existent till geometric man was developed.

Science, moreover, looks confidently forward, as well as back. She counts on the discovery of new laws, and the disclosure of marvels in Nature as yet unknown. The principal organ in this country announces itself as destined to set forth from week to week "the grand results of scientific research." What are the elements of the calculation by which these are prognosticated? Can we assume that we shall find in Nature fresh proofs of order, unless we be assured that order has been there before us, and that all the phenomena we discover are traces of a power that has made a weight for the winds and weighed the waters in measure, given a law to the rains and appointed a way to the sounding storms?

# A Tangled Tale.

In the logical methods of our popular evolutionary teachers there is nothing more remarkable than the guileless and engaging simplicity with which they hold to the belief that it is quite possible at once to eat your cake and have it. The cardinal point of the doctrine they proclaim is that no purpose operates in Nature, and that the explanation of everything we see is to be found in the mechanical forces of matter. So far so good; the human mind, no doubt, finds a certain satisfaction in thus reducing to the simplest possible elements the machinery of the universe. But if purpose be abolished, the means of explanation which purpose affords must be abolished too; we can, in this case, no longer explain the forms and arrangements we meet in Nature, by saying that they are means devised for the attainment of an end; that is to say, they will not be accounted for by anything that follows from them. It will obviously be no explanation of the shape of a flint hatchet to say that its form was needed for cutting, unless we suppose that it was meant to cut. If we once imagine such a stone to have been shaped by the forces of Nature alone, we must face the difficulty of supposing the rain and the frost to have produced, without purpose, just such an article as purpose would have contrived. And in exactly the same manner, when we find such a structure as a bird's feather, so fashioned as exactly to meet the requirements of flight, we cannot, discarding the idea of purpose, proceed to argue that the need of such an instrument for flying purposes accounts for its production: for where, in the nature of things, is the necessity that anything should fly? Unless it has been predetermined that flying creatures should be produced, a feather is a work of chance, evolved from dead matter by a series of lucky accidents, and flight itself is an accident resulting from the chance production of various structures, feathers amongst them.

This is the situation which materialistic philosophy should face and account for; but, despite its professions, it never really attempts to do so. The idea of purpose, we are indeed assured, is overthrown, and many a war dance do we witness executed over its prostrate form; but when the need for an explanation arises, an explanation which nothing else will furnish, the idea of a preordained end is quietly smuggled in, so wrapped up in words as not to appear what it really is; and as "inherent potentiality," or "correlation," or "heredity," or "epigenesis,"[1] or "ontogenesis," or "cephalization,"[2] or "molecular polarity,"[3] or under some other sounding name, a force is introduced which either means nothing at all, or means that there is some predetermination whereof the operation is visible.

These are, however, but satellites of the great central luminary of the evolutionary system—Natural Selection—and it is generally found more convenient to explain things simply by referring them to it.

[1] "In the progress of organic evolution, each stage determines its successor, consensus of the whole impressing a peculiar direction on the development of the parts, the law of epigenesis necessitating a serial development." (Mr. Lewes, *Fortnightly Review*, June, 1868.)

[2] "In these creatures (the cuttlefish), the tendency to head development, or cephalization, reaches its maximum." (Dr. Andrew Wilson, *Chapters on Evolution*. p. 362.)

[3] "The specific shape of an organic plasma is always dependent on the polarity of its molecules, and is due to the operation of immanent properties." (Lewes, *ubi sup.*)

Natural Selection, we are constantly assured, altogether dispenses with the need of purpose for the explanation of the world we see. Things, it is said, have come to be as they are, not because they were beforehand meant to be so, but because they have been made to be so through stress of circumstances. Every species of animals and plants tends to vary, in a greater or less degree, from the specific type. As there is a perpetual struggle for existence in progress amongst living creatures, which are produced in far larger numbers than the earth can support, those whose variations chance to be in an advantageous direction get a start in the race for life, and handing on their special variations, still more developed, to their posterity, they thus produce in course of time the infinite varieties of structure which the world of life exhibits. It is by taking advantage of such variations that man has been able to form his breeds of sheep, of horses, and of pigeons; it is so that the nursery-gardener produces his prize varieties of auriculas or jonquils, and the orchard-man of apples. He selects those spontaneous variations which tend in the direction he wants, and by judicial crossing he makes his animal or plant develop along that line. What man can thus do in a brief time, Nature has surely been able to do in the countless ages at her disposal; and thus in the constant perpetuation of whatever is better for the purposes of life, we have a full and satisfactory explanation of every part of the machinery of Nature we so much admire; for in the mere fact that each portion thereof exists, we have a clear proof that it is better for its particular purposes than are others; a proof just as clear as we should have, were we to know that it had been specially designed.

Such is the nature of what is commonly described as the "Force of Natural Selection"; but, whatever else may be said of it, it is obvious that in no true sense is it either a *force* or a *selection*. It can no more be called the force originating development than a window can be called the cause of light in a room, or than a net is the cause of little fishes slipping through its meshes. All that, according to the showing of its advocates, Natural Selection does for development is, not to arrest its progress along certain lines; its functions must, at best, be purely directive, and, without a true force to direct, it would be as powerless as would be a coachman without horses.

But—which for present purposes is even more important—if it has no rightful claim to be called a force, it has still less to be called *selection*, and this title which it has appropriated has done more to veil its nakedness than any advocacy, however able. For the term "selection" at once introduces an idea which appears to furnish the theory exactly with that which it most grievously lacks.[1] Natural Selection is compared with artificial selection, as though they were analogous. But man's selection *is* a selection: individuals of a species are picked out for a purpose; they are made means to an end; and subsequent development is thus removed from the domain of chance. In Natural Selection, on the other hand, the goal to be attained can in no way serve to guide the course; progress is left to chance, and the chances are against it. This it is, more than anything else, which renders impossible the process of development by Natural Selection. Let us suppose a quality to be required by man among some of his domestic animals, for instance, long straight horns among his cattle. Some of the young animals born in his herd will have horns slightly longer and also straighter than their crumpled-horned parents. He *selects* individuals of this type, and pairing these he secures that there shall be individuals in the third

[1] Dr. Andrew Wilson, an enthusiastic Darwinian, is very jubilant over this title, but fails to note the point which his laudation of it serves powerfully to emphasize. He writes: "The term 'Natural Selection,' applied by Mr. Darwin to his theory of evolution, is in itself a highly expressive designation. It indicates an analogy with the process of 'selection' whereby man *chooses the animals he intends to breed from.*" (*Chapters on Evolution, p.* 7). But this is precisely what Nature cannot do.

generation still farther developed towards the ideal with which he started; and so on till that ideal be attained. But if the same work be left for Natural Selection to do, the conditions are altogether changed, the one element that in the former instance secured success being omitted—the element of *selection*. No doubt there will still be in the second generation individuals showing a slight tendency in the required direction; and if one individual could hand on the race, we might indeed expect to find the feature still more developed in the third generation. But a mate is needed, and the concurrence of a pair duly qualified to transmit the development must be purely fortuitous; for the first minute stages of variation are insufficient to account for selective preference.

If, therefore, starting from a generation of undeveloped animals, we suppose that in each succeeding generation so large a proportion as one half vary in the right direction, and that consequently one half of the second generation are so developed, the chances will still be even that each of these developed individuals will find an unsuitable mate, a mate whose development is not in the same line; and that development will consequently be arrested. One half of the individuals capable of transmitting the development being duly mated, or one fourth of the whole race, one half of their offspring (one eighth of the whole), will, on our supposition, carry the development a stage farther. But the chances are now only one in eight of their making a suitable match, or seven to one against it. That is to say, each of the duly developed has seven wrong mates to choose, for one right one; and but one eighth even of the selected band (or one sixty-fourth portion of the whole) can succeed in transmitting the development. So the improbabilities continue to augment; in the next generation the representatives of development will be to the undeveloped but as one to a hundred and twenty-seven, and the chance of a suitable pair occurring will have reached the hopeful figure of one to 16,383. This only in the fourth generation. The improbability will of course increase in a like ratio at each step, that is to say, for all practical purposes, probability disappears at once.[1] It would in fact be vastly more likely that we should cast aces three hundred times running, with a pair of unloaded dice, or toss "tails" two thousand times with an honest coin, than that a development should be handed down by Natural Selection through ten generations, even if we start with so favourable a supposition as that one half of the offspring tend to vary in the required direction. What would it be if we were to take the number as one in twenty, or one in two hundred, though even that, as we shall presently see, must be immensely beyond the truth? But giving chance the most favourable odds, this is all it can make of them; and chance, be it once more observed, is the ruling power of development, unless there be predetermination; and if there be, it is predetermination, not Natural Selection, that accounts for development towards the predetermined end.

It is thus evident that there is no true parity between man's selective power, and that by a false analogy attributed to Nature. Man loads the dice, and therefore is sure of his throws. Nature, on the Darwinian hypothesis, plays with unloaded dice, and therefore she cannot rival the feats of the human player. It will also be seen that the element of time, on which evolutionists so much rely, avails them nothing. Even were astronomers willing to allow, as they are not,[2] the hundreds of millions of

[1] Taking $\frac{1}{4}$ as the probability of a suitable pair in the second generation, the figure in each succeeding case is found by dividing the preceding fraction by 2, and squaring the result so obtained. In the fifth generation the probability would therefore be as $\frac{1}{1073741824}$

[2] "What then does the physicist tell us was the initial condition of this globe? I will not go into the vexed question of geological time, though as a geologist I must say that we have reason to complain of Sir W. Thomson. Years ago he reduced our credit at the bank of time to a hundred millions of years. We grumbled, but submitted, and endeavoured to diminish our

years which Darwinians postulate for the world's existence, it would only make their case worse, for their mass of improbabilities, like a monster snowball, gathers as it goes.

Such, then, is the "force" that is so confidently invoked to account for the complicated machinery of Nature. Natural Selection is constantly spoken of as though it were a magician that could at any moment bring out of the hat whatever was at the moment needed; and a creature's demand for new apparatus is represented as in itself enough to create a supply, just as though there were a benevolent rich uncle to appeal to. Having seen what Natural Selection really means, it will be instructive for us to consider some examples of the manner in which the Darwinian theory is worked by its advocates, and observe how invariably they ignore the fact that it is chance factors they profess to be working with, and invoke anything but chance to account for facts.

Mr. Grant Allen, who is certainly amongst the most popular exponents of the creed, affords us an excellent instance in his essay on the skeleton of a crow.[1] He picks out from it the clumped tail bone. "A strange fragment truly," he tells us, "with a strange history." Birds, he goes on, are a development from reptiles; reptiles have long, bony tails, the tail of a bird consists of "several separate vertebræ, all firmly welded together by a single piece." How came this transformation of the member? "It is," he assures us, "not difficult to see." The tail, in its elongated form, is useful to swimming reptiles, and to reptiles that glide on land, like lizards and serpents: these therefore have kept it. "But to flying birds, on the contrary, a long, bony tail is only a inconvenience. All that they *need* is a little muscular knob

drafts. Now he has suddenly put up the shutters, and declared a dividend of less than four shillings in the pound. I trust some aggrieved shareholder will prosecute the manager." (Professor T. G. Bonney, *The Foundation Stones of the Earth's Crust.* Brit. Association, 1888. See *Nature.* November 22, 1888, p. 93.)

[1] "A Study of Bones," *The Evolutionist at Large*, pp. 59—66.

for the support of their tail feathers, which they use as a rudder in guiding their flight. *Accordingly*, the bones *soon grew fewer* in number *and shorter* in length, while *the feathers simultaneously arranged themselves side by side* on the terminal hump." A simple and easy explanation, surely! We have seen how Natural Selection would work in the simplest possible case, in the modification merely of one organ, and that in size and shape only. And if even there it seemed hopelessly incompetent for the task, what are we to say of the load of work thus carelessly cast upon its shoulders? The bones grew *fewer:* let that pass; and *shorter:* how was it arranged that these two variations should coincide in the same creature, still more in the same pair? And unless they coincided, and continued to coincide, through succeeding generations, we have no sort of explanation of the result we see. Yet the improbability of this coincidence is the multiple of the improbabilities already considered. Then the feathers, where did they come from? We are told that they are developed scales.[1] But what a development is here! and what a playground for the vagaries of chance! A feather, however it may have been produced, is a most artistic structure, exactly fitted for the needs of birds. It is strong and yet light, yielding and yet elastic, its parts adhere without clogging, and separate without a fracture. How was such an instrument carded out of the homogeneous plate of a lizard's scale? How did any two of the required qualities happen to coincide? The structure of the mid-rib and of the web, for instance; or of any two strands composing the web? A feather, to have been made by Natural Selection, should have been made piecemeal; there could not possibly have been a movement through all the parts of a scale towards the corresponding parts of a feather, unless under the influence of a force tending definitely to

[1] "The plumage, which seems to impress a specific character upon the bird, is therefore to be traced from the formation of scales." (Oscar Schmidt, *Doctrine of Descent*, p. 265.)

create a feather; and such a force implies an end, which is precisely what Darwinians preclude themselves from supposing.

The structure of a single feather, therefore, unites in itself scores of such improbabilities as we have seen to be singly so overwhelming. And how does the formation of one feather account for the formation of another, unless we again introduce a feather-making force? How in particular does the production of a quill account for a plume of down, or of any of the totally different forms that feathers take? Again, even granting feathers, how came they to *arrange* themselves just in the proper fashion, a fashion very different from that of scales? And how, above all, account for all these various features — fewness of bones, shortness of bones, feathers and arrangement—having agreed to meet in one and the same tail? It may be that, as Mr. Grant Allen goes on to pronounce, "one will find the philosophy of tails eminently simple," but assuredly this will not be the case on the principles by which he professes to steer. I say *professes*, for never for one moment does he really attempt to do so. At every step he calls in the aid of the end to be attained in order to account for the existence of the means for attaining it. The birds get the tail they have because they "need" it for flying: the frog as a tadpole has a tail,[1] because he "needs" it to swim, and afterwards drops it, because it would be an encumbrance: the lobster has a powerful, muscular tail, because he "requires" it for his particular mode of life,[2] and the crab has but a stump, because to him a tail would be "useless"; and, in fine, as to tails in general, "those animals that *need* them evolve them; those animals that do not *need* them, never develop them; and those animals that have once had them, but no longer use them for *practical purposes*, retain a mere shrivelled rudiment, as a lingering reminiscence of their original habits."[3]

[1] p. 64. [2] p. 66. [3] *Ibid.*

Thus does the Darwinian theory fare at the hands of its friends. The explanation of an organ is always found in the purpose it serves, in that which follows from its production. It is only by starting from the idea of its function that our theorist can, in his own words, "spell out" an organ's history. He does not find the explanation of the effect in the cause, but of the cause in the effect. A bird's motion in steering is the effect of its tail, yet the argument we have heard is, not that it steers because it has a tail, but that it got a tail in order to steer. The result is thus presented to us as, in a true sense, the cause of its cause, the cause of that which physically produces it. The cause which physically produces an effect is styled by philosophers as an *efficient* cause. A *designed* effect, however, causes its designer to contrive causes efficient to produce it; and of these it is therefore termed the *final* cause. Thus the laying of bricks and the sawing of rafters are the efficient causes of the production of a house; but on the other hand, the production of a house is the final cause that makes bricks be laid and timbers cut. We can, in this way, explain the existence of efficient causes by the resulting effect only, if we suppose the effect to have been predetermined, and the efficient causes on that account set in motion. We cannot account for the rubbing of two boughs in a gale till flame appears, by saying that the forest is burnt down in consequence; but the cooking of his dinner satisfactorily accounts for the rubbing of two fire-sticks by a Hottentot. To say therefore that a steering apparatus resulted from the need of steering, or that wings are explained by the requirements of flight, is to say that the power of steering or flying was designed before the needful apparatus was constructed.

This is a point of supreme importance, inattention to which is productive of much confusion. Evolutionist philosophers, who dislike above all things, and most naturally, the word "chance" in connexion with their system, are wont to contend that chance does not exist, because the effects we see necessarily follow from the efficient causes which produce them. Taking as proved the doctrine of the descent of one class of plants or animals by development from another, an assumption with which for present purposes we need not quarrel, they proceed to argue that, as each change affected in the process is the necessary result of the forces which effect it, the mechanical forces producing development are obviously sufficient to account for all those forms which they have in fact produced. As Dr. Oscar Schmidt puts it[1]: If we start from the bird and go back to the reptile, we can trace the chain of effects and causes that changed the one into the other, a chain so compacted as to leave no room for chance. Why then speak of chance when we start from the reptile to proceed forwards to the bird? The chain is the same, only its links are followed in the opposite order. It is only our ignorance that prevents us from tracing the connexion of cause and effect forwards as well as backwards, and if we knew more of the laws of Nature, we should be able to foretell what will be, as we can now recapitulate what has been. Therefore to allot a place to chance is but a weakness of "purblind humanity," and, as Mr. Grant Allen tells us, [2] to speak of the "accidental" is to employ an "unphilosophical expression."

It would appear that to those who so confidently employ it, such an argument seems to have a meaning, especially when they talk, as does Dr. Schmidt,[3] of the "quackery" and "jargon" of their opponents. Yet to what, after all, does their argument amount? Simply to this, that effects necessarily follow from their efficient causes; that, given the cause, we are sure of the effect. Of course we are. Any series of natural operations depends wholly on this principle: if the various effects did not follow from their several causes as a matter of course, the process would not

[1]*The Doctrine of Descent and Darwinism*, p. 193. (International Scientific Series.)

[2]*Evolutionist*, p. 200. [3]*Doctrine of Descent*, p. 2.

be natural. If therefore we suppose development to have been worked out by natural laws, we assume, in that very supposition, the chain of natural causes and effects which, being as it is, could not have resulted otherwise than as it does. But how does this affect the question of purpose or chance? It is precisely in the selection of causes calculated to produce a desired effect that purpose is discovered, and it is the absence of such selection that constitutes chance. Causes there must be, if there is to be change of any sort; and purpose can work only by their instrumentality. Take, for example, the key which fits the complicated lock of a banker's safe; its precise form, down to the minutest particular, is the necessary result of the various operations of forging and filing to which it has been subjected. Given these, it could not possibly be otherwise than as it is. But the point to remark about it is, not that it has a definite shape, which every material thing must have, but that it exactly fits the lock. This is the coincidence which we find impossible to explain on any supposition except that it was meant to fit it. It is obviously no explanation of this fact to say that it fits because it was forged and filed exactly as it was, unless we can also say how it came to be so forged and filed.

Now it seems to be too often forgotten that in Nature mechanical problems are solved, infinitely more difficult than that of fitting a key to a lock, or making a watch, or building an arch; problems in which there must be absolute accuracy of result in all parts, and wherein any defective portion would vitiate the whole; and it is the exact fitness of organic structures to satisfy such complex requirements that is the plainest and most palpable evidence of the presence of design.

An explanation is in fact worthless unless it suffice to account for *all* essential phenomena, and there is one phenomenon, the most noteworthy of all, whereof the materialistic theory can give no account, the coincidence, namely, between the effect a mechanical cause produces, and something existing beyond, quite independently of that effect and of its efficient cause. Granting that hammer and file must change the shape of a piece of iron, how comes the metal fashioned by them to be a key capable of opening or closing a lock? And in just the same manner, supposing mechanical forces to have turned a scale into the finest of combs, how is it that the article so fashioned is a feather, exactly meeting the requirements of flight, requirements which the feather does not create, but which it exactly satisfies? As Newton exclaims, "Is it possible that the maker of the eye was ignorant of the laws of optics?" And in like manner we may ask whether wings were made without full understanding of all those complex problems which we have to solve in order to explain their use.

Therefore unless we presume a final cause, there is a gap in the chain of causality, a gap which chance, and chance alone, is left to bridge; and we can thus estimate at its true value the logical worth of the conclusion with which Dr. Oscar Schmidt declares himself satisfied. "Anyone," he tells us, "who fancies himself present at the genesis of the reptiles, may, from his antediluvian observatory, look upon the development of the reptile into the bird as a 'chance,' if he does not, peradventure, regard it as predestined. To us, who trace the bird backwards to its origin, it seems the result of mechanical causes."

Clearly, therefore, Dr. Schmidt conceives that this backward process of argument, from effect to cause, reverses, not only the order of phenomena, but the laws of logic as well, and solves all difficulties without the agency either of chance or of design. How can it be imagined that it does so? A structure exists, called a feather, suitable for a creature that shall fly[1]: this is the final point from which we start

[1]A typical feather is thus described by Dr. Alleyne Nicholson *(Manual of Zoology*, p. 425*)*: "The inferior service of the shaft always exhibits a strong longitudinal groove, and it is composed

to reckon back. How comes this structure to be fit for purposes of flight? Obviously, not merely because material forces produced it somehow, but because they made it *fit*. We may account for its weighing a grain, by saying that a grain of matter was incorporated in it; or for its whiteness, by saying that it has been chemically bleached; but how about its *fitness?* This is not explained till we trace it to a cause determined to its production, as a chemical cause may be determinative of colour, or a mechanical cause of weight. Either, therefore, we come somewhere to a cause determined to production of fitness for flight, or such fitness arises without a cause. In the one case fitness is predestined, in the other it is a chance. Where is the possible middle term between the horns of this dilemma?

It thus appears that "chance" has a very definite and real meaning, evolutionist assertions to the contrary notwithstanding. Professor Huxley, for example, talks[1] of "chance-worship" as being "the most singular of these, perhaps immortal, fallacies, which live on, Tithonus-like, when sense and force have long deserted them." According to him, those who talk of chance commit the absurdity of signifying an independently existent being, like the Pagan Goddess, Fortuna, and he challenges his adversaries to define their meaning otherwise. This is easily done. Chance

of a horny external sheath, containing a white, spongy substance, very like the pith of a plant. The shaft carries the lateral expansions or 'webs' of the feather, collectively constituting the 'vane.' Each web is composed of a number of small branches, which form an open angle with the shaft, and which are known as the 'barbs.' The margins of each barb are, in turn, furnished with a series of still smaller branches known as the 'barbules.' As a general rule the extremities of the barbules are hooked, so that those springing from the one side of each barb interlock with those springing from the opposite side of the next barb. In this way the barbs are kept in apposition with one another over a greater or less portion of the entire web." In the case of non-flying birds, such as the ostrich and emu, the barbs are disconnected.

[1] *Life and Letters of C. Darwin*, ii., pp. 199 seq.

is the coincidence of independent phenomena, that is, of phenomena not co-ordinated to an end. This would seem to be plain enough, yet, to judge from the example which the Professor selects to confound his opponents, he does not appear to have seized the point. He describes, in vigorous language, a storm raging on the shore: here, if anywhere, he tells us, will it be said that chance rules supreme: "but the man of science knows that here, as everywhere, perfect order is manifested; that there is not a curve of the waves, not a note in the howling chorus, not a rainbow-glint on a bubble, which is other than a necessary consequence of the ascertained laws of Nature." Obviously true; but what then? It would be impossible to select an example more utterly wide of the mark. The phenomena here described end with themselves, they lead to nothing else; nothing follows from them. They are mere effects and not, so far as we know, a means to obtain a result beyond. The one element, therefore, which constitutes chance is wanting here. Undoubtedly waves curl according to the laws of mechanics, and bubbles glint according to those of light. So do feathers; but does that fact sufficiently explain the painting of a peacock's train? If it did, Mr. Darwin would surely not have been confronted by the difficulty in the way of his theory which he so honestly describes,[1] "The sight of a feather in a peacock's tail, whenever I gaze at it, makes me sick."

Truth to tell, in spite of their indignation against the lax reasoning of their adversaries, it is quite impossible to make out what Darwinians themselves mean. Given the laws of Nature as they are, the results must, of course, be as we witness; but the whole question is, How came they to be so given? Professor Huxley apparently conceives that he solves the difficulty when he tells us[2] that Mr. Darwin's whole theory "crumbles to pieces if the uniformity and regularity of natural causation for illimitable

[1] Letter to Asa Gray, *Life* ii., 296. [2] *Ibid.*, p. 199.

past ages is denied." But assuredly if everything must have a cause, this uniformity and regularity must have one; and if everything depends on these, all ultimately depends on the cause producing them. It is of this cause that we are in search. How does Professor Huxley aid the quest by declaring[1] that the region of true science is "free from the snares of those fascinating but barren virgins, the Final Causes, against whom a high authority has so justly warned us." What this may mean it is hard to conceive: it seems much of a piece with the daring philosophy that prophesied

> Cause and effect shall from their thrones be cast
> And end their strife with suicidal yell.

Nor can such a principle lead to any state of mind more satisfactory than the puzzlement in which Mr. Darwin himself was landed, and which he lugubriously confessed to Dr. Asa Gray, pleading guilty at the same time to that reliance on chance with which, according to Professor Huxley, no one can possibly charge him. "I grieve," he writes,[2] "that I cannot possibly go as far as you do about design. I am conscious that I am in an utterly hopeless muddle. I cannot think that the world, as we see it, is the result of chance: and yet I cannot look at each separate thing as the result of design. . . . Again, I say I am, and shall ever remain, in a hopeless muddle."

To take a few examples more in illustration of this essential point. The form of Phidias' statue of Olympian Zeus is no less due to a mechanical cause, the artist's chisel, than that of Mount Blanc is due to glaciers and weather. In the arrangement of letters known to us as *Paradise Lost*, we find the effects of a mechanical cause, the hand that wrote them, or the compositor who set the type, exactly as in that of toy letters tumbled by a child about the nursery floor. The iron which composes a steam-

[1] *Life* ii, p 254. [2] *Ibid*, p. 353.

engine can no more help being where it is, and as it is, than the ore at the bottom of a mine. What we find ourselves compelled to seek in the one set of instances, and not in the other, is a cause sufficient to account, not merely for the existence of the effect, but for that effect being just what it is. In each series of cases mechanical forces actually produce the observed effect; but it does not thence follow that in each are mechanical forces, by themselves, equally sufficient to account for results.

In fact there is one way, and only one, of ejecting chance from the materialistic system, which is by invoking necessity; by saying that things were from the beginning so arranged as to give but one possible set of results, the set actually produced. To such a solution are writers like these, sooner or later, compelled to betake themselves, whatever be the profession of faith with which they start. Thus, in spite of what we have heard, Dr. Schmidt lays down[1] that "our conviction of the truth of the doctrine of derivation is due to its *adjustment* of the phenomenal series of causes and effects," and that "if we were in possession of the formula of the universe, all future evolutions might be computed in advance." But this is to say that they are predetermined by some law, or else how are they to be computed? Astronomers can calculate the motions of a planet only because these are determined and necessary. And if so, what becomes of Natural Selection as the ruling force of development? It will then be but a part of the machine, "adjusted" so as to select the right things, just as the pins in a musical box are adjusted to strike the right notes. It is not therefore Natural Selection, but the cause adjusting it, to which the final effects must be due. Yet Dr. Schmidt is preaching Natural Selection in the very work in which he thus abolishes its potency as an independent force; while Mr. Grant Allen, who is nothing if not Darwinian, is at the same time pleased to call himself a "Determinist."[2]

[1] p. 193. *Evolutionist*, p. 145.

In the next place, even from the determinist standpoint, to say that a machine is adjusted towards a certain work is not a final explanation. We must know what adjusted it: and if we go, as science bids us, to experience for explanation of phenomena, we know of but one way in which such adjustment may be secured, and that is, by foreknowledge of the end, and by a design to attain it. Fitness is a quality to be recognized, not by an eye, but by a mind—to be produced, not by a simple effect, but by arrangement of effects. From our experience it is impossible even to conceive how anything but conscious intelligence can make such an arrangement.

A bird's tail, it would thus seem, is not altogether easy of explanation on Darwinian principles. But all this is only the beginning of troubles. A bird is not all tail, nor only in its tail does it differ from a reptile. Its limbs are different, its heart is different, its circulatory system is different, and in a word, although there are to be found several important similarities in the two classes, it nevertheless remains true that no creatures are more unlike than a bird and a reptile.[1] Therefore, if we suppose the one to have been developed from the other, we must imagine that while the tail was being transformed as we have seen, the fore limbs were changing into wings, the hind limbs into legs fit for a biped, the heart was becoming four-chambered instead of three-chambered, a complete double system of circulation was being set up, the blood was becoming extraordinarily hot,[2] all the scales were changing into feathers, and to feathers of very different form and fashion according

[1] "It is, no doubt, at first sight, an almost incredible thing that there should be any near bond of relationship between the birds and the reptiles, no two classes of animals being more unlike one another in habits and external appearance." (Dr. Alleyne Nicholson, *Manual of Zoology*, p. 393.)

[2] The average temperature of blood in birds is as much as 103° to 104°, in reptiles it is little warmer than the surrounding medium.

to their different functions, and an oil gland was being provided to lubricate them; to say nothing of less easily observed modifications of muscles, nerves, bones, lungs, and stomach. Modification of each of these organs includes a host of separate modifications; and all this countless multitude of changes must be simultaneously operated, by chance, in the same subject, or rather, at least, in two. Of what possible good could it be to a creature to get a steering tail without propelling wings? or to have the skeleton of its fore-limbs fashioned to wing-like form if it remained clothed with scales? How even with wings and tail would a bird fare in the air if its three-chambered heart afforded it only the sluggish blood of a reptile? or how could feathers be aught but an encumbrance, without Nature's varnish to keep them waterproof? Some of these organs, moreover, are far more complex, and exhibit more adaption to a purpose than that with which we started. The wing, for instance, is thus described by Mr. Pettigrew[1]: "There are few things in nature more admirably constructed than the wing of the bird, and perhaps none where design can be more readily traced. Its great strength and extreme lightness, the manner in which it closes up or folds during flexion (ascent), and opens out or expands during extension (descent), as well as the manner in which the feathers are strung together and overlap each other in divers directions, to produce at one time a solid resisting surface, and at another an interrupted and comparatively non-resisting one, present a degree of fitness to which the mind must necessarily revert with pleasure."

The heart also is a structure worthy of remark. That of reptiles is three-chambered, and does not avail to keep arterial and venous blood wholly separate. But birds have a four-chambered heart which effectually separates the two currents, a heart agreeing in this important respect with that of

[1] *Animal Locomotion*. p. 180 (International Scientific Series).

mammals. Yet birds and mammals have, we are told, been both developed from reptiles, but along wholly separate and distinct lines; each must, therefore, independently, have hit by chance upon the same formation for this most vital organ. Is this a more philosophical explanation than to say that creatures having like needs were designedly supplied with like instruments?

Such then is, in merest outline, an indication of the difficulties that confront the theory of development by Natural Selection alone, that is, of development by chance; the factor to which Darwinians profess to restrict themselves. Thus Mr. Grant Allen himself tells us[1] that the results we see "are in the last resort dependent upon all kinds of *accidental* causes—causes, that is to say, into which deliberate design did not enter as a distinct factor."

Can men realize the meaning of their own words when they declare that a process thus governed could have succeeded in making a bird that should fly, or any single feather upon it? Yet such is the doctrine they profess to teach—a doctrine the rejection of which, we are constantly informed, is due to unscientific bigotry alone.

Having thus attempted to understand the true state of the case, let us, for a little, return to our original task of observing how the theory is worked in practice, and how its difficulties and impossibilities are ignored. After the examination which we have been making it will be unnecessary to comment as we proceed on the various evolutionary stories told us—it will be enough to listen and admire.

Here for example is the plain and simple history of the manner in which the *Cyclostoma*, a land-snail, was developed from the *Paludina*, a water-snail.[2] "It is, in fact, one of these gill-breathing pond-snails which has taken to living on dry land, *and so has acquired the habit of producing lungs.* All molluscan lungs are *very simple*: they consist *merely* of a *small sac*

[1] *Evolutionist at large*, p. 205 [2] *Ibid.*, p, 177. Italics mine.

or hollow behind the head, *lined with blood-vessels.* So primitive a mechanism as this *could be easily acquired* by any soft-bodied animal like a snail."

But the caterpillar would appear with equal ease to have acquired far more complicated apparatus. We are constantly told that the developments of form which the individual undergoes in its imperfect state are a summary history of the developments of the race. In hearing, therefore, what each caterpillar of to-day does, we understand what the race of which caterpillars come has done. This is the history given by Mr. Grant Allen of the transformation of a caterpillar.[1] "After a considerable span of life spent in feeding and walking about in search of food, the caterpillar one day found itself compelled by an inner monitor to alter its habits, and sank peacefully into a dormant state. Then *its tissues melted* one by one into a kind of organic pap, and *its outer skin hardened* into a chrysalis. Within that solid case *new limbs and organs began to grow* by hereditary impulses" (an assistance, by the way, which in the original development the race cannot have had). "At the same time *the form of the nervous system altered*, to suit the higher and freer life for which the insect was unconsciously preparing. *Fewer and smaller ganglia now appeared* in the tail segments, while *more important ones sprang up* to govern the motions of the *four wings*. But it was in the head that the greatest change took place. There a *rudimentary brain made its appearance*, *large optic centres* answering to the *far more perfect and important eyes* of the new butterfly. *For* the flying insect will have to steer its way through space . . . . which *demands* from it *higher and keener senses* than those of the purblind caterpillar."

As with animals, so it is with plants. This, for instance, is how nettles came to sting.[2] "These hairs are often more or less glandular in structure, and therefore liable to contain various waste products of the plant. *Suppose* one of these waste products in

[1] *Evolutionist*, p. 147. Italics mine.
[2] *Vignettes from Nature*, p. 117.

the ancestors of the nettle to be at first slightly pungent, *by accident as it were*, then it would exercise a slightly deterrent effect upon nettle-eating animals. *The more stinging it grew*, the more effectual would the protection be: and as in each generation the least protected plants would get eaten down, while the more protected were spared, the tendency would be for the juice to grow more and more stinging till at last it *reached the present high point* of development."

As we have been told that the *Cyclostoma* is a water-snail that has taken to living on land, so on the same authority,[1] the water-crowfoot is a buttercup that has taken "to living pretty permanently in the water." Of course it has found it a matter of equal ease to modify its organs accordingly, cutting its leaves into threads and lengthening its stem, because without the one arrangement it would have been smothered and without the other swamped.

We might go on multiplying such examples indefinitely, so let one more suffice. The hedgehog and mole, according to the Darwinian account,[2] are mammals of the lowest type found in this country, which have survived in spite of developments going on around them, because they have accepted "menial or dishonoured places" in Nature's household, skulking about by night, or leading a burrowing, sunless life, and so picking up a livelihood where more ennobled creatures disdained to seek it. But even these low beasts have been wonderfully "specialized" for their ignoble purposes. The hedgehog has contrived his wonderful suit of spiked armour, because without it his slowness and stupidity would have made him too easy a prey to his enemies; while the mole has quietly possessed himself of "the *peculiar powerful shovel hands*, *the hidden eye*, *the covered ear*, and the *close fur*, which *fit it so well* for its underground life."

Always in fact the root question of all is utterly ignored. Why should there be life at all? Why

[1] *Vignettes from Nature*, pp. 36, &c. [2] *Ibid.*, pp. 58, &c.

should creatures survive? Why should flying or swimming or burrowing animals exist? Leaving out of consideration the question as to why inanimate matter should combine into living organisms, how shall a creature, unfit to live in one set of circumstances, obtain the means to live in another, unless he is meant to live? For ages the earth was without life: for ages more without animal motion, swimming, crawling, walking, flying. Why did it not for ever remain so? How did the needs of creatures create their own supply, instead of killing off the needy race? That would be the obvious and inevitable effect of their deficiencies, unless the deficiencies were provided for and their supply designed.

The fields of air doubtless lay waiting to be occupied, till the first flying creatures appeared; even as America lay waiting for Columbus. But of what avail was this to creatures that could not reach them? The existence of America did not build ships to take emigrants there, nor did lack of clothes invent the spinning-jenny. The arch-contriver man is no doubt stimulated by an object worth attaining to devise means for attaining it; but he it is, not the enticing object, that creates the means. And so the air might have remained for ever fit to be the highway of birds, yet its highway has been untrodden for want of creatures capable of treading it. The water is capable of floating a boat, but that does not relieve us from the necessity of building boats that will float; nor could the air have been invaded, had not Nature contrived a mechanism that should satisfy the laws of pneumatics; it was full of good things, but for those only who could reach them.

It is by suppression of simple and obvious considerations such as these that the manufacture of evolutionary romances is rendered possible for the benefit of a confiding public. The methods of this manufacture are excellently illustrated in the practice of Mr. Gilbert's ingenious but untrustworthy Japanese hero, Poo-Bah, who appropriately described himself as able to trace his ancestry "to a protoplasmal primordial atomic globule." The imaginative trappings, with which our evolutionist legends are tricked out, serve precisely the purpose he claims for the embellishments of his fiction, "Merely corroborative detail, intended to give artistic verisimilitude to a bald and unconvincing narrative."

To which, it will be remembered, his interlocutor replies, "Corroborative detail indeed! corroborative fiddlestick!"

# Missing Links.

For students of Darwinism nothing can be more opportune than the appearance of such a work as that lately presented to us by Mr. Wallace.[1] No man now living has a better right to speak for the theory of which he is the joint, if not the original, author, while the space of time elapsed since Mr. Darwin's death has produced a mass of observations shedding a flood of light on almost every point of the question which has to be discussed. Therefore, when Mr. Wallace sets himself to exhibit Darwinism for us in the clearest light, we may reasonably expect to be enabled at least to grasp the outlines of the system as a connected whole, and to perceive with some completeness the series of arguments by which its adherents believe it to be established.

And yet there must be some who rise from the perusal of the book bewildered rather than enlightened, and with less assurance even than before that they have got so far as to know what the Darwinian theory is. Such a state of mind would have a good deal to show in its own justification by raising various pleas on the evidence which Mr. Wallace affords, but for the present it will be enough to confine our attention to one.

From the fuller light which has now been cast on the facts bearing on the evolutionary theory, a result

[1] *Darwinism: an Exposition of the Theory of Natural Selection, with some of its applications.* By Alfred Russel Wallace, LL.D., F.L.S., &c. Macmillan & Co., 1889.

would appear to follow analogous to that which might conceivably ensue from a fuller examination of the geological record. Increased knowledge of that record might without doubt contradict the Darwinian theory of evolution. Darwinians have never pretended that we have direct evidence of the existence of all the forms of life in whose existence they believe. The species, whether living or extinct, which have been presented to actual observation are but as a scattered group of islands, the relics of a vanished continent. Their contention is, that with means of observation more ample than we have, we should find the intervening chasms to have been once solidly bridged by grades of life shaded by scarce perceptible gradations from one to another of the species that we know. But, supposing that as our knowledge increased we were to find no trace of this—were to find the forms of life persistently grouping themselves around distinct centres, instead of arranging themselves in a linear chain—we should have a weighty argument against the hypothesis in whose favour the story of the rocks is invoked as a witness. Something like this it is which occurs in considering, with increased knowledge of facts, the various points of the argument whereon Darwinism rests.

It should not be forgotten that the various points of natural history which Mr. Darwin and other observers have established are in themselves as separate and distinct one from another as are the various species of animals and plants which we behold, and that their connexion in one whole, as Darwinians connect them, is as yet just as much a matter of hypothesis as is the connexion of those species by intermediate links. It has been shown, for instance, that there is a perpetual struggle for existence among the various inhabitants of the organic world: it has been shown that the individuals of a species tend to vary, more or less, from the normal type: also that man can avail himself of these variations to modify the qualities of the animals in his herds, and the plants in his gardens. This has been proved. But that variation, trimmed and pruned by the struggle for existence, has modified species in a state of nature, as has man's conscious selection in a state of domestication—this is as yet but hypothesis, and hypothesis which needs confirmation from fuller inquiry into the facts of the case, just as much as the other hypothesis of the continuity of forms between one species and another. As we learn more about the struggle for existence, and about the variability of species, though more fully establishing these as separate verities, we may possibly find that they do not play into each other's hands as they have been assumed to do, just as fresh observations of the path of a comet may show it to be, not an ellipse, but a parabola—not re-entrant, but divergent.

Mr. Wallace has some important modifications to make in the statement of the observed facts with regard to variability as known to Mr. Darwin. In the *Origin of Species*, the variations on which Natural Selection has had to work are always represented as *slight*. It is in "the accumulation of innumerable slight variations, each good for the individual possessor," that Mr. Darwin finds the means by which organs and instincts have been perfected[1]: all organs and instincts are, he tells us, "in ever so slight a degree, variable"[2]: there must have been "an interminable number of intermediate forms,"[3] "an infinitude of connecting links,"[4] between species and species. So undeniable, indeed, is this, that a frequent objection to the Darwinian theory has been the impotence of variations so minute, as was supposed, to benefit in any practical degree the creatures in which they occur.

Mr. Wallace, however, shows that the differences which are constantly found to exist between individuals of the same species are by no means slight. In his own words,[5] "Individual variability is a general character of all common and widespread

[1] *Origin of Species*, c. xiv., p. 459. (fifth thousand.) [2] *Ibid.*
[3] *Ibid.*, p. 460. [4] *Ibid.*, p. 461. [5] *Darwinism*, p. 81. Italics mine.

species of animals or plants: this variability extends, so far as we know, to every part and organ, whether external or internal, as well as to every mental faculty. Yet more important is the fact that each part or organ varies to a considerable extent independently of other parts. Again, the variation which occurs is very large in amount—*usually* reaching ten or twenty, and sometimes even twenty-five per cent. of the average size of the varying part: while not one or two only, but from five to ten per cent. of the specimens examined exhibit nearly as large an amount of variation." The proofs brought in support of these assertions are overwhelming. Among the lowest foraminifera, amongst sea-anemones, mollusks, insects, reptiles, birds, and mammals, abundant instances are quoted. It will perhaps be sufficient to take one or two examples.

Amongst fourteen specimens of the wall-lizard (*Lacerta muralis*) examined by Mr. Milne Edwards, no single character except the scales on the head was found to be constant, the neck, trunk, tail, legs, and colour all "varying wonderfully," as shown by a diagram which Mr. Wallace appends.[1] Fifty-eight specimens of the cardinal bird (*Cardinalis virginianus*) yielded scarcely a single one in which any of the more notable features corresponded exactly with the normal type of the species. In regard of the tail, for instance, three at most could be said to have it of about the regulation length, twenty-four having it shorter, and thirty having it longer: but the extremes of variation were in the direction of defect rather than of excess, four specimens having their tails very short and only one very long. In the total length of the birds themselves, the discrepancies were still more remarkable, no one individual making any pretence to conform exactly to the stock pattern. They generally inclined to be larger rather than smaller, but instances of excessive variation were again somewhat in the other direction. The same sort of thing is to be seen in the length of their

[1] p. 65.

wings, and the bill, the tarsus, the toes, are all found in this and other species to show an equal disregard of law. So amongst quadrupeds ; one squirrel varies somewhat from another, within the limits of the same species,[1] as to the length of the head, a great deal as to the length of the feet, and extraordinarily as to the body, and especially as to the tail. In the same species of wolf and of bear,[2] extraordinary differences are found as to the several proportions of the skull—its length, its width, the sizes of the orbits, the palate, the nose, and the jaw-bone.

These are, I repeat, but specimens, taken from the mass of evidence produced by Mr. Wallace, and no one who examines that evidence as a whole can fail to see that he has established his case. The variations of form and structure which occur among wild animals—and the same is to be said for plants—are, not occasional and minute, but incessant and important. There is clearly an end of the objection, above referred to, based on the supposed infinitesimal character of variations.

Very little reflection is, however, needed to show that if one difficulty is removed, it is only by introducing another vastly more formidable. If individuals are perpetually varying in such a fashion as we have seen, how comes it that species do not, like them, vary under our eyes ? If every organ and function in each concrete specimen that we meet tends to depart from the normal type, how is it that the type remains normal, and that these variations persistently arrange themselves about it ? The deflections and nutations of a planet prove the existence of the force which in spite of them prescribes a fixed path and position, and unless the minor members of a solar system tended, of their own momentum, to fly off into space, we should not know that there was an overmastering power anchoring them to one centre. In the case which we are considering, the persistence of uniformity amid continual variation is

[1] *Sciurus carolinensis* is Mr. Wallace's example, p. 67.

[2] *Canis Lupus* and *Ursus labiatus*, pp. 70—72.

far more remarkable. Each of these variations is a handle, and a powerful one, for Natural Selection to grasp, and so to modify subsequent development. If the centrifugal tendency, which such variability indicates, were all—every varying climate and soil and circumstance on the face of the globe should make its own species, or rather there should be no species at all, but a fleeting and evanescent succession of individual forms, like the shapes of clouds in a windy sky. It is idle to pretend that the features which any species constantly exhibits are specially adapted to existing circumstances, for in no two habitats are existing circumstances the same. To take examples familiar to everyone: The house sparrow[1] flourishes in the north within the Arctic Circle, and on the Albert Nyanza, close to the Equator, in Siberia, and in Madeira, the Faroe Islands, and Moscow. Our common water-crowfoot, whose white blossoms float on pools or sluggish streams, is to be found in all temperate regions, north and south, except New Zealand and the Pacific.[2] Now, who can say that in either of these instances, which might be reinforced by a host of others, the conditions of existence are so precisely the same for the species as a whole as to stereotype its characteristics—to perpetuate among sparrows, for instance a white streak over each eye, a black lore, and a bar of white on the middle wing-coverts? It must be remembered that unless such absolute uniformity of type were everywhere visible, systematic naturalists would be only too glad to pronounce that the species were different: it is only the clearest evidence of continuous similarity, down to the minutest details, that can hinder them from doing so. And what is the force, we may ask once again, that preserves this uniformity, amid continual false starts along other paths? What hinders their varying

[1] *Passer domesticus.* See Howard Saunders' *Manual of British Birds*, p. 171.

See Sir J. D. Hooker, *Student's Flora of the British Isles*, p. 5.

surroundings from fashioning individual variations into permanent varieties?

It would therefore appear that the new crop of facts gathered by Mr. Wallace, while establishing on a broader basis than before the truth of variation, does not at the same time serve to establish the variability of species through Natural Selection, but, on the contrary, brings into more prominence than ever the idea of a controlling force strong enough to draw things together which circumstances would naturally drive apart. Instead of a fresh link being added to the chain of argument yoking together variability and struggle for existence as joint factors in the work of development, a link is snapped which we fancied to be forged. With infinitesimal variations, developments might be going on before our eyes, and yet be as invisible to us as the movements of the shadow on the dial. But with such variations as are now established, development, on Darwinian principles, should proceed at a rate at which we see that, in fact, it is not proceeding.

Therefore, just as we might find from a fuller investigation of the rocks evidence for the isolation, and not for the concatenation, of the various forms under which life is known, so do we find like evidence from a more complete understanding of the state of the case with regard to variability. The forms tend persistently to group themselves round types, which yet remain ideals never, perhaps, actually realized in any concrete instance, and whose continuance cannot therefore be well explained by what we are accustomed to call heredity.

The above considerations may assist us to a clearer conception of what we mean by a *species*. Everyone uses the term, and everyone knows what is meant; yet none ever succeeds in a satisfactory definition. Mr. Darwin seems to imply[1] that no definition can be framed without including "the unknown element of a distinct act of creation." De Candolle[2] defines

[1] *Origin of Species*, p. 44.
[2] Quoted by Mr. Wallace, *Darwinism*, p. 1.

it as a collection of individuals which resemble one another more than they resemble anything else, which hand on their peculiarities from generation to generation, and which, from analogy, we suppose to have sprung from one individual. Swainson,[1] still more awkwardly, defines a species as an animal which, in a state of nature, is distinguished by certain peculiarities from another animal, and propagates after its kind; whose peculiarities, therefore, are permanent. It would seem to be simpler and plainer to say that a species is a permanent group of plants or animals framed in all particulars after a single type. This emphasizes the most remarkable fact about species—the fact, namely, that in all cases, man alone excepted, we can describe a species very much as an individual. Not only as to bodily qualities can we say that the cock-sparrows born next season will have narrow white streaks over their eyes, but we can securely beforehand set down the whole brood, cocks and hens alike, as impudent, quarrelsome, and thievish, and addicted, despite all experience, to building nests in water-pipes. We can describe the fox as cunning, the booby as stupid, the robin as familiar, the tom-tit as plucky. We may set traps openly on the tops of bare poles, knowing that hawks will infallibly perch upon them, and circumvent the more astute crow by poisoning eggs which he will with equal certainty eat. We know exactly the habits of mind which will induce the wild duck to enter our decoys, and the wheatear our traps. We know that a trout when hooked will behave in one way and a salmon in another; we talk of one fish as game, and of another as faint-hearted. Red ants, we prophesy, will make slaves, and black ants submit to slavery; moths will fly into candles; jackdaws will run off with anything that glitters; dogs will attach themselves to masters. The characteristics of each race may vary in what seems the most arbitrary manner, and yet be obviously for that race the rule which they follow by no inde-

[1] *Darwinism*, p. 2.

pendent volition of their own ; in spite of the argument by which the cat in the fairy-tale proved its own madness, "A dog isn't mad, is he? Well, he growls when he is angry, and wags his tail when he is pleased: but I growl when I am pleased, and wag my tail when I am angry."

The description which naturalists give of species descend to particulars still more minute than these ; and generation after generation we find these descriptions verified. The component individuals are all obviously made after one pattern, like the uniforms of the same regiment. Species are thus the ultimate moulds in which Nature casts her organic products; the terminal buds on her genealogical tree. It is extraordinary how near one species may run to another, remaining at the same time fundamentally distinct. An excellent example is afforded by two of our commonest summer migrants, the willow-wren and the chiff-chaff. When once they open their mouths to sing there is no mistaking them ; but till they do that it is almost impossible to distinguish them. Even when we hold them in our hands, except for a slight difference in their size and in the colour of their legs,[1] we find no apparent distinction. The surest test is found in the quill feathers of the wing. In the willow-wren the second quill is equal in length to the sixth, in the chiff-chaff to the seventh ; in the former only six quills and in the latter seven have the outer webs sloped off or emarginated. In habits the two species are as like each other as in form. They live on the same food, build most similar nests, and lay eggs similarly marked, though with slightly different colours. Yet running so very close to each other, they are as distinct as species can be. As already said, their song is utterly distinct, the one emitting a cheerful though very simple strain from a bush, while the other, seated aloft in a tree, hammers away persis-

[1] The length of the willow-wren is 4·9 inches, and of the chiff-chaff 4·75 : the legs of the former are light brown, of the latter, dark brown.

tently at a couple of notes, or, as it seems to all but the most delicate ears, at one note only. The points of difference which we can specify between the two are slight and seemingly trivial, but for all that it is perfectly clear that a willow-wren is one thing and a chiff-chaff quite another; they go each their own way in absolute independence, and very often do not inhabit the same districts. There is something which discriminates them, beyond any point of difference on which we can put our finger; they rally round different standards, and obey different watchwords.

From what has been said it would appear that the most striking characteristic presented by species, as we know them, is their isolation one from another. It is most important to bear this constantly in mind when considering any theory which professes to explain how they are linked together. On Darwinian principles we have to hold that any two species may ultimately be traced back to a common form from which both have sprung, just as the buds of a tree, whereto I have compared them, may be traced back to the same bough, or at least to the same stem. But, more than that, we have to maintain that these buds, fraught with the potency of yet further developments, have come to be where they are, not through any innate laws of growth within the tree which bears them, but simply through the mechanical operation of external forces. According to this view, Nature's genealogical tree differs from other trees in having no predisposition stamping its growth with any particular character; it will be an oak, a palm, or a bramble, as circumstances choose. Therefore when we lay down that the one species, or genus, or family, has sprung from another, not only must we assume that every form intermediate between the two has once existed, we must also postulate that the conditions of the earth have been such that each intermediate form has in its own time been the most advantageous in the struggle for existence.

Birds, for example, we are told, have descended from reptiles, whose forelegs have been developed into wings, and their scales into feathers. If we are good Darwinians, not only must we hold that the bird-form is the best for one set of conditions, and the reptilian for another; we must suppose that a form half-way between the two, with legs half-wings and scales half-feathers, was once upon a time better for those creatures who fell in for it, than the old reptile-form which they had left. According to this theory, no advance is made along the path of development in view of any point to be gained beyond. If any single step is taken, it is because the position gained is good in itself, better for those who occupy it than the situation they have left, and enabling them to fight for life on better terms than those who have stayed behind. It is like saying that the only way in which men could have got from London to York was by building a town all the way; each fresh suburb and street and house being added, merely because it was good for man to be *there*, because the situation afforded advantages unknown before. And just as in the map of England there are wide tracts where no trace of a hamlet or a hut speaks of human occupancy, and where no feature of the district suggests any motive that could make men dwell there, so in the scheme of organic life, as known to us, there are wide gaps which it baffles our very imagination to fill. We can fancy, easily enough, that all the conditions of the globe, that we witness, have been changed for their contraries—tropic heat for arctic cold, land for water, loam for rock. We know what other changes would be involved by these in the world of life, for in our flora and fauna we have abundant instances of forms adapted to all. But for such creatures as those which we have to suppose, it would seem that another sort of world was needed, and other rules of the game of life, of the existence of which we have no evidence at all beyond our own speculations. It is not merely that links are missing in the chain of life-forms; they are missing just where they ought to be found, if we are to be justified in talking of the exidence afforded by observation in favour of the Darwinian theory.

The difficulty thus arising has, it is true, been to some extent anticipated by Mr. Darwin himself, who attempts to supply an answer. It would, however, seem that there are important factors in the problem which his solution does not consider. His contention is that if we do not find link-species actually existing, it is because they have been beaten in the race of life by their more developed descendants; and if we have not found them in the rocks, it is because of the extreme imperfection of our geological record.

As to the first point of this argument, he bids us remember that we must not look to find forms indicating the direct descent of one of our existing species from another. The birds, for example, of the present day are not to be traced to any of our living lizards, but bird and lizard alike to a common ancestor, more lizard-like than bird-like. From this unknown progenitor the fowls of the air have branched off in one direction, utterly modifying the ancestral organs, and our creeping things in another, still applying the organs to their original purposes, but improving their structure variously for the same. Therefore, he argues, the more modified species, in whatever direction their modifications may have lain, have improved their position in life, relatively to the original, which they have consequently exterminated: just as the rifleman has extinguished the arquebusier and the arquebusier the crossbow-man. "Hence," in his own words,[1] "if we look at each species as descended from some other unknown form, both the parent and the transitional varieties will generally have been exterminated by the very process of formation and perfection of the new form."

The non-existence of intermediate forms as living species being thus accounted for, it remains to explain why they are not found as fossils. As Mr. Darwin puts it,[2] "Why is not every geological formation and every stratum full of such intermediate

[1] *Origin of Species*, p. 72. [2] *Ibid.*, p. 280.

links ? Geology assuredly does not reveal any such finely graduated organic chain ; and this, perhaps, is the most obvious and gravest objection which can be urged against my theory. The explanation lies, as I believe, in the extreme imperfection of the geological record." How imperfect our knowledge of that record is he proceeds to show. Only here and there on the earth's surface have we the opportunity of getting a glimpse into the volume whose pages are the rocks. A water-worn cliff, a mine, a quarry, a railway-cutting, show us here and there the fragment of a leaf; but how insignificant a portion of the globe's face is scarred by any of these. What we know of the geological record must, from the nature of the case, be to what we do not know as a minute and altogether insignificant fraction. The fact, therefore, that we know little or nothing of intermediate links is, not surprising, but natural, and till our knowledge of the whole be vastly greater than it is, we can found no argument upon our ignorance of a part.

Rightly to understand the complex bearings of a line of reasoning such as this is no easy task, and he would be a bold man who could pretend with any confidence to grasp them all; but assuredly there are some obvious considerations, not indicated by Mr. Darwin, whereof account must be taken before we can draw from his premisses the conclusion he would have us adopt.

In the first place, it must not be forgotten that in any direct line of descent, such as he supposes, amongst successive species of plants or animals, although each generation is better fitted for the struggle of life than its predecessor, it does not therefore follow that the tide of life on earth has continuously increased in volume, as do the waters of a river from its head to its mouth. The less developed had to contend with less developed antagonists, and were just as capable of establishing a firm and durable empire as were the ancient Romans, though they knew nothing of gunpowder, Life must, at all times, have been co-extensive with the capability of the earth to support life, and there is no reason whatever to suppose that this has developed as time went on, for while one class of creatures have been modifying themselves more effectually to consume others, those others have, by the same rule, been guarding themselves against being too easily consumed. The stream of life must therefore be taken as constant at all periods and in all stages of development, on the border lines between our present forms, just as much as within the tracts that include them.

It must, moreover, be remembered that the Darwinian theory, though commonly spoken of as dealing with the origin of *species*, claims equally to deal with the origin of more primary and fundamental divisions in the organic world, of genera, orders, classes, and even kingdoms.[1] On its principles we have to assume that the procession of life-forms has been continuous, from the least organized jellies of the primitive world to the most complex structures of our own. As has been said, every step of the road must once upon a time have been occupied in force, one as much as another, and occupied during the enormous periods of time needed for development to be wrought. All the border-lands between our existing forms must once have been thronged with life, if one class of creatures has grown out of another. It should therefore seem that the classification of extinct organisms ought not in any degree to coincide with that of those which are living. Granting that the latter have been developed into strongly-marked differences, yet in the series which led up to these we should find

[1] The organic world is divided into the *vegetable* and *animal* KINGDOMS. The latter is divided into two SUB-KINGDOMS, *vertebrates* (back-boned animals) and *invertebrates*. *Vertebrates* have five CLASSES, *fish*, *amphibians*, *reptiles*, *birds* and *mammals*. Each of these has various ORDERS, as amongst birds, *swimmers*, *waders*, *runners*, *scratchers*, *climbers*, *perchers*, *birds of prey*. Within each ORDER are FAMILIES, as the *sparrow family*, among the *perchers*. The GENUS *Passer*, a subdivision of this, includes various SPECIES, as the house sparrow and the tree sparrow.

such differences melt away. The diagram of extinct life should be to that of existing life as a continent to an archipelago. More than this: we have actually good reasons for anticipating that, if Darwinian principles were true, we should find more traces of those forms which have no near counterpart in actual life, than of others. The more fundamental a development has been, the more time must have been needed to work it. Any species, therefore, in which such development has been operated, must have been long-lived and multitudinous, in exact proportion to the importance of differences which separate those between which it constitutes a link. For example, whatever space of time may have been required to evolve the features which distinguish one bird from another, a goose from a humming-bird, an immeasurably larger space must have been needed to make a true bird out of a true reptile, and countless myriads of creatures must have lived and died in a condition between the two. But the most notable fact about the record, as we know it, of geology is, its harmony with the broader features of the existing order of things. Mammals we find, and birds, reptiles, fishes, insects, mollusks. They do not fit in, it is true, with our actual genera and species, but there is no doubt as to where to place them in our larger classes. Instead of manifesting a character completely at variance with our present classification, with its broad, intersecting gulfs separating forms from forms, the geological record adopts that classification, lending itself with singular facility to its arrangements—gulfs and all. Therefore, although it be true that we know but little of that record, yet what we do know points all in one direction.

Still more notable is it that what might seem at first sight to be possible links present us with some of the most perplexing problems. For instance, to keep to our example, there have been flying reptiles,[1] and there has, at about the same period of the world's history, been a bird with sundry reptilian

[1] *Pterodactyls.*

features.[1] Some writers have hastened to declare that this at once proves the case for the descent of the one from the other. But in the first place the pterodactyl, although he could fly, was as clearly a reptile as the bat is a mammal; and although the archæopteryx had lizard-like teeth, a long tail, and free digits on his wing, no one can read Professor Owen's account[2] without seeing that he was as true a bird as the canary. But, moreover, whatever else these species may be, they cannot be links in the same chain of development. The pterodactyl had a wing, to be sure, but it was a wing constructed on utterly different principles from that of a bird. In it the little finger of the hand[3] is abnormally developed, and, with the aid of a membrane, performs all the work of flight. In the bird this digit is suppressed altogether, and a totally different modification of parts exhibited. The archæopteryx has a bird's wing, and a completely developed wing, too; the proportions of some of the more important parts are, according to Professor Owen, like those of the peregrine falcon, while as a whole he compares it to the wing of a grouse. And yet it is not even this member which, on the same authority, most evidently stamps the creature with the character of a bird, but its breast-bone, and especially its feet.

Instead, therefore, of filling the void, such an instance as this does but serve to emphasize its existence. Reptiles, we see, might have come to fly as well as birds, and yet be as far from being birds as the crocodile, or, rather, still further, for it would be easier to make a bird's wing out of a crocodile's fore-foot than from the wing of a pterodactyl.

Once more then, by another road, we are brought

[1] The *Archæopteryx* of the oolite.

[2] *Phil. Trans. Royal Society*, for 1863, pp. 33 seq.

[3] It is scarcely necessary to observe that in the skeleton of all vertebrate animals the same fundamental parts are to be traced: thus the hand of man, the wing of the bat of the bird, the flipper of the whale, the paw of the lion, the fore-foot of the lizard, all contain the same ultimate elements variously modified according to the creature's various needs.

back to the consideration with which we started, that the most striking feature presented to us by these various tribes of organic creatures which we know is their isolation one from another, far more than their intercommunion. Everywhere we seem to find evidence of forces working actively from within, and determining the fundamental character of each class, and not of a mere passive plasticity ready to assume any form which surrounding circumstances may impress. Yet it is for this colourless passivity that Darwinians argue. In Mr. Wallace's words: "In this way [by preservation of variations happening to prove useful] every possible modification of an animal or plant, whether in colour, form, structure, or habits, which would be serviceable to it or to its progeny at any period of its existence, may be readily brought about."[1] More noteworthy still are his words that follow: "There are some curious organs which are used only once in a creature's life, but which are yet essential to its existence, and thus *have very much the appearance of design by an intelligent designer*," an appearance which he clearly holds to be illusory, for he proceeds to explain how Natural Selection can sufficiently account for all the facts. Here we may clearly see the distinction to be drawn between a theory which teaches merely that there has been development in the history of the organic world, and one which lays down that the development has been operated by the agency of Natural Selection alone. For those who hold development to have proceeded on a plan and along fixed lines, the difficulties urged above are not formidable. A man intending to reach a distant spot does not embark on a railway with the intention of spending his life thereon, but as a means to his destination. The idea of a foreknown end once introduced, there is no necessity of holding that every step along the road was once a terminus. But take such an end away, and it is hard to understand how the ground-plan of Nature, as it has in fact

[1] *Darwinism*, p. 113. Italics mine.

resulted, should be distinctly traceable in every phase of its past history.

To recapitulate. The constant variability of individuals within the same species, while the specific type endures unvaryingly, points to an energetic intrinsic force as the operative agency by which species are moulded, and discredits the idea that their forms are the sport of extrinsic conditions. On the latter supposition there would be required, in order to account for the development of one class of creatures from another, a chain of conditions rendering each intermediate form, in its season, the most advantageous hitherto acquired by any organism in that line of development. Some of the conditions thus postulated must have been so alien to all now existing upon earth, that the advent of the present state of things has utterly obliterated the races which existed therein, as effectually as an atmosphere of choke-damp would extinguish our present fauna. Moreover, the creatures thus exterminated, though they must have been once found in as large numbers as those of other periods, have melted away like a wreath of mist, leaving no trace behind, and thus enabling the series of life-forms exhibited by the rocks to tally with our own, as to both its contents and its gaps.

Travellers tell us of hosts of ants which in their migrations overcome all obstacles by lavish sacrifice of lives, filling up pits and damming streams and even extinguishing fires by the sheer force of numbers, willing to perish that others may find a path over their remains. Were we to track their course to confirm such an account, we should look to find their remains most plentiful where their difficulties have been greatest. So should it be, on Natural Selection principles, with the march of life. There, too, there are chasms to be filled on the way, if that way is to be continuous from end to end. The passage from invertebrate to vertebrate, from fish to reptile, from reptile to bird or to mammal, demands changes so fundamental that the earth should be laden with the failures. But it is just where the dead should be lying thickest that we find them not at all.

There is yet another quarter where our missing links may be sought. The history of the development of each individual animal, as we are often told by Darwinians, is a summary of the history of the race to which that individual belongs. A mollusk, for instance, a reptile, a bird, and a mammal, have their origin in primitive cells absolutely similar, and, in the course of its progress towards what is to be its final form, the reptile is at one period indistinguishable from a fish, and the mammal from a reptile. "A better proof of this," says Mr. Darwin,[1] "cannot be given than a circumstance mentioned by Agassiz, namely, that having forgotten to ticket the embryo of some vertebrate animal, he cannot now tell whether it be that of a mammal, bird, or reptile."

The fact is certainly important and significant, but it is hard to see in it a proof of what Darwinians would have it prove.

In the first place, as has been well pointed out by Mr. Mivart,[2] though, in some cases of individual development, there be progress from one form to another, that progress is ruled by a force extrinsic to the developing creature, and not by intrinsic circumstances. The future dog may for a time be indistinguishable from a lizard, but a lizard it is not, and nothing on earth can make it one, or can even change it to a wolf. A dog it must be or nothing. "If then," argues this able writer, "the development of the individual is an epitome of that of the species, the latter must, like the former, be due to the action of definite innate laws, unconsciously carrying out definite pre-ordained ends and purposes."

For our present object it is still more noteworthy that the abridgement of evolutionary history thus presented by the embryo is as silent on the subject of the link-forms whereof we are in search as are the voluminous tomes of the rocks. We obtain no

[1] *Origin of Species*, p. 439.

[2] Articles in the *Tablet* newspaper, March to June, 1888.

hint at all as to how one class or order of beings can have been changed to another, but again seem to recognize life in all its stages as being attached to one or other of the typical forms to which we are accustomed.

But more than this. In some of the lower animals the processes of individual development are displayed nakedly before our eyes, like the works of a skeleton clock. In the class of insects, for example, we see in the larva a totally different life-form from that of a perfect insect. A caterpillar differs from a butterfly, not so much indeed as a lizard from a bird, but yet sufficiently to make it instructive to observe by what kind of form he links these two phases of his existence. He does so by becoming a chrysalis. Did any caterpillar ever go into the chrysalis unless with the purpose of coming out as a butterfly? If the intermediate form were ever his final stage he might as well, so far as his individual development was concerned, have gone into his coffin or into the crop of a sparrow. Here then, at least, is a form such as we have sought, connecting conditions of existence altogether different, but it is a form which can never have been the terminus of development, for in that case the terminus would have been final.

However, therefore, we approach the problem, the solution offered by Darwinism appears less satisfactory the more it be examined. Intrinsic forces working definitely towards one plan, not indeterminate forces swept hither and thither by external agencies like a cloud of dust, are suggested by the phenomena of Nature, whithersoever our eyes are turned. It would be strange were it otherwise. Organic Nature in all its parts we find to be inexorably ruled by law. How then shall we expect that with the whole it should be otherwise? Lawless or really random variation, says Dr. Asa Gray,[1] would be a strange anomaly in this world of law, and a singular conclusion to be reached by those who insist upon the universality of law in Nature.

[1] *Contemporary Review*, April, 1882, p. 609.

# The Game of Speculation.

Half an hour's walk by our neighbouring river will be sure to afford us a chance of seeing a water-ousel, a sight which, in spite of its local familiarity, would seem to be, for naturalists, somewhat of a privilege. Mr. Yarrell, who did so much for British ornithology, is fain to acknowledge that he must depend for his account of the habits of the bird on the testimony of others, having never had the opportunity of watching it himself; while, still more strangely, such a companion of Nature as Mr. Ruskin regretfully declares[1]: "I am sixty-two, and have passed as much time out of these years by torrent-sides as most people. But I have never seen a water-ousel alive."

To the angler who has wandered among north-country streams, the idea that the ousel can anywhere be rare will come with a shock of surprise, for he must have found it at every turn haunting his steps as though it were the familiar genius of his craft. Indeed, it would rather seem as if those who have once been properly introduced cannot shake off its company. I know, for my own part, that up among the Carpathians, on the Bialy Dunajecs, one of the head waters of the Vistula, though the region was almost birdless, and though what birds there were were mostly unfamiliar, while by the waterside grey-headed wagtails and green sandpipers replaced our English friends, the water-ousel stuck by me, as though his presence by a trout-stream was a matter of course.

[1] *Love's Meinie*, p. 99.

But, however that may be, he is to be found any day we choose to look for him here upon the Hodder. Every reach of the river contains a pair, and as they never leave the river-bed we have but to walk along the bank and watch. Presently, with something of the equable velocity of a bumble-bee, not very high above the stream, and faithfully tracking its windings, a bird scuds past, a bird wearing a very white waistcoat, and, seemingly,[1] a very black coat. Perhaps, instead of this, we first catch sight of him perched on a stone, in mid-stream by preference, dropping a series of incessant curtseys to the universe at large ; or, again, our first notification of his neighbourhood may be a tinkling, silvery trill, heard through the rush of waters, something like the song of the wren, and, like that strain and the redbreast's, gracing autumn as well as spring.

The bird thus recognizable is the water-ousel, otherwise the dipper, and, if we pay a little attention to his movements, we shall have no difficulty in understanding how he comes by this other name. Though, as we have seen, he flies well, he obviously does not feed on the wing, and when in search of food he imitates in his manœuvres none of the birds we are accustomed to see. He does not hop like the robin, and though he will run the length of the stone on which he is, he does not, like the wagtail, patter up and down the shore-line in quest of prey. Not the surface or edges of the stream, but the bottom, is his hunting-ground, and to it at no long intervals down he goes. Ever and anon, we can hardly mark how, he is gone from the stone where we saw him, disappearing in the water like a bubble that bursts or a may-fly sucked down by a trout. Presently he is out again, on the same stone or another, but the chances are that we discover him there, without

[1] Seen even from a short distance the ousel appears to be entirely black and white, and hence his local names of "water-piet" and "water-crow." In reality the head and nape are chestnut, and the plumage elsewhere is of a much less decided black than we should be inclined to think.

being able to notice how he arrives, as though he had been shot into vision as he melted out of it. Sometimes from the wing he will plump into a tumbling stream, going down in it as if made of lead, and after a time he is on the surface as buoyant as a cork, and then sinks again without the apparent effort of a diving-bird, simply ducking his head and vanishing. At other times he works in shallow water with only his back above the surface, finding, as it seems, no difficulty in keeping himself submerged, raising his head and lowering it again to forage at the bottom, as he moves. How he performs these feats no one appears to know with certainty. The first bird-book I read as a child declared that the dipper takes down with him a supply of air under his wings, on which to subsist while beneath the surface; but this ingenious notion mistakes the nature of the problem. The difficulty is to explain how a bird so light contrives to reach the bottom and to stay there, even though he does not buoy himself up like a balloon. There are authorities who declare that, by some mysterious law, the ousel is able to walk about at his ease on the bottom, as other birds on land, which idea is somewhat countenanced by his conduct in shallows, as above described.

Others deny him this power of walking under water, and declare that he progresses there by flying, as we may see guillemots in aquarium tanks, using no organ but his wings; while, according to a third account, he struggles with all his might, his head and body protruded, clutching at stones with his feet, and working his wings "with considerable exertion and apparent difficulty, quite unlike the comparatively facile movements of a coot or cormorant, or any bird of similar specific gravity." An account of the matter, compounded of these two, is suggested by the case of the young ousels, to be quoted presently.

But however the feat be performed, one thing is certain—the bird is not carried away with the stream, for he will work backwards and forwards, with perfect unconcern, across a tumbling rapid. He goes down, of course, in quest of food, but as to the precise nature of that food the testimonies, again, are not in full accord. Mollusks and the larvæ of insects he certainly devours, but what about fish? Macgillivray bears witness that, having dissected many dippers, he never found a trace of either fish or spawn, and to the same effect speaks the author of *Autumns on the Spey*. On the other hand, I am assured by an observer of first-rate accuracy that, though the birds will not themselves eat fish, he has seen minnows brought by the parents to their young, when, being rejected by them, they dropped upon a heap which lay beneath the nest in various stages of decay. Finally, yet another naturalist tells me that he has watched a dipper catching and killing minnows in a brook, and this in autumn when there were no nestlings to whom they might be offered.[1]

The nest is in keeping with the bird's habits, being built hard by the waterside, on the face of a rock, on the pier of a bridge, under an arch, or even sometimes, it is said, on a dry spot behind a waterfall, so that the parent bird has to go in and out, and the young catch their first glimpse of the world at large

[1] To the above historic doubts may be added another. In nearly all the illustrations accompanying ornithological works, the dipper is represented as tilting up his tail, after the manner of a wren. In Yarrell's *British Birds* he is made to hold it almost at right angles to his body, like a turkey-cock. In Johns' *British Birds in their Haunts*, Selby's *British Birds*, and the Duke of Argyll's *Unity of Nature*, the figure presented is of what the author of *Sylvan Folk* happily describes as a "crescented form." Such a posture, I am convinced, is by no means normal with the bird: he assumes it for a moment immediately on emerging from the water; but as a general rule he sits with tail horizontal or even slightly drooping—certainly he does not sing in the other position, as Johns makes him. A general impression of the jerkiness of his movements seems to have caused this mistake. It is a curious fact that birds do not appear to recognize their enemy Man when he approaches them by swimming. I have known a wagtail attempt to settle on my head, and afterwards, perched on a rock in a deep pool, it allowed me to put my face within a foot of its position Watching a dipper in similar fashion, at a distance of three or four yards, I particularly noted that its tail was carried perfectly horizontal.

through a curtain of rushing water. The nest is domed, like that of the wren, and is most artistically assimilated to its surroundings, being likewise carefully felted to make it waterproof. The young, as befits their situation, long before they have left the nest, understand that the water is their safest refuge, and how best to make use of it. A young naturalist friend of mine furnishes the following interesting description[1]: "I lately took some young water-ousels, barely fledged, out of their nest, and placed them in the stream over which it was built. Though they had never been in the water before, they dived immediately, and, swimming a considerable distance beneath the surface, took refuge close to the opposite bank, crouching behind the stones and overhanging grass, with their heads out of the water. They afterwards swam with great facility, both with and against the current, which was very strong. In swimming they made use of the full extent of their wings as well as their legs, and always descended and rose to the surface in an oblique direction. I then placed them carefully back in their nest, and, after leaving a handkerchief at the entrance for a short time, that they might settle down till the parent birds should return, I left them apparently none the worse for their early bath."[2]

[1] *Stonyhurst Magazine*, vol. i. p. 24. I am informed that the experiment has lately been tried of putting a starling's egg in a water-ousel's nest. It was duly hatched, but on the third day after, the parent birds, terrified by the uncouth cries of the strange nestling, deserted the whole brood.

[2] Since this was written I have myself had an opportunity of observing a young dipper in the water. This was a half-fledged nestling, the quills on the wings just beginning to develop, which accidentally fell from its nest on an overhanging branch into a very boisterous rapid. Swimming and diving, it contrived to evade the main current with wonderful dexterity, and attempted to climb a rock on its margin, but this was steep and slippery, and before assistance could be brought the bird was carried away and swept over a small waterfall, entirely disappearing beneath the current. A few yards down, however, it came to the surface and struck out vigorously for the shore, where I rescued it and dried it, then leaving it apparently hale and hearty in the nest again.

The water-ousel is thus stamped in the family of birds with an individuality, not only notable, but unique, uniting in his single self the most extraordinary contradictions—"a water-bird that sings, a song-bird that swims and dives."[1] For though in his habits more truly aquatic than a duck—though he lives above the waters, except when getting his living below them, though waters to please his taste must be turbulent and brawling, so that, turning his back on placid low-country streams, he elects to dwell on rivers that foam over rocks, and burns that leap from the sides of hills—yet, but for the fact that he is what he is, he has no right, that naturalists can discover, to be called a water-bird at all: none of the classifications which they can make will bring him into relationship with any birds but those that most distinctively belong to the land: no single feature of his structure would give a closet-naturalist any hint of the kind of life he leads. "The acutest observer," says Mr. Darwin,[2] "by examining the dead body would never have suspected its sub-aquatic habits."

The dipper, in fact, according to most naturalists, is a species of thrush, or a link between that family and the flycatchers.[3] He has the feet of a thrush,

[1] Johns' *British Birds in their Haunts*, p. 72.

[2] *Origin of Species*, p. 185 (fifth edit.).

[3] The newest classification, however, that adopted by the British Ornithologists' Union, has in this, as in other cases. upset pre-existing arrangements. According to the new system, the dipper stands amongst British birds between the hedge-sparrow and the titmice. This change, as is obvious, does nothing to explain the problems suggested by his economy, but rather adds several perplexing elements thereto. In support of this account of the development of the dipper from the same stock as the thrush, Mr. Wallace quotes the fact that the American water-thrushes (*Seiurus*) wade in water, and often plunge head and neck beneath the surface, though their plumage is still pervious to water. But if the new classification be the right one, we have to suppose that dippers and thrushes parted company before either had acquired the characteristics now observable. In fact, whichever way we decide to class them, a puzzle confronts us. If the dipper be next-of-kin to the tits, how came he, leading so utterly different a life, to evolve characters which have made naturalists rank him as a thrush? And if he be a thrush, whence come his tit-like characters?

with no trace of a web, the bill of a thrush, and the plumage of a thrush. Yet his foot never perches on a tree, and a minute's immersion would reduce a thrush's feathers to a condition of bedraggled uselessness.[1]

Here, therefore, we have a problem presented to us of which account must be taken by any theory which deals with the origin of species. If the water-ousel be really a development from the same stock whence spring the thrush, the blackbird, and the fieldfare, what has been the agency which has availed to make him as unlike them all as one bird can be to another? For, after all, it is not the frame of bones, muscles, and nerves that constitutes a creature's essential character, but the mysterious force which energizes through them. The dipper's thrush-like features no more make him a thrush than likeness of face and gait showed Major Pendennis to be of the same stuff as the Duke of Wellington. The problem is so notable that such a theory as the Darwinian must needs take account of it, and in studying that account we have an opportunity of studying in the best possible form—that is to say, in a concrete instance—the sort of explanation in which that theory deals.

Mr. Wallace, in his recent work,[2] thus handles the question: " Here then we have a bird, which, in its whole structure, shows a close affinity to the smaller typical perching birds, but which has departed from

[1] I have had the opportunity of observing a thrush in the water. A young bird, essaying a flight across the tidal pool at the mouth of the Awe, lost heart in the middle, and tried to turn back, but bungled the business and fell into the river, luckily for itself not having reached the main stream. Such was its natural buoyancy that its wings at first floated clear of the water, and with them it raised itself in a series of jerks towards the shore. At each stroke, however, its plumage becoming soaked, it sank lower and lower, till its wings, extended to the full, lay along the surface, and it made scarcely any way. So waterlogged was it that it seemed impossible that it should accomplish the last yard between itself and the shore, which at last with infinite difficulty it reached.

[2] *Darwinism*, p. 117.

all its allies in its habits and mode of life, and has secured for itself a place in nature where it has few competitors and few enemies. We may well suppose that, at some remote period, a bird which was perhaps the common and more generalized ancestor of most of our thrushes, warblers, wrens, &c., had spread widely over the great northern continent, and had given rise to numerous varieties adapted to special conditions of life. Among these some took to feeding on the borders of clear streams, picking out such larvæ and molluscs as they could reach in shallow water. When food became scarce they would attempt to pick them out of deeper and deeper water, and while doing this in cold weather many would become frozen and starved. But any which possessed denser and more hairy plumage than usual, which was able to keep out the water, would survive, and thus a race would be formed which would depend more and more on this kind of food. Then, following up the frozen streams into the mountains, they would be able to live there during the winter; and as such places afforded them much protection from enemies, and ample shelter for their nests and young, further adaptations would occur, till the wonderful power of diving and flying under water was acquired by a true land-bird."

It may be well to remind ourselves that in the history thus sketched one fragment only is matter of fact, namely, that there are water-ousels. The rest is pure speculation based, not upon that fact, but upon an assumption as to how the fact came to be. "Well," as Uncle Remus has it, "it might have been so; but then, you see, it mightn't." The construction of histories, such as we have heard, proves only this—that by taking a great deal for granted we can imagine things to have proceeded in a certain way. But unless we have good reason to believe that we thoroughly understand the laws and constitutions of organic life, we can have no assurance that the process so imagined is even possible, and, still less, if less can be, that it has actually occurred.

It seems very needful to remind ourselves of this, for apparently it is often assumed that, because we can thus in fancy bridge over a difficulty, the difficulty vanishes. But it is hard to see what scientific purpose such imaginative stories serve.

If we wish to know how an ousel dives, the only thing to do is to go and look; it would be worse than useless to consult instead our inner consciousness, as Aelian or Pliny would have done, and then tell the world, as a contribution to its knowledge, how we think it likely that the operation is performed. And yet we know that dive he does, and that there must be some explanation of the operation. In regard of his history, on the other hand, we *know* nothing, except that he exists; we do not know that there is any explanation of his development from a land-bird, because as yet we have not proved that he has so developed; and even if we knew this, we could scarcely pretend, with any show of reason, to describe the complex process of his genealogical descent, when we know that we could not, by a like method, arrive at the truth concerning the mode of his descent into the water. It is, in fact, only where our ignorance is complete that we venture to amuse ourselves with such conjectures; the greater our knowledge the more we perceive their futility.

There was a time when men fancied that a swarm of bees could be produced by a putrefying heifer, when it was conceivable to them that Daedalus could fly by means of wings fastened with wax to his shoulders, and when they devoted their lives to the quest of the philosopher's stone which should by its touch turn everything to gold. If we find it utterly impossible nowadays to believe these fables, it is simply because we know something more of the real nature of the problems involved. And with all our advance of knowledge the results we have to show are negative rather than positive. We have discovered that much is impossible which had been supposed possible, but we still understand the causes of things so little that we cannot forecast their effects until we have seen them in operation. We have not, I suppose, got so far as to prove theoretically that birds can fly, though we see them do it every day; we pride ourselves, and justly, on Newton's great discovery, but what gravitation may be we have no conception, nor of its action, except in those circumstances wherein we see it work. The same is true of electricity.

Still more does it hold of the mysterious force we call life. We see it in action, and we witness its propagation: but of its origin, of its nature, of the infinitude of checks and counterchecks which rule its development, we know nothing. We have never seen development going on except under the guidance of man's selection, and, while we have no positive proof that Natural Selection could do even so much as man's, we know that man's can do none of those things which Natural Selection is assumed to have done. We can develop in our domestic animals or plants certain of the qualities which we find in them, but we can never produce a new quality, still less a new species; and the moment we withdraw our hand the race reverts to the original type. How, then, can we say that we know enough about the conditions necessary for the production of fundamental and permanent changes, to make the remotest guess at the manner in which they have been wrought? Has any philosopher ever attempted to explain how it is that the Duke of York's Island encourages whiteness in its birds and insects, and the Philippines metallic colours?[1] that the *Æneas* butterflies have tails towards the Tropics, but never on the Equator? that twenty kinds of American trees differ from their nearest European allies in having their leaves less toothed? that dogs bred in India differ notably from their English parents? that at Mambas cats exchange their fur for stiff hairs? that the caterpillars of Texan moths[2] brought to England and fed on English walnut-leaves developed into moths of apparently a different

[1] Most of these examples are given by Mr. Mivart in his letters to the *Tablet*, May, 1888.

[2] *Saturnia.*

species? that the Australian fishbone-tree should at different stages of its growth exhibit such diverse characteristics as to have been classed in different genera? Again, how shall we explain the fact that the feet of birds, as in pigeons and bantams, often produce feathers exactly on the analogy of wings? No one supposes that they are descended from ancestors with four wings and no legs. How, again, have creatures radically different possessed themselves of some one common feature? Thus an eel and a skate are electrical: a skate and an ant-eater have teeth of a structure quite different from anything found in any creatures intermediate between them; of venomous fangs there are two distinct classes amongst serpents, and a third kind is found in a lizard[1]; the pike, the angler-fish, and some brought from the bottom of the Atlantic by the *Challenger*, have hinge-teeth, the only feature they have in common; orchids and asclepias, plants as dissimilar as possible, have the same machinery for their pollen-grains, described by Mr. Darwin[2] as "a very curious contrivance."

These instances will serve to indicate how supremely little we know of the laws governing life developments: but if we descend towards the root of the matter, to those phenomena which concern the beginnings of life, we find our ignorance still more abysmal. No one has ever been able to guess how it is that from one germ proceeds a frog, and from another, precisely similar, a salmon or an eagle; or from one egg a cock, and from another a hen. How is it that amphibians, as a class, which we are told came before reptiles, differ from these, in some respects, as to the first stages of growth, and agree in the same respects with mammals; and that a few amphibians differ from their own folk and agree with reptiles? How is it, again, that while frogs and newts are generally born as tadpoles, passing to full maturity only in the perfect state, one frog[3] is never a tadpole even in

[1] *Heloderma.* [2] *Origin of Species*, p. 193.
[3] *Rana opisthodon.*

the egg, and some newts[1] breed as tadpoles? All this, and much besides, baffles conjecture, and in face of it how can we pretend to talk of the shapes life would have assumed in circumstances of our imagining? When there is so much before our eyes that we are utterly incompetent to explain, how can we gravely set ourselves to chalk out the course taken by things that we have never seen? In the imaginary history, for example, given of the dipper, we do not even know that any one of the factors ever existed which we employ in our calculation. We do not know that there ever was a "common generalized ancestor" from whom our perching birds are sprung. Even given that ancestor, we do not know by what several lines our existing species have descended from him, for naturalists cannot agree how to classify them. Finally, granting this point again, in evidence for the possibility of all the various stages through which we trace the bird's formation, we have nothing to quote but our own ignorance: we can say no more than this—that we see no difficulty in the way, while there may be ten thousand difficulties which we do not see. It would be cold comfort to the passenger by an express train rushing onward, through a densely dark night, to be told by the driver that he could see no signals at all, and therefore, was not aware of any portending danger; and in like manner we require from our scientific guides, if they are to inspire our confidence, not merely that they should perceive no obstacles, but that they should descry positive indications that the course is clear.

It will doubtless be said that this is just what evolutionists do, that they deduce from other considerations the truth of the Darwinian theory, and construct hypothetical histories, only to show that there are no insuperable difficulties in the way. But in the first place it may be answered that these histories have no value at all, even for such a

[1] *e.g.* the Axolotl.

purpose, and therefore can serve for nothing but to delude us with a false appearance of knowledge: and in the second place the Darwinian argument, as a matter of fact, does rest largely on proofs of this nature. It is, in fact, only by means of speculations such as this that the process itself of development under Natural Selection is known to us at all. We neither see it in progress, nor have we discovered the various successive forms through which it has operated, nor do we know the original whence it started. We assume that certain forces and agencies, about which we know a little by observation, might have wrought certain changes, if there were nothing to prevent them; but that there is nothing we have no better proof than that we know of nothing. Accordingly, from the very nature of the case, we find this brought as an argument by Darwinians again and again. Mr. Darwin, speaking of the slave-making instinct of ants, after recounting what he conceives to be a possible mode of its origin, concludes by saying[1]; "*I can see no difficulty* in Natural Selection increasing aud modifying the instinct." To explain the origin of the hive-bee's architectural skill, he recurs to the example of the Mexican *melipona*, which makes cells circular where free, and flat where they touch other cells. From these, he argues, the hexagonal cells of the bee might have been developed by Natural Selection, and the mode of argument is this[2]: "We must *suppose* the melipona to make her cells truly spherical and of equal sizes: *and this would not be very surprising*, seeing that she already does so to a certain extent, and seeing what perfectly cylindrical burrows in wood many insects can make. We must *suppose* the melipona to arrange her cells in level layers . . . and we must *further suppose*, *and this is the greatest difficulty*, that she can somehow judge accurately at what distance to stand from her fellow-labourers. . . . We have further to *suppose*, *but this is no difficulty*, that after hexagonal

[1] *Origin of Species*, p. 224. [2] *Ibid.*, pp. 227, 235.

prisms have been formed . . . she can prolong the hexagon to any length requisite. . . . Thus, *as I believe*, the most wonderful of all instincts can be explained by Natural Selection." By an analogous process, he tells us, [1] "*I believe* that the strange instinct of our cuckoo could be, and has been, generated." So of the eye,[2] "*I can see no very great difficulty in believing* that Natural Selection has converted the simple apparatus of an optic nerve merely coated with pigment and invested by transparent membrane, into an optical instrument so perfect." And again of the lungs,[3] "*There seems to me to be no great difficulty in believing* that Natural Selection has converted a swim-bladder into a lung": and as to the independent production of similar organs in different classes of plants or animals,[4] "*I am inclined to believe* that in nearly the same way as two men have sometimes iudependently hit on the very same invention, so Natural Selection . . . has sometimes modified in very nearly the same manner two parts in two organic beings."

Mr. Darwin was the most scientific and cautious of Darwinians, and his disciples have far outstripped him in the field of speculation. As Mr. Mivart has remarked, Darwinism has this advantage in its favour, that it needs only the suggestion of some seemingly possible advantage as the result, to recommend any of the developments in which it believes. It has accordingly become no small portion of the work of its advocates to set themselves to imagine such advantages. To do so, especially with a little practice, is not difficult: it is a game, and a game very easy to play. On the other hand, when all is done, the result remains imagination, and has no right to present itself on the same platform with fact. In the words of the late President of the Linnean Society, to trace the relation between existing floras and faunas and those of other epochs "requires a more lively imagination than I can lay claim to, or

[1] *Origin of Species*, p. 217. [2] *Ibid.*, p. 188.
[3] *Ibid.*, p. 191. [4] *Ibid.*, p. 193.

perhaps than it is desirable to employ in any strictly scientific investigation."[1]

Here, for instance, is another example contributed by Mr. Wallace, an explanation of the fact that rabbits have white tails. This member, he remarks, at first sight appears to be dangerous to the animal as making it conspicuous to its enemies. "But," he goes on, "a little consideration will show that the white upturned tail is of the greatest value, and is really . . . a signal-flag of danger. For the rabbit is usually a crepuscular animal, feeding soon after sunset or on moonlight nights. When disturbed or alarmed it makes for its burrow, and the white upturned tails of those in front serve as guides and signals to those more remote from home, to the young and the feeble; and thus each following the one or two before it, all are able with the least possible delay to regain a place of comparative safety. The apparent danger, therefore, becomes a most important means of security." Obviously it would be a very robust faith that should be wholly satisfied with this demonstration. The hare has a tail even more conspicuous than the rabbit's, yet hares are not gregarious, nor do they run into burrows for safety. The house martin, the bullfinch, and the wheatear are rendered as conspicuous as any rabbit by the white patches they all bear on their backs, yet no one supposes that in their case these serve as signals. This is an excellent illustration of the facility with which a reason for anything can be found by one who sets himself to seek it. "One story is good until another is told," and the first may be left in possession by the simple process of leaving the other out. Mr. Darwin himself seems to account for the fact that dogs have tails, by saying that these help them to turn,[2] although his candour compels

[1] *Address to Biological Section of British Association*, 1886. By William Carruthers, Pres. L.S., F.R.S., F.G.S., President of the Section.

[2] *Origin of Species*, p. 196.

him to remark that hares double equally well without any such help.

Instances of this sort might be multiplied indefinitely: the following must serve in conclusion. If the caterpillar of the small tortoiseshell butterfly be exposed to light reflected from gilt surfaces, the chrysalis is of brilliant golden lustre. According to the Darwinian theory, this aptitude to become resplendent must point to some advantage accruing to the race, in the past, from its possession. Accordingly it has been assumed that in the original habitat of the species some glittering substance abounded, that it was of advantage to the chrysalis to glitter, that so the insect might be concealed during the most helpless stage of its existence, by assimilation to the rocks from which it was suspended, and that caterpillars sensitive, in this particular fashion, to light, thus survived. The only native substance sufficiently brilliant for this purpose is mica; therefore, it has been said, mica was plentiful in the ancestral region of this butterfly, and by fixing its chrysalis to mica rocks whose sparkle they had learnt to simulate did the more favoured of its members succeed in life. But the regions where micaceous rocks occur are few and narrow, while the range of the butterfly is very wide, and therefore, as Mr. Wallace cautiously concludes,[1] "this seems a rather improbable explanation." Accordingly, as he goes on to admit, the occurrence of this metallic appearance still remains a difficulty.

There yet remains another point of view from which the method of scientific research hitherto discussed must be considered. The fashion of adopting theories as established dogmas, and making it our task, not so much to test them, as to devise a mode of reconciling to them whatever facts we discover, appears to threaten a real danger to science itself. It seems at the present day to be considered a necessary part of a scientific outfit that one should have some sort of a theory by which to explain every

[1] *Darwinism*, p. 198.

department of the world of life. That an inquirer should have no speculation in his eyes seems to be thought as uncanny as is the case of Banquo's Ghost. Yet it may easily be that the glitter of such hypotheses blinds the eye for sober facts, and that the adoption of a theory makes a man, quite unconsciously, a mere special-pleader. As has been already said, it is no hard task to devise a plausible-looking explanation which shall harmonize fact with theory; and it is to this task that writers of the modern school appear too often, before all else, to devote themselves. Yet the scientific investigator, as such, is the very humble servant of facts: his business is to question them, not to suggest their answers; and, in so far as he forgets this, he is false to science.

It is not difficult to find evidence that even Mr. Darwin himself did not escape this peril. Honest and conscientious as he was, once he had adopted his own hypothesis he seems to have seen everything through its medium, and, quite unwittingly, his first impulse in face of a new phenomenon was to ask, not what it might really portend, but how it might be made to tally with the theory he loved: in fact, as he once playfully confessed,[1] "There is nothing like one's own hobby-horse." It seems impossible to avoid the conclusion that his mind was thus unduly biassed, when we find that phenomena which seemed to militate against his theory were distasteful to him. Thus he, clearly, could never really persuade himself that the complex mechanism of the eye, and other organs, could have been devised by Natural Selection, and on this subject he writes: "I remember well the time when the thought of the eye made me cold all over, but I have got over this stage of the complaint, and now small trifling particulars of structure *often make me very uncomfortable*."[2] The artistic beauty of certain structures affected him in the same way. So, again, the theory that butterflies have been made beautiful by the operation of sexual selection receives a shock from the fact that

[1] *Life and Letters*, ii., p. 257. [2] *Ibid*, ii., p. 296.

caterpillars, which do not breed, are sometimes beautifully and artistically coloured, and, moreover, so coloured as to make them conspicuous instead of protecting them. "What would you answer?" Mr. Darwin asks Mr. Wallace. "I could not answer, but should maintain my ground." Again, of the same Mr Wallace's article in the *Quarterly*, agreeing in the main with his own views, but differing with regard to man, and arguing powerfully for his separate place in nature, Mr. Darwin speaks regretfully[1]: "Wallace's article struck me as admirable, . . . but I was dreadfully disappointed about man; it seems to me incredibly strange." Of a fact with regard to the colour of insects which supports his theory, he says[2]: "The case of the *Solenostoma* is magnificent"; of another fact about the colours of birds, which seems to contradict it: "I find it is most difficult, but not I think impossible, to *imagine* how, for instance, a few red feathers appearing on the head of a male bird, and which are at first transmitted to both sexes, could come to be transmitted to males alone"[3]: and of the dull colours of certain female birds with brilliant mates,[4] "I *earnestly wish to see reason to believe* that each is specially adapted for concealment to its environment."

Other samples of the same sort might be quoted, but these appear sufficient to show that the first question suggested by a new discovery was, not so much what it naturally appeared to signify, but how it might be reconciled with the theory of Natural Selection. Mr. Darwin, however, always remained the most painstaking and accurate of observers, his theory notwithstanding; in the case of others of his school the faculty of observation itself seems to be affected by this sort of enthusiasm for a preconceived hypothesis. An excellent example may be cited from Mr. Wallace. Insects, as we know, are valuable auxiliaries to flowers, carrying the pollen from one to another of the same species, and thus

[1] *Life and Letters*, iii., p. 117. [2] *Ibid.*, ii., p. 122.
[3] *Ibid.*, ii., p. 123. [4] *Ibid.*, ii., p. 124.

securing cross-fertilization. According to the Darwinian explanation, the colours of flowers have been developed through this agency, those which best help the insects to find honey having been preserved. Enlarging on this theme, Mr. Wallace writes[1]: "Economy of time is very important both to the insects and the flowers, because the fine working days are comparatively few, and if no time is wasted the bees will get more honey, and in doing so will fertilize more flowers. Now, it has been ascertained by several observers that many insects, bees especially, keep to one kind of flower at a time, visiting hundreds of blossoms in succession, and passing over other species that may be mixed with them.[2] It is probably to assist the insects in keeping to one flower at a time, which is of vital importance to the perpetuation of a species, that the flowers which bloom intermingled at the same season are usually very distinct both in form and colour. In the sandy districts of Surrey, in the early spring, the copses are gay with three flowers—the primrose, the wood-anemone, and the lesser celandine, forming a beautiful contrast, while at the same time the purple and white dead-nettles abound on hedge banks. A little later, in the same copses, we have the blue wild hyacinth (*Scilla nutans*), the red campion (*Lychnis dioica*), the pure white great starwort (*Stellaria Holostea*), and the yellow dead-nettle (*Lamium Galeobdolon*), all distinct and well-contrasted flowers. In damp meadows in summer we have the ragged-robin (*Lychnis Floscuculi*), the spotted orchis (*O. maculata*), and the yellow rattle (*Rhinanthus Crista-galli*): while in drier meadows we have cowslips, ox-eye daisies, and buttercups, all very distinct both in form and colour." A description of this kind seems intended to afford a complete picture, and the reader who is not a botanist will probably conclude that a full catalogue has been given of the flowers likely, at

[1] *Darwinism*, p. 318.

[2] It may be remarked in passing that observation does not bear out this assertion.

any season, to be intermixed. What may be the case in Surrey I cannot say of my own knowledge, but certainly things do not arrange themselves thus simply in the North. Of spring flowers, not mentioned by Mr. Wallace, there are the violets, whereof we have three species,[1] including probably several varieties; and it should be remarked that a species is in most danger from a mistake between it and a kindred species. Besides this, flowering at the same time with the scentless violets, there is the ground-ivy,[2] so like in colour as often to deceive the eye, and the bugle[3] is so like this again as to puzzle young botanists. The red campion and ragged-robin bloom with us simultaneously, and their hue, though not their form, is much the same, while the wild geraniums, which often accompany them, are in this respect very similar. The greater stitchwort is not ill-matched by the starwort[4] and the wood-sorrel,[5] while several of the cresses resemble it in colour. But, not to multiply examples, it is in the description of the summer flora, that of the honey-season, when guidance should most be needed, that omissions are found. In meadows, Mr. Wallace tells us, we then find "cowslips, ox-eye daisies, and buttercups, all very distinct both in form and colour." With us the cowslips go long before the ox-eyes appear, and almost before the buttercups, but let that pass. Of buttercups there are three kinds, equally common, and to non-botanical eyes quite indistinguishable,[6] and of their own family we probably find the spear-wort and marsh marigold,[7] like them in shape and colour, in their near neighbourhood. Besides these, we find the silver-weed,[8] the cinquefoil,[9] the tormentil,[10] and the bird's-foot trefoil,[11] all like the buttercup in hue, and all except the last in form; to say nothing of all the tribe of the composites, dan-

[1] *Viola odorata*, *carina*, and *palustris*. [2] *Nepeta Glechoma*.
[3] *Ajuga reptans*. [4] *Stellaria nemorum*. [5] *Oxalis Acetosella*.
[6] *R. acris*, *repens*, and *bulbosus*. [7] *R. Flammula* and *Caltha palustris*
[8] *Potentilla Anserina*. [9] *P. reptans*. [10] *P. Tormentilla*.
[11] *Lotus corniculatus*.

delions, hawk-bits, sow-thistles, and hawkweeds, all of them also yellow. This is not an imaginary picture: all of these I myself found, inextricably intermingled, in the first field I visited after reading the description quoted from Mr. Wallace. There are in fact many flowers, always neighbours, which seem positively to counterfeit one another. What can be more alike than the true and the barren strawberry?[1] than the cross-leaved and five-leaved heaths?[2] than the scabious, the devil's bit, and the knautia?[3] than the various forget-me-nots, and speed-wells, and thistles, and, still more than these, the large classes which are compendiously classed by the public as "dandelions" and "hemlocks,"[4] respectively, whereof the former jostle one another in our fields, and the latter in our woods; most of all, perhaps, the various willows? For an insect which can steer his way among the various species of these puzzling tribes any guidance of colour or form can scarcely be necessary.

It would thus appear that theory may be so exalted as to usurp the province of facts, shaping them to its requirements, rather than taking its shape from them. This must be the inevitable result of the premature adoption of hypotheses before we are in possession of a mass of facts, the plain teaching of which is all one way, irresistibly suggesting one conclusion. A theory about which we have to be perpetually on the strain, ever explaining away difficulties, and dredging for fresh arguments, is by that very fact condemned. We cannot imagine Newton, after the discovery of gravitation, to have been in the fever of excitement as to the verdict of others in which Mr. Darwin's correspondence proves him to have been, even to the end. A doctrine which speaks for itself stands in no need of other approval: the loss is theirs who fail to embrace it.

[1] *Fragaria vesca* and *Potentilla Fragariastrum.*
[2] *Erica Tetralix* and *cinerea.*
[3] *Scabiosa arvensis*, *S. Succisa*, *Knautia arvensis.*
[4] *Compositæ* and *Umbelliferæ*

In a word, therefore, we know far too little to frame histories of any value in the domain of organic life; and by attempting to do so we delude ourselves into the flattering belief that we have discovered the causes of things, while the only sound theory for us is that of these causes we know nothing. We may easily, moreover, become the propagandists of a theory for its own sake rather than that of science, and in its interests may discard the open mind and colourless eye that should mark the philosopher. As a consequence, the result of our work may be rather a plea for theory than a genuine contribution to knowledge. To extend to the whole domain of biology what Dr. Robert Brown says of one of its departments, that of migration[1]: "There is much speculation and many specious theories intended to dove-tail into some broader hypothesis, but sound inferences from well-confirmed facts are much rarer than one might have hoped after the years of observation which have been lavished upon it."

### Postcript.

Since the article here reproduced was written, I have had an opportunity of watching the behaviour of a young dipper in the water, on a singularly trying occasion. A nest built on a branch over one of the most boisterous portions of our river contained a brood as yet unfledged, the quill feathers of the wings just appearing. One of the young birds having been taken out for examination, another, disturbed apparently by the proceeding, clambered through the opening and fell headlong into the water. He was on the edge of a strong current, with no smooth water within reach unless he could climb over a slippery stone which bounded the rapid. This he could not manage, but swimming and diving, he nevertheless contrived, for about a minute, to avoid being swept away, the place being too difficult for a rescue. Finally, the current caught

[1] *Short Studies from Nature*, p. 66.

and whirled him away, taking him over a small fall, below which he was carried under water and appeared hopelessly lost. Nevertheless, he presently came to the surface, as full of resource as ever, and a few yards down, where the current began to tail away, he swam quickly to the shore, where, being immediately picked up and dried, he was restored to the nest apparently in good health and spirits.

The nature of the water made it difficult to observe his motions when beneath its surface, but my impression was, that he certainly used his wings as well as his feet for propulsion.

I have this spring (1891) heard the song of the dipper in very peculiar circumstances, namely, when flying at full speed. The bird was pursuing his mate down the river, and while so engaged poured out an unbroken strain. I heard it coming towards me, growing louder and louder with singular rapidity, but could not imagine whence it came till the singer rushed past, something in the manner of a whistling express.

# The Empire of Man.

In order to discover whether there are men in the moon, it was once ingeniously proposed to take some large plain on the earth's surface, so large as to be visible to observers in our satellite, as the Sahara, and thereon to construct on a colossal scale the figure by which Euclid solves his forty-seventh proposition. If there are beings like ourselves in the moon, it was argued, they must by this time have worked out the same theorem for themselves; they will recognize the figure as a signal hung out by an intelligence, and will respond in similar fashion, and thus will a beginning be made towards a code of intercommunication.

Whatever may be thought, from a practical point of view, of this suggestion, it serves, at least, to emphasize the fact that there are certain steps on the road to intellectual development which it may be assumed that man would make, simply as man, certain advances which we might reckon on his race accomplishing, quite apart from any circumstances in which it might be placed. But when our attention is directed to this point it must very soon appear that what we could thus anticipate of the condition of the race, taking into account its own inborn resources alone, is extremely little. To construct for ourselves any real idea of the point of progress reached by a race like ours, it would be absolutely necessary to know what instruments were afforded by the world in which they were placed to enable them to work it out. For the discovery of pure mathematical truth man has sufficient materials in himself: it is not so with scientific truth, still less with arts and industries. As Sir John Herschel has remarked, it is conceivable that a man shut up in a solitary dungeon should think out for himself all that we know of mathematics, but he could never tell without trying what would happen to a lump of sugar when put into a cup of tea. In like manner it would not avail, for the purpose above described, to flash an electric signal to the moon, unless we were certain that, if there be inhabitants there, they must necessarily have the materials needed for the production of the electric light; and even the geometrical symbol whereof we have spoken would have to remain unanswered, though such inhabitants recognized its import, if the stuff of which their world was composed could be worked into no tools bigger than toothpicks.

The development of the human race, in fact, of which we are so proud, its conquest and subjugation of the earth, its manufactures, its arts, its engineering triumphs, its commerce, its inventions, its scientific discoveries, even what seems to be most purely its own, the *litteræ humaniores*, its accumulated literatures —all is found to be inexorably conditioned by the material circumstances of the earth on which our lot is cast. What would the case have been had there been nothing that could serve the function of paper and ink? What if no tree had borne anything like cotton, and no animal produced any fleece like wool, or any web like silk? What would have become of navigation had there been no timber but grass-stalks, or if hemp had been unknown? Where would the chemist, or the astronomer, or the microscopist have been without glass? or the sculptor without marble, that paper specially prepared, as Mr. Ruskin tells us,[1] and hot-pressed for his particular requirements?

[1] *Stones of Venice*, III. i. 41, 42.

It must be remembered that we might very conceivably have been without many or all of these things. We are so accustomed to have them that we are too apt to take them for granted, and thus to miss the full significance of their presence. The plants for example which afford us clothing stuffs, as cotton and flax, are a very small minority in the vegetable kingdom. That minority might very easily have been stamped out in the struggle for existence. Everything which bears a flower bears also what is botanically known as a "fruit." Yet how small a proportion of these can serve the purpose of food. Is there anything in the nature of things to make it necessary that this purpose should have been served by any?

Nor only this. How much of man's development would have been possible had there not been in the organic world around a capability of development under his hand: if the wild originals of our wheat and oats had not been ready to swell their ears in his fields, as they will never do elsewhere; if the crab had not contained the potentiality of the apple, a potentiality to be realized only in his orchards: if the sheep had not been prepared to yield him a richer fleece than she would ever have provided for her own needs, the silkworm to spin a fuller and finer cocoon, the cow to provide a supply of milk at once more ample and richer, the horse and the dog to endow the hunter and the shepherd with powers new, not only to him, but to themselves till they fell under his guidance and control?

Nature was from the beginning fitted to his hand, and no less was his hand fitted to rule Nature. It has been pointed out by Mr. Wallace[1] that there is much in the physical structure of the lowest savage which cannot be accounted for by any experience of the race prior to that point of development at which such savages stand, and which consequently is not explained by any merely materialistic theory of evolution. We are assured by those who propound

[1] *Natural Selection*, pp. 349 et seq.

such theories that only those qualities arise and survive which are of service to the individuals possessing them. They are therefore a record of the past, and of the past alone ; to be accounted for only by what has been, not by that which is to be. But there are infinite possibilities in the hand, for instance, of a savage, which are of no actual use to him, because he has nothing on which to exercise them, and cannot have been of service to any of his progenitors, if they have been still lower in the scale than himself. His nicest instruments are perhaps a club or a stone scraper, yet is his hand quite capable of being taught to manipulate a penknife or a needle. His voice, too, is capable of being trained to sing, though he has no notion of any nearer approach to the divine art of music than a more or less monotonous howling. "It seems," says Mr. Wallace, "as if the organ had been prepared in anticipation of the future progress of man, since it contains latent capabilities which are useless to him in his earlier condition."

Still more, according to the same author, is this true of the most important of all organs—the brain. The size of this, as science emphatically declares, is closely connected with the intelligence of its possessor. It would therefore appear that only where intelligence has been actually developed to its highest pitch we should find a corresponding development of brain capacity, and in the lower and undeveloped races of men we should find that size of the organ, and no more, which would correspond to the advance they have accomplished beyond the brutes in intellectual power. Yet this is far from being the case. The brain of the savage, Mr. Wallace again tells us,[1] is far larger than he needs it to be, or than his history will account for its being ; and what is probably the very oldest known skull, that of a man contemporary with the mammoth and the cave bear, "might," according to Professor Huxley, "have belonged to a philosopher." Thus it seems to be, not the past, but the future history of man's race,

[1] *Natural Selection*, p. 337.

which explains his outfit; he is seen to have had a power, at the very outset of his career, which he could not have acquired for himself; and this power of his, making him fit to mould Nature to his requirements, is the exact complement of Nature's passive capacity to be moulded, whereof we have seen something above.

From such considerations it must appear that the history of human progress, the last and the noblest page in the history of the development of the earth, is very far more complex and intricate than philosophers of the evolutionary school would lead us to suppose. To judge from their utterances, it would seem that we have but one factor to deal with, the developing creature himself. The nearest approach to a fundamental philosophy with which they favour us is an assurance that, given the play of organism and environment through a sufficient number of ages, such a state of things as that in which we live was bound to come about, through the constant survival of those most worthy to survive; and we are invited from a view of what has actually resulted to accept the conclusion that this and no other must have been the result, and that therefore the creed of Evolution is justified by its works.

Obviously, however, it is no such thing, and there are many elements which have most powerfully affected the actual issue, whereof the evolutionist theory affords no explanation at all. Granting that Natural Selection, or any other materialistic machinery, could do all that is claimed for it, that it can suffice to explain the presence of all organs and all instincts or other mental powers, how does it account for the fact that there were metals in the earth, or that water was convertible into steam, that there were such things as fuel and potter's clay, such vegetables as grapes and potatoes, such animals as dogs? All of these have been instruments, all of them powerful, some absolutely essential, for making human civilization what it is, but assuredly it is not the power of Natural Selection as it may have worked in man that explains their existence.

The final outcome of development, therefore, as witnessed in the actual progress of the human race, is very far from affording an argument in favour of the evolutionary doctrine as popularly proclaimed; on the contrary, it presents the gravest possible objections against it. Evolutionists have been labouring these many years to convince the world that man might have come to be as he is, in bodily structure and mental power, by the operation of blind material laws, without calling in the aid of design to account for results. But even supposing their success in this endeavour to be on a par with their professions, they are but landed at the end in face of a swarm of fresh difficulties, and have to confront their old antagonist, the doctrine of design, as vigorous and as formidable as ever. For, undoubtedly, to suppose the world in its entirety to be the product of a designing mind would be an explanation of the existence of all the machinery it contains, however complex; while it is equally apparent that Natural Selection can no more account for it than the science of geometry can explain the attraction of gravitation.

So evident is this, that as a matter of fact evolutionist philosophy either leaves this point altogether out of sight, or, if it deigns to notice it, does so in terms which, when looked into, are found to be absolutely devoid of meaning, as may be seen from the following example.

Nothing assuredly has more powerfully contributed to establish man's dominion over the earth and all it contains, than the supply of coal and iron which he has used for every kind of purpose. When men had nothing but flint stones to make their weapons and their tools, it was quite impossible for them to reach any notable height of material civilization. Even when they had possessed themselves of bronze and brass there was much still quite beyond their reach, without which at the present day we should hardly consider life worth living. We need iron equally for purposes of agriculture, of manufacture, and of locomotion; all that constitutes the special glory of the nineteenth century depends absolutely on our possession of this metal; and to have iron to use, or to be able to use it when we have it, we require coal. Assuming therefore that England at the present day presents a fair sample of the highest stage of development yet reached by man, we have to acknowledge that, if we have attained it, the fact is to be attributed quite as truly to our coalfields as to ourselves, and we wish to know how it came to pass that, in the first place, our race possessed potentialities which could be realized only by the existence of something quite distinct from ourselves and beyond our control, and in the next place how it came about that what we thus required lay ready and awaiting us.

On these points Professor Huxley apparently intends to enlighten us in his well-known lecture on the Formation of Coal.[1] In listening to him we have the satisfaction of knowing, not only that he is probably the ablest advocate of the evolutionary creed, but that in particular he pleads guilty to an ineradicable fondness for clear speaking, and is most severe on the speech which darkeneth counsel, as he finds it exhibited in the writings of Suarez. Moreover, he was accepted by Mr. Darwin himself as the clearest expositor of his theory, as one who made the matter so plain that to none but a blockhead could it fail to be as clear as daylight.[2] Therefore, if there is an explanation forthcoming from the evolutionary standpoint, it is from this writer that we may expect to learn it. To what does Professor Huxley's explanation amount?

In the first place, he fully concedes to coal the important place in the history of development that we have claimed for it. Speaking of the growth of our manufactures and industries, he tells us[3]: "Coal

[1] *Critiques and Addresses*, pp. 92—110.
[2] *Darwin's Life and Letters*, iii. p. 30.
[3] *Critiques and Addresses*, p. 109.

is as much an essential condition of this growth and development as carbonic acid is for that of a club-moss. Wanting coal, we could not have smelted the iron needed to make our engines, nor worked our engines when we had got them. But take away the engines, and the great towns of Yorkshire and Lancashire vanish like a dream. Manufactures give place to agriculture and pasture, and not ten men can live where now ten thousand are amply supported."

So far then we are clear. Coal is an essential factor in our development. But how came that factor to be supplied? There would seem to be but two possible replies, either its occurrence was due to chance, or it was due to design. But according to Professor Huxley it was due to neither. Chance, we know, he utterly repudiates as an absurd and impossible agent. As to design, it will appear to most minds, as to Professor Stokes, that it is altogether unmeaning without a designing mind, which is just the last thing which philosophers of Professor Huxley's school are willing to recognize.

What then was it that provided coal for man, if it was neither chance nor purpose? Professor Huxley tells us that it was "Nature." Early in the earth's history, he tells us,[1] "Nature" invested an enormous capital in the formation of coal-beds. Six millions of years, as he calculates, must at the least have been needed to provide them as they are, and so lavish was the process that a being capable of thinking, who had witnessed its progress, would have moralized on the wanton extravagance which she displayed in her operations.[2] But "Nature" knew better; she seems to have had always before her eyes the adage, "Keep a thing long enough, and you will find a use for it." She kept her coal stores accordingly till the eighteenth century arrived, and with it James Watt. The brain of that man was the spore out of which was developed the steam-engine, and all the prodigious trees and branches

[1] *Critiques and Addresses*, p. 106. [2] p. 108.

of modern industry which have grown out of this. "Thus," concludes the Professor, "all this abundant wealth of money and of vivid life is Nature's interest upon her investment in club-mosses and the like, so long ago. But what becomes of the coal which is burnt in yielding this interest? Heat comes out of it, light comes out of it, and if we could gather together all that goes up the chimney, and all that remains in the grate of thoroughly-burnt coal fire, we should find ourselves in possession of a quantity of carbonic acid, water, ammonia, and mineral matter, exactly equal in weight to the coal. But these are the very matters with which Nature supplied the club-mosses which made the coal. She is paid back principal and interest at the same time; and she straightway invests the carbonic acid, the water, and the ammonia in new forms of life, feeding with them the plants that now live. Thrifty Nature! Surely no prodigal, but most notable of housekeepers!"

In the name of bewilderment, what is the meaning of this? *Quid est hoc? Quantum sapio, quantum capio, quid est hoc?* Who or what is it that does all these fine things—investing capital, and saving principal and interest, and proving the thriftiest of caterers? Nature? Who is she? Or what is it? Is it meant that the coal was stored up on purpose to be burnt? Surely not, for to say this would be a piece of "coarser and commoner teleology," like saying that the eye was made for the purpose of seeing—a doctrine against which Professor Huxley pronounces anathema.[1] Is it meant, on the other hand, that coal happened to be formed by one set of circumstances, and happened to prove useful through another set, wholly and entirely different? But if so, where is the housekeeper? And why pay any compliments to the thrift exhibited in the transaction? We do not call a piece of amber thrifty because it entraps a fly, and then succeeds in securing interest as a curiosity in a museum, while keeping the principal hermetically sealed up. Are

[1] *Darwin's Life*, ii., p. 201.

words supposed to convey a meaning? and, if so, what is the meaning of "Nature"? As Mr. Wollaston well puts it,[1] "Who is this Nature, we have a right to ask, who has such tremendous power, and to whose efficiency such marvellous performances are ascribed? What are her images and attributes when dragged from her wordy lurking-place? Is she aught but a pestilent abstraction, like dust cast in our eyes to obscure the workings of an intelligent First Cause?"

That is in fact what it comes to. "Nature" is a word to juggle with. The need of purpose to explain the world is so stringent that even those who would deny it are fain to have recourse to it; essaying at once to run with the hare and hunt with the hounds, they talk in a way that means nothing at all unless it means that purpose has operated, and to escape from the necessity of admitting a mind whose the purpose is, they tell us that it was "Nature's," and that Nature is unconscious. "Some people," says Dr. Asa Gray, "conceive of unconscious purpose: it seems as easy to conceive of white blackness." If, according to Professor Huxley's own definition, Nature is "that which is," we mean no more by saying that its capital was invested in club-mosses and realized through steam-engines, than that there have been club-mosses and have likewise been engines, and Topsy's philosophy is the true one—"'Specks I growed."

This point is not an accidental and insignificant one, which may be neglected with impunity; it is really the foundation-stone on which any philosophy of the world must rest, and on which, as far as professions go, evolutionary philosophy is content to base its claims. Professor Huxley, amongst others, is very positive on the point, declaring[2] that "perhaps the most remarkable service to the philosophy of biology rendered by Dr. Darwin is the reconciliation of teleology and morphology, and

[1] *Annals and Magazine of Natural History*, Third Series, vol. v. p. 132. See *Darwin's Life*, ii., p. 284.
[2] *Darwin's Life*, ii., p. 201.

the explanation of the facts of both, which his views offer." But his championship of the doctrine, under this aspect, is precisely of the nature most calculated to ruin it. His native gift of a clearness which few can rival, when he is speaking of an object that can be clearly spoken about, is apt to let in inconvenient light on these whose only possible habitation is fog and mist. The most accurate of draughtsmen must needs fail if he essays to delineate a square triangle, or the landscape of a world of two dimensions only, and we find it quite as impossible to form an idea of the system which Professor Huxley would portray and present for our acceptance, as being that which rules the destinies of the universe.

In the first place, it is an unfortunate, but perhaps inevitable, circumstance that he should always speak of "teleology," instead of using a plain English word to express his precise meaning. "Teleology" means, from its derivation, "the science dealing with ends." But what sort of ends? The ends to which things come? or those to which they are directed? There is all the difference in the world between the two. It hardly needs a philosopher to tell us that coals come to be burnt: but it is otherwise with their being made for that purpose. The rock of St. Helena was, in a very true sense, the end of Napoleon's ambition, but to understand his life we have to consider a very different end of his schemes than this. As far as we can make out from his words, however, it is in the former sense alone that Professor Huxley speaks of "teleology." Acknowledging and glorying in the fact that Mr. Darwin's theory deals a death-blow to the idea that the eye was made on purpose to see,[1] he goes on to assure us that "there is a wider teleology which is not touched by the doctrine of Evolution, but is actually based upon the fundamental proposition of Evolution. This proposition is that the whole world, living and not living, is the result of mutual interaction, according to definite laws, of the powers

[1] *Darwin's Life*. ii.

possessed by the molecules of which the primitive nebulosity of the universe was composed. . . . The teleological and the mechanical views of nature are not, necessarily, mutually exclusive. On the contrary, the more purely a mechanist the speculator is, the more firmly does he assume a primordial molecular arrangement of which all the phenomena of the universe are the consequences."

In order to understand to what this explanation comes, we must ask what we are to understand by "laws," for these it is, apparently, that govern the process here adumbrated. Professor Huxley himself answers the question. He tells us[1] that a law is nothing more than a convenient way of stating that from past experiences we are justified in expecting certain phenomena in certain circumstances, as that a stone, if left unsupported, will fall. Moreover, he explicitly denies that "law" in his sense implies necessity. "It is very convenient," he says, "to indicate .that all the conditions of belief have been fulfilled, by calling the statement that unsupported stones will fall to the ground a 'law of Nature,' but when we change *will* into *must*, we introduce an idea which does not lie in the observed facts, and has no warranty that I can discover elsewhere. For my part, I utterly repudiate and anathematize the intruder. Fact I know, and Law I know; but what is this Necessity save an empty shadow of my own mind's throwing?" Again, in another work he declares[2] that "calling our often verified experience a 'law of nature' adds nothing to its value, nor in the slightest degree increases any probability that it will be verified again, which may arise out of the fact of its frequent occurrence."

But if this is so, what is the possible meaning of saying that the present order of the universe has been worked out "according to definite laws," and that the recognition of this fact is the truer and nobler "teleology"? If "law" is only a more con-

[1] "On the Physical Basis of Life." (*Lay Sermons*, p. 143.)
[2] "Hume," *English Men of Letters*, p. 131.

venient term for "verified experience," how does it differ from "fact"? And what more do we signify by saying that things have been worked out according to a certain law, than that they have, as a matter of fact, proceeded in a certain way? It would appear, therefore, as already said, that we are to mean no more when we speak of "teleology" than that things have resulted as they have resulted, through various stages which have been just what they were. The proposition is sufficiently obvious, but what other claim to consideration it may possess is hard to discover.

There is another point in Professor Huxley's explanation which must not be overlooked, if we wish fully to appreciate the scientific value of his system. Though, as we have seen, he repudiates and anathematizes the introduction of Necessity, and has reduced Laws to a convenient term for verified facts, he yet assures us that the said Laws enable us to forecast the future. We know, for example, that unsupported stones will fall to the ground. What is the process by which we arrive at this knowledge? "Simply, that, in all human experience, stones have fallen to the ground under these conditions; that we have not the slightest reason for believing that any stone so circumstanced will not fall to the ground; and that we have, on the contrary, every reason to believe that it will so fall."[1]

This looks very much like saying that we know they will fall, because we know it. But if anything in the shape of a reason is offered at all, it is that stones have always been known to fall. But surely that is no reason, though the phenomenon may help us to discover one. The appearance of the *Times* newspaper from Monday to Friday is not the reason of its appearance on Saturday, though I may gather from the regularity of its issue that there is a staff at work capable of making it appear again. The constant repetition of the same phenomenon tells me

[1] *Lay Sermons*, p. 143.

no more than that it is not an accident, but due to some ulterior cause producing regularity. "It may be urged," says Cardinal Newman,[1] "if a thing happens once it must happen always; for what is to hinder it? Nay, on the contrary, why, because one particle of matter has a certain property, should all particles have the same? Why, because particles have instanced the property a thousand times, should the thousand and first instance it also? It is *prima facie* unaccountable that an accident should happen twice, not to speak of it happening always. If we expect a thing to happen twice, it is because we think it is not an accident, but has a cause. What has brought about a thing once may bring it about twice. *What* is to hinder its happening? Rather, what is to make it happen? Here we are thrown back from the question of Order to that of Causation. A law is not a cause, but a fact; but when we come to the question of cause, then we have no experience of any cause but Will."

There, in effect, is the knot of the whole question. Is it possible for our minds even to conceive an intelligible solution of the problem, other than the operation of a Will? The *Times* appears, because man's will has determined its appearance; we can trace the chain of effects involved, satisfactorily, to that as the initial cause. A stone falls, because the earth attracts it; the earth attracts it because—what? Because it *does*, is the only answer vouchsafed by the new philosophy.

It is constantly assumed by our scientific expositors that, because we have tracked back the sequence of events occurring in Nature far beyond the point at which the ancients had to abandon it, we have therefore entered into the felicity proper to those who understand the causes of things. But till we find some solid ground on which to start, what else are we doing but resting the earth on the elephant, and the elephant on the tortoise? To say that the thousandth link of a chain must hang securely

[1] *Grammar of Assent*, p. 69.

because the hundredth does so, is not to tell us what supports the first. Yet it is a precisely similar conclusion with which our modern teachers would have us rest satisfied. It seems to Professor Huxley, for instance, a sufficient explanation of the origin of our present order to tell us that "the existing world lay potentially in the cosmic vapour, and that a sufficient intelligence could, from a knowledge of the properties of the molecules of that vapour, have predicted the exact constitution of the animal kingdom in Britain, to-day, with as much certainty as one can say what will happen to the vapour of the breath on a cold winter's day."

Brave words these indeed: but what, after all, do they come to? Simply to this, that one who could see what the world was going to be could predict its future. It does not follow, because I know when a clock will strike twelve, that I can tell who made it: and all that the foregoing explanation means is that the universe is a clock which at a certain remote time was going. Once more we are given as philosophy what is but a bald statement of fact.

To come back to our original example. Which philosophy seems to afford the more rational explanation of the multitudinous circumstances which have served to make the race of man what it is? Is it that which talks of Nature and Law as the ultimate agents? or that which tells us that God, making man, blessed him and said to him, Fill the earth and subdue it, and rule over the fishes of the sea, and the fowls of the air, and all living creatures that move upon the earth?

# The New Genesis.

Those who wish to understand the new Gospel of Evolution in its entirety, to see what the theory is to which, we are assured, science gives its sanction, have hitherto laboured under many difficulties. Not everyone has the time to peruse the works of Mr. Darwin and Mr. Herbert Spencer, or Professors Huxley and Haeckel; and few of those who have the time have the power to master the teaching in all its bearings, or to construct therefrom a system of philosophy. At the same time, the new ideas, of which these are the authorized exponents, are so much in the air, their praises are so loudly sung, and their superiority to old and effete notions so vociferously proclaimed, that curiosity must needs be awakened, and it must be felt as a hardship to be shut out from the intellectual wealth of the new Eldorado into which these bold explorers have pushed their way. It must, therefore, be a source of much satisfaction to have this wealth brought to our own doors, to have the evolutionary theory "in relation to the totality of things" set forth "in clear and, as far as possible, simple words." This boon Mr. Edward Clodd has conferred on the world in his *Story of Creation: a plain account of Evolution*,[1] and in studying it we have the satisfaction of knowing that we are listening to an accepted authority of the

[1] *The Story of Creation:* a plain account of Evolution. By Edward Clodd, Author of *The Childhood of the World*, &c. Fifth and sixth thousand. Longmans, Green & Co., 1888.

evolutionary propaganda. Mr. Clodd has written other books, dealing with separate branches of the evolutionist creed, works which are translated into many languages and issued in cheap editions for the benefit of school-children, and in embossed type for the blind; works which have been bought by many thousands. We need, therefore, be under no fear lest we be defrauded of enlightenment by having the great doctrine inadequately set before us.

What, then, is the outcome of this "plain account"? Obviously the work which undertakes to present it courts examination, and, as obviously, the subject calls for plain speaking. Either the evolutionary doctrine is the greatest boon ever presented by human sages to their fellow-men, or it is an utter nuisance. It claims to sweep away all existing creeds, and all the foundations on which morality has hitherto been supposed to rest; to prove them false and misleading; and to substitute for them another belief, and another basis of right and wrong, truer and more substantial. If its claim be established, it certainly deserves our unbounded gratitude, both for what it takes away, and for what it gives; but if the story it asks us to accept be an absurdity, and the foundation on which it bids us build be but a bag of wind, it becomes a manifest duty to lay bare the fraud in uncompromising terms.

Let us, therefore, study honestly, and from the standpoint of pure reason, the story of evolution as told by Mr. Clodd. In the first place, this is what the story comes to, and it shall be given, as far as possible, in his own words,

"The Universe," by which word is designated "all that exists," "is made up of Matter and Power,"[1] the power being material and inherent in the matter.[2] "The problem we have to consider is this: Given Matter and Power as the raw material of the universe, is the interaction of Power upon Matter sufficient to account for the totality of non-living and living contents of the universe?"[3] This question we are to

[1] p. 6. [2] p. 137. [3] p. 136.

answer in the affirmative. "All changes of state are due to the re-arrangement of atoms through the play of attracting forces and repelling energies"[1]; "the nebulous stuff, of which the universe is the product, held latent within its diffused vapours, not only the elements of which the dry land and the waters are built," but also all life, and man into the bargain, with all his works.[2] Life is but an arrangement of matter, so as to live; mind is but an arrangement, so as to think; the "chemic lump arrives at the plant and grows; arrives at the quadruped and walks; arrives at the man and thinks."[3] The process has been this. First from diffused matter were evolved stellar systems; and "given the play of force and energy upon the diffused matter, the mechanics of the process which resulted in the visible universe are not difficult of explanation."[4] Worlds being thus provided, the next step was to develop life. "The simplest compounds of elements were formed first, the combinations becoming more and more complex, until they reached that subtile form which is the physical basis of life, and which, starting in water as a structureless jelly, has reached its fullest development in man."[5] For finally, "mind, as a special form of life, takes its place as the highest product of Power upon Matter."[6]

Man must needs fall under the province of evolution, for otherwise evolution would not be true,[7] and accordingly, since his appearance on the earth, he has been the principal theatre for the play of its laws. He has developed, not only various races, but chiefly various mind-products; society and its laws,[8] language,[9] morals,[10] and religions[11]; the laws of society and of moral conduct being identical, and springing from his inherited knowledge as to what is good for his race; and religion being a vague and cloudy structure, compounded of ignorance and fear, a state

[1] p. 137. [2] p. 5.
[3] Quoted by Mr. Clodd from Emerson, p. 135.
[4] p. 138. [5] p. 230. [6] p. 231. [7] p. 206.
[8] p. 211. [9] p. 216. [10] p. 218. [11] p. 214.

of error, through which it was necessary for him to pass on the road to truth,[1] the frenzy of the savage and the ecstasy of the saint having a common base in undisciplined imagination. Finally, truth has been reached in the doctrine of evolution: "from the action of mind on mind, has arisen that social evolution to which, in a supreme degree, is owing the progress of man in knowledge, whereby he has subdued the earth."[2]

It cannot be denied that here is a very ample bill of fare for our entertainment. Never, surely, was such a feast of reason promised to the mind of man as is by this philosophy of the totality of things. Now shall we, at last, be enfranchised from the thraldom of mystery, and proudly stand, like Homer's warriors, looking forwards and backwards, our minds the monarchs of all they survey.

But it will, doubtless, be the part of prudence, first to examine on what basis all these pretensions rest; what bridges are afforded us to span the chasms over which we have to make our way, as we follow the course of things from the beginning to the end. Nay, what about the beginning? Mr. Clodd calls his book *The Story of Creation;* but creation is precisely that which he does not tell us about, and about which he confesses he has nothing to tell: "the whence of the nebula and its potential life," being "an abiding mystery that overawes and baffles us."[3] "Of the beginning, of what was before the present state of things, we know nothing, and speculation about it is futile."[4] Nor only that: the beginning is, to the evolutionist, so hopeless a mystery, that he cannot even find a name for it, but must needs call it "creation," though creation evidently implies a Creator, and that is just what the whole story is meant to dispense with. Therefore, as the first stage in this supereminently rational inquiry, we must, like good little children, open our mouths, and shut our eyes, and swallow down the first bolus of mystery,

[1] p. 227. [2] p. 231. [3] p. 5. [4] p. 136.

and of mystery to which we postulate that there can never be a solution; either for our mind or for any other; since it is written: "Positive knowledge does not, and never can, fill the whole region of possible thought.[1] At the uttermost reach of discovery there arises, and must ever arise, the question, What lies beyond?"[2] Therefore, as Mr. Clodd naïvely confesses, to get to work at all, we must take things as we find them, and elect to begin somewhere. "Since everything points to the finite duration of the present universe, we must make a start somewhere. And we are, therefore, compelled to posit a primordial, nebulous, non-luminous state, where the atoms, with their inherent[3] forces and energies, stood apart from one another."[4] Which, being interpreted, means that we must take for granted that matter existed; and existed in a state contrary to that whereto the exercise of its own forces tends to bring it. Its atoms were far apart to begin with: they have been drawing nearer and nearer to one another ever since.

Here, therefore, at the very first throw-off, we experience a check, which promises to be final, and which must needs set us a-questioning our instructor. If he knows nothing about it, how comes he to be able to explain it all? Granting matter to be self-

[1] Verily this is a hard saying. "The region of possible thought" must be that in which thought is possible; and the region to which thought cannot penetrate must be impossible to it. But thought penetrates a subject only by knowledge. Therefore, to say that knowledge cannot fill the region of possible thought seems to be the same as saying that there is a region of possible thought wherein thought is impossible.

[2] Herbert Spencer, *First Principles*, p. 16 (3rd edition). Quoted by Clodd, p. 5.

[3] "The word 'inherent' passes with some people for an explanation, but, unfortunately, it is the very thing that wants explaining. 'Inherent' only means sticking in, and nobody will doubt that if such a power once got into an atom it would be likely to stay there. . . It is amazing that people in this boasting age of science should promulgate and accept such empty phrases as these for a solution of the problem of the origin of the laws of nature or the present state of the universe." (Lord Grimthorpe, *Origin of the Laws of Nature*, pp. 27, 28.)

[4] p. 137.

existent, an enormous concession, what about its forces; and what about its primordial state? The forces of nature could never have got it into that state, from which, as science demonstrates, they can only more and more remove it. Yet there the state was, and it requires to be accounted for. It is, moreover, the foundation of all that has since been made of matter; therefore, till it be explained, nothing is explained. That the teaching of science is as I have stated, we need not go far to show. "Astronomy," Professor Huxley tells us,[1] "leads us to contemplate phenomena the very nature of which demonstrates that they must have had a beginning, and that they must have an end." It is supposed, says Balfour Stewart,[2] that the particles of matter originally existed at a great distance from each other; and that, being endowed with the force of gravitation, they have since gradually come together, generating heat in the process; and that they will continue to approach one another, till further motion becomes impossible, and heat can no longer be produced. "The process goes on, and always in one direction."[3] The tendency, therefore, of the particles which make up matter, when left to themselves, is to come together: how came they at first to be apart? And as their being apart was necessary for all the work[4] ever to be done in the universe, we understand nothing till we understand this.

But we have by no means as yet got clear of our difficulties. It is very easy, and rhetorically very advantageous, to talk about "matter" as existing of itself, and endowed with forces, and with that still

[1]*Lay Sermons.* "On the advisableness of imparting Natural Knowledge."

[2] *Conservation of Energy*, p. 151.

[3] The term *work* in scientific language designates the change of condition of a body, as from motion to rest or rest to motion, from one temperature to another, or from one chemical or electrical condition to another, as will be seen later.

[4] Balfour Stewart, *Conservation of Energy*, p. 142.

more convenient attribute, "potentialities." But what does this word "matter" stand for? Not for one thing, but for hundreds of millions of billions of totally distinct and independently existent atoms, each having its being of itself, without owing anything to any other; not to be changed or subdued by any force in nature. Through all change of circumstances and surroundings, Mr. Clodd tells us, an atom remains unchanged. "It matters not how many millions of years have elapsed during these changes, age cannot wither or weaken it; amidst all the fierce play of the mighty agencies to which it has been subjected, it remains unbroken and unworn"[1]: and it seems to him appropriate to apply to the atom the words of the Apostle, "The things which are not seen are eternal."[2] So stubborn, in fact, and untamable are these atoms, that, as Lord Grimthorpe has well remarked,[3] the materialist doctrine really means, "Every atom its own God." How, then, comes it, that they are so law-abiding a race? that they have combined to work out that order of the universe which affects none of them one whit? that they have agreed each to be like some atoms, and unlike others?[4] How in particular has it been arranged that their ceaseless jarrings and buffetings should produce the harmony we witness? For work is done in the universe only where there is resistance to force; and if the elements had not agreed to differ, and had not been in a condition to differ with effect, there could have been no heat and no life upon the earth.

Such are a few of the difficulties which lie upon the threshold over which we are invited to trip so easily, when we are asked to "posit" a primordial nebulous, non-luminous state, where atoms endowed

[1] p. 11. [2] p. 11.

[3] *Origin of the Laws of Nature*, p. 29.

[4] There are, so far as science knows, about seventy kinds of atoms, from which, as from letters of the alphabet, all material things are composed; as oxygen atoms, hydrogen atoms, carbon atoms, iron atoms.

with inherent forces and energies stood apart from one another; as being a simpler and plainer account of the matter than the old one, that "In the beginning God created the heavens and the earth."

But perhaps it is only the first step which is hard, and if we can make up our minds to jump blindfold across this preliminary abyss, we shall be rewarded by finding our lines laid in pleasant places on the further side. Let us try. After the genesis of matter, the next great problem which we have to face is the genesis of life. What explanation has the evolutionist to offer in regard of this? Alas! "The ultimate cause which, bringing certain lifeless bodies together, gives living matter as the result, is a profound mystery"[1]: that is all. Again, a gulf that may not be passed yawns across our path; and again, just when we want him, our guide is as ignorant as ourselves; while the old story which he asks us to discredit in favour of his own goes unfaltering on: "And God said: Let the earth bring forth the green herb . . . and He said: Let the waters bring forth the creeping creature having life, and the fowl that may fly over the earth . . . and let the earth bring forth the living creature in its kind. And it was so done."

As with life, so with Mind. We are assured over and over again that it is only a form of matter; but when we come from assurances to demonstration, we must be fain to rest content with the soul-satisfying declaration that "the gulf between consciousness and the movement of the molecules of nerve-matter is impassable,"[2] or, as Professor Tyndall more elegantly puts it, "unthinkable."

What then, with all these monstrous limitations are the credentials of the evolutionary creed? What is the purport of the evidence of that "cloud of witnesses" which, we are told, science brings to prove "the unbroken intercalation of all things"?[3] Truth to tell, nothing could more accurately describe

[1] p. 149. [2] p. 152. [3] p. 145.

the character of the testimony presented, than to call it a "cloud"; unless, indeed, it were to be called a "fog." The one fact given us is, the existence of evidence to show that various species of plants and animals have probably, or possibly, been developed one from another. This, so far as it goes, is matter for scientific treatment; and the theory of evolution, within the limits thus afforded, has a right to be called a scientific hypothesis. But, whether this portion of the theory be true or no, it assuredly does not furnish a foundation for a doctrine of evolution extending to the "totality of things." Yet this is precisely what it is assumed to do. Taking it as proved that animals and plants have developed into fresh species, it is taken for granted that evolution is, therefore, a law, extending backwards into the inorganic world, and forwards into the mind of man. Yet nothing could be more utterly unlike than the processes which are thus conveniently grouped under the one term of "evolution." Let it be a fact, that a fish has developed into a bird, because, in the struggle for existence, bird-like qualities enabled it to outlive other sons of fishes; what possible light does this throw on the question as to what induced atoms of oxygen, hydrogen, carbon, and nitrogen to combine into living tissue? The atoms gained nothing, as atoms, by so doing. *They* have no struggle for existence, for, as we have heard, they are eternal; they are as much atoms, and mere atoms, of oxygen and nitrogen in the brain of a man, as in the vapours of a nebula; only that and nothing more. The one element which is proclaimed to be the mainspring of organic evolution is totally and absolutely wanting in the inorganic—the element of strife for survival. And on the other hand, nothing can be more diametrically opposed than the selfish struggle between individuals of the same species, to which, we are told, organic development is due, and the virtues which, since Christianity has been seen on earth, men have perforce agreed to esteem; charity, justice, and compassion. The struggle for existence on which Darwinism is built, so far as it has modified species, has been a struggle, not between creatures of different kinds, but between those of the same kind; the strong trampling out the weak, the robust crushing and exterminating the feeble. No individual animal or plant has ever, or is ever supposed to have, striven for the good of its race, but for its own; and it has benefited the race only by making itself, through successful struggle, a more vigorous progenitor for its own offspring. Yet because animals have thus struggled, the fittest always surviving and making the weakliest go to the wall, we are asked to believe that man has, as their inheritor, naturally evolved the instinct of doing good to others, of self-conquest, of obedience,[1] of everything in short which is the exact opposite of the instincts whence his are said to be derived.

Yet this false analogy, founded on inexact and unscientific use of words, is absolutely the only shred presented to us which can, even by courtesy, be called an attempt at proof. For the rest, there is nothing but bald assertion, bad science, and, above all, vague dithyrambic declamation, which, considered as poetry, is very poor stuff indeed, and, considered as philosophy, has absolutely no meaning. This last is indeed the war-horse of your evolutionist, and he always, while modestly proclaiming his weakness for "simple and plain language," contrives to spin for himself a web of phrases in which we can find only what Hamlet found in the letter, Words, Words, Words. It seems in fact to be a maxim with such writers, that a difficulty is got over by describing it in terms coined from the Latin or the Greek—a sort of embossed type for the blind, the force of which, if not seen, can at least be felt, like the blessed word Mesopotamia. From plain English they flee, as from the face of a serpent. The great prophet of evolution himself has set the

[1] p. 224

example in the celebrated dictum, "Evolution is a change from an indefinite, incoherent homogeneity, to a definite, coherent, heterogeneity, through continuous differentiations and integrations."[1] The disciples prove themselves apt imitators of the master. Take, for example, the following piece of demonstration concerning the distinction between living and lifeless matter.[2]

"Speaking relatively—for nothing is absolutely motionless—the crystal is stable, irresponsive: the cell is plastic, unstable, responsive, adapting itself to the slightest variation; it 'stoops to conquer,' and so undergoes ceaseless modification by interaction with its ever-changing environment. Life involves delicacy of construction; hence the transient nature of the organic in contrast to the abiding nature of the inorganic. And, strange as it may seem, separation is life; integration is death. For life is due to the sun's radiant energy, which, setting up separative movements, enables the plant to convert through its mysterious alchemy the lifeless into the living, thus forming energetic compounds which are used, partly by the thrifty plant for its own vital needs, and largely by the spendthrift animal for its nutrition, to repair waste and maintain functions. Ultimately the energy thus derived from the sun, directly by the plant and indirectly by the animal, passes into space, and 'the dust returns to the earth as it was.' For life is only a local and temporary arrest of the universal movement towards equilibrium."

Of a truth, here is plain and simple language, adapted to the meanest capacity; and proving to demonstration the thesis which it is brought to sustain, that "the origin of life is not a more

[1] Herbert Spencer, *First Principles.* Thus unfeelingly Englished by Mr. Kirkman: "Evolution is a change from a no-how-ish, untalkabout-able, all-alikeness, to a some-how-ish, and in-general-talkabout-able, not-all-alikeness, through continuous something-else-ifications and stick-together-ations."

[2] p. 151.

stupendous problem than the origin of water."[1] Surely, if clear utterance denotes clear thinking, we have it given us to drink a crystalline draught of thought.

But the writer has not in the foregoing passage put forth all his strength. Here is another, pitched in a higher key of the style I call dithyrambic. It is designed to do away with the slight difficulty presented by the fact that the machinery of the universe is found by science to be running down like a clock, that the inevitable end of all life is seen to be approaching, and that the phenomena from which we learn this tell us also that there was a definite beginning. "The ultimate transference of all energy to the ethereal medium involves the end of the existing state of things. But the ceaseless redistribution of matter, force-clasped and energy-riven, involves the beginning of another state of things. So the changes are rung on evolution and dissolution, on the birth and death of stellar systems—gas to solid, solid to gas, yet never quite the same—mighty rhythmic beats, of which the earth's cycles, and the cradles and graves of her children, are minor rhythms."[2]

This is certainly pretty well for a man who confesses that he knows nothing of what he is talking about, that "of what was before the present state of things, of what will follow the end of it, we know nothing, and speculation is futile:"[3] for through the nebulous, non-luminous stuff, of which, like his primeval universe, our author's explanations are composed, there glimmers unmistakably the assertion, decently wreathed in vapourings to veil its crude absurdity, that there never was a beginning and never will be an end; that the teaching of science is, "One universe down, and another come on."

[1] p. 150. The origin of life is on p. 149 "a profound mystery." Here "it hides no profounder mystery than the lifeless." On p. 230 it is fully explained by calling the combinations of elements producing it "subtile." [2] p. 231. [3] p. 136.

Till I read such productions as this, I used to fancy that the author of *Dombey and Son* had overpassed the limits of caricature in the speech assigned to Captain Bunsby. I now conceive this great man to have been an evolutionist, evolved before his time, and his oracle as to the likelihood of a certain son and heir having gone down, to be a foreshadowing of the pronouncement of sages as to the coming up of the son and heir of evolutionary ages. "What I say, I stand to. Whereby. Why not? Do I believe he's gone down? Mayhap. Do I say so? Which? A skipper isn't forced to run upon the Goodwins. But he may. The bearing of this observation lays in the application on it. That ain't no part of my duty. Avast then: keep a bright look out, and good luck to you."

To take one more specimen of what the old Areopagites called "word-scattering," which common folk call "talkee-talkee," and evolutionist philosophers call "proof." Let it be this time the supply of an acknowledged want in evolutionary machinery that serves as a sample.[1]

"Professor Huxley says, that 'the great need of the doctrine of evolution is a theory of variation.' When, however, we consider the minute complexity of structure of living things invisible to the naked eye, and their response to every shiver of energy from without, we have sufficing factors to produce unstableness, which will result in unlikeness of parts. Given a body which, although a minute speck, contains billions of molecules performing complicated movements of immense rapidity, and sensible in an inconceivable degree to the play of vibrations impinging upon them at the rate of hundreds of trillions per second, would not the marvel be if these quivering particles of the structure, shaken by energies within, and by still more potent energies without, did not undergo continuous redistribution?"

From this style of argument it would appear, so far as it is possible to attach to it any meaning

[1] p. 162.

whatever, that a sledge-hammer being a sufficing factor "to produce unstableness" in a lever watch, it would be a marvel if it did not convert it into an eight-day clock. Is not this sort of thing worth translating, for the benefit of Finns and Sekwanas? and a boon whereof school-children should by no means be defrauded?

The field we have been exploring is so vast that, to get on at all, we must take a hint from Mr. Clodd, and elect to make an end somewhere: so I will content myself with these specimens—albeit there are finer to be found—proceeding at once to another point, whereto some of the above quoted utterances will serve to introduce us.

Many of my readers will doubtless have been puzzled by Mr. Clodd's use of the term "energy," and puzzled they well may be, for thereby hangs an extraordinary tale. The great obstacle which science throws in the way of the eternity of the universe, of that mighty rhythmic beat and those misty cycles, chanted by Mr. Clodd, is the doctrine of the Conservation of Energy. According to this, which now takes rank among physicists with the doctrine of gravitation, energy is defined as the power of doing work, and work is done when the state of a body is changed. Work is done in the impact of a rifle-bullet upon a target by the heat and change of form that results in both. The sun does work upon a pool of water by vaporizing it, or upon a lump of ice by melting it. Work is done in the burning of a candle, in the first place by chemical combination between its carbon and the oxygen of the air, and then by evolution of heat in the process. Work is likewise done when a stick of sealing-wax is rubbed on a cloth and becomes electrified, and it can then do the work of electrifying another body, or of moving such objects as scraps of paper, or pith-balls. It is thus evident that one sort of energy can be changed into another: motion, into heat or electricity, and *vice versa*. Moreover, energy can exist in two conditions, kinetic and potential. Kinetic energy is the energy of movement, potential energy that of position. The rifle-ball flying to the target has kinetic energy only—it can do work only because it is in motion. The water in a mill-reservoir has energy of position only—it can do work because it has been raised up against gravity, and because gravity will pull it down again when it has the chance, and so enable it to do work by turning the mill-wheel. Energy, therefore, is to be found in a body, only when work has been done upon that body; on the bullet by the explosion of gunpowder; on the water by the sun's evaporation, or the pressure of other water, or the pumping of a steam-engine. Therefore energy, as we know it, is the product of force: and it is always expended in doing work. Another important point of the doctrine is that though the sum of energy, in the universe, is constant, the sum of energy available for work is growing continually less. The energy of motion can be entirely converted into heat, but heat cannot be entirely converted back into motion; from which it must inevitably come to pass that heat will supplant motion and become the form of energy dominant in the universe. But heat, in the first place, never brings all its force into play to do work. Much of it is radiated into space, into what Mr. Clodd calls the ethereal medium, and does no work, because it finds nothing to act upon.[1] In the second place, heat can do work only between bodies of dif-

[1] "Universally diffused heat forms what may be called the great waste-heap of the Universe, and this is growing larger year by year." (Balfour Stewart, *Conservation of Energy*, p. 153).

I am aware that Professor Crooke, whose authority as a chemist is very great, has, with the sanction of Professor Stacey, suggested a theory to meet the difficulty thus presented; namely, that the heat radiated to the confines of space there generates new operative energy and brings it back thence into the universe, thus keeping the store of available energy ever up to the same level, and that he says, "Hence Sir W. Thomson's startling prediction falls to the ground." (See the *Times*, April 4, 1888.)

But I observe that he speaks of this only as "hazarding a conjecture," and of the work being done "by some process of nature not yet known to us." It is clear, therefore, that the

H

ferent temperature; once obtain thermal equilibrium between two bodies, and they can no more do work upon each other, than two ponds at the same level can establish a mill-race between them. As heat always tends to produce such equilibrium, the warmer body heating the cooler, and that cooling the other, by absorbing more heat than it returns, it follows that the time is coming on when heat can do work no more, and when, mechanical energy being changed into universally diffused heat, "the universe will no longer be a fit abode for living beings."[1]

It is by this line of argument that science demonstrates the essentially finite nature of the present state of things. The end, as we see, is inevitable, and no less obvious is it that there was a definite beginning. If the machine of the universe is ever spending its working energy, it cannot have been going for ever, or the energy would have been expended long ago.[2] It is clear that, when the

theory gains nothing from his authority as a chemist, and this is a case wherein is apposite the remark of Lord Rayleigh:

"It would be easy to lay too much stress upon the opinion even of such distinguished workers as these. Men who devote their lives to investigation cultivate a love of truth for its own sake, and endeavour to clear up, and not, as is too often the object in business and politics, to obscure a difficult question. So far the opinion of a scientific worker may have a special value; but I do not think that he has a claim, superior to that of other educated men, to assume the attitude of a prophet. In his heart he knows that underneath the theories he constructs there lie contradictions he cannot reconcile. The higher mysteries of being, if penetrable at all by human intellect, require other weapons than those of calculation and experiment." (*Presidential Address to the British Association*, 1884.)

[1] Balfour Stewart, *Conservation of Energy*, p. 142.

[2] "It has been well pointed out by Thomson, that looked at in this light, the universe is a system that had a beginning and must have an end; for a process of degradation cannot be eternal. If we could view the universe as a candle not lit, then it is perhaps conceivable to regard it as having been always in existence; but if we regard it rather as a candle that has been lit, we become absolutely certain that it cannot have been burning from eternity, and that a time will come when it will cease to burn." (Balfour Stewart, *Conservation of Energy*, p. 153.)

machine was first endowed with energy, it not only got that sum which it now possesses, but got it in a highly advantageous form; probably, so far as science can tell, in the form of very violent motions, since toned down in the production of heat and electricity. If we are, as a start, to "posit" atoms at great distances from one another, we must either suppose that they were posited there by someone; or that there is a natural force that can drive them apart, against the action of gravity tending to draw them together, and, in fact, drawing them continually together more and more. Once get the atoms apart, and no doubt we get the potentiality of plenty of motion, from the power of gravity; just as when we get a mass of water into a tank on a hill. But where is the power which is to do this work? Hitherto it has been unknown to science.

Such a power being, however, a necessity of evolutionary theory, it has, in accordance with the fitness of things, been itself evolved by Mr. Clodd, with the assistance of Mr. Grant Allen. They felt "the difficulty arising from the lack of precision in standard books on physics, in the use of the terms 'force' and 'energy,'" and determined to meet it, by giving "rigid and definite meanings" to the terms, so as to afford "a clearer conception of cosmic dynamics." A precious theory it is that this pair of philosophers have excogitated, and employment of their "rigid and definite" meanings of terms, would ensure the plucking of a schoolboy at the hands of any examiner who knew his business. In brief, their novel doctrine is this. Energy, instead of being a product of Force, is an independent and antagonistic Power counteracting the work of Force; belonging to matter, but not inherent in it, whatever that may mean, and capable of being passed about from one particle to another, like the one eye and one tooth which the Grey Sisters had amongst the trio, or like the books in Mudie's Library. Energy tends to separate bodies, as Force to draw them together. "Force is the attracting or pulling power;

Energy is the repelling or pushing power, and by the antagonism of these the work of the universe is done."[1] "If Force had unresisted play, all the atoms in the universe would gravitate to a common centre, and ultimately form a perfect sphere in which no life would exist, and in which no work would be done. If Energy had unresisted play, the atoms in the universe would be driven asunder and remain for ever separated, with the like result of changeless powerlessness. But with these two powers in conflict, like the Ahriman and Ormuzd of the old Persian religion, the universe is the theatre of ceaseless redistribution of its contents, whether in the sweep of the stars and their attendant systems through space, or in the pendulum-like vibration of the invisible particles of every body, or in the throbs of the ethereal medium."[2] It is the introduction of this sort of Energy that renders the mechanics of the process of making worlds "not difficult of explanation." And the explanation of the process runs thus:

"The Force bound up in each atom, acting as affinity, combined the atoms as molecules; acting as cohesion, it united the molecules into masses; acting as gravitation, it drew the masses towards their several centres of gravity. As the atoms rushed together, Energy, which had hitherto existed in a state of rest as passive separation, became active in *molar* and *molecular* form. As *molar* energy, IT IMPARTED MOTION TO EACH MASS[3]—a motion of rotation on its own axis and motion in an orbit. As *molecular* energy, it IMPARTED a rapid vibratory, backwards and forwards MOTION to the molecules."[4] This Energy is, therefore, a highly convenient factor for evolutionary purposes in cosmic dynamics. The only difficulty is that it is, not only unknown to

[1] p. 14.

[2] p. 14. It is perhaps worthy of note that a few pages earlier (p. 7) the existence of this ethereal medium is only a "probability."

[3] The emphasis in these words is mine. The italics are the author's.

[4] p. 138.

science, but is directly opposed to those laws on which physical science rests. The first of Newton's great laws is, that a body at rest will continue at rest unless moved from outside, as it will, if in motion, continue in motion unless similarly stopped. But here is a power (Mr. Clodd will not allow us to call it a force) whereby a body moves itself, and he asks us to believe that if the moon does not fall upon the earth it is because this inherent[1] energy holds it off, not because its orbital velocity is the resultant of the various attractive forces to which it has been subjected. Mr. Clodd's Energy is much of a piece with that to which Mr. John Morley has given countenance,[2] and which Baron Holbach imagined. "Motion," the Baron taught, "is a fashion of being which flows necessarily from the essence of matter." The doctrine thus stated does not need the authority of Newton to condemn it. A "tendency to move" is inconceivable without a definite direction in which that tendency lies. The tendency of a particle to move indefinitely in all directions is equivalent to a tendency to stop where it is, like a donkey between innumerable bundles of hay. And how is the particle to get from itself a preference for one direction over another, when all are, for its private purposes, one as good as another?

It must also be remembered that there are repulsive forces known to science, such as that of the magnet. But these are true forces, acting according to the laws of force, not according to that of energy; but constantly existent and active, not spent, like energy, in doing work. Such forces Mr. Clodd apparently finds so repulsive that he never mentions them; they are conspicuous by their absence from his tabular summary of forces and energies. Are they absent because he knows nothing about them? or because their presence would be inconvenient, as

[1] Although energy is, on p. 13, stated to be inherent in matter, yet, as on p. 137, energies *are* inherent, I conceive myself to be justified in using the term.

[2] *Fortnightly Review*, August, 1878.

upsetting his rigid and definite definitions of force as a pulling and of energy as a pushing power? In either case it is a serious matter for an instructor to make such a mistake, who is so desperately anxious to teach everybody.[1]

Thus, then, is evolutionist machinery manufactured, and the spectacle is, not only an edifying one, but instructive too. If such wild attempts are made to fill the gap, it shows that there is a gap to be filled, and that the properties of matter do not suffice to fill it. Energy there must be, to be sure, somewhere, to account for the fact that the machine of the universe works, but science has availed to show that it cannot be the energy of material force alone. No tinkering with terms, no new and rigid definitions of meanings, will suffice to supply the void.[2] With Mr. Herbert Spencer himself we are

[1] There is also another new wheel to the coach in the shape of electrical units, though what these may happen to be must be left to be gathered from Mr. Clodd's own note: "This concept of electrical units, which may be the equivalent of polarity of the atom, is here added merely as a convenient mode of envisaging a certain order of phenomena." (p 17.)

[2] Since this paper was written, Mr. Grant Allen's work on this subject has been reviewed in *Nature* by Professor O. J. Lodge. (January 24, 1889, pp. 289 seq.) From this review I extract the following passage: "There exists a certain class of mind, allied, perhaps, to the ancient Greek Sophist variety, to which ignorance of a subject offers no sufficient obstacle to the composition of a treatise upon it. It may be rash to suggest that this type of mind is well developed in philosophers of the Spencerian school, though it would be possible to adduce some evidence in support of such a suggestion.

"In the volume before us, Mr. Grant Allen sets to work to reconstruct the fundamental science of dynamics, an edifice which since the time of Galileo and Newton, has been standing on what has seemed a fairly secure and substantial basis, but which he seems to think it is now time to demolish in order to make room for a newly excogitated theory. The attempt is audacious, and the result—what might have been expected. The performance lends itself to the most scathing criticism; blunders and misstatements abound on nearly every page, and the whole structure is simply an emanation of mental fog. . . The puzzle (of the moon's centrifugal motion) was solved completely long ago, in the clearest possible manner, and the 'Principia' is the witness to it; but it is still felt to be a brought to the conclusion, that, "amid the mysteries which become the more mysterious the more they are thought about, there will remain the one absolute certainty, that we are ever in presence of an Infinite Eternal Energy from which all things proceed."[1]

This brings us to the last point, which at present I propose to treat, and the most fundamental of all. What can we know beyond the objects of sense? Can we ascend from the seen to the unseen? Mr. Clodd is very positive that we cannot, and that any attempt to do so violates the fundamental principles of right reason. His arguments on the subject are exactly represented by those of Professor Paul Darnley in Mr. Mallock's clever extravaganza.[2] "He first proclaimed to his hearers the great primary axiom in which all modern thought roots itself. He told them that there was but one order of things, it was so much neater than two; and if we would be certain of anything, we must never doubt it. Thus, since countless things exist that the senses can take account of, it is evident that nothing exists that the senses cannot take account of. The senses can take no account of God; therefore God does not exist. Men of science can only see theology in a ridiculous

difficulty by beginners, and I suppose there is no offence in applying this harmless epithet to both Mr. Grant Allen and Mr. Clodd, so far as the truths of dynamics and physics are concerned. . . . His difficulties about understanding normal acceleration and the generality of Newton's second law were natural and excusable. though hardly the subject to write a book about. . . . The thing which strikes one most forcibly about the physics of these paper philosophers is the extraordinary contempt which, if they are consistent, they must or ought to feel for men of science. If Newton, and Lagrange, and Gauss. and Thomson, to say nothing of smaller men, have muddled away their brains in concocting a scheme of dynamics wherein the very definitions are all wrong; if they have arrived at a law of conservation of energy without knowing what the word energy means. or how to define it; if they have to be set right by an amateur who has devoted a few weeks or months to the subject, and acquired a rude smattering of some of its terms—what intolerable fools they must all be!"

[1] *Nineteenth Century*, January, 1884, p. 12.

[2] *Positivism on an Island; or, The New Paul and Virginia.*

light; therefore theology has no side that is not ridiculous." Similarly Mr. Clodd, on the ground that our senses can take no account of anything but the changes of matter, pronounces that to say there can be substance which is immaterial is "the unverifiable assumption of dogmatic theology,"[1] and, as he elsewhere declares that "a dogma learned is only a new error," it is plain that theology deals only with fable.

The province of our reason, in fact, comes to an end, he assures us, with the visible, the ponderable, and the measurable. "Beyond that barrier we cannot go. We can neither affirm nor deny; we can only confess ignorance."

But it is obvious that ignorance is just what he does not confess. There are indeed acknowledged gulfs of mystery in his way, but he knows all about what there is on either side of them, and across them into the bargain, of that "unbroken intercalation of things" which extends from end to end of the world's history; he knows, for he has told us, how worlds were formed; that the living differs from the non-living only in the mixing of its particles[2]; that man is identical, as to "the stuff of which he is made," with the meanest flower that blows; that there is nothing in him which is no part of the material contents of the universe, and no free-will which lies outside the range of its causation[3]; and that his mind is but a product of matter and material power, being nowise different in kind from the structureless jellies which are the lowest form of life,[4] and to which he finds applicable the description by Scripture applied to the Almighty, "Thou art the same, and Thy years shall have no end."[5] In a word, "Thought and emotion are as completely within the range of causation, and as capable of mechanical explanation, as material phenomena,[6] although language marks the impassable gulf between the mental capacity of man and every other animal."[7]

[1] p. 152. [2] p. 149. [3] p. 206.
[4] p. 230. [5] p. 158. [6] p. 6. [7] p. 215.

It thus appears that though the assumed limitations of our knowledge will serve, as well as any other stick, to beat the theological dog, they are altogether inoperative to control evolutionary dogmatism. But what is to be said as to the assumed limitation? Is it true that we can argue from the seen only to the visible? Do we violate any rule of reason in deducing an unseen cause from an observed effect, or the existence of that which is not subject to the laws of matter, from a study of those laws?

It is in the first place clear that no one does or can limit the province of his knowledge by the range of his senses, and that evolutionists do so least of all. To say nothing of that chimerical energy whereof we have heard, who has ever seen or felt or weighed force? We talk about gravitation, and assume its existence as a sort of axiom, yet what have we to show in proof of our belief? Simply the fact that bodies are observed to tend to come together, according to a law which nothing else we can imagine will explain. And it does not matter that the theory of gravitation is beset by such difficulties as to make Sir John Herschel call it "the mystery of mysteries," and Faraday consider it an evident paradox. There are the facts, and they must have some explanation, and this explanation is at least less difficult than any other. So again of the luminiferous ether, Mr. Clodd's "ethereal medium," we have no proof whatever that there is such a thing, except the fact that there is such a thing as light, and that we can account in no other way for light being possible. And yet we are, for various reasons, compelled to attribute to this substance qualities which to the experience of our senses seem absolutely contradictory. It is so much thinner than the thinnest gas as to offer no resistance whatever to planets ploughing their way through it; yet it is not a gas, nor even a liquid, but a solid, at least as solid as a jelly.[1] Whence again, except

[1] See Lord Grimthorpe's *Origin of the Laws of Nature*, p. 31.

from such process of reasoning from effect to cause, can we know anything about those potencies or potentialities of matter in which good evolutionists so devoutly believe? How does Mr. Clodd know that his primordial nebulous stuff "held latent within its diffused vapours all that, through work of man for good or ill, has composed the warp and the woof of this world's strange, eventful story,"[1] or, in plain English, man and all his works? He himself, in fact, tells us in many places that this is the method of argument on which science rests. Thus, for his cosmic dynamics, it is necessary, not only that atoms should be posited far apart, but that they should be posited irregularly, so as to provide different densities of matter. Why so? Because "on no other theory is its segregation into a multitude of bodies explicable."[2] So again the great theory of the conservation of energy "does not admit of demonstration, but justifies itself as the only tenable explanation of the several states and distribution of bodies in space."[3] And have we not been told, in terms as clear as those of the oracle at Delphi, that electrical units are but a concept, introduced as a convenient mode of envisaging phenomena?[4]

It is therefore plain that error lies, not with him who argues from the sensible to what is beyond sense, but with him who argues wrongly, who professes to find a conclusion in premisses which do not contain it, or attributes effects to a cause which could not produce them. Mr. Clodd tells us[5] that "'The Law of Parsimony' forbids us to invoke the operation of higher causes to account for effects which lower causes suffice to explain." But there is a still more stringent law telling us that every effect must have a sufficient cause, and that if a lower cause be insufficient, we are therefore compelled to admit a higher, even though that higher cause, in its own nature, be beyond the scope of our

[1] p. 5. [2] p. 141. [3] p. 140. [4] p. 17. [5] p. 149.

intellect. If material causes be inadequate to explain the effects we observe in matter, we are led by sheer necessity to the recognition of a cause which is not material. And that material causes are inadequate, as a basis for the philosophy of the universe is just what science proves. When men knew less about matter and its laws, it was conceivable that they should attribute to matter the powers which were needed for the beginning of things, and imagine the fire, or the wind, or the swift air, or the circle of the stars, or the great water, or the sun, or the moon,[1] to be the ultimate rulers of the universe; though even long ago it was taken to be the part of wisdom bluntly to call such men fools. But now that physical science has been developed, we may say of such beliefs, as Mr. Clodd says of theology, that they are begotten of sheer ignorance. We know enough about the laws of matter to be able to say, not only what it can do, but also what it cannot. We know its laws of motion, of crystallization, of chemical combination, sufficiently at least to be assured that it cannot break them, and to be able to foretell what it will inevitably do in given circumstances. We have in fact pried so far into its constitution as to know, not only what is there, but what is not there, and to be assured that it does not contain the First Cause.

To take an example. In an egg, which is the type of the physical origin of all animal life, not only do we not find any of those parts, muscle, nerve, or bone, which, in suitable conditions, are thence developed, but the microscope demonstrates their non-existence. Neither are they introduced from without. Yet in the egg they are bound to appear. We know exactly of what elements the egg-contents are composed, how much oxygen, how much hydrogen, how much nitrogen. We can blend them in those proportions accurately for ourselves; yet cannot all the powers of science make an egg that shall hatch

[1] Wisdom xiii. 2.

so much as a tadpole.[1] It is evident that there is a something present which the science that deals with matter cannot detect, and this something is the real cause of the developments ensuing, and determines them in the definite directions they assume, "whether it is to be a mollusk, a frog, or a mammal that is to be developed from apparently identical primitive cells."[2]

This problem is, of course, according to his wont, airily solved by our evolutionist. "The answer obviously is that, *the ingredients being the same, the difference must lie in the mixing*."[3] But take the eggs of a hen and of a duck. The microscope shows that there is no difference in the mixing, that there is absolutely no distinction in their contents whereof science can take account. Yet inevitably the potentiality of swimming and quacking lies dormant in the one, and of sparring and crowing in the other. Does not science teach us rather to say that the difference must lie in the Mixer?

Such, at any rate, is the conclusion of some philosophers who are not unworthy of the title of scientific men, and in whose company we need not be ashamed to stand, even in the face of the cloud of witnesses whom evolutionists claim to produce.

"To treat of God," says Newton, "as a deduction

[1] "It is true that there are those who profess to foresee that the day will arrive when the chemist by a succession of constructive efforts may pass beyond albumen, and gather the elements of lifeless matter into a living structure. Whatever may be said of this from other standpoints, the chemist can only say that at present no such problem lies within his province. Protoplasm, with which the simplest manifestations of life are associated, is not a compound, but a structure built up of compounds. The chemist may successfully synthesize any of its component compounds, but he has no more reason to look forward to the synthetic production of the structure, than to imagine that the synthesis of gallic acid leads to the artificial production of gall-nuts." (Sir H Roscoe, *Presidential Address, British Association*, 1887.)

[2] Mr. St. George Mivart.

[3] p. 49. The italics are Mr. Clodd's.

from what we see, is a part of natural philosophy."[1] "The whole variety of created things could arise only from the design and the will of a Being existing of Himself.[2] This exact machinery of sun, planets, and comets could not originate except from the plan and the power of an intelligent and mighty Being."[3]

But perhaps Newton's ideas are out of date, and the scientific world has unanimously transferred its allegiance to Mr. Darwin and Mr. Spencer. Let us hear Sir G. Stokes, now President of the Royal Society. "The theory [of Darwin] has been accepted by many eminent biologists with a readiness that is puzzling to an outsider, especially one accustomed to the severe demands for evidence that are required in the physical sciences."[4] "We have evidence in the commencement of life on earth, of the operation, in time, of a cause, which, for anything that we can see, or that appears probable, lies altogether outside the ken of science."[5] "When we contemplate all this" [the phenomena of light], "it seems difficult to understand how we can fail to be impressed with the evidence of design thus imparted to us. But design is altogether unmeaning without a designing mind. The study then of the phenomena of nature leads us to the contemplation of a Being from whom proceeded the orderly arrangement of natural things that we behold."[6]

Professors Stewart and Tait are likewise blankly unconscious of the limitations of our knowledge as formulated by Mr. Clodd. "We assume, as absolutely self-evident, the existence of a Deity who is

[1] "Hæc de Deo, de quo utique ex phaenomenis disserere, ad philosophiam naturalem pertinet." (*Principia Scholium generale.)*

[2] "Tota rerum conditarum pro locis et temporibus diversitas, ab ideis et voluntate entis necessario existentis solummodo oriri potuit." *(Ibid.)*

[3] "Elegantissima hæcce solis, planetarum et cometarum compages, non nisi consilio et dominio entis intelligentis et potentis oriri potuit,"

[4] *Address to the Derby Church Congress*, 1882.

[5] *Burnett Lectures*, p. 327. [6] *Ibid.*, pp. 334, 335.

the Creator and Upholder of all things,"[1] and Professor Tait throws in another remark which must not be omitted. "When the purposely vague statements of the materialists and agnostics are stripped of the tinsel of high-flown and unintelligible language, the eyes of the thoughtless who have accepted them on authority are at last opened, and they are ready to exclaim with Titania, 'Methinks I was enamoured with an ass.'"[2]

A like disregard for evolutionary canons of thought is displayed by Sir William Thomson, who has been such a sore trouble to evolutionists, from Mr. Darwin himself onwards. He tells us that "overpowering proofs of intelligence and benevolent design lie around us: showing to us through Nature the influence of a free-will, and teaching us that all living beings depend upon one ever-acting Creator and Ruler."[3]

In the same sense speaks another President of the British Association, Sir William Siemens. "We find that all knowledge must lead up to one great result, that of an intelligent recognition of the Creator through His works."[4]

And a third President, Lord Rayleigh, is cruel enough to notice, not only the argument which leads to this conclusion, but its opponents. "Many excellent people are afraid of science as tending towards materialism. That such apprehension should exist is not surprising, for unfortunately there are writers, speaking in the name of science, who have set themselves to foster it. It is true that amongst scientific men, as in other classes, crude views are to be met with as to the deeper things of Nature; but that the life-long beliefs of Newton, of Faraday, and of Maxwell are inconsistent with the scientific habit of mind is surely a proposition which I need not pause to refute."

Sir John Herschel is another who has a right to

[1] *The Unseen Universe*, p. 47.
[2] *Nature*, July 17, 1879. [3] *Presidential Address*, 1882.
[4] *Presidential Address*, 1884.

bear witness on behalf of science, an authority whose opinion of the Darwinian theory its author was most anxious to know, and was bitterly disappointed to learn. At his hands the easy explanation of world formations already presented to us finds scant sympathy. This is his irreverent account of it:

"In the beginning was nebulous matter, or *Akasch*. Its boundless and tumultuous waves heaved in chaotic wildness, and all was oxygen, and hydrogen, and electricity. Such a state of things could not possibly continue, and, as it could not possibly be worse, alteration was here synonymous with improvement.

"The relations in which atoms stand to one another are anything but simple ones. They involve all the 'ologies,' and all the 'ometries,' and in these days we know something of what that implies. Their movements and interchanges, their 'hates and loves,' their 'attractions and repulsions,' their 'correlations,' their what not, are all determined on the very instant. There is no hesitation, no blundering, no trial and error. A problem of dynamics that would drive Lagrange mad is solved *instanter. Solvitur ambulando*. A differential equation which, algebraically written out, would belt the earth, is integrated in an eye-twinkle; and all the numerical calculation worked out in a way to frighten Zerah Colburn, George Bidder, or Jedediah Buxton. In short, these atoms are most wonderful little creatures."

And he goes on: "*The presence of* MIND is what solves the whole difficulty: so far at least as it brings it within the sphere of our own consciousness, and into conformity with our own experience of *what action* is."[1]

"Will without Motive, Power without Design, Thought opposed to Reason, would be admirable in explaining a chaos, but would render little aid in accounting for anything else."[2]

[1] *Familiar Lectures*, pp. 457-458. The italics, &c., are his.
[2] *Ibid.*, p 475.

In a similar strain speaks Sir J. W. Dawson for Geology.[1] "There are certain principles to which we may firmly hold without fear of being dislodged by any assailant. First : No system of the universe can dispense with a First Cause, eternal and self-existent; and the First Cause must necessarily be the living God, whose will is the ultimate force and the origin of natural law." And again[2] : "The reason of man is an actual illustration of mind and will as an efficient power in nature, and implies a creative mind. The inherent absurdity of the evolution of powers and properties from things in which they are not even potentially contained appears nowhere more clearly than here."

We must again determine to make an end somewhere, so these are a part, by no means the whole, of the testimonies that might be adduced. The voice with which they speak is that of common sense enlightened by science. We know better nowadays than to fancy that Tenterden steeple can be the cause of the Goodwin Sands, and we ought to know better than to think that the attractions and affinities of oxygen and carbon can have produced Hamlet, or the Dresden Madonna, or the precept, "Thou shalt love thy neighbour as thyself"; and to know better, therefore, than to believe that "all that is, from fire-fused rock to the genius of man, was wrapped up in primordial matter."[3] I say we *ought*, for we have faculties to use them, and this conclusion is so natural to the human mind that there can be no excuse for missing it. Nothing can be got out of a sack but what is in it, nor out of a nebula. If there now be in the world goodness, beauty, and truth, there must have been from the beginning, and what we see in Nature must be the manifestation of what has ever been. Therefore has it been said that the invisible things of the world are so manifested by the visible, as to make those inexcusable who remain in ignorance concerning them.

[1] *Modern Ideas of Evolution*, p. 228. [2] *Ibid.*, p. 201. [3] p. 137.

What are we to say of those who, in the interests of an otherwise unworkable theory, upset the fundamental laws of science, and, wrapping up crude notions and baseless speculations in the tinsel of high-flown and unintelligible language, scatter it among the young and the ignorant, who can learn from it only one clear doctrine, that there is no such thing as right or wrong; that morals are a convention, relative not absolute[1]; that where there is no society there can be no sin[2]; that, consequently, what society condones ceases to be sin, and that, among ourselves, seduction is in that case?[3] How is the passion of youth likely to interpret Mr. Clodd's jubilant pæan, "What dead weight of care do morals thus regarded lift from the heart of man!"[4]

"These be thy gods, O Israel!" It is of vapid and vapouring stuff like this that the idol is constructed, which we are bidden to fall down and worship, to the tune of the trumpet and the cornet and the flute, of the sackbut and the psaltery and the symphony, and all kinds of wind instruments assiduously puffed by those whose assumption to speak in her name, as Lord Rayleigh has told us, is a misfortune for Science. Unhappily, a cuckoo-cry is easily caught up, and becomes effective by its mere repetition, like that of the bird itself.

> Whose note full many a man doth mark,
> And dares not answer Nay.

But whether the creed, as we have seen it presented, have any shred of science to recommend it, readers will judge for themselves.

[1] p. 220. [2] p. 218.
[3] p. 220. It is impossible to get any other meaning out of Mr. Clodd's words.
[4] p. 222.

# The Voices of Babel.

If one thing should be clearer than another to students of modern scientific literature, it is that the philosophers of our generation are in process of building an edifice more enduring than bronze, and more lofty, not only than the ancient pyramids of kings, but than anything that men or demigods ever yet contrived to rear upon the earth. Never before has arch-contriving man succeeded in raising himself to so lofty a perch, to one whence he can, with eagle glance, take in every nook and cranny of the universe. The old race, who thought to get to regions of empyrean light by use of brick and mortar, the giants who, with like intent, piled Ossa on Olympus, and leaf-shaking Pelion upon both—these indeed failed, and deserved to fail, because they used so clumsy and unintelligent a machinery. But the work they ambitioned can be done, and we are doing it. The unceasing discoveries of science, not only give us knowledge of the facts of Nature, but, cemented and compacted by exact thought, grow into a stately pile which has already pierced the clouds and vapours hitherto bounding mortal vision, and shown us what is above them, or, more truly, what is not. For the great net result of discovery in these sublime regions is assuredly this, that they are empty and void, containing nothing of all that with which human ignorance has credited them hitherto. All proves to be as unsubstantial as the baseless fabric of a dream, except only the tower of science, and the solid earth of material facts whereon its base reposes. There is no God in sight beyond, no power, no will, no mind. Heaven has been taken by storm, in the sense that the light of knowledge has been cast into its recesses, and they have been found to be empty; and men need therefore trouble themselves no more about anything there, or about anything that professes to issue thence.

Such is undoubtedly the purport of the dispatches that come floating down to us humbler mortals who have had no hand in the edifice, as we still plod our accustomed ways beneath, from those whom we understand to be on its summit. He who may claim to be the very mast-head man, "Our great philosopher," Mr. Herbert Spencer, "the only man in England who can lay claim to the title; the only man in Europe now living who has constructed a real system of philosophy,"[1] "The Apostle of the Understanding,"[2] proclaims to us in words which would appear to have got somewhat mixed with cloud in coming down, "that difficulties, some of which are often discussed, but never disposed of, must force men hereafter to drop the higher anthropomorphic characters given to the First Cause, as they have long since dropped the lower. The conception which has been enlarging from the beginning must go on enlarging, until, by disappearance of its limits, it becomes a consciousness which transcends the forms of distinct thought, though it ever remains a consciousness."[3] In other words, and perhaps more plainly, none of the faculties we know in man are to be found in the world beyond, neither intelligence nor free-will; as the tower has grown, this has become the more obvious, and the highest object of our thought is one we cannot think about.

The line of argument by which this conclusion is reached, with which argument I am not now concerned, is enthusiastically welcomed by Mr. Frederick

[1] Mr. F. Harrison, *Nineteenth Century*, Sept 1884, p. 354.
[2] Professor Kingdon Clifford, *Essays*, p. 417.
[3] *Nineteenth Century*, Jan. 1884, p. 8.

Harrison as absolutely unanswerable, and as the last word in the controversy with theology. "That word," he assures us, "is decisive, and it is hard to conceive how theology can rally for another bout, from such a *sorites* of dilemma as is there presented."[1] In fact, to sum up what does not require proof, in the words of one who, at any rate, had the full courage of his opinions, and expressed them in terms the clearest he could command, it is generally agreed amongst "philosophic thinkers," that Professor Clifford spoke truly when he declared[2] that "those who can read the signs of the times read in them that the Kingdom of man is at hand."

The Kingdom of Man! He has established his position as the roof and crown of things, there is nothing above him or equal to him in the universe, if there be naught else that can think and freely act; and it therefore behoves him to take command of the position, as the only superior officer present. He has dispelled the phantoms of theology, which, phantoms as they were, did yet, in some sort of way, contrive, and for a considerable number of years, to furnish motives which, in some degree, dominated the lives of men, and led them to make society possible, by agreeing to certain rules of the game of life, commonly called the moral law: rules which have prevented the world from presenting on a large scale the drama of the Kilkenny cats. Theology being gone, its laws have, of course, gone too, or at least the sanction on which they rested. But, as society will not go on without law, it is incumbent on the new rulers, as on Zeus and his brothers, when they had turned out their father's dynasty, to get their realm in order, by promulgating a new code, or at least by finding a new basis for the old one. It is into the latter problem, indeed, that their task resolves itself, for there seems to be a pretty general consensus, that, in themselves, the old laws were right; that justice, brotherly love, self-denial, truthfulness, and decency, must continue to rule the

[1] *Ibid.*, March, 1884, p. 495. [2] *Essays*, p. 417.

world, if the world is to go on creditably, and if society is not to resolve itself into primitive nebula. The great difficulty is that, as there is no use in a law unless there be something to make men keep it, some motive power must be found to replace the fear of the Lord, formerly held to be the beginning of wisdom, and the love of Him, which was its end.

Our leaders of thought feel themselves abundantly equal to the task, and the air around is resonant with their voices, eagerly telling their several discoveries of what will fulfil the needful function, But it rather begins to look as if history were going to repeat itself; as if the necessary result of so lofty a station as that they have attained were to produce a confusion of tongues, such as once already is reported to have marred an enterprise of similar ambition. Our high authorities, it is apparent, have ceased to understand one another, for the main purport of the various utterances borne to our ears is flat contradiction, each of all the rest.

The materialist assures us, looking down to the base on which material science rests, that matter is all, and all is matter. In it, says Professor Tyndall,[1] "we discern the promise and potentiality of all terrestrial life. We claim, and we shall wrest from theology, the entire domain of cosmological theory. The doctrine of evolution derives man, in his totality, from the interaction of organism and environment through countless ages past." "Thought," says Moleschott,[2] "is a movement of matter." Man is therefore only a machine so constructed as to think, and in the mechanics of thought the chief factor is phosphorus; "without phosphorus, no thought."[3] From this, of course, it follows that we are, as Professor Huxley has hinted, "but the cunningest of Nature's clocks," and, if so, we need not trouble ourselves about any rule of action, for we can no more help doing what we do, than a clock can help striking.

[1] Belfast Address. [2] Quoted by Janet, *Materialism*, p. 34.
[3] Id. *Ibid*, p. 33.

But no sooner is the materialistic creed enunciated, than it is drowned in a tumult of scientific indignation. It is a doctrine, Mr. Leslie Stephen tells us,[1] already dead and buried, and "it has died because it is too absurd a doctrine even for philosophers. It is as easy as it is edifying to expose materialism. As Comte says, it is the most illogical form of metaphysics." Professor Huxley, though he sails very near the wind in its regard, is resolved to find a way to avoid falling into a doctrine of which, he tells us,[2] "I believe materialism to involve grave philosophical error." "Utter materialism and necessarianism," according to the same authority, is "crass"[3]; it "may paralyze the energies, and destroy the beauties of a life."[4] Professor Clifford pronounces it, though resting on high authority, to be a "singular" doctrine, "founded on confusion of thought."[5] Mr. Leslie Stephen goes on to stigmatize it as a "degrading" doctrine which "men of science have abandoned as completely as metaphysicians." He declares that "to say that intellect is made up of phosphates is, not so much error, as sheer nonsense."[6]

Materialism, then, is clearly naught according to scientific canons. But why, continues its last-quoted opponent, should we trouble our heads about any doctrine at all? Let us take things as we find them. We are men; what matters it how we became so? We have our actual powers and faculties none the less, if they have been derived from lowly and, to our minds, disgusting ancestors. Here they are, and let us use them. And so for our ideas of what it is proper to do. Probably those ideas originated in the struggles and needs of brute progenitors, "dragons of the prime that tare each other in their slime," and so on down to the last link, *Simia quam similis turpissima bestia nobis.* But what of that? "Property is not the less sacred because it originated in physical force;"[7] nor marriage because the primitive rite was probably

[1] *Essays on Freethinking*, p. 89.
[2] *Lay Sermons*, p. 139. [3] *Ibid.*, p. 140. [4] *Ibid.*, p. 146.
[5] *Essays*, p. 328. [6] *Ibid.*, pp. 89, 90. [7] *Ibid.*, p. 91.

to fell the beloved object with a club and carry her off in triumph.[1] Our religion, therefore, if religion we must have, should consist in respecting and acting on those principles which mankind have, somehow or other, come to acknowledge. This is the simple creed formulated by Sir James Fitzjames Stephen, who with his brother appears to operate in a corps of freethinkers unattached. "If," he says,[2] "human life is in the course of being fully described by science, I do not see what materials there are for any religion, or indeed what would be the use of one, or why it is wanted. We can get on very well without one, for though the view of life which science is opening to us gives us nothing to worship, it gives us an infinity of things to enjoy. The world seems to me a very good one, if it would only last; love, friendship, ambition, science, literature, art, politics, commerce, professions, trades, and a thousand other things will go on equally well, as far as I can see, whether there is or is not a God or a future state."

But this simple creed finds scant favour in other well-informed quarters: in fact its simplicity is not precisely considered to constitute a merit. According to Mr. Harrison, it is an "original idea"[3] on the part of Sir James. Love! friendship! good-nature! kindness! Whence, on such principles as his, is he going to get these excellent things? Nor does it seem probable to Mr. Harrison[4] that for the work of purifying the great masses of mankind an agent will be discovered in the common-sense maxim that "This is a very comfortable world for the prudent, the lucky, and the strong." No, no! theology, to be sure, is gone: a clean sweep has been made of that; but Mr. Harrison is quite positive that religion must remain: we must have an object towards which to direct our love and our duty, and a sense of duty to make us do it. Mr. Spencer concurs. Religion is the word: they are wrong who think that science is

[1] *Essays*, p. 80.
[2] *Nineteenth Century*, June, 1884, p. 917.
[3] *Ibid.*, Sept. 1884, p. 377. [4] *Ibid.*, Sept. 1884, p. 378.

dissipating religious beliefs and sentiments,[1] for, he tells us, "whatever of mystery is taken from the old interpretation is added to the new," which it certainly would seem to be with compound interest. But at all events Mr. Spencer is as firm as Mr. Harrison, that religion there must be, and that it is the highest outcome of development. He pronounces that[2] "the ultimate form of religious consciousness is the final development of a consciousness which, at the outset, contained a germ of truth obscured by multitudinous errors."

Of like mind is Professor Clifford. All religions hitherto existent, have, it is true, been, to his mind, as bad as can be; so bad that they must be spoken of in whatever terms seem most likely to pain and shock their adherents. But for all that, says he,[3] "there are forms of religious emotion which do not thus undermine the conscience," and such a form is "Cosmic Emotion."[4]

But Mr. Harrison will not stand this; it is flat pantheism. For Cosmic Emotion means awe, and delight, and poetic rapture, in view of the universe as such, of the starry heavens, the clouds, the ocean, the alps. And how can this be religion unless the universe be God? But to say that everything is God is just as absurd as to say that everything is matter. To say that everything is God is to say that right and wrong are equally Divine, that "being and not being are identical, and that the identity of being consists in its being the union of two contradictories."[5] "If," he continues,[6] "God and universe are identical expressions, we had better drop one of them. Let us, in the name of sense, get rid of these big, vague words, and having got rid of God and soul, as a verbal spiritualism, let us say simply—things, and have the courage of our opinions, and boldly profess as our creed, 'I believe in nothing except in things in general!'"

[1] *Nineteenth Century*, Jan. 1884, p. 10. [2] *Ibid.*, p 9.
[3] *Essays*, p. 386. [4] See Essay under this title, pp. 394—417.
[5] *Nineteenth Century*, August 1881, p. 289. [6] *Ibid.*

He goes on to inquire what practical benefit a cultivation of Cosmic Emotion is likely to bring to mankind; whether it will serve to comfort the sorrowful, to counsel the doubtful, to sustain the weak, to compel the wayward. Go, he suggests, and tell a debauchee to control his passions, by thinking that they are part of the Divine Essence; console the widow and the orphan by talking of sunsets or stellar infinities; "and when social passions rage their blackest, step forward with the religion of sweetness and light, and try if self-culture, so exquisitely sung by Goethe and his followers, will not heal the social delirium. It would be like offering roses to a famished tiger, or playing a sonata to a man in a fever."[1] "When people," he adds,[2] "decline to be bound by the cords of a formal theology, and proclaim their devotion to these facile abstractions, they are really escaping in a cloud of words from giving their trust to anything: for 'Things in general, as understood by myself,' is only a roundabout phrase for that good old rule, the simple plan—'What I like.'"

So far, therefore, it would appear that we have not got far forward in our quest: but then we have not yet given ear to the great upsetter of theologies, Mr. Spencer himself, to whom, if to anyone, belongs the right of setting up a new order in their stead; for to the victors belong the spoils. He, of course, has his suggestion ready. He tells us in effect[3] that others miss the mark, because they do not look with the philosophic eye, and do not look in the right direction: they do not duly explore the new region into which science has lifted us. It contains nothing, to be sure, which we know, or can know: but what then? It follows that it contains what we know not and can never know: the great Unknowable. This must be the true object of evolved worship; in it we shall find all that we require: "An Infinite, Eternal

[1] p. 290. [2] p, 289.

[3] "Religion: a Retrospect and Prospect," *Nineteenth Century*, Jan 1884.

Energy, from which all things proceed."[1] But we are not to mistake him: it is not another name for God. He cannot tell us what it is, but, what it is not; for not He, but It, is its style and title: It has not mind, It has not will: Its attributes are negative, "the Ultimate Reality transcending human thought."[2]

These are solemn and sonorous tones, but, unlike those of Virgil's grave and meritorious man, they by no means induce the crowd of disputants to hold their peace and listen with outstretched ears. On the contrary, they only arouse a hubbub ten-fold more boisterous than before. Mr. Harrison clearly conceives this to be of all ridiculous proposals by far the most ridiculous. It can at best, he declares, give us a "Ghost of Religion."[3] And as to its object: why the Unknowable? And why spell it with a big U? If you know nothing about it, how do you know it is unknowable? And how that it is infinite, eternal, or *an* energy, not energies? Write it with a small letter, therefore, and call it the unknown.[5] But, however it be spelled, Mr. Harrison is quite certain that it will never do for a god; and he sets to work with infinite gusto to hew in pieces Mr. Spencer's idol. "To make a religion out of the Unknowable," he says, "is far more extravagant than to make it out of the Equator, or the Binomial Theorem."[6] "If religion there is still to be, it cannot be found in this No-man's land and know-nothing creed"[7]: this creed, "summed up in one dogma—The Unknowable is everywhere, and Evolution is its prophet"[3]; a "creed having for its object such a mere *chimæra bombinans in vacuo*,"[8] which "might be a gooseberry or a parallelopiped."[9] Mathematics, he goes on, will enable us accurately to understand its Nature. In them $x$ standing always for the unknown, $x^n$ must symbolize the Unknowable: so that "where

[1] *Nineteenth Century*, p. 12. [2] *Ibid.*
[3] See essay under this title, *Nineteenth Century*, March, 1884.
[4] p. 495. [5] p. 501. [6] p. 497. [7] p. 500. [8] p. 504,
[9] *Ibid.*, Sept. 1884, p. 374.

two or three are gathered together to worship the Unknowable, they may be heard to profess their unwearying belief in $x^n$."[1] And its potency to do religious work he thus illustrates:[2] "A child comes up to our Evolutionist friend, looks up in his wise and meditative face, and says: 'O wise and great master! what is religion?' And he tells that child: 'It is the presence of the Unknowable.' 'But what,' asks the child, 'am I to believe about it?' 'Believe that you can never know anything about it.' 'But how am I to learn to do my duty?' 'Oh, for duty you must turn to the known—to moral and social science.' And a mother wrung with agony for the loss of her child, or the wife crushed by the death of her children's father, or the helpless and the oppressed, the poor and the needy, men, women, and children in sorrow, doubt, and want, longing for something to comfort them and to guide them, something to believe in, to hope for, to love, and to worship, they come to our philosopher, and they say, 'Your men of science have routed our priests, and have silenced our old teachers. What religious faith do you give us in its place?' And the philosopher replies (his full heart bleeding for them), and he says, 'Think on the Unknowable.'"

"One would like," he adds,[3] "to know how much of the Evolutionist's day is consecrated to seeking the Unknowable in a devout way, and what the religious exercises might be. How does the man of science approach the All-Nothingness? the microscopist? or the embryologist? or the vivisectionist? What do they learn about it? What strength and comfort does it give them? Nothing, nothing, it is an ever-present conundrum, to be everlastingly given up." At most, "The religion of the Agnostic comes to 'the belief, that there is a sort of a something about which I can know nothing.'"[4]

Mr. Harrison is not alone in his attack upon this unlucky deity. Sir James Stephen joins in the

[1] *Nineteenth Century*, March, 1884, p. 503. [2] *Ibid.*
[3] p. 502. [4] p. 496.

onslaught with equal zest. "In fact," he says,[1] "Mr. Spencer's conclusion appears to me to have no meaning at all. It is so abstract that it asserts nothing. It is like a gigantic soap-bubble, not burst but blown thinner and thinner, till it has become absolutely imperceptible. If this is the prospect before religion, it would surely be simpler to say that the prospect before it is that of extinction. But if this conclusion is reached, why not say so plainly?"

But, as we have seen, this is just the conclusion that must not be reached. Religion there must be, and as Mr. Spencer cleared the ground of theology, so Mr. Harrison has cleared it of all rival philosophic systems, including Mr. Spencer's own, and the world stands vacant for the religion of the future, Mr. Harrison's peculiar creed.

All have erred fundamentally, he tells us, who do not look for a basis at once solid and vital whereon to build. Science alone can give us solidity, but only one branch of science can give vitality besides. Matter, things in general, the sun, moon, and stars, the Unknowable, on none of these can we found a rule of duty, none will serve as a stimulus for right-doing. Those of them which we can know we cannot love, the unfortunate Unknowable we cannot even know. Yet "what," he asks,[2] "is religion for? Why do we want it? What do we expect it to do for us? If it can give us no sure ground for our minds to rest on, nothing to purify the heart, to exalt the sense of sympathy, to deepen our sense of beauty, to strengthen our resolves, to chasten us into resignation, and to kindle a spirit of self-sacrifice—what is the good of it? Religion is not a thing of star-gazing and staring, but of life and action."

Where are we to find a basis for such a religion as will do all this? Theology is out of the question, for, *ex hypothesi*, it has been finally disposed of by Mr. Spencer. We are confined to science, and, as already intimated, amongst the objects whereof

[1] *Nineteenth Century*, June, 1884, p. 908.
[2] *Ibid.*, March, 1884, p. 501.

science treats, there is but one that can awaken in us any feeling that prompts to action. This solitary object is man: it follows that man must be the object of rational religious emotion, and that the religion of science must be that founded by M. Comte: the Religion of Humanity, or Positivism.

"The purpose of the Positive Scheme," Mr. Harrison tells us,[1] "is to satisfy rational people that, though the ecstatic 'worship' of supernatural divinities has come to an end, intelligent love and respect for our human brotherhood will help us to do our duty in life. In plain words, the Religion of Humanity means recognizing your duty to your fellow-men on human grounds." The object of its cult is collective man—Humanity. "When we think of Humanity our minds are not set on the band of the 'elect,' but on the millions who people the earth and subdue it, leaving each century on the whole a richer inheritance in comfort, in thought, in virtue."[2] The great end to be proposed to the religious mind is so to live as to help on the increase of this inheritance, and thus to make unborn ages somewhat better for each of us having lived. In this we find a motive power sufficient to make us live well, a stimulus made more active when we cast a respectful glance at the more bright particular stars of our race who have so lived in the Past—the saints of the Positivist Calendar. "It is for this reason that M. Comte has insisted so much on the Past, and the religious value of a true conception of human civilization."[3] "Those who know the harmonious power with which Comte has called forth into life the vast procession of the ages can best judge how weak by his side Mr. Spencer appears."[4]

Such, in outline, is Mr. Harrison's position. His statement has the merit of being perfectly clear and intelligible: but alas! alas! the clearer he makes it, the more does it excite the scorn and contradiction of his philosophic friends: nay, they find in it every

[1] *Nineteenth Century*, Sept. 1884, p. 369.
[2] *Ibid.*, p. 372. [3] p. 373. [4] p. 367.

one of those fatal flaws which he has taught them to see in other systems, aggravated by not a few peculiar to itself.

Says Sir James Stephen,[1] "Is not Mr. Harrison's own creed open to every objection which he urges against Mr. Spencer's? Humanity with a capital H, is neither better nor worse fitted to be a god, than the Unknowable, with a capital U. They are as much alike as six and half a dozen. Each is a barren abstraction to which anyone may attach any meaning he likes. It seems to me that it is just as 'unknowable' as the Unknowable itself, and just as well and just as ill-fitted to be an object of worship. But if Mr. Harrison's religion presents to the mind no object of worship, has it the smallest chance of being able to 'govern men and societies'? The Unknowable is certainly singularly ill-adapted for the functions of government, but Mr. Spencer never proposed to govern by it. Mr. Harrison does propose to govern. How does he mean to set about it? What will Positivism do with the vast mass of indifferent and worldly people? It can neither hang them nor damn them."

Mr. Spencer has a chapter of faults equally grave to urge against it. In the first place, Positivism is essentially unphilosophic; it contradicts the law of evolution: it is a "Retrogressive Religion."[2] Its unphilosophic character is manifest in its absurd respect for authority. "Papal assumption is modest compared with the assumption of 'the founder of the Religion of Humanity.'" Moveover Mr. Spencer discovers in it precisely the same absurdity which Mr. Harrison found in Pantheism: it tries to blend contradictories, in ranking equally amongst its saints men who hated each other fiercely and each other's principles, and who set a diametrically opposite example to the world—Frederick the Great and St. Paul, Louis the Eleventh and Washington, Locke, Cyrus, and Fénélon, to say nothing of Hercules

[1] *Nineteenth Century*, June, 1884 pp. 909-912.
[2] See article under this title, *Nineteenth Century*, July, 1884.

and Orpheus.[1] Surprise is the feeling awakened in Mr. Spencer[2] on observing the incongruity between the astounding claims made by the propounder of this new creed, and the great intelligence of disciples whose faith "appears proof against the shock which these astounding claims produce on ordinary minds."

Professor Huxley, too, fails to be impressed either with the creed or its founder. He acknowledges that he found M. Comte potent in destruction, but thus continues[3]: "Great, however, was my perplexity, not to say disappointment, as I followed the progress of this 'mighty son of earth' in his work of reconstruction. Undoubtedly *Dieu* disappeared, but the *Nouveau Grand-Etre Suprême*, a gigantic fetish, turned out brand-new by M. Comte's own hands, reigned in His stead. *Roi* also was not heard of, but in his place I found a minutely-defined social organization which, if it ever came into practice, would exert a despotic authority such as no sultan has rivalled and no Puritan presbytery, in its palmiest days, could hope to excel. While as for the *culte systematique de l'Humanité*, I, in my blindness, could not distinguish it from sheer Popery, with M. Comte in the chair of St. Peter and most of the names of the saints changed."

Professor Huxley, moreover, does not seem to discern M. Comte's 'harmonious power,' but, on the contrary, considers him a singularly unfortunate head for a scientific religion. He found in Comte's writings, he tells us,[4] "the veins of ore few and far between, and the rock so apt to run into mud, that one incurred the risk of being smothered in the working." Moreover,[5] "that part of M. Comte's writings which deals with the philosophy of physical science appeared to me to possess singularly little

[1] *Ibid.*, p. 11. To the list might be added such choice specimens as the following: Moses, Numa Pompilius, Mahomet, Godfrey de Bouillon, St. Bernard, Voltaire, St. Ignatius, Hobbes, Richelieu, and Heloise.

[2] *Nineteenth Century*, p. 10. [3] *Lay Sermons*, p. 148,

[4] *Lay Sermons*, p. 147. [5] *Ibid.*, p. 154.

value, and to show that he had but the most superficial and merely second-hand knowledge of most branches. He was at once singularly devoid of real knowledge in these subjects, and singularly unlucky. I find therein little or nothing of any scientific value, and a great deal which is as thoroughly antagonistic to the very essence of science as anything in ultramontane Catholicism. In fact, M. Comte's philosophy in practice might be compendiously described as Catholicism *minus* Christianity."[1]

But it is for the object of devotion that the full vials of scorn are reserved. "The Great Being Humanity," says Mr. Spencer,[2] has done nothing for us, and how could it? Look at the common herd of unphilosophic men and see what a sorry lot they are. The Northern Farmer was clearly right: "Take my word for it, Sammy, the poor in a loomp is bad."[3] And even of the people who remain after leaving out the worst—"mostly fools," will evidently be the verdict of other sages than him of Chelsea. Humanity, in fact, declares Mr. Spencer,[4] is like nothing so much as a bubble floating on the great river of the Unknowable, and a Positivist would be fitly typified by a man who should look at the bubble and ignore the stream. "Even if, instead of being the dull, leaden-hued thing it is, the bubble Humanity had reached that stage of iridescence of which, happily, a high sample of a man or a woman sometimes shows us a beginning, it would still owe whatever there was in it of beauty to that Infinite Eternal Energy, out of which Humanity has quite recently emerged, and into which it must in course of time subside." "I am told," he continues,[5] "that by certain of M. Comte's disciples (though not by those Mr. Harrison represents), prayer is addressed to 'holy' Humanity. Had I to choose an epithet, I think 'holy' is about the last which would occur to me. So far from seeing in the Great Being Humanity anything worshipful, it seems to me that the con-

[1] p. 140.

[2] *Nineteenth Century*, July, 1884, p. 15. [3] p. 23. [4] p. 17. [5] p. 15.

templation of it is calculated to excite feelings which it is best to keep out of consciousness."[1]

Still less would the epithet "holy" suggest itself to Sir James Stephen. "Mankind," he exclaims,[2] "is the object of our worship—mankind; a stupid, ignorant, half-beast of a creature, For my part, I would as soon worship the ugliest idol in India."

Finally, we are assured that humanity is itself so little captivated by the invitation to its own worship, that a Positivist congregation may be compendiously described as "Three persons—and no God"; and if Mr. Harrison tells Mr. Spencer[3] that he has "defecated religion to a true transparency," Sir James Stephen responds[4] that "Mr. Harrison's language about awe and gratitude to humanity (the mainspring of his religion) represents nothing at all except a yearning for some object of affection, like a childless woman's love for a lapdog."

There is a game known to unphilosophic children as Blindman's Buff. In it all have full use of their eyes, excepting him on whom for the moment devolves the office of seeking. Would it not rather appear as if the Fates, in sportive mood, had turned the game of our philosophers into something of the kind? They are marvellously keen-sighted, none keener, so long as they have but to worry and harass the unfortunate groper after truth, and they never fail to find the exact right spot on which to pummel him. But the moment their own turn comes to set out on the quest, as if they had donned the fatal bandage, they are inevitably delivered over helpless to their tormentors.

It would therefore seem that the result of our quest is not very brilliant, and that having gone out for wool we are likely to come home shorn to the quick, stripped, not only of theology, but of the comforts of philosophy as well. When Cadmus sowed the dragon's teeth, the warriors who came up there-

[1] *Nineteenth Century*, June, 1884, p. 917.
[2] *Ibid.*, June, 1884, p. 917. [3] *Ibid*, March, 1884, p. 500.
[4] *Ibid.*, June, 1884, p. 911.

from slaughtered each other pretty effectually, it is true; but there were five who survived, and these sufficed to found Thebes. But of our *pentathlon* of rival systems, which would appear to exhaust the possibilities, can any one outlive the thrust of the poisoned rapier that we have seen pass from hand to hand in the course of the struggle? If these be indeed the clear thinkers we have been taught to take them for, is it not most disquieting to have a verdict of four to one against every single proposal that has been put forward? Must the verdict be, as in that "caucus race" witnessed by Alice in Wonderland, that everyone has beaten everyone else?

If any positive verdict be at all within our reach, it must certainly be arrived at by a process similar to that adopted by the Greeks when they wished to decide who had been the hero of Salamis. Each of the captains who had to vote put himself first, but they unanimously put Themistocles second. And in our inquiry it is to be observed that while none of the disputants will grant any status at all to any philosophic groundwork of religion, except his own peculiar vanity, they acknowledge that the old belief had after all some sort of merit. It was false, to be sure—on that they are agreed--but it could and did to some extent influence the lives of men; and was therefore far better for its purpose than the substitutes proposed by rival sages, which can never do anything of the kind.

Thus Professor Clifford, though as a rule anything connected with the name of God produces upon him much the same effect as we read of in the case of the young man "whom immediately the spirit troubled, and being thrown down he rolled about foaming," in a passage unusually plain and clear[1] "fully admits" that the theistic hypothesis is in itself "a reasonable hypothesis, and an explanation of the facts," which is a great deal more than he will say for "that singular materialism of high authority and recent date,"[2] which he appears to consider the only possible philo-

[1] *Essays*, p. 388. [2] *Ibid*, p. 328.

sophical rival of his own creed. Mr. Spencer pronounces[1] that the "retrogressive religion of Humanity falls below the creeds to which men had already developed their minds. Humanity is only another sort of a name for ghosts and goblins; but men had come to something far higher in 'the conception of a spirit far transcending humanity.'"

So Mr. Harrison for his part, sticking stoutly to his text that "the essence of religion is, not to answer a question, but to govern and unite bodies of men,"[2] and while positively certain that neither the cultus of the Unknowable nor Cosmic Emotion will ever do this for one instant, yet acknowledges[3] that "theologies long did it," did it "for twenty or thirty centuries," and did it so well that[4] "the hallowed name of religion *has meant* in a thousand languages man's deepest convictions, his surest hopes, the most sacred yearnings of his heart, that which can bind in brotherhood generations of men, comfort the fatherless and the widow, uphold the martyr at the stake, and the hero in his long battle." This is surely pretty well, and it would seem that on its own principles Positivism should include in its objects of veneration the agent which has done all this for humanity, and exhibit to the world one more spectacle of the identity of contradictions, by the strange phenomenon of a religion worshipping its own rival; for undoubtedly theology has thus, by Mr. Harrison's showing, done a great deal more for mankind than any individual saint of the Positivist calendar; its domain is already the irrevocable Past, while Positivism aspires, and can aspire, to no more than the uncertain Future. More than this, Mr. Harrison would appear, *in seipsum saeviturus si desint alii*, to admit, in an unguarded moment, that his creed can never fill the place of the old belief. When declaiming against Mr. Spencer's Unknowable, and recounting all that it would have to do in order to supply the void left in human needs by the destruction of faith,

[1] *Nineteenth Century*, July, 1884, pp. 12, 13.
[2] *Ibid.*, March, 1884, p. 497. [3] p. 499. [4] p. 504.

he emphatically tells us[1] that men demand something to *worship*. This cannot be the Unknowable: but he presently adds that neither is it Humanity. "We do not ask anyone to worship Humanity." "Humanity is neither the shadow of God, nor the substitute for God, nor has it any analogy with God."[2] Can he be serious, then, in proposing to make it take the place of God, and in expecting it to fill the void which he himself so eloquently described as the result of the disappearance of belief in God?

Sir James Stephen, for once, fully agrees with Mr. Harrison about Humanity. It certainly is not an object of worship, and therefore Sir James infers that no more than Cosmic Emotion or the cult of the Unknowable will it have the slightest chance of doing any sort of work at all. He does not, as we have heard, himself see the need of any religion at all, but he takes advantage of the "originality" of this position to assure all and sundry of his philosophic friends that if religion there is to be they will find none to work at all but Christianity.[3] It has worked so long, precisely because it differs in every essential respect from its proposed substitutes. Unlike the creeds of Mr. Spencer and Mr. Harrison, it deals with the Personal, not the Abstract, with the Known, not the Unknown. Jesus Christ, says he, has reigned so long, "the object of passionate devotion and enthusiasm" to so great a multitude of all times and all lands, only because He has been believed to be living, and to possess authority which His acts had proved to be Divine. All who set about to found a new religion, without providing themselves with some sort of credentials to the same effect, are foredoomed to failure; and Sir James points the moral by the well-known story of Talleyrand, who, when consulted by a Frenchman as to the best mode of getting a new creed afloat, recommended him to try the effect of being crucified and rising again in three days.

[1] *Nineteenth Century*, March, 1884, p. 500. *Vide supra.*
[2] *Ibid.*, Sept. 1884, p. 369. [3] *Ibid.*, June, 1884, p. 911.

The practical conclusions, then, to be gathered from this war of words would seem to reduce themselves to two. Man requires a religion for a special work; and this special work can as a matter of fact be done only by a theology. This is unquestionably a good deal to have learned; and it at once suggests the question, If a belief in God can thus supply our wants, "is not that very divination of our needs in itself a proof that is the supply of them?"[1]

At any rate, when we thus see theology stamped, at the hands of its bitterest enemies, with what looks so strangely like a note of truth, we must needs be thrown back on our starting-point, and ask ourselves whether it be not just possible that, after all, the walls are still standing whereof this not altogether harmonious blare of trumpets has announced the overthrow.

And still confining our attention to the testimony of our advanced thinkers, without any addition of our own, it is, to say the least, instructive to observe that, while the work of destroying theology has been done by pure exercise of reasoning, and while our friends think a great deal on one another's reasoning power so long as it is in agreement with themselves, they find no absurdities too great for it to perpetrate, so soon as they begin to differ.

Mr. Spencer, for example, to whom, according to Mr. Harrison, belongs the chief credit of having cleared out Olympus; wins this praise by an essay which, while in accordance with Mr. Harrison's views, is described[2] as "packed with thought to a degree unusual even with Mr. Herbert Spencer," as a "memorable essay" wherein the evolutionary creed is formulated "with a definiteness such as it never wore before," and theology receives a blow that is absolutely "final." But in the self-same essay, and indeed in that part of it which is its main purport, having the misfortune to disagree with Mr. Harrison, Mr. Spencer, we are assured, proceeds to fall into

[1] Newman, *Grammar of Assent*, p. 48.
[2] *Nineteenth Century*, March, 1884, p. 494.

"a paradox as memorable as any in the annals of the human mind,"[1] to talk "a theologico-metaphysico jargon," and to take refuge from an awkward dilemma by a mere rhetorician's artifice.[2] His theory of the origin of religion is pronounced to be full of paradoxes, and Mr. Harrison frankly avows that he has always considered it the most unlucky of all Mr. Spencer's sociologic doctrines.[3] Moreover "a certain 'fallacy of the Den' runs through his historical notions"[4]; he even "hardly acts with the candid mind that befits the philosopher in all things"[5]; he falls into "the slip slop of theologians"[6]; he asks us to take things as "proved" on the strength of "a pile of clippings made to order"[7]; if he does not think persistently along defined grooves, Mr. Harrison does not know what that process means[8]; he makes singular slips in logic[9]; he has fallen at various times into astounding paradoxes, which Mr. Harrison respects him too much to recall[10]; and finally he is warned,[11] great philosopher that he is, "that philosophers who live, not so much in glass houses, as in very crystal palaces of their own imagination, should give up the pastime of throwing stones at their neighbours' constructions."

It is undoubtedly very sad to find an apostle of the understanding doing all this sort of thing; but if we turn from Mr. Harrison's to Sir James Stephen's account of the matter, it looks no better. To him the evidence for Mr. Spencer's fundamental theory seems weak, and assuming the evidence the conclusion is not plain[12]; his argument appears to be an unmeaning play of words[13]; he reminds Sir James of the blind heathen derided by Isaias, "He works his words about this way and that, he accounts with part for ghosts and dreams, and the residue thereof he maketh a god, and saith Aha, I am wise, I have seen

[1] *Nineteenth Century*, March, 1884, p. 506.
[2] *Ibid.*, p. 504. [3] *Ibid.*, Sept. 1884, p. 362. [4] *Ibid.*, p. 368.
[5] *Ibid.*, p. 365. [6] *Ibid.*, p. 359. [7] *Ibid.*, p. 364. [8] p. 363.
[9] p. 374. [10] p. 366. [11] *Ibid.*, p. 366.
[12] *Ibid.*, June, 1884, p. 905. [13] p. 907.

the truth." In brief, though his work of negation is not to be gainsaid, the positive part appears to be unfounded, nay "baseless, and wholly unimportant."[1]

It is of course only to be expected that Mr. Harrison should, in his turn, hear some home truths from his candid friends. He also, according to Mr. Spencer, thinks persistently along defined grooves[2]; in fact, Mr. Spencer was the first in the field with this particular charge, and Mr. Harrison's counter-charge was of the nature of a *tu quoque*. Mr. Spencer likewise intimates that Comte and Mr. Harrison "commit intellectual suicide"[3]; than Mr. Harrison's performances in that line, misrepresentation can go no farther[4]; he is in an attitude of discipleship unfavourable to inquiry[5]; he exactly transforms the doctrine of opponents[6]; and his description of such doctrine is a fabric framed on his own imaginations.

As Mr. Spencer's strong point is metaphysics, so is Mr. Harrison's the science of man, which in his opinion affords a more solid foundation whereon to build, inasmuch as in the sublimer science "every philosopher falls from time to time into astounding paradoxes."[7] But, in his own field of predilection, Mr. Harrison appears to Sir James Stephen to assert a great deal more than he can possibly know[8]: even when they are in agreement, Sir James intimates that Mr. Harrison is plainly speaking much beyond his brief; "it is," he sarcastically remarks, "doubly satisfactory to agree with a man so positive and well informed"; a man who knows, or at least affirms, "which he would hardly do unless he knew," that in regard of times wholly prehistoric, one thing is true, "beyond all doubt," and "nothing is more certain than another," "not even," suggests our critic, "the multiplication table." While Mr. Harrison, who can generally be trusted to give as good as he gets, sets down Sir James' utterances about Humanity as "the ravings of Timon of Athens."

[1] *Ibid.* [2] *Ibid.*, July 1884, p. 5.
[3] *Ibid.* [4] p. 6. [5] p. 8. [6] *Ibid.*, Nov. 1884, p. 831.
[7] *Ibid.*, Sept. 1884, p. 366. [8] *Ibid.*, June 1884, p. 908.

Finally, to explain in one word the vagaries of his antagonists, Mr. Harrison tells us that they are "merely philosophers attacking an opponent."[1]

Just so! Philosophers attacking an opponent are evidently not to be trusted for philosophy. It would appear to be the part of wisdom not to take on faith, bitter opponents as they are, their own assertion that belief in God has received its death-blow at their hands. We must first examine their reasoning, and, which is far more, must make sure that we understand it. It may be that we shall fail to make head or tail of it; and should we be lucky enough to discover what it means, it is not impossible that we shall yet find in it some of those fatal flaws which in one another's case they have shown us in such profusion.

In a word, to confine ourselves to what we have heard, does it not seem to ordinary common sense, that, on their own showing, our philosophic thinkers, who would find in mere human science an object to satisfy the heart of man, are engaged in a Danaid's task of filling sieves with water, a task at which all the wit of man may labour everlastingly in vain? Does it not appear that we may sum up the matter in the words of a thinker at least as clear as any to whom we have been listening, when he speaks[2] of "the impatience I feel at able men daring to put out for our acceptance theories so hollow and absurd."

So speaks Cardinal Newman, and, surely, by his mouth speaks common sense.

[1] *Ibid.*, Sept. 1884, p. 371.

[2] Cardinal Newman, Letter to Mr. Wilfrid Ward (*Clothes of Religion*, p. xix.)

# "THE COMFORTABLE WORD 'EVOLUTION'"*

It is much to be wished that some of our scientific men, or of that section to whom the title is commonly attributed, would publish a glossary of the terms they employ, with the exact meaning to be attached to each; for thus would be avoided much vain beating of the air and many a game of cross purposes, from which at present there appears to be no escape when an outsider ventures to discuss the subjects of their predilection.

What, for example, are we to understand by the word "Evolution"? We are constantly assured that, whatever else may be dark and doubtful, "Evolution" is an indisputable fact; this mode of accounting for it, and that, and the other, may indeed be unsatisfactory and improbable—but, for all that, the question as to whether Nature has worked through "Evolution" has long since passed beyond the phase of discussion among scientific thinkers;† the Darwinian system of Natural Selection is sinking more and more below the range even of hypothesis, while Evolution itself is almost beyond the range of doubt. "The theory of descent is safe," declares Professor von Hartmann, "but Darwinism has been weighed and found wanting."‡

It is obvious, however, that to the term "Evolution" very different significations may be attached. It is unquestionably by a process of "Evolution" that an oak comes

* Lord Salisbury; Address to British Association, 1894.

† *Nature*, September 10, 1891.

‡ *Annalen der Naturphilosophie*, vol. ii. (1903).

from an acorn, a butterfly from a caterpillar, or both from an egg. When we say that there has been "Evolution" in nature, are we to understand Evolution of this kind, the only kind whereof we have practical experience? Are we to say that one life-form produced another, inevitably and because "it was its nature to," as the seed produces the plant? Or, are we rather to say that there was no predetermination in the original forms of life towards one development rather than another, and that extrinsic causes have governed the production of those we now observe? It is obvious that the two things are not the same; they are, in fact, as different as possible. On the one supposition, given the original form, Evolution is secured, just as we secure salmon or trout for a river by getting the ova; the after-development being as much part and parcel of an organism as the initial state. But in the other case the original form has no more tendency to become anything else than has the ore in an iron-mine to become a steam-engine; if it is to do so, it must be wrought on by forces altogether independent of itself. We may style the one or the other process "Evolution," but does it serve any useful purpose to turn the word loose on the world till we have determined which it means? To say that "Evolution" is established, but that we have no knowledge as to the mode in which it has been worked, is merely to declare, after the manner of the king's astrologer in the ballad, our power to divine that something has occurred, but not what that something may be.

It will doubtless be answered that we know the fact of Evolution by evidence altogether independent of the process which has ruled it. We find in life-forms a certain orderly gradation of types, one pointing to another, like footprints in sand; and, as from such footprints we can assure ourselves that a man or animal has passed that way, can learn what has been the course of the march of life. But the point to remark is, that in the one case we know of a force that can cause motion from point to point, and in the other we do not. We must know that creatures walk before understanding the meaning of their tracks.

Mere sequence does not necessarily imply connection. We have amongst crystals, for example, a wonderful progression of forms, the same general type being worked up, in the case of different elements, to greater and greater complexity. It has been observed by Mr. Ruskin,* that if crystals were endowed with the power of reproduction, we should be taught to conclude that those of galena, gold, and oxide of iron were developed from a common ancestor, because they are all octohedric; and we should certainly be tempted to argue that the extreme complication of construction exhibited by certain crystals, requiring a portentous terminology to describe,† must have been arrived at through the simpler figures upon which they are based. But, as crystals do not breed, we know this not to be the case, and that whatever be the true explanation of their phenomena, it is not Evolution: the basis of our judgment being the obvious absence of any force or cause capable of bridging the interval between form and form, and so leading from one to another. So long as there is nothing to do this, it matters not how much alike these forms may be, nor how well graduated a series they compose; development does not explain their production. In the case of living things we are not certified of the absence of such a force, and therefore may conceive of development as possible; but till we are certified of its presence, we cannot be sure that development there has been. To be justified in proclaiming it as established, we should therefore be possessed of some certain knowledge as to the mode in which it has been operated.

To take another instance. The truth of Evolution is frequently assumed on the strength of the existence of what are called "rudimentary," or "vestigial" organs—organs, that is, so minute or incomplete as to be of no use whatever to their possessors. The only explanation of their existence, we are assured, is that the possessor's ancestors had and used the same organs in their full form, but that

* *Love's Meinie*, p. 56.

† As the *Tetrakisdodecahedron*, *Hexakisoctohedron*, or *Icositetrahedron*.

in course of time change of habits and conditions having thrown them out of work they have dwindled away, existing now as a mere trace of the past. This is doubtless a possible, we may even say a plausible, explanation : but is it the only explanation that can exist? To say that it is so, we ought to be possessed of a very thorough knowledge of the processes and principles of Nature; in other words, we should be sure that we understand how the life-forms in question have been produced, the very problem we are attempting to solve. That we possess no such knowledge is evident. We allow ourselves the widest possible latitude in framing explanations of what we see,—declaring, for example, that the sole explanation of the complicated adornments of a peacock is the superior attractiveness he thereby gains in the eyes of pea-hens, though we have no evidence at all that their judgment in such matters agrees with ours; and equally pronouncing the warts on the face of a baboon to be decorative adjuncts, though appearing to us disfigurements. We satisfy ourselves with such explanations because no others are forthcoming, conceiving their validity to be thereby proved. In spite, however, of this facile mode of procedure, there are cases, not a few, where we cannot even imagine an explanation, and this in the case of organs not rudimentarily but fully developed. Such an instance is afforded by the strange and complicated shields borne on the heads of certain working ants, the use of which is an absolute mystery. Who has any idea of the practical utility of the spots and stripes wherewith some caterpillars are adorned, which cannot justify themselves on the ground of sexual attraction as they do not breed in that stage; or of the tuft of hair on a turkey's breast?

It would therefore appear, to come back to the original point, that until we know something of the manner in which the present state of life has been brought about, we can mean nothing particular in talking about "Evolution," and it is not worth while to talk much about it without a meaning. Yet, as has been said, writers are found in plenty to imply, if not to declare, that not knowing what the process has been, or what forces have been at work, we can yet be scientifically certain of the fact of "Evolution." They speak as if the word had a strict and definite meaning, and are impatient of any hesitation as to its acceptance, allowing no explanation of such hesitation save unscientific bigotry. Thus, as has been well observed with regard to rudimentary organs, they not only suggest an explanation, but proceed to declare it to be the sole explanation possible, and if any one demurs, they accuse him of dogmatizing.

They go in fact much further, and assume that in admitting "Evolution" we have to admit a great deal about its secret history, whereof they have professed to claim no knowledge. The word, as we have seen, would apply to a process of development from a germ pre-ordained to develop; and it is obvious that such pre-ordination is at least compatible with the idea of a pre-ordaining mind. But "Evolution" being taken as granted, we are straightway led off on lines of argument resting on the supposition that the notion of Design is now finally disposed of, that "Evolution" must mean an automatic and unintelligent process, subject to none but material laws.

It may, in fact, be suggested that if we wish to understand what "Evolution" may signify, no example will be so instructive as that of the term itself. Until the period of Mr. Darwin's appearance, although the relationships of living things one to another were fully recognized—at least in their broader features—which is, indeed, the basis of any "natural" system of classification, the idea that community of descent furnished the explanation was not adopted, simply because there appeared to be no means by which transformation could have been effected. Mr. Darwin came, with his theory of Natural Selection, claiming to supply this deficiency, and to show that there was a force in nature capable of doing what was needed by changing one species into another. His system, elaborated with much ingenuity and immense industry, appeared so satisfactory that the conclusion was widely and enthusiastically adopted that he had succeeded fully in his attempt, and made clear what had hitherto been dark: "Evolution" being now accepted as proved, not because of the phenomena previously known, but on account of the meaning put upon these phenomena by him. Time went on, and further investigation has been unfavourable to these first conclusions; serious objections have presented themselves, difficulties have accumulated, till now, as we have been told, the Natural Selection theory has sunk beneath the rank even of an hypothesis. Meanwhile, no other theory that has been proposed to take its place has succeeded in obtaining any acceptance, even provisional, at all comparable with that which Darwinism once received; so much so that this system has never been dethroned in the popular imagination, simply from the want of a substitute, it being still commonly supposed that the "Evolution" theory and the "Natural Selection" theory are one and the same, and the belief in the former is based on the arguments of Mr. Darwin.

It thus appears that the grounds on which the doctrine of "Evolution" originally rested have disappeared, and that we are just where we were before Mr. Darwin published his *Origin of Species*. To recur to an illustration already employed, we may indeed in the meantime have discovered numerous fresh footprints in the track, but are as far as ever from knowledge of a force capable of taking a single step. Yet, while this is so, it seems to be assumed that the value of the final conclusion is nowise impaired, and that the validity of the "Evolution" theory is quite independent of that of the other theory whereon it was originally founded. The Darwinian hypothesis is made, in fact, to do the work which a nest does for a young bird, who requires to be sustained by it for a time, but presently spreads his wings and soars away self-supported, serenely indifferent to the fate of his early cradle.

There has thus been effected a complete change of front in the evolutionary army. Their original position was this: "We believe in Evolution, because Mr. Darwin's theory, which is a theory of Evolution, explains the phenomena:" whereas now they say, "We believe in 'Evolution' because of the phenomena, though unable to construct a theory which shall explain them."

Considerations such as these afford at least some justification for the attitude of those who ask for fuller information before they pin their faith to the popular creed; and, unless it can be shown that the state of the case has been here wrongly exhibited, other motives than unreasoning bigotry may account for the position they assume. They wish to know what it is precisely that they are asked to believe. They do not wish to accept the doctrine contained in a word capable of many meanings, without knowing which of these is to be attached to it, and why it is to be accepted; not because of such acceptation to find themselves involved in a system of beliefs resting on nothing more substantial than the unsettled nature of the terminology employed.

Our review of the situation would, however, be incomplete without further inspection of the evolutionists' position according to themselves, and of the line of argument on which they would justify their unshaken belief in their cardinal dogma, despite their forced abandonment of the substructure on which it originally rested. The chain of progression in organic life, from lower to higher types, is, they say, undeniable. Whatever be the forces at work in organic nature, it is evident that as a matter of fact those forms were first produced wherein the various organs were less developed, and gradually through many stages of development its fullest perfection has been reached. Such facts naturally suggest the evolution of one form from another, although we have not yet discovered how that evolution was effected. The marks in the sand bear so unmistakably the stamp of connection that we must perforce link them together, and we can do so only in this manner. On any other hypothesis than that of "Evolution," the orderly succession of families, genera, and species is altogether meaningless, while "Evolution" explains it all: "Evolution" is therefore truly scientific—as Professor Marsh has said, "To doubt it is to doubt science."

Now, although, as I have been contending, such an argument leaves much to be desired on the score of logical cogency, it undoubtedly appeals strongly to the imagination, and it will therefore be well, prescinding from the previous question of ways and means, to meet it on its own ground and inquire what, so considered, it is worth. What of the succession of life-forms upon the earth? How does its history, so far as we know it, bear out the doctrines we have heard laid down?

The means of answering these questions are supplied by the late Sir J. W. Dawson in his little book *Modern Ideas of Evolution*; * wherein we shall find in convenient form, and with the sanction of competent authority, facts enough for our present purpose.

In the first place, then, we have to begin by assuming the existence of life. On this, the foundation-stone of the whole edifice, Evolutionists do not claim to throw any light. Life, their ablest representatives strenuously declare, can come only from life. Life, on the other hand, by the testimony of the rocks, has not always been upon the earth. It had a beginning, but about that beginning science has no word to say. It may well appear that this deficiency vitiates all possible value in her after-conclusions, for the force producing life must surely have something, if not everything, to do with all its further developments. This, however, is not our question now: we must, with those whose doctrines we are considering, take things as we find them, and proceed to inquire how far the history of Life as we know it accords with the assertion that the "Evolution" theory alone explains the facts.

In the first place, what of the alleged fact that life began on earth with the simplest forms, and has gradually mounted to greater and greater complexity, from a single generalized organ performing many functions in a less perfect manner, to a multitude of organs, each specialized for the due performance of one? Broadly speaking, we find this to be true, but that there is a most important qualification to be made. The first discovered forms of life were of low grades, indeed, but of high and perfect types within those

* London: The Religious Tract Society.

grades;* that is to say, they were forms to reach which a long process of development would be required. And similarly of the first specimens of the various tribes and families which have succeeded. With regard to the plants of the coal period, Sir William Dawson tells us: † "The land was clothed with an exuberant vegetation, not of the lowest types nor of the highest, but of intermediate forms, such as those of the pines, the club-mosses, and the ferns, all of which attained in those days to magnitudes and numbers of species unsurpassed, and in some cases unequalled, in the modern world. Nor do they show any signs of an unformed or imperfect state. Their seeds and spores, their fruits and spore-cases, are as elaborately constructed, the tissues and forms of their stems and leaves as delicate and beautiful, as in any modern plants. Nay more; the cryptogamous ‡ plants of this age show a complexity and perfection of structure not attained to by their modern successors."

In like manner with regard to animals: § "The compound eyes and filmy wings of insects, the teeth, bones, and scales of batrachians and fishes; all are as perfectly finished, and many quite as complex and elegant, as in the animals of the present day." Neither is it true to say of these that their earliest representatives represented their lowest orders: for instance,‖ "Fishes appear, and soon abound in a great variety of species, representing types of no mean rank. . . . On the land batrachian reptiles now abound, some of them being very high in the sub-class to which they belong." At later periods of the geological chronicle the same sort of story is repeated. At one time it is broad-leaved forest-trees that enter upon the scene,¶ altogether different from those of the previous chapter: at others lizard-like reptiles, birds, and mammals, each stamped at its first coming with the essential characteristics of its class as we know it to-day, so that "it is impossible, except by violent suppositions, to connect them genetically with any predecessors." But still

* *Modern Ideas of Evolution*, p. 93.
† P. 99.
‡ *I.e.*, flowerless.
§ *Ibid.*
‖ P. 98.
¶ P. 100.

more important is it to note the mode of appearance of each succeeding class. On the "Evolution" hypothesis, a new type of life should make its appearance but gradually, and as it were tentatively. Mr. Darwin could not believe that the complex coincidences of many circumstances needed for the production of a new species could occur twice over, and so held that a species once extinct must for ever remain so, the exact causes which had originally produced it never recurring. Therefore the members of each group of allied forms must, he tells us, have sprung from some one progenitor.* According to this, a new form should have been propagated from the first representatives, elaborated by development, spreading gradually from the centre where these had appeared, to occupy other regions. But, as we read it in the rocks, this is not the account of the matter: on the contrary, "Many new forms appear to have been introduced at one time and apparently suddenly,† entering upon the scene 'abruptly and in large numbers.'" Such is the case with ferns, club-mosses, horse-tails, and later on with the more perfect fruit-bearing trees; and among animals with corals, lamp-shells, crinoids, amphibians, reptiles, and mammals. Thus in what is known to geologists as the Cambrian age we obtain "a vast and varied accession of living things, which appear at once, as if by a sudden and simultaneous production of many kinds of animals,"‡ the sea swarming with creatures near akin to those which still inhabit it, and nearly as varied. Again, in the latter half of the Palæozoic period "we find a number of higher forms breaking upon us with the same apparent suddenness as in the case of the early Cambrian animals":§ fishes appear, batrachian reptiles, scorpions, spiders, insects, millipedes, and land snails; and this not in one locality only, but over the whole northern hemisphere.|| So we proceed to the Mesozoic, or secondary rocks, with their

* *Origin of Species*, p. 303. It may be remarked that he should have said, "from one *pair* of progenitors," each member of which would have had to be independently developed to the same pattern.

† *Modern Ideas of Evolution*, p. 93.

‡ *Ibid.*, p. 97.

§ *Ibid.*, p. 98.

|| *Ibid.*, p. 99.

dominant reptiles, where also birds and mammals first leave their trace; and to the Kainozoic, or Tertiary, where mammals displace the reptiles as the ruling class, and show themselves in infinite multiplicity of species. "So greatly indeed did mammalian life abound in this period that in the middle part of the Tertiary most of the leading groups were represented by more numerous species than at present, while many types then existing have now no representatives." *

It is quite true that Mr. Darwin, who could not but see the difficulty thus raised, has set himself to answer it. He tells us † that we continually over-rate the perfection of the geological record, and that, imperfect as it is, types of plants or animals may well have existed long before we can find evidence of the fact. Moreover, that we do not make sufficient allowance for the enormous times covered by each of our geological periods, so that there may have been an ample sufficiency for the gradual production of forms which appear to us to have been sprung suddenly upon the world. These pleas deserve full consideration—but, whatever their value, it has still to be confessed that it is not the facts of geology which inculcate upon us the truth of "Evolution," but, rather, those facts, so far as we know them, have to be explained away in favour of that theory. Nature, so far as we have explored her records, knows as little of the manner in which, according to the evolutionary system, her various life-forms ought to have come on the stage, as she does of the melting of one form into another, not observed facts, but what Sir J. W. Dawson calls "violent suppositions" being in each case the basis of operations.

Considerations no less important connect themselves with the question of time, on which subject, to judge from the utterances of the highest scientific authorities, there is still the most bewildering uncertainty. Evolutionists were long accustomed to treat the bank of Time as practically unlimited in its resources, and so drew upon it without scruple for millions and thousands of millions of years, wherein the

* P. 101. † *Origin of Species*, p. 303.

transformations required by their system might have been effected; and the "enormous intervals of time" spoken of above by Mr. Darwin had always played an important part among the postulates of his school, the evidence for their existence being mainly derived from the formation of our various rocks and the rate at which, according to the ordinary laws of nature, they may be supposed to have been deposited. There are, however, other modes of attacking the problem, and these afford a very different result. It is several years since Lord Kelvin startled the scientific world by the announcement that, as the result of calculations based upon three distinct lines of investigation,* all geological history must be limited within a maximum of one hundred million years. This was a mere fraction of the period required for evolutionary purposes, but more recently the same authority has found reason still further to reduce it by eighty per cent., now allowing but twenty million years at most for geological purposes.

In this state of things it is hard to arrive at fixed and definite opinions on this all-important point, and the state of mind is surely excusable which elects to await fuller information before declaring a system to be indubitably proved, which requires for its justification, an allowance of time in the past practically unlimited.

But, although thus unable to compute our time, with any certainty, in terms of years, we can form a tolerably accurate notion of the relative length of geological periods, comparing each with the sum-total of them all. This relative computation opens up sundry questions both interesting and important, whereof one may be taken as a typical example.

To the objection urged by anti-evolutionists that we do not find in nature, either living or fossil, the intermediate forms required to link species, genera, and families together, two answers have been given. The first of these we have already heard, namely, that the geological record is so imperfect as to make its silence by no means conclusive. But it is further maintained that in certain cases we actually

* *Viz.*, the action of the tides upon the earth's rotation, the age of the sun, and the temperature of the interior of the globe.

have discovered the forms wanted, the links here being no longer "missing" but "found," and on the analogy of these we are invited to believe that fuller knowledge would remove the difficulty in other cases. Of the creatures for which it is claimed that an actual pedigree has thus been supplied none has been made more prominent than the horse. "Of course," says a popular writer,* "everybody knows the wonderful pedigree of the horse and donkey family," and in any work that undertakes to demonstrate "Evolution" we are pretty sure to find a plate representing the comparative anatomy of the various discovered forms, leading gradually up to that with which we are so familiar. The instance is indeed for evolutionary purposes almost an ideal one. The earliest discovered animal in the series was about the size of a fox, had four distinct toes, and even the rudiment of a fifth; the creature, even at this early stage, having already begun, in the words of the author last cited, "to develop towards the distinctive peculiarity of his race—the solid hoof, adapted to free scouring over open grass-grown plains." † After him comes another, rather larger, with four toes only, and then a third, the size of a sheep, with but three, whereof the central is distinctly the largest, portending the ultimate absorption of the others. Then we come to a species which has attained the dimensions of a donkey, with one stout middle toe, much like a modern horse's hoof, and a lateral toe on each side, which does not reach the ground—this arrangement being supposed to be adapted for soft and swampy ground. Finally, the full-blown horse himself has a single solid hoof, but retains in his splint-bones a vestige of these his last-lost toes. The chapter is undoubtedly a most interesting one in the history of animal life, but before we are asked to put upon it the meaning for which evolutionists contend, there are sundry important considerations to be weighed.

In the first place, the forms of which we have spoken, though composing an interesting and tolerably consecutive series, appear certainly *not* to have been the ancestors of our actual horse. It is in the New World that we find remains

* Mr. Grant Allen, *Vignettes from Nature*, p. 191. † *Ibid.*

of the animals above described (*Eohippus*, *Orohippus*, *Mesohippus*, etc.), and, if these evolved into a horse at all, it was into the aboriginal horse of America, extinct long ago, for the horses now found on that continent are all descended from animals imported from Europe. The genealogy of the extant horse has to be sought in quite a different line, being traced back to a much less promising source, the *Palæotherium*, a creature which would seem to have closely resembled the modern tapir.* Of the American horse, fossil remains have been discovered, and there can therefore be no doubt that any evolutionary process must connect with him the less perfect forms which America has produced. At the same time, as Dawson remarks, it is equally certain that had we not known of the American animal, these lower forms would have been unhesitatingly claimed as ancestors for ours. "This simple consideration," he adds,† "is sufficient to show that such genealogies are not of the nature of scientific evidence." The horse, in fact, "has too many imaginary ancestors."

The American horse suggests another perplexing question. Traced, as we have seen, to a line of ancestors totally different from those of our genus *Equus*, he has all the essential characters of that genus. Accordingly, as Dr. Mivart remarks, it would appear that "Evolution" must be conducted on principles the very reverse of those generally assumed, not the starting-point, but the term to be reached ruling development, and diverse lines of organic structure being conducted to meet in one point.

All this, however, although too important to be altogether neglected, is but incidental to our main point, which is concerned with the question of geological time. For evolutionary purposes it is not enough that the American horse should have been developed from the tiny

* This fact is quite lost sight of in many popular works on the evolutionary side, as those of Mr. Clodd, Mr. Grant Allen, and Dr. Andrew Wilson, from which it would appear that the New and Old World forms compose but one series, and that the members of each are available to fill gaps in the other.

† *Modern Ideas of Evolution*, p. 110.

*Eohippus;* the latter should himself be developed from a long line of mammalian ancestors. For *Eohippus* is an Ungulate and the Ungulate family have members and organs so specialized for their peculiar purposes that an enormous period of time must have been required to evolve them, as evolutionists suppose. The fore-limbs of a horse, for instance, are constructed out of materials of which we recognize the exact counterpart in the wing of a bat, the paddle of a whale, the paw of a tiger, or the hand and arm of man. Describing them in terms of the last, a horse does not walk on the palms like a bear or monkey, nor on the fingers only, like a cat or dog, but on the tips of his finger-nails. What we call his knee is really his wrist (just as his hock is the ankle), the portion of his "leg" thence to the pastern is his hand, and the hoof is the nail of the one big finger which has absorbed all the others. What a limitless period must have been needed to elaborate such a member, while, meantime, other creatures were modifying the same raw material for the purposes of flight, or swimming, or digging, or climbing, or as a weapon of offence! At least ten times the space must have been required which was occupied in the comparatively simple process of changing one Ungulate animal into another. But for this essential operation the geological record allows no time at all.

The succession of the strata wherein are pressed and preserved the remains of plants and animals has been clearly determined, and they are found to divide themselves, as it were, into three great volumes, laid one upon another, which, beginning from the oldest and lowest, are named Primary, Secondary, and Tertiary. It is only at the beginning of the Tertiary series that any trace is found of true—or "placental"—mammals, the class to which Ungulates belong, and from the common parent of which they have, as we are told, developed,—and early in the same Tertiary volume *Eohippus* comes on the scene, hoofs and all, and with all the essential features of an Ungulate already acquired. Had he been evolved according to the theory we are discussing, the Secondary volume, and even the Primary as well, should bear witness to the existence of a stock whence he might descend, and of other branches ramifying from that stock: for it has taken the whole of the Tertiary period to develop his decendants into horses, if such development there has been, the fossils of the latter animal being found only towards the end of the volume.

This may, I think, be fairly taken as a sample of our experience, should we attempt rigorously to examine the cogency of those arguments by which "Evolution" is commonly held to be established. That they "prove" anything, understanding "proof" as science usually understands the term, can hardly be seriously maintained: till scientific proof be produced, to suspend our judgement should not be unscientific.

# THE FOUNDATIONS OF EVOLUTION

In the previous paper * I have endeavoured to show that the fashionable evolutionary creed labours under certain disadvantages in the eyes of those who, not wishing to adopt a belief merely because it is popular, endeavour to form for themselves a clear idea as to what it is, and why it is to be accepted. In the first place, the terminology is vague and unsettled, so that it is impossible to say what it signifies. Moreover, so much has to be assumed without the possibility of explanation or comprehension, as to deprive the system built on these assumptions of all scientific value. Finally, the proofs adduced in favour of Evolution are vague and inconsequent and do not bear close inspection.

Prescinding, however, from all this, there remain other lines on which an inquiry into the claims of the Evolutionary theory can be conducted, and it may be worth our while at present to consider one of these. Let us altogether abstract from the biological or geological arguments brought forward by Evolutionists; let us for the present suppose these to be as cogent as they are said to be; let us shut our eyes to the difficulties which have been raised on the score of terminology and definition : taking the creed at its own valuation, and admitting its exposition of itself to be comprehensible and satisfactory, we shall find ourselves still confronted by a problem of insoluble perplexity.

* "*The Comfortable Word 'Evolution.'*"

It must be borne in mind that "Evolution" claims to be not a fact merely, but a principle. Not only, as we are told, have beings of various kinds been actually evolved, one from another, but there is a law in "Nature" making such evolution imperative, which law is, indeed, supreme and paramount over all others, forcing them all to co-operate towards its own ends, and making its power felt in every department of the universe. Not only has there been organic evolution, producing the various species of plants and animals, but previous to this and preparatory for it there was inorganic evolution of the material world, while subsequently there has been, and still is, mental evolution of individuals and sociological evolution of collective man. Such is the essence of the new gospel promulgated by Mr. Herbert Spencer and incessantly preached and popularized by the multitude of his disciples. New it undoubtedly is, and if it be also true, there is abundant justification of the attitude of mental superiority assumed by its partisans in regard of all other schools of philosophy that have ever been. If this be indeed the great illuminating principle of the nature of things, and if all generations of men up to the present have not even suspected its existence, what is more obvious than that they have all been lost in Egyptian darkness, and that their speculations may without further ado be summarily dismissed as absolutely worthless?

It is no less clear that for a principle which makes such enormous claims there should be very solid grounds, and that like other fundamental truths it should be capable of imposing itself imperiously upon the mind. Though too blind to see it for ourselves, we ought, now that it has been discovered for us, to recognize its harmonious power, and, observing how it throws light where hitherto there had been but darkness, to be impressed with the assurance of its truth.

If we would proceed to a fuller examination of the system which has been briefly outlined, it is undeniable that we may look to find it more clearly illustrated in the inorganic than in the organic world. Life is still—even for the most accomplished biologists—an acknowledged mystery. Of its origin they confessedly know nothing; of its laws they know so little as to be quite unable, with any exactitude, to calculate their course. All that they can pretend to do is to verify the operations of these laws as they occur, and conjecturally to construct a history for them in the past. But with the inorganic world it is otherwise. There, while the origin of the prevailing laws is utterly unknown, their operation is so clearly understood as to earn for the sciences that deal with them the title of "exact." The natural philosopher, the astronomer, the chemist, the electrician—all deal with that which can be not only verified but foretold: knowing the circumstances, we know how matter will inevitably behave when placed in them; how one body will fall and another rise, how planets will revolve and rotate, what chemical affinities will prove themselves more potent than others, how the needle will be deflected on the passage of an electric current.

This being so, if there be any province in which we may reasonably expect to find the truth of Evolution unmistakably exhibited, it must be that of the material forces with which these exact sciences deal: here we should find it not in the shape of an induction more or less ingenious, and more or less vague, but reducible to a rigid formula, and demonstrable by the methods of mathematics.

What is the fact? Do we find in the material history of the world, as known to us, plain evidence of continuous and continual progress towards greater and greater perfection, fraught with infinite possibilities in the future of ever-evolving life and power? On the contrary: the process which we trace is one not of advance but of degradation, the term which we are able clearly to foresee is one not of indefinite expansion for the powers of nature, but of absolute extinction of them all; while no less assuredly do we learn that the condition of things which has rendered possible all the multitudinous laws with which science deals is one for which no merely mechanical theory of Evolution can even attempt to account.

To understand this we must go back to the beginning of things whence Evolution is to start. Confining ourselves to our own system of sun and planets, we are told, and with every appearance of probability, that the original condition of the matter composing them was a vast " nebula "—a sort of cloud or vapour—wherein the countless multitude of atoms, now packed together in solid bodies, standing far apart one from another, as an enormous sphere more than seven thousand million miles in diameter, filled at least the whole space between the sun and the outermost of the planets, probably extending far beyond.

In this condition, which we have to postulate in order to account for what follows, there is one element for which science can nowise account, and to which are due all those operations whereof she takes cognizance—the position of the atoms far apart. Had they been close together the world that we know would never have been ; while to drive them apart a force is needed whereof we find absolutely no trace in physical nature.

That the world should become the theatre of those manifold laws which we daily witness in operation, it was absolutely necessary that there should be available a store of power capable of doing the work required, just as to drive a mill by water-power we must have a reservoir higher than the wheel that is to be turned, or to make a clock go the weights must be raised, which in their descent are to supply motive power for the machinery. In these cases, and all others where the operations of nature are performed, we require first that bodies be placed in a condition different from that towards which their own inherent forces tend to bring them ; and it is the play these forces find in reasserting themselves that gives them the opportunity of acting. The water in the mill-dam or the weights of the clock have of themselves no tendency to do anything but descend, the action of gravitation causing all bodies to tend to approach one another, and these therefore to approach the earth. The force expended in putting them in an unstable position is thereby stored up, its exact equivalent being returned as they resume their natural position. Similarly when we bend a bow we forcibly alter its natural shape, and thus allow its elasticity to become available to propel the arrow.

When we fire a gun we let loose the constituents of the powder from the chemical combinations they have been made to adopt; we do the like when we burn a piece of coal; the immediate result in the one case being an expansion which furnishes propulsive power, in the other a supply of heat.

The original situation of the particles composing the world at a distance one from another, was exactly analogous to that of the clock-weights when raised to their highest point. They were in an unstable position, in a position contrary to that whereto their own forces tend to bring them, and it is their constant running down towards that position that is the main and most essential factor in the work of Nature. Given motion we at once get heat, from the friction or impact of particles and particles. Given variations of heat, we get change of chemical combination; similarly we get electrical action: all, in brief, that we have in the way of active forces in Nature, we owe to the fact that the world was at starting in a condition to change itself by its own forces. That is to say, I repeat, it was in an unstable, and in what we may call an unnatural, condition; its particles were placed where it would require enormous work to be done against gravitation to replace them in a position from which they have been inevitably departing and must invariably continue more and more to depart. In other words, the weights of the clock are continually running down.

That is what I mean by saying that the process we find going on is one of degradation, for what is expended can never be recovered. Just as the weights of the clock cannot lift themselves to their first position, and the more work they do are less capable of further work; just as we cannot twice fire the same powder or burn the same coal, so every exercise of the forces of Nature marks a diminution of the stock on which it is possible to draw.

The sun, to take the chief example of all, is the great central engine of our planetary system, an engine of illimitable capabilities. He it is that pumps our water supply from the oceans into the clouds, feeding our lakes and rivers, and irrigating our fields. His rays it is that enable plants to grow, and to assimilate carbon from the atmosphere, binding it up in chemical combinations within their tissues for future use. It is because our coal-fields were once growing forests that they are able to furnish fuel; and when we burn a piece of coal we do no more than let loose the energy stored there of old by the sun. So, also, all animal force is supplied, for either directly or indirectly we all subsist on grass, the ox and sheep directly, and those who eat beef and mutton through them as intermediaries. The enormous work thus done by the sun upon our globe is but an insignificant fraction of that which he is capable of doing, for only those rays do this work which happen to light on our tiny sphere, and it would require more than two thousand million earths, at our distance from him, to catch them all. The small portion of his power thus exerted upon us is, however, so potent that if the land and sea were covered with horses, one to every twenty-five square feet, their united efforts would just avail for the work he does; while it is calculated that every square yard of his surface has a working-power equal to the steam of eleven of our largest ironclads.

Still, vast as it may be, this power of the sun is but another instance of energy, requiring a cause to explain its existence, and diminishing as it is exerted. That the sun is hot is undoubtedly an effect of that original position of the particles of matter which we have been considering. It is clearly shown that the impact of large masses rushing together with great velocity—or, which is more probable, the shrinkage of the mass—amply suffices to explain the phenomena of solar heat, however wonderful. But wonderful as they are, the sun can no more than a farthing rushlight burn without being consumed. All this enormous store of energy which he so lavishly throws about space, has to be drawn from his capital; and he is ever, of necessity, hurrying along the road that must inevitably terminate in total extinction.

Neither is it possible that by conversion of the heat, which has originated as we have seen, back again to motion, things can be restored to their original condition. From its nature heat is incapable of being fully utilized in this manner. Only that portion of it, or of any form of energy, which does work can be used; and to do work it must encounter a body to work upon. But being radiated in all directions, much heat never meets with such a body, but travels vaguely into space, and though never destroyed becomes for ever inoperative, and we have seen how immense a proportion of the sun's heat is thus squandered. Therefore, although from a given amount of motion we can obtain an exact equivalent of heat, we cannot from that heat get back the equivalent of motion. Heat has therefore to be fed at the expense of motion, which being destroyed, as motion, in producing heat, and never adequately restored in its original form, is constantly growing less and less throughout the universe. All motion that we know tends constantly to be thus translated into heat.

Heat is therefore a most wasteful form of energy, and it is that which must inevitably supplant the others. Besides this, heat can do no work except between bodies of different temperature, and the inevitable result of its action, when left to itself, being to produce uniformity of temperature between bodies, it must when there is no more motion, or other form of energy, to feed it, render itself powerless to do work at all, and then, in the words of Professor Balfour Stewart, the universe will no longer be a possible abode for living things.

Such, in very brief outline, is the doctrine that comes to us with the fullest authority of science, in connection with one of her latest and greatest discoveries, that of the law of the conservation of energy. Imperfect as so summary a sketch must be, it will perhaps suffice for present purposes and enable us to answer the question as to the claim of the Evolutionary theory to explain the history of the universe. Looking forward to the future, we see that even supposing Evolution to be at present a fact, this can at most be but a transitory phase of the world's history. So far from there being any promise of continuous and ever-progressive ascent from height to height of greater and greater Evolutionary triumphs,—there is no hope: Evolution and all its works must inevitably go down into the pit of the dead lifeless heavens and earth which science has enabled us to foresee, and towards which every exertion of the forces which alone make Evolution possible brings us appreciably nearer.

Still more instructive is it to look backwards to the past. Let it be again repeated, the original condition of things, that on which everything depended, is one for which no theory of Evolution can account. No forces known to us in physical nature could possibly have produced that original condition: they could not even conserve it when it was given, and if they had left it as it was, the result would have been dead lifeless inactivity, exactly as that other condition to which we are tending. If the weights of the clock are drawn up but not allowed to descend, the result is precisely the same for the timepiece as if they had run down to their lowest, and, in like manner, it was only because there was matter so situated that it could be made to run together, and forces capable of making it do so, that the complex machinery of the universe was rendered possible. Nowhere, outside of poor Robert Montgomery's poem, did a stream ever "meander level with its fount," and the law which forbids such a feat is precisely that which has regulated the whole course of Nature, ordaining that course to be one of steady descent from the most advantageous form in which her constant sum of energy could exist, to other forms ever less and less capable of future work.

In all this it is hard to discern the presence of Evolution, ruling from end to end and dispensing with the need of anything but itself to explain the totality of things. Yet such, be it remembered, is the claim set up on behalf of the new doctrine. Unless the "great law of Evolution" runs through everything, it is not what it pretends to be, and here in this department of science where more than in any other can precise conclusions be arrived at, we find its claims utterly discredited at both ends of the chain of life.

May we not unhesitatingly go further and say that what we do clearly learn is this: That there must have been from the beginning a power in existence, capable of doing all that had to be done in order to make "Nature" possible, a power differing from the forces of physical nature in being independent of accidental conditions for its effective exercise, not requiring to receive energy from another, nor spending it in its exercise—a power to which must be ascribed every operation of Nature that we witness, as to the arm that wound it is to be attributed the going of the clock? If we do not finally arrive at such a power as this, philosophy is no more than an endless game of hunt-the-slipper, and every system of cosmogony does but reproduce, under other names, the series of elephants and tortoises wherein Hindoo astronomy would find a support for the world. But if there be such a power, and if it be, as it must, one that could by no possibility be evolved, for it is the necessary pre-requisite of all processes, what more can Evolution be, if Evolution there is, than part of that system of law which flows from the condition with which the First Power ordained that the operations of Nature should start?

It will probably have occurred to the reader that not only in respect of the position in which the particles of the primitive nebula were placed, does the state of things postulated as a starting point by evolutionists demand explanation. Not only were the particles set wide apart against the force of gravitation, but the whole mass they composed was in motion, rotating upon its own axis with immense velocity. Whence came this motion? Matter cannot move itself, for, as we know from the first of Newton's great laws, a body at rest will continue at rest for ever unless acted upon by some force. It is true that in order to meet the difficulty thus created by the inertia of matter, Voltaire's friend, Baron Holbach, boldly enunciated the principle that motion is an inherent property of matter, which of its own nature tends to move, which unscientific idea has recently been revived by Professor Haeckel. But a doctrine so patently absurd has failed to obtain any acceptance. Not only does it contradict all experience, but on very slight examination it is seen to have absolutely no meaning. If matter tends to move, it must be in some one definite direction. A tendency to move indifferently in every direction at once would anchor it just to the position actually occupied, like the rope in a "tug-of-war" when the rival parties are equally matched. And why should matter tend to move in one direction rather than the opposite? The globular nebula, for instance, to which we have been introduced, must have been turning on one particular axis; and that its movement was from west to east is evidenced by the rotation of the sun and planets composing our solar system, and the revolution of the latter in their orbits, which is traced to the rotation of the mass whence they were thrown off.* How came it, we may ask, that this particular axis came to be selected rather than any other? And why was the rotation from west to east, rather than east to west? Here is another prime factor in the machinery of the universe which has to be accounted for before we can speak of having found an explanation that explains anything. And this initial condition of motion is a factor of the first importance. This it is that furnishes the centrifugal force, but for which the centripetal force of gravitation, or mutual attraction of particles, would straightway draw all together as a solid sphere round the centre of the mass, and had this been, there could be no room for any of these operations which make Nature what she is. By virtue of this initial rotation alone can the mass perform, as it does, the function of a gigantic fly-wheel, capable of keeping the machine going for millions of years after the original impulse has ceased to act. But an initial impulse there must have been, and to it each succession of evening and morning, of winter and summer, bears witness, for, like the sum of available energy throughout the system, so this particular energy of motion can only tend, however slowly, towards its inevitable term.

The daily rotation of the earth, for example, was once

* With the probable exception of the satellites of Mars.

supposed to afford an instance of motion absolutely invariable. More exact observations, however, have shown that this is not so; the action of the tides in a contrary direction act as a drag, and cause retardation, at a rate which, however slight, is nevertheless appreciable, and must, one day, infallibly destroy the motion altogether, reducing the earth to the inert condition already reached by the moon.

Once more, therefore, the results of science lead us perforce to the recognition of a Power beyond those of physical Nature, from which alone, as Newton declared,* the condition of things which we behold can possibly have originated.

To sum up. We have seen, as a result of the investigation of science, in that department where her knowledge is most truly scientific, that Evolution cannot be spoken of as a law of irresistible progress, sufficient for itself and imperiously working out its own operations: for, far more surely than any progress, there inevitably awaits it the utter extinction of all that it has ever done. Moreover, supposing Evolution to be the present law of things, the fact that it is so does not explain itself, but postulates of necessity a force beyond and behind all the forces of physical nature, whence alone can the law of Evolution or any other law derive the powers it has to work at all.

Mr. Herbert Spencer in his well-known definition describes Evolution as "an integration of matter and concomitant dissipation of motion; during which the matter passes from an indefinite incoherent homogeneity to a definite coherent heterogeneity; and during which the retained motion undergoes a parallel transformation." † Many will feel that this definition, lucid as it doubtless is, does not altogether remove the mystery which surrounds the subject, but, whatever be obscure and difficult, it is obvious to ask whence came the conditions rendering possible this integration, this dissipation and this trans-

* *Principia: Scholium generale.*

† *First Principles*, § 145.

formation; whence came the motion to be dissipated and transformed, the indefiniteness capable of definition and the incoherency capable of being made coherent. Finally —if Evolution be really this, how can a process contingent on so many conditions be described as explaining anything —how can it with any show of reason be presented to us as the final principle which shall solve the mystery of the universe?

# THE MECHANICS OF EVOLUTION

Evolution, as I have endeavoured to show,* so far from being a living principle capable of explaining the origin and subsequent course of Nature, cannot explain itself, but postulates as a requisite of its own existence a state of things which it could nowise have produced, requiring, as a condition indispensable for the operation of any physical forces, that matter should be given them to work upon, and in a position to which they could never bring it.

This is, however, but a part of the difficulty, which we shall better understand by further consideration of Mr. Herbert Spencer's definition already quoted. "Evolution," he tells us, "is an integration of matter, and concomitant dissipation of motion; during which the matter passes from an indefinite incoherent homogeneity to a definite coherent heterogeneity . . ." This utterance has, by the profane, been likened to the original condition of things, as being indefinite and incoherent; but it would at least appear to speak plainly on one point, the homogeneous state of the original universe, that "homogeneity" in progress from which towards "heterogeneity" Evolution mainly consists.

But here again we find that the original condition of things, as reported by science, is fatally at variance with

* *The Foundations of Evolution.*

such an idea. The atoms composing the material universe cannot, to begin with, have been homogeneously disposed: that is to say, the system made up of these atoms cannot have been of like structure throughout, but, on the contrary, there must have been a most complex heterogeneous arrangement, in order to account for what has actually occurred. We have elsewhere considered * one essentially heterogeneous element, of fundamental importance, which the primitive nebula must be assumed to have exhibited—viz., the motion of rotation in one definite direction and no other. And but for this motion of rotation the solar system, with its revolving and rotating planets, could never have existed, and, for want of a centrifugal force to keep them apart, all the particles of matter must long ago have been drawn together by the force of gravitation to form a solid sphere as uniform as a billiard-ball.

For quite apart from this question of the movements of sun and planets, every operation of Nature tells the same tale. For the due working of her laws it is absolutely necessary that there should be infinite and endless varieties of conditions in her different parts. That heat should do any work there must, as we have seen, be difference of temperature between different bodies, and that there should be difference of temperature, the motions producing heat must be greater in some quarters than in others. Similarly as to chemical combination, the same sort of atom will behave in totally different ways according to difference of circumstance. Thus oxygen exists free in the air, combined with hydrogen in water, combined with calcium in limestone, with carbon and other elements in vegetable and animal tissues, and in countless other forms. Every atom of oxygen is equally ready to play any of these parts, what part it is to play depends wholly on the circumstances in which it is put. These must accordingly be infinitely various if such a world as ours is to be made and maintained. What has been said of one chemical element is true of all; what has been said in regard of motion, heat, and chemical action, must

* *The Foundations of Evolution.*

equally be said of electricity and magnetism and of all the modes in which energy is manifested.

From this it follows that the primæval world can by no possibility have been homogeneous, and, moreover, that whatever heterogeneity it was afterwards to develop must have existed from the first, as the plant exists in its seed, in the original arrangement of particles on which all subsequent operations depended. The evolutionary theory bids us to consider the world from the physical side only, and to regard all its developments as the necessary result of the forces of the matter composing it. The fundamental proposition of Evolution, Professor Huxley tells us,* is "that the whole world, living and not living, is the result of mutual interaction according to definite laws, of the powers possessed by the molecules of which the primitive nebulosity was composed." But in a material system, such as is here spoken of, all depends not only upon the forces to which it is subject, but also upon its configuration; given these and it is at once certain what must happen, the system can have but one future before it. I have already compared the universe to a clock, wherein the weights must first be lifted as an essential condition of motion. But this is not the only condition, the weights can never by themselves make the clock go, still less go right. The works must be correctly constructed, so that, by the various functions of the different parts, the force supplied by the weights may be properly applied. Due provision for this proper application of the force is as essentially requisite as provision of the force itself; and as in the case of the clock, so, in precisely the same manner, in that of the universe.

This is a point of supreme importance, which is too frequently altogether ignored. We are often assured, in vague general terms, that the "forces of Nature" are sufficient to account for everything, and that it is futile and unreasonable to demand anything more. But, as Mr. Croll has well contended, † force by itself explains nothing: to

* *Life and Letters of Charles Darwin*, vol. ii.

† *The Philosophical Basis of Evolution.* London: Edward Stanford, 1890.

produce any given effect force must be applied in one given way, and in this only—and, to understand the effect, we must understand how it was so applied. The explosive force of gunpowder, for instance, does not explain the hitting of the bull's-eye by a bullet, for it was equally available to send the ball in any one of a myriad different directions. The rifleman gets a prize, not because his gun went off, but because he directed it aright. The steam power of a vessel is equally ready to take it towards any port in the world or on to any rock ; the energy stored in the waters of an upland pool will turn a mill, or drive a dynamo, or irrigate a field, only according as a direction is given to their descent. And similarly in nature, if different atoms of the same substance perform totally different functions, as air or water or rock, it is only because of the different circumstances in which they are placed, of the different direction given to the forces to which they are subjected ; if an electric or magnetic current runs in one direction rather than another ; if one portion of the world is comparatively hot and another comparatively cool ; if the same body exists in one spot as vapour, in another as liquid, in a third as solid, it is all because of the variety of conditions established throughout the universe—and this variety is the machinery of the clock.

What is therefore to be thought of the assertion that Evolution starts from homogeneity? And to make the matter still more hopeless of comprehension, we are further told that this homogeneity was "indefinite." But regarding the universe as a purely mechanical system, and thus, be it remembered, we are bidden to regard it, nothing is more absolutely certain than that the original arrangement of its parts must have been definite in the extreme, definite down to the minutest particular, so that any alteration in it, however small, would have produced a different world from that in which we live. "It at once follows from the laws of motion," says Professor Tait,* "that a material system left to itself has a perfectly determined future, *i.e.*, that upon its

* *Contemporary Review*, January, 1878.

configuration and motion at any instant depend all its subsequent changes; so that its whole history, past and to come, is to be gathered from one sufficiently comprehensive glance." One particular arrangement of every atom and molecule composing the universe, and one alone, at the moment when the forces of Nature were first let loose, that is when the weights of the clock were at their highest and were started on their descent, can alone account, on evolutionary principles, for the course which the laws of Nature have actually taken: this arrangement must, as has been shown, have been essentially heterogeneous, absolutely definite, and of unimaginable complexity, securing in the sequel the application of every force ever exerted in the universe, so as to produce the effect actually produced, forming a machine of countless millions of wheels, and wheels within wheels, checking and counter-checking one another, and exhibiting as they run those laws of Nature which it is the highest privilege of science to observe. Until we can account not only for the existence of force, but for the mode in which it is thus applied, we have done nothing towards reaching "the final equation of the universe." The claims of "Evolution" to solve that equation are obviously worthless, for of neither of these unknowns has it anything to tell.

So much for what is purely material and mechanical. We have seen, however, on the authority of Professor Huxley, that Evolution claims to account not for the lifeless only, but for the living world. Into this latter field, after what has been said, it may seem needless to go, but, as this sort of claim is constantly reiterated, a word on the subject will not be irrelevant. It may be said, in the first place, that as regards life, to say that it comes by "Evolution" through the action of mechanical force on matter is the merest and most gratuitous assertion without any warrant of science whatever. "To say," writes Professor Tait,* "that even the lowest form of life can be fully explained on physical principles alone, *i.e.*, by the mere

* *Ubi sup.* See also Clerk Maxwell, *Life*, p. 573.

relations, motions, and interactions of portions of inanimate matter—is simply unscientific. There is absolutely nothing known in physical science which can lend the slightest support to such an idea." Leaving this, however, alone, the material structures in which life dwells will, in our present connection, afford a profitable object of study.

Let us, for example, consider the case of two trees of different kinds, an oak and an ash. They are made up of the same substances, and the molecules which build up one might have been used for the other, just as the same stones might be used to build a cathedral or a factory, and a play of Shakespeare or a cookery-book might be printed with the same types. Each tree is built up molecule by molecule, and each molecule takes up a determined position which has to be filled that the general plan of the tree may be carried out, just as each stone of the building and each letter in the book has its particular part assigned it, in relation to the whole. A molecule that goes into the oak takes up a different position from that it would have taken up if drawn into the ash, and a position different, moreover, from that taken by all the other molecules which compose the oak. Each takes its place automatically under the influence of forces which make it take that place and no other, and the forces working in the tree to produce its growth are therefore differently directed or determined in regard of every particular molecule on which they act. But the activity of these forces is just as automatic and blind as the passivity of the molecules, they act only as they cannot help acting in each particular condition, every action of theirs is but a necessary sequence from the original constitution of the machinery whereof they form a part. What is true of plants is true also of animals, though in their case the processes to be performed are still more complex and wonderful, so that we find that on the original arrangement of the particles of the universe must have depended the correct placing of every molecule in every blade of grass or flower or tree, and in every creature that has moved on the earth from the remotest epoch of geology, down to the present day and onwards to the end of time.

It should further be remarked that we not only believe the laws of Nature to have worked in a satisfactory and orderly mode up to this present moment, but confidently look forward to similar behaviour on their part in the future. We anticipate, for instance, that this next summer, there will not only be evolutions among atoms and molecules such as gravitation, electricity, and heat tend to produce, but that these evolutions will take the form of producing roses and strawberries and nightingales, just as has been the case in the past. None of these new products will, in all probability, be the exact facsimile of any of their own kind that has yet existed,—but come they will, and of that kind they will be. There must therefore be some power in "Nature" capable of producing them. They will not appear *because* their like has been before. When Hamlet and Polonius watched a cloud and found it first like a camel, then like a weasel, and then very like a whale, they did not and could not assume that on account of these resemblances which had occurred, others would certainly follow, and that the next change of form would display an elephant or a giraffe. If we believe in orderly production as the necessary sequel, we must believe in some cause or other which produces it. The Evolutionist who traces back everything to the original constitution of the material universe must postulate that its particles were arranged upon a plan which has not only *de facto* ensured the regular succession of all that has hitherto been, but was and is determined to the production of order and not of chaos. Of the existence of this plan he is bound to offer some explanation if he is to explain anything at all.

This is no overstatement of the evolutionary position; it is not one with which evolutionists should quarrel. The existing world, Professor Huxley tells us, lay potentially in the cosmic vapour, and a sufficient intelligence could, from a knowledge of the molecules of that vapour, have predicted the exact constitution of, for instance, the animal kingdom as existing in Britain to-day, with as much certainty as one can say what will happen to the vapour of the breath on a cold winter's day.

It is therefore clear that on evolutionary principles we must suppose, as the beginning of things, a precise and definite constitution of matter, of infinite and bewildering complexity, whereby the exercise of all its forces was directed and determined to the production of every result actually produced in the history of the world. But if we have this there is no need of anything else, and no room for anything else in the economy of Nature—if the account of the matter we have heard be the true one, everything that happens in Nature is but part of the tune which she was preordained to play, and could by no possibility have been other than it is. Yet so little do evolutionists appear to believe in their own system that they are ever seeking fresh and independent forces, not included in the primæval machinery, to account for what we find. The utterance of Professor Huxley, for instance, which we have seen above, occurs in a paper devoted to a description of the services rendered to science by Mr. Darwin's theory of the Origin of Species through Natural Selection.* But if the imperious law of Evolution has done everything that has ever been done on earth, where does Natural Selection come in? and what has Mr. Darwin done to improve our knowledge by introducing this new and altogether futile factor into the business? If all that ever has been came from the original constitution of the cosmic vapour, why trouble ourselves any further about the origin of species which, with all the individuals composing them, were bound from the very first to come just as they have come and not otherwise? Yet, in spite of his professions, Professor Huxley finds no words of praise too high for Mr. Darwin's book; it "lights the path of the investigator," its ideas are "profound," they have become "household words and everyday conceptions," and have "vast and far-reaching significance." And yet, if Mr. Darwin says anything, does he not say this, that what he calls Natural Selection changed the course of natural progress and made things come about otherwise than, but for it, they would have come?

* *The Genealogy of Animals* (*Critiques and Addresses*), reprinted in the *Life of Darwin*, p. 201.

The instance is by no means solitary or singular; on the contrary, every evolutionist would seem to have some pet system of his own which he calls in to supplement Evolution and to account for its processes: we have, for example, Neo-Darwinism, Lamarckism, Neo-Lamarckism, Weismannism, physiological-selection, sexual-selection, and a host of other theories, by which to explain that which, if evolutionary theories are true, needs no explanation, and to demonstrate that their respective champions do not really grasp, still less hold, the creed which they profess, and do not believe that the law of Evolution can in fact make things be evolved.

We appear, indeed, in this matter to have reached the extreme limit of confusion. If Evolution be indeed the supreme and central verity of all science and the ruling principle of Nature, then are all subsidiary systems not merely superfluous but inconsistent, for all that is, one thing no more than another, must be a phase of Evolution. If, on the other hand, we build our arguments and our beliefs on any of the minor forces or processes which we claim to have discovered, we thereby demonstrate our own incredulity in the all-compelling power of Evolution. Yet this is the course usually taken by evolutionists, who would have us yet believe that the truth of Evolution is altogether independent of the validity of their particular systems, the mere assertion of which destroys the basis on which it ought to rest.

In a word, if we are really bound, as we are so frequently assured, to accept the evolutionary doctrine in the name of reason and science, this must be because it is demonstrated either as an inevitable principle or as an accomplished fact. Is it demonstrated as a principle? Then what of the store of force it required but could never have provided, and what of the arrangements for the right applications of that force, which it can never have made? What, moreover, on this supposition, is the meaning of arguments that Evolution has worked through Natural Selection, or in any other mode, when there can have been no such thing as selection at all, as nothing can have ever come to pass except the inevitable and inexorable results towards which Evolution was from the beginning predetermined? Are we, on the other hand, to accept Evolution on the ground that it is a demonstrated fact? If so, on what line of argument is it demonstrated? We cannot say the process has been historically traced, for neither amongst existing, nor amongst extinct species known to us do we find any such series of allied forms as has to be supposed. Are we to say that "Evolution" is to be accepted because we have discovered a process at work in Nature which must produce Evolution? If so, what is that process? That called Natural Selection, once so popular, has long been tacitly abandoned, and in its place we find a number of rival systems, each claiming to be the real thing, but none able to secure the adhesion of any but its own inventor and the comparatively small group of his immediate disciples. These systems divide and subdivide in bewildering and antagonistic variety—where then is the demonstration they afford?

Meanwhile, be it remembered, we have, as far as possible, left out of consideration the gravest and most profound difficulty of all—that arising from the existence of life, of volition, of consciousness, for which, as Professor Tait has told us, nothing known to science can pretend to account. What then are we to think of the doctrine so constantly and so aggressively thrust upon us, which dogmatically asserts that the philosophy of Evolution is so manifestly justified by our science as to make us guilty of self-stultification in hesitating to accept it.

I speak of the philosophy of Evolution as popularly understood. In a sense, no doubt, there is much to be said for Evolution in the light of modern science—but, as I began by saying, the term is capable of many significations, and evolutionists, while never explaining which of them they adopt, are prone to bring arguments which avail only in favour of one sort of Evolution, and then to deduce consequences which would follow only if they had proved it in another. Undoubtedly we find that, speaking broadly, the history of life on the earth has been a history of Evolution—that is to say, the scheme of vegetable and animal life, as we know it, has been gradually unfolded in a progression of types from lower to higher, the same general lines of structure being elaborated to greater and greater perfection. Undoubtedly, also, our acquaintance with the operations of Nature leads us to believe that successive changes have been wrought by continuous operation of natural laws rather than by constant and abrupt interference with their course. In other words, we judge it more probable that the species of plants and animals have been produced as we see each individual produced, by the development of a germ predetermined to develop. But this is not what is meant by Evolutionary Philosophy and it is not of "Evolution" in this sense that I have been speaking. What evolutionists contend for is a process uncontrolled by any power but its own, a process explaining itself and eliminating from the universe every other active principle. Thus Professor Huxley assures us * that the Evolution theory, or Mr. Darwin's Natural Selection theory (it is not quite clear which) has dealt a "death-blow" to the idea that any purpose has operated in Nature—that the eye, for example, was made in order to see; which is to say that we have found Evolution to be so self-sufficient that there can be no power behind it, that it is proved to be not an instrument for the accomplishment of an end, but itself the eternal mainspring of the universe.

Is it not more true to say that never has a system of philosophy so imperiously endeavoured to impose itself on the world with such arrogant pretensions to a monopoly of truth, while utterly lacking any credentials capable of enforcing the assent of reasoning beings?

At the same time it is with no such negative conclusion as this that we must leave the subject. As from the supply of power which the machine of the universe must have required before the laws of Nature could begin to work, we gather a clear evidence of a supreme and self-existing Power transcending all physical forces and working through them all—so from the wonderful and unimagin-

* *Reception of the Origin of Species.*

able mechanism which the mechanical theory of the world postulates as an essential prerequisite of all that these physical forces have ever been able to produce, we must learn that there was in the beginning a Cause producing order, harmony, and law, constituting the world not as chaos, but as cosmos, establishing those laws the mere recognition of which is so commonly held to constitute the supreme triumph of human intelligence.

# EVOLUTION AND EXACT THOUGHT

Our modern philosophers, as is well known, feel themselves qualified to correct the erroneous conclusions of their predecessors, by reason of the improved methods of argument whereon they rely, and in particular they have two weapons in their armoury, the possession of which gives the battle entirely into their hands, enabling them with ease and certainty to shatter all systems but their own.

In the first place they start, according to Baconian principles, by securing a solid foundation in the observation of fact,—the only foundation upon which any knowledge deserving the name can be based. And besides this, while restricting the province of pure reason to deduction from such facts, they have at the same time so improved its methods as to secure for the conclusions at which they arrive a conclusiveness to which the lax argumentation of other days could not pretend. Words used to be employed to veil and disguise the confusion, poverty, or absence of thought, and down to our days men have been unable really to argue, those who pretended to do so having confined themselves to a futile exercise of chopping logic, whereby no scientific result could possibly be attained. But now we have changed all that; thought has become "exact"; as we start not with words but with things, so all our words are but the symbols of realities, symbols definite and precise as those of mathematics, and therefore guiding mankind, for the first time in its history, into the regions of indisputable truth.

It will hardly be denied that claims to this effect are constantly advanced, and still more frequently taken for granted; it may in fact be said that this claim of the modern school to have revolutionized the science of argument, is universal.

At the same time there are undoubtedly those, trained according to older methods of thought, to whom this claim amongst all the mysteries attending on the evolution theory is by far the most mysterious, and whose main difficulty in accepting its tenets is their utter inability to grasp the processes of reasoning by which they are supposed to be established. To such it appears that in no respect is such reasoning so defective as in the utter confusion of its phraseology, and the fallacies which such confusion begets; and moreover that, apart from this, no attempt has yet been made to provide the system with a solid groundwork whereon it may ultimately rest; without which, were its parts ever so harmoniously jointed, it must ever remain a mere castle in the air.

These are grave charges to bring against a philosophical system so widely and so devoutly accepted, and there will doubtless be many found to deem it impossible that such men as have proclaimed themselves evolutionists can have overlooked defects like these. It will therefore be necessary to examine with all care and without prejudice some reasons in support.

Be it, however, first observed, to avoid a species of misconception against which experience strenuously warns us, that no denial is here intended of what are called the facts of evolution. That the progress of organic life on earth has been through a course of development from lower to higher forms, is certain. That this development has, at least in certain instances, been wrought by natural instruments is most highly probable, far more probable than a contrary supposition. But if that which has not been proved in any one instance should be clearly demonstrated of all, if it could be shown that every species now existing has been evolved from another, and that all species but the first have been evolved from it,—the point now under examination would be just where it is. Our affair is not with evolution as a fact, but with what is styled the evolutionary theory, which is a totally different thing. This theory presents itself not as a chronicle, but as a philosophy, not as giving us to know the course of things alone, but their causes likewise: it comes before us not as a subsidiary system dealing with one department of Nature, but as the great fundamental principle which eliminates from the universe all other forces and agents but its own. It is precisely because it does so that it holds its place before the world. Were it satisfied with saying that one animal has come from another animal, and that environment, or sexual-selection, has been the instrument of the metamorphosis, the world at large would feel but a feeble interest in its teachings. It is otherwise when it builds up a whole cosmogony with natural forces alone, and tells mankind that they need take account of no others here or hereafter. It is because evolutionists undoubtedly claim to do this—implicity always and often explicitly as well—that their doctrine has for men the importance that it has.

It is with the claim of "Evolution" to be a philosophy of causes that we are now dealing. There are undoubtedly many and serious points to be considered before we can accept the historical account it gives of the process through which Nature has reached its present position; but these we are not considering. Let it be supposed, as has been already said, that all has been as its disciples would have us believe—the question remains, Where is the prime agent to which we must ascribe its production? And it is in connection with this that we have to examine the value of evolutionist argument.

To begin with the matter of phraseology, in which there at once presents itself a notable example, assuredly of importance sufficient to justify its employment. If we ask, in regard of the assumed evolution of one species from another, by what means this has been brought about, we are very commonly told that it has been by the operation of the law of Natural Selection. This explanation affords an excellent instance of what I mean, for when examined it appears to be a phrase, and a phrase only, and to explain nothing, while it has yet been largely, and at times universally, accepted as the key which shall unlock all the secrets of Nature.

It is true that an increasing number of scientific men, while firm believers in evolution, do not believe in Natural Selection as the instrument by which it has been effected, but their objections would seem to be grounded rather on facts which appear to be at variance with Mr. Darwin's doctrine, than on more fundamental considerations regarding that doctrine in itself: in other words, they believe that Natural Selection might have caused evolution, but that *de facto* it has not done so. My contention is, on the other hand, that to allow it even this qualified merit is altogether to overlook the radical difficulty. For what is meant by "Natural Selection"? It is what is otherwise described as the "Survival of the Fittest." Nature, we are told, tries all her creatures by the wager of battle—the struggle for existence—and awards the prize of Life to the winners. Any member of a species that has organs better fitted than those of its companions to help it in this struggle, will survive when the others die, and handing on its superior equipment to its progeny will advance its race one step upwards. But it is obvious that thus far the theory elucidates nothing beyond the fact that if some creatures are better fitted than others to get on, they will get on better. Things must be in existence before they can be "selected," and creatures must have become more fit than others to survive, before they survive them. But of that modification of organs which is the raw material on which Natural Selection must work, Natural Selection itself throws no light whatever.

It is undoubtedly true that, as we shall see just now, other agencies are invoked to supply these preliminary conditions, but it is equally certain that not these other agencies but Natural Selection has been so long in the forefront of the battle, and that with its name evolutionists have conjured when difficulties were adduced. How often have we been told that it is Natural Selection which has converted fins into wings or feet, scales into feathers, swim-bladders into lungs, which has fashioned the hand and the ear, and converted the rudimentary into the perfect eye? And so far as these things, or the like of them, have been said, we have reason enough to complain that words are used without any definite meaning which can be attached to them.

And next, as to the agent which is to do the necessary work before Natural Selection can begin. This, we are told is the Law of Variation, which providing that there shall be improvements in structure, rendering survival more easy, will furnish the proper objects for selection. But the "Law of Variation" is only another name for the fact that young animals and seedling plants are not the exact images of their parents, varying from them in degrees more or less minute, some in one direction, others in another. Does this fact afford the slightest ground for believing that any members of the younger generation will be equipped with organs more serviceable than those of their elders? Unless this be so, Natural Selection will have nothing to work upon. Is it not obvious, however, that variation from one pattern does not of itself and by itself tend to produce another? all that it tends to do is to destroy the one. Mere disarrangement of the types set up to print a page of Martin Tupper has no tendency to produce one of Shakespeare; nor if ten thousand printer's devils each tried his hand at a shuffle, should we have warrant for anticipating that so much as a solitary emendation would result. It is not variation itself, but the determining force, that rules it, to which must be ascribed the result attained. It is not because a marksman misses a pigeon that he kills a crow, but because his gun is pointed towards the crow. In like manner, it cannot be that, merely because an organ varies from a working model, it must hit on another working better. Yet on the assumption that it must be so does the whole system rest which we are considering.

Here in fact we find a prime example of a fallacy shrouding itself under confusion of phraseology. Doubtless that one organ should be an improvement upon another it is necessary that the second should vary from the first; but by no means does it follow that variation is the agent. Purposive variation is one thing, purposeless variation quite another. The first is the method of the inventor, the second of the destroyer, and yet it is to this that Darwinians look as the power capable of producing all the exquisite machinery we find in nature.

To this indeed they are compelled. If there be a force directing successive modifications in one direction, to the production of organs more and more elaborate and efficient, then must this force, and it alone, be credited with the results. The Law of Variation and Natural Selection will no more explain the production of new forces than the fact that the water from Thirlmere has perforce to run to Manchester explains how the pipes came to be laid which take it there.

It is precisely on the claim to dispense with the necessity of any such directive force that Darwinism takes its stand, and it is in variation altogether purposeless that it professes to find a sufficient instrument. It is, for example, by a succession of "slight accidental variations" in the required direction that Mr. Darwin himself * explains the development of the eye, from the simple apparatus of an optic nerve coated with pigment and invested by transparent membrane, to the complex organ of "inimitable contrivances" † which we now behold. What such an explanation really means it is well worth to inquire. We all know that the various friction to which bodies at the bottom of a river are exposed inevitably changes their form, that is, makes them vary. If we were to throw in amongst the gravel ten thousand or ten million cubes of glass, is there the slightest probability that any one of them would be shaped into a lens fit to use in a telescope, such a lens as the variations wrought by an optician produce every day? Yet this is exactly what we are asked to believe, that a system of variation equally random has actually done in the eye, and

* *Origin of Species*, p. 189. Fifth thousand. † *Ibid.*, p. 186.

might be counted upon to do. It is nothing to the purpose to say that Natural Selection in the one case and not in the other would have preserved the successive approximations to the desirable form; for, as we have seen, something worth preserving must be produced before Natural Selection can act, and the question is precisely whether anything worth preserving would ever be arrived at in such a fashion. This, the crucial point of the matter, has apparently been ignored by Darwinian writers; they assume that because improvement implies variation, therefore variation implies improvement, and if there be any of them who have even discussed the validity of this assumption, it would be interesting to know their names.

It must, moreover, be observed that hitherto we have reduced the problem to its simplest proportions, and considered the capabilities of variation in respect of the easiest task that could be set it. The eye no more than the telescope is composed of one piece of mechanism only, but of a multitude, which not only do optical work, but supplement one another, the form of each bearing a close and accurate relation with those of the rest. If it is inconceivable that one piece of glass should be ground, by the method we have considered, into a lens, what of the chances that two should be shaped so as to satisfy the conditions required respectively for eye-piece and object-glass? And what then of the supposition that the complex contrivances of the eye, cornea, iris, aqueous humour, crystalline lens, sclerotic, retina, and within this the subtle apparatus of its various sub-divisions, have all simultaneously "varied" each into the form fitting it to play into the hands of the rest, and do its part in the joint work? If the eye had been made in the first instance as it now is, and merely been endowed with the power to "vary" in its various parts, could the power of sight have been handed down for one generation? for a wrong variation anywhere would have thrown the whole out of gear.

Nor is it only in one organ that we have to accept such a supposition. Everywhere throughout the world of life, in myriads of diversely-fashioned mechanisms amongst animals and plants, Nature must in the same haphazard fashion have blundered on those exquisite devices which fill us with wonder when we recognize their functions. And it is the doctrine which so teaches that we find thus described: "An extremely valuable, and in the highest degree probable doctrine, indeed the only extant hypothesis which is worth anything from a scientific point of view." *

It must further be remarked, that the examples frequently adduced by evolutionists to support their argument combine with the ambiguity of their phraseology to conceal its weakness. We are told, for instance, that in very small, solitary islands insects that fly much will be liable to be drowned, being caught by the wind and carried out to sea; and our attention will be called to the fact that those found in such situations are short-winged and very limited in their powers of flight. Accordingly it is argued that in successive generations some, by the law of variation, have had larger wings, and some shorter; that the former have been taken and the latter have been left; and that here we have a clear example of the working of Natural Selection. In reality it is nothing to the purpose. In respect of dimension, things can vary in two directions only—the greater and the less. Given variation in size, some must be larger and some smaller. But this is not the work required of the agent that invents new species and invests them with improved organs. For this, definite and exact conditions have to be fulfilled, conditions that could be laid down with precision beforehand, for laws have to be satisfied of the most rigorous and definite character, before those results can be attained which alone explain the existence of a creature's organs. That an animal should see, or hear, or fly, depends on the manner in which the requirements of optics, or acoustics, or pneumatics are met; and that they should be met, the mechanism must be elaborate and a number of different functions must be efficiently performed by various parts. The possibilities of variations are not restricted to a couple, but multiplied into myriads—all wrong but one. The fact that wings which do not

* Professor Huxley, *Lay Sermons*, p. 295. Second Edit.

remain of constant length must be either longer or shorter throws no light whatever on the attainment of such accurate complexity.

Nor have we as yet by any means sounded the depths of the problem. We are assured that not only has one species been developed from another, but that creatures now most remote from one another in every detail of structure have been similarly produced from a common original; that, to take an example, birds and reptiles are tolerably near relations, and have descended from a quasi-reptilian ancestor. But if this be so, not only in the various parts of one member or organ, but in all at once, variation must have been constantly hitting on the infinite multiplicity of modifications which make the two classes as unlike each other from head to tail as they possibly could be.

In truth the law of Evolution, as we find it stated, is absolutely at variance with those other laws of Natural Selection and of Variation which so frequently are supposed to be synonymous with it. If Nature be ever on the march of development, if it be her law that species shall follow from species and genus from genus in ever-evolving variety of artistic finish, then assuredly she is working on very different lines than a mere tendency to abandon the types she has already produced; and if we believe that in the world of life there is orderly succession, it is that we believe, despite our inconsistent theories and systems, that there is some force at the bottom of all, not aimlessly producing change, like random currents of the air, but shaping for life, forms in which it can better and better dwell.

Having thus considered evolutionist phraseology, and some of the questions connected with it, there remains the still more important point for all valid reasoning, the basis whereon all rests. This again is a matter in regard of which our philosophers exhibit no false modesty. It is their boast to have founded their system on the solid rock, and, of all things in the world, they find this in the Principle of Causality. Professor Romanes,* to call

* *Darwin and after Darwin*, p. 17.

a recent witness, bids us regard it as an *à priori* truth "that Nature is everywhere uniform in respect of method or causation; that the reign of law is universal; the principle of continuity ubiquitous." This means, as we are presently told on the same authority, that we have established the fact that Nature from the beginning has worked through causes and effects similar to those which we trace in science; that is to say, all causes have been "natural," or material, and we need no other to explain the totality of things.* Similarly, Professor Huxley informs us,† that the fundamental proposition ot evolution is, that the whole world, living and not living, is the result of the mutual interaction, according to definite laws, of the powers possessed by the molecules of which the primitive universe was composed. And while the first Professor explicitly asserts that his system of material causes and effects eliminates from our calculation any such First Cause as God, the second concordantly affirms that his fundamental proposition deals a death-blow to the idea that eyes were designed for the purpose of seeing. In other words, each is satisfied that science has got to the root of the matter, and traced the origin of things to a final point whereon all that is in the universe may rest without ever an elephant or a tortoise to sustain it.

This may be fundamental philosophy, but to the ordinary mind it looks very like the architectural system of the Laputans who began the building of their houses at the top. We are told by Professor Romanes that Nature throughout is uniform in respect of method or causation, that is, at no point has her method stopped; back to the very beginning it has operated as it does now. But have we ever yet discovered a Cause in Nature? Is it not the most characteristic feature of her method of working that it depends at each step upon some condition of things, itself depending upon some other, and that as she proceeds she is ever spending her capital of available

* *Darwin and after Darwin*, p. 412.

† "On the Reception of the Origin of Species," *Life of Darwin*, vol. ii. p. 201.

energy, to which she can never add the most insignificant fraction; that accordingly she can by no possibility have furnished herself with the outfit required for the work we find her doing? That in respect of method or causation she cannot have been uniform from the first is the plainest lesson to be learnt from her phenomena—"phenomena," says Professor Huxley,* "the very nature of which demonstrates that they must have had a beginning," and from consideration of which, as Lord Kelvin tells us, † we are made "absolutely certain" that the machinery of the universe cannot have been working for ever. What, indeed, is the possible meaning of eternal evolution? If things have been uniformly progressing for ever along the line of development, how is it that they have got so short a way, and that there are possibilities of development yet remaining? And if they have not been thus everlastingly evolving, where is the *à priori* truth which we have been told to grasp? On the one hand, evolution starting from a point does not show the method of Nature to be uniform beyond that point; on the other hand, evolution without a point to start from is utterly discredited by science, and is, in scientific phrase, "unthinkable."

But if the "*à priori*" truth of Professor Romanes affords such a treacherous quagmire for a foundation, what is to be said of Professor Huxley's "fundamental principle"? If it be true that all the marvels of the universe lay ready made in its primæval constitution, then was that constitution to after-developments, as the acorn is to the oak-tree, or the egg to the chick. But acorns require oaks to produce them, as much as oaks require acorns, nor do we know of any method of getting eggs except from fowls. Whence then came this primordial germ of the universe? what is its parent? how came it by its powers? Doubtless if everything was in that mystic casket, everything could be got out of it; but this scarcely explains how everything got in. It is, therefore, hard to see what this fundamental proposition does for us, or can pretend to do, in the way of furnishing

* *Lay Sermons*, p. 13.

† See Balfour Stewart, *Conservation of Energy*, p. 142.

a foundation for our knowledge. It tells us no more than that the effects of the causes operating in Nature have been exactly as we find them to be, and that given the conditions in which the forces of Nature have actually worked, the effects could not be different from what they actually are. But as for the arrangement which secured such conditions, we are told absolutely nothing, and have to rest content with the soul-satisfying assurance, "The world is what it is, because in the beginning it was what it was."

It will not improbably be answered that Professor Huxley has included in his principle the very item here said to be wanting, and that the above criticism is therefore futile. For does he not tell us that all has been worked out "according to definite laws"? But in truth if there be anything that can make our confusion worse confounded, it is this very phrase. For what are we to understand by this potent term? What are the "Laws" of which he speaks? To judge from his principle, as it has been quoted, these "laws" should certainly appear to have had something to do with the result, nay, they must have had the chief hand in determining what that result was to be. But leaving aside the not unimportant question as to whence such laws might themselves have originated, we find the same teacher elsewhere laying it down,* that law is but another name for verified experience, and that by calling it law we invest it with no power of domination. To say that things have worked themselves out according to definite laws, sounds at first sight—to employ Mr. Ruskin's phrase—"rather instructive": on examination it turns out to mean no more than that they have worked themselves out as they have, and not otherwise. It would be equally true to say that Shakespeare wrote *Hamlet* according to a definite law, for he could not have written it as he did, and yet have written it as he did not: but when this was said we should not have got very far towards a philosophy of the poem.

This, then, is what was meant when it was said that the evolutionary system is of its very nature a castle in the air.

* *Lay Sermons*, p. 143.

It lacks all foundation more secure than can be afforded by a cloud of words. While it professes to rest upon science, the very nature of the forces with which science deals, clearly indicates, as she has herself discovered, that there must have been a point where they began to act; and therefore, since nothing can happen without a cause, there must be a source whence they draw their powers, and wherein those powers were all potentially contained, but which does not depend for its operation on those conditions which regulate their play. It is this "non-natural," or non-mechanical, cause that writers such as we have been considering desire to eliminate from the universe, and it is in attempting to do so that they set themselves to a task as hopeless as that of filling sieves with water, under the name of the new philosophy of exact thought.

We have by no means finished with perplexities. As Professor Huxley's fundamental proposition categorically asserts, everything that was ever to be was potentially contained in the universe as originally constituted; and he goes on to tell us that a "sufficient intelligence" could, from an inspection of the cosmic vapour, have foretold exactly what was to issue from it in each stage of the world's development. But in his sketch of Hume,* after instituting a comparison of singular infelicity between a miracle and that fabulous creature a centaur, Professor Huxley assures us that "every wise man will admit that the possibilities of Nature are infinite, and include centaurs." Now every wise man, presumably, will also admit the "fundamental proposition" of Evolution. But if he makes both admissions, what does our wise man mean? Either centaurs were contained in the cosmic vapour, or they were not. If they were contained there, they are not only possible but inevitable, as inevitable as buttercups or sparrows. In such a case the world could not possibly exist without them, and they would be just as legitimate an object of scientific research as cray-fish. On the other hand, if they were not contained in the primæval vapour, what is meant by saying that the possibilities of

* *English Men of Letters*, pp. 135, 136.

Nature include them? This can be only on the supposition that the vapour might possibly have been different from what it was. But how so? What was to make it different? If the actual constitution which that vapour at first possessed be the fundamental verity whereon all others rest, then nothing could ever have been but that which has been. If, on the other hand, Nature's possibilities include anything more, to say nothing of their being "infinite," there must be a power which arranging things in one way, might have arranged them otherwise, and it is to that power that we must apply any proposition pretending to be fundamental. Such is the not unnatural result of attempting to base a philosophical system upon a vapour.

The phenomena of astronomy will enable us to see this more clearly. Are we to say that eclipses are possible beyond those calculated at Greenwich? Given the existing orbits and motions of the planets, we must say that no others are possible. If we say that the possibilities of Nature include others, we say that the mechanism of the heavens might be other than it is. What should we think of the assertion that the way in which the heavenly bodies move is the only way in which they possibly could have moved, but that nevertheless other eclipses are possible beyond those which occur? Yet this is exactly what Professor Huxley does. He does not believe that there ever has been a centaur, or ever will be, and precisely for that reason likens centaurs to miracles. Yet he believes centaurs to be possible, that is, he believes in possibilities not included in the cosmic vapour as originally constituted, and in doing so he denies that his own fundamental proposition is in truth fundamental.

There is yet one example more that may be profitably studied to help us to understand the state of mind which such a process begets, and the state of mind described as "scientific." In his "Lay Sermon" on the advisableness of improving natural knowledge,* Professor Huxley has de-

* *Lay Sermons*, p. 17.

voted his chief care to an exposition of the habits of thought engendered by the pursuit of science, and their application to various departments of human knowledge. In conclusion, he touches the crucial point of religious and moral belief, and here, he tells us, the great enemy against which science has to fight is the conviction that authority can be a true guide, and that submission to authority can be our duty; whereas it is the "unquestionable fact" that the improvement of natural knowledge is effected by methods which directly give the lie to such principles, teaching that scepticism is a virtue, and faith a sin. It is not with the substance of this contention that I am now concerned, but with its terms. Among the propositions which science bans is set down the following: "That when good authority has pronounced what is to be believed, and faith has accepted it, reason has no further duty." From this it is clear that even if an authority be "good" it is our duty to criticize its teaching. But what is a "good" authority? Surely it can be nothing but one which we have good reason to trust: one which, as we have reasonably convinced ourselves, is able to teach us better than we can teach ourselves. To say that in the name of reason we are to doubt its teachings, is to say that in that name we are to doubt our own reasoning, by which alone can the "goodness" of an authority be recognized. To say that we are to call an authority "good" and yet to doubt it, is to say that we are to believe and disbelieve it at the same time.

It may perhaps be supposed that Professor Huxley means to deny the possibility of truth coming to us by authority which we cannot discover for ourselves. But in the first place we are at present engaged in examining the manner in which he argues, and if this be what he means, why does he not say so, and why does he give us instead a proposition contradicting itself in its own terms? In the second place the proposition suggested as a substitute for his, and probably implied therein, would assuredly not lack difficulties of its own. It is to authority, and to it alone, that we owe by far the greater portion of whatever knowledge we possess. If I desire to understand the structure of a cray-fish, I should be a fool if I did not prefer Professor Huxley's book on the subject to what I might gather by my own researches. My faith in his teachings would assuredly be the best act of my reason. There is no man but has to rely on the teachings of some other man, in far more points than these wherein he can suffice for himself. And in matters of religious belief, the whole question is whether there be knowledge to be had, beyond what we can ourselves discover; whether our reason is capable of leading us to recognize a teacher whose knowledge is greater than our own. This is not the place to discuss whether there be such a teacher, or how he is to be found; but if there be, and if our reason can lead us to him, instead of running counter to the methods of acquiring knowledge to which science trains us, it will but repeat the lesson which it teaches us every day, of the narrow limits within which our own faculties are confined, and the illimitable realms of truth beyond.

# AGNOSTICISM IN THEORY AND PRACTICE

ASSUREDLY if ever a school of thought claimed to hold the domain of reason in fee simple, it is that which describes its position as "Agnostic." So completely—we are given to understand—has this philosophy made right reason its own, that all controversy is at once determined in its favour, if only such reason be accepted as the arbiter, and antagonists are troublesome only so far as they can, by one means or another, guard themselves from being reached by rational argument. Against the fatal possibility of being so assailed they were long assured by the ignoble armour of skulls too thick to be penetrated by scientific truth; * but this can no longer avail them, and they have in consequence become a feeble folk, like the conies which make their dwellings among the rocks, and find safety by bolting rabbit-like into the obscurity of their burrows, when the light becomes painful to their unaccustomed eyes. In consequence, the task of the "philosopher" now resolves itself into one of earth-stopping: all that he has to do is

* "Since physical science, in the course of the last fifty years, has brought to the front an inexhaustible supply of heavy artillery of a new pattern, warranted to drive solid bolts of fact through the thickest skulls, things have been looking better: though hardly more than the first faint glimmerings of the dawn of the happy day, when superstition and false metaphysics shall be no more, and reasonable folks may 'live at ease,' are as yet discoverable by the *enfants perdus* of the outposts." (Professor Huxley, "Hume," *English Men of Letters*, p. 59.)

to prevent his antagonist from getting away; * can he but succeed in this the enemy is delivered helpless into his hands.

This is, no doubt, a highly satisfactory creed for those who can see their way to profess it, and one eminently calculated to give them that good conceit of themselves for which the Scotch minister prayed. They will, at the same time, of course, be the last to object to any discussion of their position, upon a purely rational basis, for in venturing to face the full light of their principles an adversary can do nothing else but commit the happy despatch.

The groundwork of the Agnostic system is the existence of "the Unknowable," of that which is not, and under no circumstances can be, the object of knowledge: and Agnostics, we are told, are honourably distinguished from others in this—that whereas these profess to know something about what cannot be known, they honestly confess their ignorance. They willingly accept whatever is demonstrated, and are prepared to accept whatever is demonstrable, but there they resolutely stop—the scientific habit of their minds forbidding them to feign assent, where assent could be nothing but a feint. Their principle, we are told, is as old as Socrates; it is the fundamental axiom of modern science, and it is thus formulated by the teacher who has provided Agnosticism with its name. "Positively, the principle may be expressed: In matters of the intellect, follow your reason as far as it will take you, without regard to any other consideration. And negatively: In matters of the intellect, do not pretend that conclusions are certain which are not demonstrated or demonstrable. That I take to be the Agnostic faith, which if a man keep whole and undefiled, he shall not be ashamed to look the universe in the face, whatever the future may have in store for him." †

But, if this be all, does it appear as if we were likely to get much further than before, by the aid of this principle?

* "The favourite 'earth,' in which the hard-pressed reconciler takes refuge, . . . is stopped in this instance." (Professor Huxley, *Nineteenth Century*, February, 1889, p. 173.)

† *Ibid.*, p. 186.

Confessedly it is as old as the hills. It may further be asked, who are the men who have ever acted, or thought it possible to act on any other? To bid us go only where reason leads, is like warning us not to write the history of prehistoric peoples. Reason is our only faculty capable of discovering truth, and it follows of necessity, that all truth to which we attain must be arrived at through it. If this be the sum total of the Agnostic's argument and rhetoric, he is but battering at an open door.

In truth, however, the contention which is uppermost in his thought is one which he has not seen fit to include in his fundamental statement: namely, that reason can lead us to truth in one way only. Agnostic arguments are altogether unmeaning, unless it be first taken for granted, that nothing is reasonably demonstrated or demonstrable but what is known through the senses: in other words, that we can have no true knowledge, save of the material universe and of the forces to which its phenomena bear witness. "Reason," accordingly, becomes, in Agnostic phraseology, a synonym for "the conclusions of physical science," and the creed which we have heard would have been more clearly formulated, as well as more honestly, had it run, "We must believe what we can prove by physical science, and nothing else."

Thus defined, the battle-ground between Agnostics and their opponents wears a somewhat altered aspect. It is one thing to say that we must believe in nothing but what reason sanctions, and another, to forbid belief in anything not sanctioned by reason in one particular way. The Agnostic, of course, says that it comes to the same thing, for in that one way alone can the sanction of reason be given. But if he would have others to agree with him, he must, in the name of reason, show them plainly wherefore they should do so. And how is this to be done? On what axiom, or on what process of argument, does his assumption rest? To such a question, it is evident, a clear and cogent answer should be forthcoming, for here is the very corner-stone of the whole system. Where such answer is to be found, or even an attempt to furnish it, is not quite so plain. But before entering upon a quest for it some other points have to be considered.

It is not in regard of Agnostic principles alone that we are apt to be encountered by an obscurity which we should scarcely expect in this temple of light. The objects with which this "reasonable scepticism" deals, are usually indicated with at least equal vagueness. At the same time, if we are to gauge the method aright, it is of prime importance to know what are the objects incapable of demonstration, in which there are men so besotted as to profess belief. Undoubtedly the first and foremost of these—that from which all the rest depend—is God Himself: the God of Theism, eternal, self-existent, Almighty and intelligent, the Creator and Upholder of all things. Disbelief—or non-belief—in Him, is the primary article of the Agnostic Creed. It is at belief in such a Being that Agnostics gird in all their utterances. We can know nothing of Him, they say, we have no means of knowing; reason affords no proof of His existence. A profession of belief in Him is, therefore, a mere futility, which all men possessed of self-respect will reprobate.

Now, we are not at present considering the arguments by which the existence of God may be proved, but the Agnostic position that no proof is possible. Belief in God, we must remember, is based, not on an acknowledgment that no evidence for it is furnished by reason, but precisely on the contention that the argument from reason is too strong to be resisted. To hear an Agnostic talk, we might well suppose that for believers the absence of reason was the very motive of belief, and that they are so preposterous a race as to claim it as their supreme merit that they give an assent for which they have nothing to show. But from the beginnings of philosophy men have been found, and those not the least worthy to be heard, who have thought with Cicero * that the existence of a God is no less manifest to us than is that of the sun in the heavens. Such an attitude can scarcely be called parallel to that implied in Professor Huxley's illustration of the sort of thing which in the name

* *De natura deorum*, ii. 2.

of Agnosticism he declines to accept. "If a man asks me what the politics of the inhabitants of the moon are, and I reply that I do not know; that neither I, nor any one else have any means of knowing; and that, under these circumstances, I decline to trouble myself about the subject at all, I do not think he has any right to call me a sceptic. On the contrary, in replying thus, I conceive that I am simply honest and truthful, and show a proper regard for the economy of time." * It is surely obvious that in such a statement of the case the only point which is at issue is totally ignored. While it is acknowledged on all hands that we have no means of knowing anything about the man in the moon, it is strenuously asserted that we have means of knowing the existence of God. Professor Huxley, it is true, and those who think with him, declare these means to be no means at all, and so obviously delusive that those who trust in them are intellectually dishonest. But it is equally true that the other side have likewise something to say. According to them, the Agnostic arbitrarily elects to throw away all the means we have of discovering truth, excepting one; and in resolving that nothing shall be true but what that one discloses, acts no more philosophically than a man would do, who should determine to admit the existence of nothing that he could not touch with his hands, and then declare his inability to know the existence of the stars.

It therefore appears that when Agnostics speak of themselves as unlike the rest of men, in that they demand reasons before yielding assent, they mean, in fact, that they alone know a good argument from a bad one, and insist on the genuine article. The one species of argument to which, outside of mathematics, they allow any validity is that furnished by physical science. Professor Huxley quotes with the highest approval the following utterance of Hume's: "If we take in hand any volume of divinity, or school metaphysics, let us ask, *Does it contain any abstract reasoning concerning quantity or number?* No. *Does it contain any experimental reasoning concerning matter of fact and existence?* No. Commit it then to the flames; for it

* *Lay Sermons*, "On the Physical Basis of Life," p. 144.

can contain nothing but sophistry and illusion." And he thus continues in his own name: "Permit me to enforce this most wise advice. Why trouble ourselves about matters of which, however important they may be, we know nothing and can know nothing." *

It is therefore plain that the cardinal doctrine of Agnosticism, the principle upon which its whole system turns, is the impossibility of arriving at the knowledge of any truth, other than those purely mathematical, save by the means of experimental science, and that all which such science cannot reach is utterly beyond our ken. That this is a proposition somewhat different from the one originally offered to us, is evident; and now that we have arrived at a clear understanding of its nature it will be well to glance back at the account we have heard as to how the creed has won its way to the imposing position it now holds.

It is the advance of physical science, as we have been told, that has done it all: to it is due the irresistible artillery against which stupidity itself cannot stand: this it is that has driven false teachers from the open field, and forced them, as Hume declares and Professor Huxley quite agrees, to take to the bush, and lurk like robbers under the shade of forests, where they may lie in wait "to break in upon every unguarded avenue of the mind and overwhelm it with religious fears and prejudices." †

But here we begin to encounter perplexities. What physical science has done, is to increase our knowledge. By what process of reasoning does it appear that in so doing it has taught us that our knowledge is limited within bounds more narrow than was previously supposed? Because we can find out much by means of experiment, is it therefore proved that we can find out nothing by any other means? And unless the advance of physical science scientifically proves this, how are the bolts forged to shatter the thick heads of opponents? Even were it assumed that science has come to the end of its possible discoveries, and shown

* *Lay Sermons*, "The Physical Basis of Life," p. 145. The italics are his.

† "Hume," *English Men of Letters*, p. 58.

us everything that by its means we shall ever know—what bearing can this have on the point in question? The implied argument is, that because science has not detected God in the world, there is no God to be found. But no one that has ever believed in God, supposed that He could be so discovered. Nay rather, if science had discovered Him, belief in Him would have ceased; for a God that could be found in a crucible or with a spectroscope would be no God at all.

It must therefore appear that the question is altogether untouched by the fact that physical science has extended its borders; being concerned not with what such science can do, but professedly with what it can not. The gulf which yawns between Agnostics and believers, is one not of disputed fact, but of principle; and the principle on which they differ was just as clear, as it now is, before any one of the triumphs of modern science had been achieved. Those who at any period found reasons for belief, would find precisely the same reasons existing in undiminished force—to say the least of it—now as then. Just as they are persuaded that there is another side to the moon, though human eye has never seen it, so are believers convinced that the objects presented to sense inevitably imply the existence of that which to the senses must ever be imperceptible.

It would undoubtedly be more satisfactory, if instead of assuming that the grounds for such a belief must be altogether worthless, Agnostics would undertake to prove them so. It would be interesting to observe how this is done. On their own principles it should be, either by abstract mathematical reasoning, or by reasoning based on practical experiment. Which is it to be? And if the attempt to find a proof be successful, will its efficacy be restricted to the discrediting of beliefs which they wish to see discredited? Are there none held by Agnostics in company with all the rest of the world, and held beyond the possibility of doubt, which would then appear to be utterly unreasonable? The argument attributed to the great Napoleon, is hard to meet. "You talk of my genius and firmly believe in it. But which of you has seen it?"

Has any of us the smallest doubt that Shakespeare had the mind of a poet, and Newton the acumen of a philosopher? Yet by what process of reasoning which Agnosticism sanctions can we have any knowledge whatever of the one or the other? Is the beauty of the Iliad less certain than the chemical constitution of water? Yet by which of the "ologies" is it disclosed? Nay, what of moral goodness? Oddly enough, in his very next sentence after that which endorses Hume's dictum, Professor Huxley continues: 'We live in a world which is full of misery and ignorance, and the plain duty of each and all of us is to try to make the little corner he can influence somewhat less miserable and somewhat less ignorant than it was before he entered it." But how is any such duty "plain"? Is it by mathematics, or by physical experiment that it is demonstrated? Or is it that the first principle of Agnosticism serves well enough in theory, especially if not too clearly stated, as a weapon of offence, but in practice is so unworkable that Agnostics themselves do not think of using it, not even while it is upon their lips?

To this difficulty succeeds another. According to the Agnostic account of the matter, all belief in what they declare to be unknowable is not merely actually erroneous, but intrinsically foolish, so foolish that it stamps those professing it as altogether unscientific. How comes it then that, not only in the benighted days of ancient philosophers and schoolmen, but amongst those upon whom beats the full light of science, those, moreover, to whom science is least a stranger, there should be found men who will persist in imagining that they can know what reason proves to be beyond the domain of knowledge? Sir Isaac Newton assuredly knew something about science, yet does not he declare that to treat of God, as a deduction from what we see, is a necessary part of Natural Philosophy.* Sir John Herschel is of like mind; so are, to confine ourselves to our own countrymen, Lord Kelvin, Professor Balfour Stewart, Professor Tait, Sir George Stokes, Sir William Siemens, Sir William Dawson, Lord Rayleigh, Professor Faraday, and

* *Principia: Scholium generale.*

Professor Clerk-Maxwell, to mention no others. Are these men of skulls so thick as to be proof against the new artillery, and that though they stand close to the very mouths of its guns?

The Agnostic theory is therefore by no means so plain and simple a matter as at first sight we might be tempted to suppose. What then are we to say of Agnostic practice? Of this we have already seen a little—but much more remains to see, and to do so aright we must attempt to follow the path by which from its initial principle we are to be led to the fullest meed of knowledge attainable by man. For it must by no means be imagined that those who call themselves Agnostics mean that they are "Know-nothings." Quite the reverse. The ignorance to which they plead guilty concerning some things, is most abundantly compensated by assured knowledge, in comparison with which all other so-called knowledge must pale its ineffectual fires. All that is worth knowing in the universe is in fact to be known to us by the scientific method alone, and this is nothing else than the method of Agnosticism. "Natural knowledge," we are told,* "is a real mother of mankind; modern civilization rests upon physical science,"† in which the whole of modern thought is steeped, and which has forced its way into the works of "our best poets." ‡ The same science has discovered the ideas which alone can satisfy "spiritual cravings"; § it has laid solid foundations for a new morality, || and a new religion "cherishing the noblest and most human of man's emotions, by worship, 'for most part of the silent sort,' at the altar of the Unknown and Unknowable." ¶ Moreover, while science thus conducts us to the most sublime philosophy of life, so can she alone guide us to sound the depths and mysteries in which the first beginnings of the universe lie hid.

The cause of Agnosticism has identified itself with that

* Professor Huxley, *Lay Sermons*. "On Improving Natural Knowledge," p. 10.

† *Ibid.*, p. 117. ‡ *Ibid.* § *Ibid.*, p. 11. || *Ibid.*

¶ *Ibid.*, p. 16.

of Evolution, and in his character of Evolutionist the Agnostic is undoubtedly acquainted with much which to the ordinary unscientific mind appears quite as unknowable as anything which we have been warned not to fancy we can know. The Agnostic Evolutionist believes devoutly in the cosmic vapour from which all things in heaven and earth have come; in its molecular constitution in which they were all pre-ordained; and in those inevitable laws of Nature according to which they were worked out.* As he believes nothing without a reason, he has, of course, a reason for all this, and a reason that will stand the test of his own principles; and in examining the process by which his system is built up, we shall have an excellent object-lesson wherefrom to gather instruction as to the scientific method of which we have heard so much.

It is undoubtedly a little startling to find that the first thing we have to do is to make an act of faith: of faith in that which, "by the very nature of the case, is not susceptible of proof." This "one act of faith in the convert to science," says Professor Huxley, "is the confession of the universality of order, and of the absolute validity, in all times and under all circumstances, of the law of causation." † "It is quite true," he tells us elsewhere, ‡ "that the ground of every one of our actions, and the validity of all our reasonings, rest upon the great act of faith, which leads us to take the experience of the past as a safe guide in our dealings with the present and the future. From the nature of ratiocination it is obvious that the axioms on which it is based cannot be demonstrated by ratiocination." Lest, however, we should be shocked, in view of the principles to which we have just listened, by this announcement, he hastens to reassure us by the declaration, that if this act of faith be not experimentally proved, it is at any rate experimentally verified, and that this is much the same thing. "Such faith," he writes, § "is not blind, but

* Professor Huxley, "On the reception of the 'Origin of Species,'" *Life of Darwin*, vol. ii. p. 201.

† *Ibid.*, p. 200. ‡ *Nineteenth Century*, February, 1889, p. 185.

§ "Reception of 'Origin of Species,'" *ubi sup.*, p. 200.

reasonable; because it is invariably confirmed by experience, and constitutes the sole trustworthy foundation for all action."

It is clear that, whatever may be their value for other purposes, these dicta afford abundant material for the exercise of our reasoning faculties. In the first place, is it plain what is to be the object of our great and fundamental act of belief? The "universality of order" and the "absolute validity of the law of causation" is scarcely the same thing as the "safe guidance afforded by our experience," yet these are severally presented as the object of the one and only act we have to make. Moreover, as any act of faith must needs deal with that which we have *not* experienced, it is scarcely obvious how our experience supports it. Experience, for instance, tells me that all the unsupported stones I have ever seen have fallen. What precise bearing has this fact, by itself, on my belief that other stones will fall? And what, by itself, has it to do with the law of causation? If, indeed, from the phenomenon of falling stones I deduce the existence of a force making them fall, then indeed, from the permanence of such cause and its activity, I may be convinced that stones in the future will behave as in the past; just as I believe there will be trains on our railways to-morrow, not because there were trains yesterday, but because I believe in the existence of railway companies and engine-drivers. But this, apparently, is not the scientific mode of arguing. "What do we know," asks Professor Huxley, "about [this] phenomenon? Simply that, in all human experience, stones have fallen to the ground under these conditions; that we have not the smallest reason for believing that any stone so circumstanced will not fall to the ground; and that we have, on the contrary, every reason for believing that it will so fall. It is very convenient to indicate that all the conditions of belief have been fulfilled in this case, by calling the statement that unsupported stones will fall to the ground, 'a law of nature.' But when, as commonly happens, we change *will* into *must*, we introduce an idea of necessity which most assuredly does not lie in the observed facts, and has no warranty that I can discover elsewhere. For my part I utterly repudiate and anathematize the intruder. Fact I know, and law I know; but what is this necessity, save an empty shadow of my own mind's throwing?" *

It thus appears that, as the first step in our scientific regeneration, we are resolutely to accept the belief that things always proceed in one manner, though nothing compels them to do so; our reason for so believing being that we have every reason, though such reasons are of too delicate a nature to admit of being stated.

Meanwhile, as is clear, we have not gained any very clear information as to the place which the law of causation is to hold in our esteem. It must, however, be supposed, that the statement of its claims is latent in the utterances which we have heard; for, as a prelude to his exposition of the act of scientific faith, which we are considering, Professor Huxley indulges in some very hard words regarding those who have not made this act, expressly on the ground of their blindness to this very principle. "Do they really believe," he asks, "that any event has no cause, and could not have been predicted by any one who had a sufficient insight into the order of Nature? If they do, it is they who are the inheritors of antique superstition and ignorance, and whose minds have never been illuminated by a ray of scientific thought." †

We must therefore believe that the starting-point of our faith, if we would deserve the name of scientific thinkers, is this. We observe all operations of Nature proceeding from material cause to material effect, each cause being itself the effect of some other cause preceding it. For instance, the falling of a stone is not caused alone by the force of gravity; it is required that the stone should be in a position whence it can fall; and that it should find itself in such position there must have been something to lift it; while again, that it should be raised to any point, it must first have been below it. Seeing the forces of Nature always and every-

* *Lay Sermons.* "On the Physical Basis of Life," p. 143.

† "Reception of 'Origin of Species,'" *ubi sup.*, p. 200.

where producing the same phenomena in like circumstances, we are to conclude, with absolute certainty, that they always have done so, and always will do so; that the key which alone can unlock the secrets of Nature is a full and frank acceptance of the principle, that there never has been any other process, or at least that we can know nothing at all of any other, and that we obey the dictates of reason in resting satisfied with this explanation of the history of the universe.

This, I say, seems to be the meaning—though I speak with some diffidence. But what then is the "necessity," against admitting which we are so earnestly warned? If unsupported stones will inevitably fall, why is it so very wrong to say that they must do so? Yet, from the warmth exhibited by our instructor, it is clear that something of prime importance turns on this. Must it not be that the intruder whose appearance is so fiercely resented is a First Cause, arranging the machinery of the universe to go in the way He wishes and not otherwise? We are to say that the laws of Nature run in one groove, because as a matter of fact it is in that we see them run; but on no account are we to say that it was made for them to run in.

This is, I hope, a fair exposition of the system, and if it be so, we have, as is obvious, ample food for thought. At present, however, we are concerned not so much with the system itself as with the method in which it is worked by its votaries, and in which they deduce from it the far-reaching consequences of which we have heard.

Since all that we see in the phenomena of Nature proceeds from material cause to effect, we have to assume with them that this has ever been the course of things, and that, in the assumption that it has been so, we find the only solid and satisfactory groundwork for any belief concerning Nature; while "Nature," we are elsewhere told, "means nothing more nor less than that which is; the sum of phenomena presented to our experience; the totality of events passed, present, and to come."* It follows, therefore,

* Professor Huxley, *Hume*, p. 131. It may be remarked in passing, that "that which *is*," can scarcely be synonymous with "*events*," and

that this principle, scientifically handled, gives us to know all about everything.

We proceed accordingly in quest of some starting-point, whence these events which make up the universe began to evolve themselves. That there was a starting-point is admitted, for astronomy, we are told, "leads us to contemplate phenomena the very nature of which demonstrates that they must have had a beginning." * This beginning was the "cosmic vapour" or "primitive nebulosity," by the interaction of whose molecules, according to the laws of matter, everything in heaven and earth has been produced. That this is the case is the "fundamental proposition of Evolution," † and Evolution being the pet theory of Agnostics, shedding the only true light on the history of things, it would appear that we are supposed to have arrived in this proposition at something which affords a stable and solid basis whereon to build our edifice of knowledge. But what, meanwhile, of the principle of causation, and its absolute validity in all times and under all circumstances, to which we have been bidden to swear allegiance? Even if we do not feel inclined to follow the example that has been set us, by calling the cosmic vapour an "event," yet undoubtedly the coming of its molecules into position must be one: nay, so must the production of those molecules themselves, for, as Sir John Herschel says, a molecule is a "manufactured article." What then was the cause of the vapour? It needs a cause as much as the steam in a boiler, or the gas in our pipes: or at any rate, if we say that it needed none we must flatly contradict the principle of causation, and begin the working of our system by denying its fundamental tenet. Yet, strange to say, not only is no information whatever forthcoming on this vital point, but it seems actually to be implied that none is needed,—because the time was so very long ago. "Phenomena," says Professor Huxley, in the passage above quoted, "the very nature of which demon-

that according to the above definition it should follow that nothing exists but what comes within reach of human sense.

* Professor Huxley, *Lay Sermons*, p. 14.

† Professor Huxley, *Life of Darwin*, ii. p. 201.

strates that they must have had a beginning, . . . . but the very nature of which also proves that the beginning was, to our conception of time, infinitely remote." What "our conception of time" can have to do with the business, is not obvious ; yet it would really seem as if we are expected on this ground to dismiss as irrelevant all further inquiry ; nay, we are asked to assent to the proposition that it is the astronomer himself, while he discovers the duration of the universe to be certainly finite, who at the same time discovers it to be "practically" infinite. "The astronomer," we are told,* "has set before us . . . . the practical eternity of the duration of the universe." He "observes the mark of practically endless time set upon the arrangements of the solar system." † In consequence, "men have acquired the ideas of the practically infinite extent of the universe and its practical eternity." ‡ Clearly, "practical" is a word to conjure with. But what does it mean? What is a "practical eternity"? and how does it differ from an eternity of any other species? In our survey of the past, either we come to a point where we have to bid good-bye to the principle of causation, or we do not. If we do, there is an end of the absolute and everlasting validity of that principle before there is a beginning of it. If we do not, how is the principle to be applied to the beginning of the universe, a beginning requiring a cause just as imperatively as any of the phases through which it has since passed ?

In plain truth, this wonderful principle, introduced with so much pomp and circumstance as the discovery of "Science," is not only of hoary antiquity, but has actually been the very groundwork whereon philosophers, of the pre-scientific days, have ever rested their belief concerning what Agnostics dub the unknowable. Since reason and experience combine to assure us that there can be no effect without a cause, and since every cause we find in physical nature is the effect of something else, it has ever been argued that Nature cannot have started her own machinery ; that there must be a Cause distinct from her, and independent of her laws ; a Cause which is not an effect, but

* *Lay Sermons*, p. 15. † *Ibid.*, p. 16. ‡ *Ibid.*, p. 17.

has its existence of itself, and which contains all the power exhibited by the forces of matter, which can have obtained their efficacy from it alone. And if the researches of physical science have demonstrated that Nature as we know her must have had a beginning, they do no more than confirm what the benighted race of metaphysicians have always told us must have been.

Being thus speedily brought up by an impassable gulf in attempting to follow the workings of the Agnostic principle even on the physical side, it can scarcely be worth our while to attempt any examination of its claims to satisfy "spiritual cravings," and provide us with a higher and purer morality, and a religion worthy of men. It would indeed be far from easy to pursue such an investigation; for beyond high-sounding assurances that it does all this, Agnosticism is provokingly reticent as to how it does it: while to the ordinary mind, that it should do so at all seems just as unlikely as that a steam-engine should write poetry. The one contention which seems to glimmer through the utterances we meet on the subject, is that a man must be improved by coming in contact with the facts of Nature, that, as Cardinal Newman puts it, he must be better for having inspected a megatherium. But, in the first place, when we ask what is meant by "better," we are told of our "plain duty" to practise various moral virtues, the mere existence of which no "scientific" process can discover. And besides this, is it not a peculiar method of inducing men to cultivate virtues or anything else, to assure them that they were contained in the cosmic vapour, and can by no possibility be anything else than its constitution ordained them to be?

This, then, is the New Philosophy. This it is that shall set the world right. Against accepting this, stupidity alone is proof.

# EVOLUTION AND DESIGN

As has already been remarked, it is exceedingly difficult to determine which of the protean forms assumed by the Evolutionary Creed is to be regarded as its genuine and authentic representative, or to whom, amid the multitude of its teachers, we may listen with confidence, as being warranted to speak on behalf of any one besides himself. The days are long past when Mr. Darwin's doctrines reigned supreme, and those who still speak of him as their master may safely be assumed to have abandoned, tacitly or openly, all that was essential to his system. The theory of Natural Selection which he elaborated with so much care has faded away amid the flood of light evoked by the interest which it aroused, the researches of a host of investigators, whom in great measure he taught to observe, having revealed innumerable phenomena in Nature with which his hypothesis cannot be made to square. His leading disciples, like the officers of Alexander the Great, have accordingly divided his empire amongst them, devising a variety of systems, which, while they differ from his, differ likewise from one another, and as none of these has succeeded in obtaining any general, or even very wide, acceptance, outsiders are naturally at a loss to know to what guide they should entrust themselves if they desire to arrive at the knowledge of evolutionary doctrine pure and undefiled.

So far as positive doctrine is concerned, this only is common to the various groups amongst which Evolutionists, properly so-called, are distributed,—that the universe has been "evolved" by some process or other, and in obedience to some law. On the negative side, however, they are more explicitly in unison, the essential backbone of every evolutionary system being the denial of an Intelligence presiding over and directing the processes of Nature, whatever they have been. "Evolution," as commonly explained, means nothing, if it does not mean that everything has been worked out by blind, automatic forces, and that we find in all Nature no evidence of a designing Mind. This is clearly the cardinal point of the doctrine, which, being granted, all can harmoniously agree to differ. But for the idea that to explain the existence of Nature, as we observe it, is required a First Cause, possessed of Understanding and Free-will, there is no tolerance, and nothing so surely arouses the anger of the more eager partisans of the New Philosophy as to hint that the world bears traces of Design.

Thus we find that, on the first promulgation of Mr. Darwin's system, to which, however, he never committed himself, Professor Huxley proclaimed it to be the great merit of its author to have dealt a death-blow to the idea that the eye was made for the purpose of sight.* Professor Romanes declared that, in face of Evolutionary Science, the Theist must despair of answering the question "Where is now thy God?" † Professor Clifford, Mr. Herbert Spencer, Mr. Frederick Harrison, and other leaders of discordant schools, are enthusiastically at one on this fundamental point.

It would even appear that a man of science, however eminent, who presumes to think otherwise, is held to forfeit all claim to consideration. Some years ago, Sir George Stokes, of whose position in the scientific world nothing need be said, being engaged to deliver the Burnett Lectures before the University of Edinburgh, chose for his subject "The beneficial effects of Light." In treating it, he was led to speak of the structure of the eye, from

* *Reception of the Origin of Species.*
† *Darwin and after Darwin*, p. 412.

which he gathered the very conclusion which Professor Huxley had pronounced to be for evermore impossible. "When we contemplate all this," he declared, "it seems difficult to understand how we can fail to be impressed with the evidence of design thus imparted to us. But design is altogether unmeaning without a designing mind. The study, then, of the phenomena of Nature leads us to the contemplation of a Being from whom proceeded the orderly arrangement of natural things that we behold." *

Such an utterance could not be suffered to pass without reproof, and straightway Professor Karl Pearson was up in arms, taking the President of the Royal Society to task in the fashion of a schoolmaster dealing with a naughty boy. Sir George, he declared, had "prostituted science"; he had degraded his high office by "dabbling in the mire of natural theology," and presenting Scotland with a new edition of the rare old "argument from design"; he was "like a resuscitated Paley, who discovers in the eye an evidence of design, and startles the countrymen of Hume with a physico-theological proof of the existence of the Deity";—and so on. †

It must, however, be remarked that, like some others who assail the argument from Design, the Professor does not seem to have been at the pains of understanding it. His antagonist is a mere man of straw, and the argument he puts in his mouth a manifest absurdity, which no one in his senses ever thought of upholding. Professor Pearson would seem to imagine that believers in Design actually argue in the fatuous style caricatured by Hegel,—that the vine was created solely to provide mankind with wine, and that the cork-tree was thoughtfully added to furnish stoppers for their bottles. ‡

No doubt, as the German philosopher observes, in arguing thus, we fall into "trifling reflections," but it might seem equally evident that puerilities such as this do not adequately

* *Burnett Lectures*, p. 327.

† "The Prostitution of Science"; printed in *The Ethics of Freethought*, pp. 33–35.

‡ Quoted by Pearson, *ut sup.*, p. 41.

represent the position, taken up, amongst others, by Sir Isaac Newton, that to treat of God as a deduction from what we see is a necessary part of Natural Science.

Still more clearly is such misapprehension exhibited by another argument frequently adduced. It is said that we can argue nothing from the actual order of the universe, for had it been different from what it is, we should still have discovered similar reasons to justify a like conclusion. This is rather like Lord Brougham's naïve speculation as to how his character would have been affected had his father married some one else and not his mother. It is quietly assumed that in any case the world must have been a scene of law and order, and the home of intelligent creatures, or else "we" should not be there at all to indulge in any speculation concerning it. But this is the whole question at issue. Those who believe in Design as a deduction from what they see, do so precisely on the ground that there could be no reign of law without a law-giver; that, as nothing can be got out of a sack but what is in it, if there be intelligence in the world now, it must have been existent from the first; that, according to Professor Francis Newman's dictum, "he who made man must have had all that man has, and more"; that all attempts to explain the existence of any order in Nature consistent with organic life, without introducing the element of an Intelligence guiding things towards a definite end, must fail to provide our minds even with what is termed a "working hypothesis." To deserve such an appellation, an hypothesis must "work"—that is to say, it must furnish an explanation which our minds may conceive to be the true one, and which is not manifestly inadequate for its purpose. It seems impossible to deny the conceivability of a sufficient intelligence having planned, and a sufficient power having fashioned, all the machinery of Nature. We may go farther and ask, with Bishop Butler, "Will any man in his senses say that it is more difficult to conceive how the world came to be, and to continue as it is, with an intelligent author and governor, than without one?" We may, accordingly, claim that the doctrine of Design is a "working hypothesis." But can we say as much for any other? Does any system which excludes this fundamental principle, furnish us with a substitute which even conceivably can suffice to take its place? This is the question that has to be answered in the affirmative before we can style such a system a "working hypothesis."

In this inquiry it will be convenient to limit ourselves to the domain of organic life, not because it is here alone that evidence of design may be found, but because its demonstration is here most simple, and therefore best adapted for popular exposition.*

We begin, therefore, by observing the fact that we constantly find in Nature complex mechanisms so admirably adapted to the production of some result, that no terms have yet been discovered by which they may be described,

* "The argument in favour of a creating and presiding Intelligence may be drawn from the study of physical agency—such as the properties of heat, light, and sound; of gravitation and chemical combination; the structure of the globe, the divisions of land and sea, the distributions of temperature; nay, the mind may rise to the contemplation of the sun and planets, their mutual dependence, and their revolutions; but as affording proofs, obvious not only to cultivated reason but to plain sense, almost to ignorance, there is nothing to be compared with the mechanism of the animal body, and the adaptations which effect the well-being of living creatures." (*Notes on Paley's Natural Theology*. By Lord Brougham and Sir C. Bell. Charles Knight's Edition, vol. ii. p. 16, 1845.)

Concerning the ultimate resolution of matter into molecules and atoms by modern chemistry, Sir John Herschell writes: "When we see a great number of things precisely alike, we do not believe this similarity to have originated except from a common principle independent of them; and that we recognise this likeness, chiefly by the identity of their deportment under similar circumstances, strengthens rather than weakens the conclusion. A line of spinning-jennies, or a regiment of soldiers dressed exactly alike, and going through precisely the same evolutions, gives us no idea of independent existence; we must see them act out of concert before we can believe them to have independent wills and properties, not impressed on them from without. And this conclusion, which would be strong even were there only two individuals precisely alike in *all* respects and *for ever*, acquires irresistible force when their number is multiplied beyond the power of imagination to conceive. If we mistake not, then, the discoveries [of chemistry] destroy the idea of an *eternal self-existent matter*, by giving to each of its atoms the essential characters, at once of a *manufactured article* and a *subordinate agent*." (*Preliminary Discourse on the Study of Natural Philosophy*, p. 38.)

except such as we are accustomed to use of works wherein we detect the hand of man. We style them "contrivances," "devices," or "instruments." In our search for an account of a method by which these have been produced, apart from intelligent design, despite the discrepancy of the views entertained by evolutionists, whereof we have spoken, it would appear that we may confine ourselves to that of Mr. Darwin, and examine the claim of his system to present itself as a "working hypothesis." We prefer to do so for two reasons. First, Mr. Darwin's theory is alone sufficiently tangible and definite for examination, and has far more than any other impressed itself on the imagination of the world at large, so that Professor Weismann can speak of it as alone furnishing an alternative to the principle of design. Secondly, apart from the question of first beginnings, about which he has nothing to say or to suggest, Mr. Darwin faces the real question at issue more fairly than do many others. He does not rest his case on "innate" or "inherent" qualities or tendencies, germinating as things go on, as does the embryo within a seed; and to postulate anything of the sort is only to remove the difficulty further back, not to meet it. It has been well said that a man hearing an organ play, and concluding that there is another man producing the tunes, is radically right, though it should prove that the instrument is played by a spring within itself; and in just the same way, to explain the adaptation of means to ends in Nature, by saying that in the beginning things were so constituted as spontaneously to produce them, is to leave us, so far as a solution of the problem is concerned, precisely where we were. Mr. Darwin, on the other hand, given life once started, in however primitive and rudimentary a form, undertakes to show how the most perfect and complex machinery might be developed, without any guiding lines to determine the process. Variation *from* an existing type, and not specifically *towards* any other, is the force on which he relies for the purpose. As it seems to be almost universally assumed that such an agent can be sufficient for the work with which we are asked to credit it, we must endeavour to realize the full meaning of such an assertion, and may conveniently find an instance by which to test it in that very organ to which Professors Huxley and Pearson have referred.

The eye, as we find it in man and vertebrate animals, is an instrument of vast complexity, consisting of an infinity of parts, which must not only do each its own appointed work towards producing vision, but supplement that of the rest, in order to produce one definite result, imperatively conditioned by the laws of light. *Cornea*, *aqueous humour*, *iris*, *crystalline lens*, *vitreous humour*, and *retina* may be roughly spoken of as the parts of this delicate "camera," nicely adjusted to ensure the production of a picture more perfect than was ever formed in that of a photographer; but each of these parts is again built up of others of bewildering complexity and extraordinary construction, * exhibiting fresh marvels and suggesting fresh problems as we succeed in pushing our observations further and further; while so well do they all subserve one end, that Mr. Darwin himself speaks of the "inimitable contrivances" † exhibited in the organ. It therefore appears that we may well say of this, as Mr. Wallace says ‡ of some structures, that it has "very much the appearance of design by an intelligent designer"; and we can easily believe the same authority when he tells us § that the thought of it, even to the last, gave Mr. Darwin a cold shiver, on account of the conclusion to this effect which it so forcibly suggested. Nevertheless, both Mr. Darwin and Mr. Wallace succeeded in persuading themselves that the eye may have been manufactured by a blind mechanical process in the following manner.

We must, it is true, take for granted that there was to start with a rude organ of vision, which originated in some unknown manner; but this may have been as simple and imperfect as we like, the extremity of a nerve which had grown sensitive to light, as other nerves are to touch, and capable only of distinguishing illumination from darkness,

* See "The Eye and its Making," *The Month*, June, 1890.

† *Origin of Species*, p. 143. Twelfth thousand.

‡ *Darwinism*, p. 113. § *Ibid.*, p. 130.

as we can when our eyes are shut. Given this, we are told that all is clear. The animal possessing such an organ would hand it on to its progeny, but Nature never copies her own work quite exactly, and the visual apparatus of the young would differ in various particulars from that of the parent. Some of these variations would be in the direction of more perfect vision, and those lucky enough to have acquired the better organs would fare better in the battle of life, and become the progenitors of the next generation; some members of that generation, on the same principle, would have an outfit still more effective, enabling them to live down all their congeners not possessing similar advantages, and exactly to reverse the lament of Horace:—

> "Our parents than their sires were worse;
> Beneath our sires have we declined;
> A generation more perverse
> We presently shall leave behind."

Each generation would, in fact, advance, though never so little, upon that preceding it; the individuals possessing desirable modifications being infallibly picked out for survival by the forces of Nature, amid the jar of which they could subsist while others perished, until something better than themselves had been produced. In living bodies, says Mr. Darwin,* variation will cause the slight alterations, generation will multiply them almost infinitely, and Natural Selection will pick out with unerring skill each improvement. Let this process go on for millions of years, and during each year on millions of individuals of many kinds; and may we not believe that a living optical instrument might thus be found as perfect as that which we find in the eye? † That is to say, we are to hold it as at least

* *Origin of Species*, p. 146.

† Mr. Darwin's own words are: "A living optical instrument, as superior to one of glass as the works of the Creator are to those of man." In his correspondence, however, he expresses regret for having so far truckled to public opinion as to employ the old "Mosaic" terms "Creator" and "Creation," and explains that when he speaks of a thing as having been "created," he means no more than that it has appeared, in some manner of which he knows nothing.

conceivable that a process such as we have seen described has resulted in the construction of a delicate and complicated optical machine, with its series of lenses of different and intricate structure, throwing a picture upon a yet more complex screen, the functions of which, even when we have with immense labour distinguished something of its various parts, we are still unable to understand.

It is not easy to find an example which shall help us even partially to realize the magnitude of the demand thus made on our belief. Let us, however, imagine a great multitude of children who have a natural aptitude for drawing, sufficient to ensure that they shall imitate very closely any simple copy set before them, but quite untrained, so as never to imitate it quite exactly. They have never seen a tree or a flower, and it is proposed to make them delineate one on the principles of casual variation, a lynx-eyed teacher watching over and directing the process. He gives as their first copy a plain straight line, proposing to lead them on to produce amongst them the likeness of a buttercup. Of the first set of drawings made, all will vary in some degree from the austere simplicity of the original; there will be, at least, the suggestion of curves and protuberances, some of which may possibly serve as the first distant approaches towards the delineation of leaves and blossoms. The most likely to serve such a function is picked out from the lot, and being faithfully reproduced to the required extent, is set before the class as their second copy; they being bidden to represent it exactly as it is. The attempt emphasizes the variations already inaugurated, the most promising of which is again selected to form the model for the third lesson. Is there any possibility that such an experiment, on however large a scale it were tried, and however often it were repeated, should result in producing a single sketch accurately representing a buttercup of the fields? And yet, the conditions of an optical instrument, like the eye, are as definitely fixed beforehand as the outlines of the required flower. The laws of light, which were in full force long before the first eye was invented, imperatively demand the fulfilment of definite conditions before an image can be formed; while the methods, we are told, on which Nature works have no more purpose in them than the inability of our copyist to reproduce what they imitate. If her only power of producing something new has been her ineradicable tendency to depart from previous types, we may truly say that the eye, and all similar organs, are the monuments of Nature's inaccuracy. We may be allowed to ask whether this appears to be a "working hypothesis," to say nothing of its dealing a death-blow to any other?

It must also be remembered that the problem from which an illustration has been sought is, comparatively speaking, very simple. How would the process we have imagined be likely to succeed in providing us with an accurate likeness of "a peacock in his pride," or a Gothic cathedral, or the engines of an ocean steamer, or, let us say, a diagram of the eye itself? Yet must the equally blind operation of random variation be credited with the production, not only of some one work, as accurately fitted and finished as any of them, but of an infinite multitude, adapted to purposes the most diverse, all accurately satisfying the requirements of inexorable laws. It is not only the one organ which we have hitherto considered in which "Nature" shows her craft; nay, eyes such as our own are not the only instruments she has invented for purposes of sight. There are compound, as well as simple, eyes, constructed on a totally different plan, which we cannot imitate, having not the least idea how it works, but which obviously satisfies the laws of reflection and refraction, enabling the creatures possessing such organs to see, in some respects possibly better than ourselves. In like manner ears are adapted to the laws of sound in a manner perhaps still more marvellous, and fitted with machinery of exquisite manufacture; the wing of every creature which flies practically solves, though the methods of solution are very different, a problem of pneumatics with which we are unable to grapple even in theory; paw and talon, fin and hoof, the fang of the snake, the sting of the bee, the tongue of the butterfly, each of them, and a countless multitude of other tools or weapons, is accurately fitted for a special work by an intricate system of most delicate machinery; nay, there is no part, however seemingly trivial, of any creature, however low in the scale of life, which does not prove on examination to be a structure wonderfully built up so as exactly to satisfy the conditions of its own functions—that is to say, when we have got so far as to know what those functions are.*

Neither must we forget that it is not in the animal world alone that we meet with this sort of thing. Amongst plants, too, there are innumerable instances of means adapted to definite ends quite as wonderful as those we have been considering. Thus, a genus of orchids † is provided with a kind of spring-gun, which, when a bee enters a blossom, discharges at him, by means of a very ingenious mechanism, the glutinous pollen-mass, and this adhering to the insect's back, is carried away by him to serve for the fertilization of the next blossom he visits. Another orchid (*Coryanthes*) secures the same object in an altogether different manner. This sets a trap for the bee, the lower lip of the flower enlarging into a bucket with a spout on one side, while two water-secreting horns above keep this vessel constantly full. A bee visiting the flower occasionally tumbles into the bucket, and then crawls out by the spout, but in doing so has to squeeze his back against a similar sticky mass of pollen, and carries it off with him, to be presently left on precisely the right part of the next *Coryanthes* he visits, for purposes of fertilization. We find, moreover, that what Mr. Darwin styles the "very curious contrivance" of a mass

* The author of a delightful book, *A Naturalist on the Prowl*, speaks thus of one such organ: "But may not a butterfly have other means of knowing than by seeing or smelling? Aye, there's the rub. For what *a priori* reason is there that the phenomena of this world should reach the brain of a butterfly only through the five gates of Mansoul? And if there are other means of access, how can we even conceive them? What are antennæ of a butterfly? 'Feelers' they are called in English, but to overawe the unlearned, we men of science write of them as antennæ, which mean the yards of a ship. Under either term we know as much about them as the butterfly knows why I carry a walking-stick."

† *Catasetum.*

of pollen-grains borne on a footstalk with an adhesive gland, is apparently the same amongst asclepiads as among orchids, though these kinds are about as remote from each other as flowering plants can be; whence it appears that nature has been able to hit upon the same ingenious device twice over.

What is the meaning of this wealth of inventive power? When the little girl voyaging in Dreamland heard of an insect whose food was weak tea and bread and butter, and asking what happened if it could not get such fare, was told that then it died, she not unnaturally objected that this must happen very often. "It always happens," was the reply. But here we have a puzzle precisely the reverse. No one of the creatures we find upon the earth could exist unless it happened to be provided with mechanisms of most extraordinary complexity, and equally wonderful efficiency. Yet it always happens that they have got them. To construct a "working hypothesis" as to how this comes to be, we must be able to find within our experience a force which of its nature is capable of doing work analogous in kind. Of one such force alone have we any knowledge—that of intelligence co-ordinating means towards an end. Therefore do we say that we find in nature traces of intelligence—and these we call the argument from Design. It is true that the Intelligence which we thus recognize must be one so immeasurably beyond our own, as to stamp it as of quite another order. It can create what we can but feebly copy, and devise what we cannot fully understand. But this only assures us that in it there is all that is in our own intelligence, and more. We may obtain true notions of a figure though we see its shadow only and not itself. The fact that the mind of Shakespeare is a puzzle to us, does not hinder us from believing that he had a mind.

Many who have read thus far will doubtless have desired long since to urge an objection, often supposed to be fatal to such an argument, which is founded upon the very example on which most stress has been laid. The eye, it is said, is far from being a perfect instrument for its purposes—in fact, it is an exceedingly imperfect one—not being properly corrected for chromatic aberration. Has not Professor Helmholtz himself declared that were an optician to send him an instrument so defective, he would at once return it to the maker as a bungling piece of work?

To this we might reply that as we have not the faintest conception as to how the eye does the work of seeing, it is somewhat premature to speak of defects in its mode of operating. We know, it is true, that its lenses throw a picture on the retina, as do those of a camera on the screen; but as to how this produces vision we know nothing at all. It used to be supposed that vision depended on this picture, just as the photograph does, and because rays of different colours penetrated the screen to different depths, it was thought that this must tend to spoil the result in the one case, as it would in the other. But it has since been suggested that the process by which the picture is connected with sight is a chemical one, and according to this theory, if the rays did not penetrate to different depths, we should not see at all. More recently, Professor Lodge has again suggested that the process may be electrical, and here again it might well be that what has been represented as a defect should prove to be an essential condition. We do not *see* the picture on our retina: its formation is but the last step which we can follow in the mechanical process whereby light is translated into sight: and what follows after that is still absolute mystery.

Let us, however, suppose that things are as the objection assumes. Let the eye be as far from ideal perfection as we like: this nowise diminishes the force of our argument. Whatever it might possibly do, there is no doubt as to what it does. It sees. The telescope used by Galileo was, no doubt, a most primitive and imperfect instrument; equally faulty was the steam-engine invented by James Watt; but do we therefore doubt that the one and the other gave proof of design? We say, not that the eye, or anything else, is the best article of its kind that could possibly be made, but that, as it actually exists, it is what nothing but intelligent design could have produced.

Another objection, and one apparently more fundamental, is probably awaiting us. Our argument has proceeded throughout on the assumption that the only force to which, on Darwinian principles, the manufacture of new organs can be attributed, is that of random variation. We shall be reminded that we have failed to reckon with the potent factor of "Natural Selection." Undoubtedly this is constantly spoken of as if it were such a force; but it is equally evident that such it cannot be. Natural Selection, on the showing of its authorized advocates, can never possibly make anything: it cannot even preserve what is made. All that it can do is to remove rivals from the path of a creature which is fit to develop. Let us suppose that there is a pond inhabited in company by gold-fish and by common carp. The latter are the bigger and stronger and get the lion's share of the food, which is, of course, limited in amount, and in consequence the gold-fish are not only few in number, but poor in condition, being stunted in growth and dull in colour. The owner, however, wishes to encourage the more ornamental species, and for this end at frequent intervals draws a net through the water, the meshes being large enough for them to pass easily through, while at least the mature carp are caught. In consequence of this action of his, the gold-fish increase and multiply, and having the benefit of a far more ample food-supply than previously, become portly of form and brilliant of hue. But though they have to thank the net for the chance of developing, it does not develop them. They must acquire the power of becoming plump and golden from some other quarter, else will they no more improve under their new conditions than do the sticks and straws which pass in their company through the meshes. Natural Selection is the exact analogue of such a net; it can initiate nothing; whatever benefits by its operation must be prepared to benefit before it begins to act: the fittest must be the most fit before it survives.

In this brief survey of the line of argument which seems to lead most easily to the recognition of Design in nature, we have confined our attention, as has already been intimated, to one particular feature of the organic world. Were we to stray beyond such limits, and consider phenomena of a wider and more complex character, though it would be less easy to draw forth with the same precision the chain of reasoning which they suggest, it would still remain true that intelligent Design is at least a conceivable explanation, and therefore furnishes a "working hypothesis"; while as to the systems arrayed against it, he would be a bold man who should say that his knowledge of the details of Nature's methods is such as to entitle him to pronounce that any one of them is even possible. Take the following graphic description, by an author already cited, of the provision made by Nature for the work which she requires in one department, and let us ask ourselves whether we can truly imagine any explanation of it, which shall be more than an imagination. The writer has been describing the manner in which beetles drag down manure beneath the earth, to provide for their grubs. He thus continues:

"It is intensely interesting to watch these little creatures toiling so industriously to make provision for their children, which will never know them or requite their care. But there is a far deeper interest in the thing. Soar above the individual beetle and its private ends, and contemplate all the myriads of beetles scattered over the face of the country, working together to carry out a great purpose which never comes within the scope of their personal aims. What is it they are doing? They are tilling the ground. These jungles are as all the face of the earth was when Adam was still uncreated, and there was not a man to till the ground. As then, so now, there often comes up a mist which waters the earth. But that is not enough. The ground must be ploughed, that that which is upon the top may go down, and that which is below may come up.

"The opposite process is for ever going on. Every tree is silently but ceaselessly at work, thrusting its roots, like fingers, down into the earth, and separating and drawing up certain constituents of the soil, and conveying them through the channels of the trunk out to the ends of the branches, and moulding them into leaves. The leaves will wither, and fall to the ground; or else cattle will eat them, or insects will feed upon them; but they too will die, and fall to the ground.

"Thus certain elements of the earth are for ever being brought up from the depths, and laid upon the surface. This cannot continue. They must be taken down again, and restored to the soil, or the foliage of the forest will soon fail, and the earth will be as barren as the moon. To carry out this great work there must be workmen, and millions upon millions there are, working as silently and as ceaselessly as the trees." *

The writer goes on to describe the process in some detail, telling us how there are different departments, each with its own staff. Wood-boring beetles are told off for old tree-trunks, turning them into powder to mix with the soil. Burying beetles take charge of animal remains, and earth-worms of the leaves, "a countless gang of laborious workmen, appointed to take the dead leaves to the place whence they came, and convert them into soil again, that the earth may be green."

Moreover, he declares that there are overseers set over these workmen to keep them to their tasks. The birds are ever looking for worms, and the worms have consequently to look out for birds. But for this necessity, they would grow lazy, and live on the surface of the ground, eating the leaves where they found them; but now they are forced, on pain of death, to live in the bowels of the earth, coming up only at night to draw down leaves.

Here then we obtain a glimpse of another kind of machinery, incomparably more complicated and bewildering than that previously studied. Not only, as it appears, must a creature develop its organs and faculties so as to satisfy its own immediate purposes, but those purposes must so respond to those of other creatures, quite alien from itself, as to co-operate with them towards a vast result. In a solemn secular process such as we see shadowed forth, how can we find a place for the operation of Natural Selection as we have heard it described? The

* *A Naturalist on the Prowl*, pp. 86–88.

race of beetles which convert old tree-trunks into mould will doubtless ultimately find the benefit of their work in the greater abundance of old trees; but when an individual introduces an improvement in the process, his distant descendants will have to wait for the benefit, when the seedlings he helps to plant have matured to decay. How, meanwhile, is his improved machinery to be handed on? to say nothing of its further development.

And yet, once again, is it not a conceivable explanation that a sufficient intelligence has ordered things to the end which we find actually attained? Such an intelligence could, according to Professor Huxley, have discovered in the constitution of the cosmic vapour every minutest particular of the world which was to issue from it, and all its successive phases. If this be so, may not intelligence have drawn the plan which intelligence can trace? And if nothing that we know except intelligence can draw a plan at all, must not the element of intelligence enter into any explanation which we frame of nature's machinery, if such explanation is to afford us even a "working hypothesis"? Sir Isaac Newton asked, "Was the eye contrived without skill in optics, and the ear without knowledge of sound"? and may we not go on to question whether the world as we find it, instinct with contrivance at every turn, could be fashioned without knowledge of those myriad-sided laws which had to be dealt with if it were ever to be the abode of life?

It is not to be supposed that considerations such as these will have any weight with the more zealous propagators of evolutionary doctrines, for manifestly it is not on the side of reason or cogency of argument that it enlists their sympathies. As in their mind the one essential feature of the creed is denial of a personal and intelligent ruler of the world, so undoubtedly its great merit is for them the elimination of such morality as a law superior to any of man's making can alone impose.

That this is so, we have sufficient evidence in Mr. Edward Clodd's *Primer of Evolution*,* a little book specially in-

* Longmans.

tended for the instruction of the young—one which those into whose hands it will commonly fall must naturally suppose to be what it professes, a manual wherein they may find in convenient and compendious form the teaching which science guarantees.

But the Primer is nothing of the kind. Scientifically considered it is a worthless production, a party tract composed on the principle that the end justifies the means. Its object is to instil into its readers the crudest and baldest materialism, to convince them that a man, a mushroom, and a boulder-stone are but different forms of the same thing; that, consequently, religion is a fable and morality a mistake. This object it endeavours to attain by a sketch of the history of the world which is grossly unscientific, for not only is it hopelessly inaccurate, representing what are mere hypotheses as established facts, but it abounds in grave errors upon fundamental points, showing that the author is ignorant of much which is essential to his subject.

Nevertheless, the Primer deserves attention. In the first place it was originally dedicated, by permission, to the late Professor Huxley.* We are frequently told that it is unfair to attribute to real men of science, who are also evolutionists, the extravagances of popular writers like Mr. Clodd and Mr. Grant Allen, who are evolutionists only, and cannot claim to speak with authority. But if such men are permitted or encouraged to place themselves beneath the ægis of greater names, the owners of those names must take the consequences. Moreover, in his dedication Mr. Clodd pronounces the supreme merit of Professor Huxley to lie, not so much in his "luminous treatment of the varied materials with which it is the province of science to deal," as in his "application of those materials to the construction of an all-embracing philosophy of life." Now, Professor Huxley loudly proclaimed himself an "Agnostic," and the essence of Agnosticism, as he explained it, is a confession of blank ignorance as to all which can furnish an ultimate basis of philosophy. At the same time, however, he habitually assumed that what

* In 1895.

he did not know could have no real existence, and as he chose likewise to assume that knowledge could be gained only through the methods of physical science, while repudiating the title of a materialist, he spoke and wrote as though there could be nothing in the universe but matter, —no soul within man and no God above. This is enough for Mr. Clodd, and constitutes for him an all-embracing philosophy. It was, we must also presume, the supreme importance of this fundamental negation that reconciled Professor Huxley to the connexion of his name with a work which, had it dealt with any other subject than evolutionary philosophy, must have received as little toleration from any man of science as do those devoted to the squaring of the circle, or demonstrations that the earth is flat.

For Mr. Clodd's purpose it is necessary to show that the material world is a machine containing within itself the principle of perpetual motion, a self-winding clock which needed no other power than its own to set it agoing, and which will continue for ever to evolve new combinations of its elements, and new forms of life. As, however, by the testimony, amongst others, of Professor Huxley himself, science teaches the exact opposite,—that the world we know must have had a beginning, and must have an end, it becomes necessary to construct a new system of physics, which he gravely sets forth as though it were the accepted teaching of men of science; whereas, as Professor Lodge pronounced when the same system appeared previously in a slightly different form,* it is an audacious attempt to reconstruct the laws of Nature as established by Newton, being replete with blunders and misstatements, and an emanation of mental fog.

This is the kind of instruction which the Primer conveys. "Matter will not move by itself: it needs some agent or cause to start it. Therefore all changes in the position

* The system of the *Primer* is a reproduction of that devised some years since by Mr. Clodd and Mr. Grant Allen, but the changes now adopted only make matters worse. Professor Lodge's criticisms are quoted in *Science or Romance?* ("The New Genesis"), p. 102.

of bodies, as also all changes in the position of the molecules of which they are made up, and of the atoms which form the molecules, are due to *Motion*, which works in two opposite ways. In the one it draws the particles of bodies together; in the other it separates them."

Such a passage would be hard to match for inaccuracy and confusion. We are given to understand that motion moves matter, that it is an "agent" which "works"—in plain English, a force. "Motion," however, is nothing but an abstraction. There is no such thing, apart from moving matter, any more than there is "solidity" apart from solid bodies. Motion is not a force, but the result of force—that is to say, force must be exerted to make a body move, or to produce motion. To talk of motion being the cause of movement, is like saying that flight makes birds fly.

Mr. Clodd proceeds to make statements still more wonderful. After telling us that the "pulling" forces, which draw matter together, are gravitation, cohesion, and chemical affinity, he thus continues: * "The Motion or Energy which *separates the particles*, or which *prevents them from coming closer together*, is of two kinds, *active* or *kinetic*, and *passive* or *potential*. The *passive* kind is represented by a stone lying on a roof or a mountain side, by a clock wound up but not going, by a seam of coal, and so on. The *active* kind is represented by the stone falling, the clock going, and the coal burning."

Therefore, a stone lying on a roof, or a seam of coal, represents "passive motion," and that sort of motion which pushes matter apart. What sort of idea will such a statement convey to the class of readers who make use of Primers? No doubt, Mr. Clodd is thinking of the doctrine of kinetic and potential energy, according to which, in the above instances, there are forces at work to keep the stone from falling in the one case, and the constituents of the coal from combining with oxygen in the other—thus counteracting gravitation or chemical affinity. But what has this to do with "passive motion"? And wherefore assume

* The italics are his.

that all the energy thus held in abeyance is of the "pulling" order, and all the forces which check it of the "pushing"? The case of gunpowder is precisely similar to that of coal; will any one say that the forces liberated when powder explodes tend to draw things together? Or again, a balloon tethered to the ground and straining at the ropes exactly resembles the stone on a roof or mountain side, or for the matter of that, on the ground—are we to say that the ropes push the balloon and earth apart, while the particular form of motion which tends to move it, namely, the buoyancy which buoys it up, is bent on pulling them together?

These, and other statements of like character, are not mere points of detail on which the writer has expressed himself unscientifically. The doctrine underlying this confused verbiage is that already indicated as essential to his whole system, for it is on the exact balance of these attractive and repulsive, or "pulling" and "pushing," forces that he depends for the machinery which he wishes his readers to believe will keep things going eternally. As he himself tells us: "If the pulling motions had unresisted play, every particle of matter would gravitate to a common centre and so form a vast solid body, inert and lifeless. And if the pushing motions had unresisted play, every particle of matter would be separated and scattered as an enormous gaseous mass through space; whereas with the *push* and *pull* motions matter is in a state of ceaseless change. . . ."

There is, however, a rather formidable difficulty in the way, for, according to the teaching of science, as conveyed to us by such authorities as Lord Kelvin and Professor Balfour Stewart, the former of the above suppositions is the true one—the "pulling" forces have it practically all their own way, and the universe *is* inevitably tending to become inert and lifeless. This being absolutely fatal to the conclusion he desires to reach, Mr. Clodd is compelled to invent a new system of his own, and to invest his "pushing motions" with powers of which science knows nothing, or rather, which she shows to be non-existent, —and this system he gives to the world as though there were no doubt about it.

It is needless further to examine his qualifications as an exponent of scientific teaching, or to inquire what weight may be supposed to attach to his dicta concerning an all-embracing philosophy of life, as, for instance, that "the origin of life is not a more stupendous problem to solve than the origin of water"; or that, "all that is, from fire-fused rock to the genius of man, was wrapped up in primordial matter"; or again, that "creeds are born and die, remaining only curious relics of illusions over which men wrangled and fought."*

But, upon one point Mr. Clodd is perfectly explicit and clear—that there is no such thing as morality, no distinction between right and wrong, beyond such as the conventions of society have agreed to recognize. As he tells us, "Morals are relative, not absolute—that is to say, there is no fixed standard of right and wrong by which the actions of men throughout all time are measured. Where there is no society there is no sin." It is true, he contradicts himself by speaking of some impulses of our nature as "higher," and others as "lower," and saying that indulgence of the latter entails remorse, which he tells us signifies "after-bite"; but his main contention is perfectly plain,

* A sample must, however, be given oi Mr. Clodd's mode of argumentation. To the objection that no intermediate forms have been discovered linking man with the lower animals, he thus rejoins: "Those who ask for the 'missing link' between man and ape only parade ignorance. Both these animals descended from a common ancestry, whence they branched off in different directions, and in any remains of man's progenitors the brain and such-like soft parts as would throw light on their differences from man-like apes would have perished long ago. And further, the 'links' between the great apes themselves are missing."

What sense can these words be imagined to convey? If a link has never been found, it is missing. Where is the parade of ignorance in saying so? And assuredly no link, whether in a direct line or collaterally, has ever been found, nor any single specimen of the common ancestry, wherefrom, as Mr. Clodd pronounces, both descend. How, again, is the existence of missing links between man and ape made more probable by the fact that other links are missing too? Mr. Clodd might indeed have added that *all* the links on which evolutionists so confidently reckon are missing throughout Nature. No single one has yet been discovered.

far too plain to escape the young folk for whom be writes—namely, that they may give free scope to their passions, so long as they do not shock the ideas of those amongst whom they live.

Here is the slime of the serpent, which experience teaches us to expect in evolutionary works of this stamp. So constantly does it appear as to suggest that such writers take up Evolution so hotly, not on any scientific grounds, for these they manifestly do not even understand, but as the readiest engine for propagating the doctrine dear to their heart—that man is a beast, and should be at liberty to behave as one. The common-sense of mankind, however, revolts against such teaching; wherefore, instead of practising their own principles and adopting the rules laid down by their fellows, they set themselves to convert their less enlightened countrymen, though they usually find it expedient to veil the grossness of their meaning in a mist of words. But, on occasion, they can be bolder and less circumspect, as was Mr. Clodd's friend and associate, Mr. Grant Allen, when he exhibited his true sentiments naked and unashamed, complaining of the tyranny of the law which prevents a man from saying anything worth hearing—the law in question being that which prohibits obscene publications.*

That to such writers the mention of Religion should be as a red rag to a bull is not surprising, but their hostility is not the least of her claims on the respect of thinking men.

But this is somewhat of a digression. To return to the subject directly engaging our attention, it is evident that, strenuously as they repudiate the idea, those who deny that Design has operated in the making of the world, ascribe to Chance the results we see. It will be asked what is meant by Chance. Chance is the negation of Design: what is not intended happens fortuitously. But within all human experience nothing remotely analogous to the countless

* "In England, where freedom of speech and thought are unknown, and where men get imprisoned under Lord Campbell's Act for saying anything worth hearing. . . ." Mr. Grant Allen in the *New Review*, March, 1890, p. 267.

mechanisms and contrivances which we meet in Nature has ever been produced except by the agency of a designing mind.

Of this no better example can be given than that which Mr. Darwin adduced to prove the opposite. Supposing a man to wish to build a house, who has no means of cutting stone to the required shapes, but lives near the foot of a precipice, whence from time immemorial rocks have in their fall been shattered into every variety of form. He picks out the wedge-shaped to construct arches, the longer fragments for lintels, the more rectangular for walls,—and so the house is built. A savage, says Mr. Darwin, would call it the work of Chance, but the man trained in the methods of science would know that, given a sufficient number of variations, every variety of shape must result, and there only is required a selective power to pick them out and arrange them. Just so; and the selective power, which produces the only precise and definite result in such a case, is the mind of the builder; without this, the most skilfully cut stones in a mason's yard would never make a house; with it, almost any materials may serve the purpose. And it is in regard of the house, not of its materials, that a substitute for design is required. If the stones from the cliff were to drop into their places of themselves, forming arches, doors, and walls, and spontaneously evolving a building, we should have an example in point; or, again, if any one amongst them were to be chipped into the likeness of the rudest hammer or arrow-head that ever came from the hand of primæval man;—but until some such result can be found, or even conceived, to be produced without the intervention of Mind, what warrant have we, in our experience, for supposing that the machines of Nature's contrivance, infinitely transcending our own, can have been otherwise constructed? And it is upon experience that Science is based.

# UN-NATURAL HISTORY

THE present generation has unquestionably distanced all others in the field of scientific research, and has imported into its investigations an accuracy of method, an ingenuity, and an industry, which are as admirable as they are new. But, as Aristotle has it, there is nothing incapable of misuse, save virtue alone; and there may be reason to fear lest our scientific merits should introduce along with them a parasitical crop of defects, going far to neutralize their advantages.

It is more particularly in the province of Natural History that symptoms of this danger appear,—if we should not rather say that Natural History, as our fathers understood it, is like to be altogether extinguished in favour of the newer science of Biology. More than this: the old-school naturalist is not merely being in great measure trampled out of existence by his younger rivals,—they deny to his pursuits the right to be classed as science at all, speaking of Gilbert White himself with undisguised contempt as "the old gardener-naturalist." There are in fact many who consider nothing to be truly scientific which does not admit of being described by a formal nomenclature and expressed in tabulated form, and who admit no elements as constituents of knowledge, except such as we can weigh and count and measure. Hence it comes to pass that while we learn from modern works a great deal about anatomy and classification, we hear comparatively little of the life-history of plants and animals; nay, it is irreverently said that not a few of our leading ornithologists would not know a thrush if they saw one, though easily recognizing its skeleton. Biology, in truth, not content with numberless triumphs in its own domain, appears to be intent on annexing that of Natural History as well, assuming it to be for all practical purposes as unoccupied as Central Africa.

Nor is this all. When the observer of the period goes afield, he is generally thinking a great deal more of what he wants to prove as to "life histories" than of what he is going to see: he cares comparatively little for the creatures he meets, and a great deal about constructing a genealogy for them. It may be said that while the naturalist of the past concerned himself with what was present, he of the present concerns himself with what is past.

That this is no overstatement we have evidence to show. The point has been most ably developed by Dr. Hudson, in a Presidential address to the Royal Microscopical Society, bearing the significant title, *On some needless difficulties in the study of Natural History*, wherein he contends, not only that the fact is as has been stated, but that we are doing an injury to science by allowing it to be so.* His words are so much in point that I make no apology for quoting them at some length.

A little while ago [he says] I read in the preface to a work on natural history, that the book was "of little value to the scientific reader, but that its various anecdotes and its minute detail of observation would be found useful and entertaining." What, then, may the "scientific reader" be expected to desire? He must be, in my opinion, a most unreasonable man, if he does not thankfully welcome anecdotes of the creatures he wishes to study, when these anecdotes are the result of patient and accurate observation. For it is precisely such information that is conspicuously absent from many scientific memoirs and monographs; the author generally spending his main space and strength in examining the shape and structure of his animals, and in comparing one with another, but giving the most meagre details of their lives and habits. Which, then, is the more scientific treatment of a group of animals, that which catalogues, classifies, measures, weighs, counts, and dissects, or that which simply

* Reprinted in *Nature*, Feb. 20, 1890, pp. 375, seq.

observes and relates? Or, to put it in another way, which is the better thing to do: to treat the animal as a dead specimen, or as a living one? Merely to state the question is to answer it. It is the living animal that is so intensely interesting, and the main use of the indexing, classifying, measuring, and counting is to enable us to recognize it when alive, and to help us to understand its perplexing actions. . . . We read much of the animal's organs; we see plates showing that its bristles have been counted, and its muscular fibres traced to the last thread; we have the structure of its tissues analyzed to their very elements; we have long discussions on its title to rank with this group or that; and sometimes even disquisitions on the probable form and habits of some extremely remote, but quite hypothetical, ancestor, who is made to degrade in this way, or to advance in that, or who is credited with one organ, or deprived of another, just as the ever-varying necessities of a desperate hypothesis require; but of the creature itself, of the way it lives, of the craft with which it secures its prey or outwits its enemies, . . . . of its perplexing stupidity coupled with actions of almost human sagacity —of all this, which is the real natural history of the animal, we, too often, hear little or nothing. And the reason is obvious, for in many cases the writer has no such information to give; and, even when he has, he is compelled by fashion to give so much space to that which is considered the more scientific portion of his subject, that he has scant room for the more interesting.

Evidence to the same effect is likewise forthcoming from the other side, from those who rejoice in the change that has been wrought as much as Dr. Hudson deplores it. Here, for instance, is the complacent account given by a writer of the modern school as to what occurs when an enlightened schoolboy interviews a primrose.*

The study of even the most commonplace object may, under the newer phases of research, be made to yield an amount of "sweetness and light" for which we might be wholly unprepared. The day of the Peter Bells, and of uninquiring moods and tenses, if not altogether a thing of the past, is happily already in its twilight stage. The schoolboy, with a primer of botany in hand, understands things at which the previous generation simply wondered. . . . The primrose still grows by the "river's brim," in truth, but it is no longer merely a yellow primrose. On the

* Dr. A. Wilson, *Chapters on Evolution*, p. 308.

contrary, the flower is in greater part understood, the mechanism of its life is well-nigh completely within our mental grasp ; and, best of all, its study has led in the past, as it leads even now, to the comprehension of wider ideas of nature, and more extensive views of plant-life, than those which formerly met the gaze of the wayfarer in scientific pastures. The appreciation of what is involved in part of the life-history of a primrose may thus serve as a starting-point for more extensive research into the phenomena of plant-fertilization at large ; and this latter topic, in its turn, falls naturally into its proper niche in teaching us plain lessons respecting the manner in which the wide domain of life is regulated and governed.

Into the "sweetness" thus claimed for the new method, as contrasted with the old, I do not propose to inquire,—with the "light" alone am I concerned. What is the truth about these "plain lessons" taught us so freely, and about the implied superiority of a modern primer to the labours of a former lifetime? Are our latter-day observers doing the best thing for science by the style of observation which they have adopted? or are they not rather in danger of losing the faculty of seeing what is, in their eagerness to speculate as to what may have been?

For a point whereon to test these questions we have not far to go, for several are suggested by what we have heard. To the old observer the flower was "merely a yellow primrose"; to the modern, the fact that it is yellow * is full of significance, and pregnant with a whole volume of life-histories. For the question of colour lands us at once in the midst of those problems which the modern naturalist delights to examine. The colours of flowers, he tells us, are intimately connected with the past history of the species to which they belong. Colour helps a flower in the struggle for existence—the factor which, according to him, rules all development—by enabling it more effectually to secure the services of insects for purposes of fertilization,

* It may, I suppose, be assumed for our present purpose, that a primrose *is* yellow, though artists, I believe, maintain that its hue is in truth a delicate green. Mr. Ruskin tells us that by a little observation we may satisfy ourselves that sun-lighted grass is of the colour of primroses, though, as he adds, few people are aware of the fact.

especially cross-fertilization.* Cross-fertilization is declared to be a necessity for plants that would be prolific and vigorous; that is to say, the pistil, which is to mature to a seed-bearing fruit, must be fertilized by pollen from the stamens in another blossom of the same species, and bees, or other insects, dusting their bodies with pollen while visiting one flower, deposit this on the pistil of the next to which they travel, thus securing for it the aforesaid benefit, and the colour of flowers has been developed through this agency—the insects recognizing what they are in search of, amongst other blossoms, by means of it.

Now it is evident that if a bee carries the pollen of one flower to the pistil of a flower of different species, he will do nothing whatever to help the cause of fertilization, for on such pistil the pollen will be entirely barren—just as barren as so much sand. Consequently we need another fact to supplement the first, namely, that bees on their part have developed an instinct making them keep to one kind of flower at a time. That this *is* a fact writers of the present day constantly assure us, and this assurance may well serve as a first example whereby to test the character of their observations.

To begin with, they shall tell their own story. "It has been ascertained by several observers," says Mr. Wallace,† "that many insects, bees especially, keep to one kind of flower at a time, visiting hundreds of blossoms in succession, and passing over other species that may be mixed with them." "It is a remarkable fact," says Sir J. Lubbock,‡ "that in most cases bees confine themselves in each journey to a single species of plant; though in the case of some nearly allied forms this is not so; for instance it is stated, on good authority, that *Ranunculus acris*, *R. repens*, and *R. bulbosus*,§ are not distinguished by the bees, or at least are visited indifferently by them, as is also the case with

* I have made some remarks upon this theory in a paper entitled, "Who Painted the Flowers?" (*Science and Scientists*).

† *Darwinism*, p. 318.

‡ *British Wild Flowers in relation to Insects*, p. 26.

§ Species of buttercup, equally common.

two of the species of clover, *Trifolium fragiferum* and *T. repens*." "Numerous naturalists," says Mr. Grant Allen,* "have put on record the preferences which individual insects have shown on special occasions for one kind of blossom alone. A single case must suffice for all. That careful observer, Mr. H. O. Forbes, saw 'by the roadside, near Kew Bridge Station, several species of hymenoptera,† of the genus *Bombus*‡ principally; one visited thirty flowers of *Lamium purpureum* § in succession, passing over without notice all the other plants on the same bank—species of *Convolvulus*, *Rubus*,|| *Solanum*.¶. Two other species of *Bombus*, and a *Pieris rapæ*,** also patronized the *Lamium*, seeking it out in the deep thicket, thrusting their probosces even into withered cups, although the *Rubus* flowers were far more accessible, and seemed much more attractive, being fresh and well-expanded.' The pages of scientific journals during the last few years have positively teemed with similar instances from all parts of the world."

So categorical are these statements, and seemingly so precise, that I must confess to having long taken them for granted. And yet, even as they stand, they present difficulties by no means slight. Sir J. Lubbock tells us that certain flowers, restharrow for example, though containing no honey, are occasionally visited by bees in a vain search for it.†† Are we therefore to say that they keep during one journey to such delusive plants? If not, the presence of the insects there is a contradiction of the general statement we have heard. Moreover it cannot but appear that the authorities to whom we have listened lack one important requisite for compulsion of our assent. They are very explicit as to the thing said to be observed, but there is an ominous vagueness as to the observers. Of these only one has been actually produced, and his evidence appears to be considered so singularly important that he is called as

* *The Colour-sense*, p. 89. See also *The Colours of Flowers*, p. 18.

† *i.e.*, Bees. ‡ Bumble-bees. § Red dead-nettle.

|| Blackberry. ¶ Nightshade. ** The common white butterfly.

†† *Wild Flowers and Insects*, p. 85. See a similar statement concerning St. John's Wort, p. 69.

Mr. Grant Allen's solitary witness in two different books. When we come to scrutinize that evidence—even by the light of book-knowledge—it at once presents a serious flaw. The bees and the butterfly observed by Mr. Forbes stuck unanimously to *Lamium* amid blossoms of *Convolvulus*, *Solanum*, and *Rubus*. But if we turn to Sir John Lubbock's book, already quoted, we find that *Rubus* and *Solanum* secrete no honey at all,* while *Convolvulus sepium*, doubtless the species meant, on the same authority,† offers such scanty attractions as to be comparatively little visited by insects. It is not wonderful, therefore, that the *Lamium* was preferred, being a flower rich in honey, and it is not easy to understand what is meant by saying that the *Rubus* flowers "seemed much more *attractive*." Of course a flower which has a monopoly of honey will have a monopoly of bees; the question is as to what will happen when there are several honey-bearing competitors. It is a pity, therefore, that we have but one witness brought, for, careful observer as no doubt he is, his evidence does not help us much upon this occasion, and it is curious to find an authority so given to out-door studies as Mr. Grant Allen contenting himself with a general reference to the teeming testimonies of scientific journals in corroboration. It is not only at Kew Bridge that wild flowers grow, and ten minutes' observation of the nearest meadow or hedgerow, or even of any flower-bed in a garden, would seem to be a preferable method of bringing the subject to book.

The reader who will make trial of this method will certainly very soon be lost in admiration of the agility of those observers who have been able to report, as we have heard from Mr. Wallace, on the course of a bee over "hundreds of blossoms." If we can make sure of him for half a dozen we shall be very fortunate; for, as a rule, there is a strange capriciousness in his evolutions, and he is continually rushing away to some other locality, at a rate we cannot follow. However, even so, it will not be long before we find ourselves in possession of abundant data whereon to base a judgment, for, if I mistake

* Pp. 93, 133. ‡ P. 133.

not, every insect we meet will flatly contradict the law in which we have been told to believe. In support of this assertion I will here set down the results of my own observations made last year,* which I might have multiplied indefinitely, had there been any object in so doing. To simplify the record, I will denote the insects observed by the letters of the alphabet, in order of observation, and when there is no indication to the contrary, the insect in question is a bumble-bee. A. after feeding on a plant of very dark wall-flower, passing over several other wall-flowers, betook himself to *Weigelia rosea*, a shrub with light rose-coloured blossoms. B. passed from rhododendron to wall-flower. C. from *Dielytra eximia* (a pink fumitory) to lilac. D. from wild raspberry to red campion and thence again to raspberry. E. from *Deutzia scabea* (white) to a very purple rhododendron. F. from bush vetch to water avens. G. from comfrey to red campion. H. worked backwards and forwards between germander speedwell and herb robert, also once visited a bush vetch; he, however, passed many red campions without a call. I. passed from water avens to raspberry. J. from figwort (*Scropularia aquatica*) to thistle. K. from campion to bush vetch, and again to campion. L. (hive bee) from chervil (a white umbellifer) to nonsuch (a small yellow clover), going backwards and forwards frequently from one to the other. M. from self-heal (blue) to yellow-rattle (backwards and forwards), once to red-clover. N. of all observed showed most constancy, to a row of dark blue (garden) pansies, which, however, he once varied with a yellow poppy. O. passed from fox-glove to snap-dragon. P. and Q. worked promiscuously among foxgloves and campions. R. passed from ragged robin to self-heal, back to the first and again to the second. S. from figwort to self-heal then to raspberry. T. from figwort to meadow-pea (*Lathyrus pratensis*). U. from yellow rattle to meadow-pea. V. (white butterfly) from campion to a butter-cup, thence to cat's-ear (*Hippochæris*). W. (brown butterfly) from cat's-ear to sow-thistle. X. (brown butterfly) from pignut to thyme. Y. from snowberry to woundwort.

* 1890.

I have drawn out this list at what may appear inordinate length, in view of the high authority guaranteeing the doctrine which it disproves. It certainly throws a strange light on the methods of modern observation, to find an assertion so boldly made, and so easily accepted, for the proper appreciation of which were needed only those materials which are within the reach of all. A sufficient commentary upon the whole story will be furnished by the reply of a most excellent field-naturalist, a working man, of whom I enquired whether he had ever observed if bees behaved in regard of flowers as we are told they do. "Yes," he answered, "I've seen it in books: but what makes them say that? it isn't because they've looked."

A small matter of detail, unconnected with the general argument, is found in Sir J. Lubbock's mention of the various buttercups, which he tells us are indiscriminately visited by bees. After what we have seen, this is not very surprising—that is, when bees visit them at all. During the whole of last season I have only once seen a bee on a buttercup, and that not in England, but in Austria.

It is, however, not a little strange to find that the assertion we have been examining should originally have been made by one who had no theory to support, and who was an admirable observer. Aristotle, in his *Natural History*,* writes: "On each flight it (the bee) does not go to flowers of different kind, but, for instance, from a violet to a violet, touching no other till it returns to the hive."

In like manner Mr. Jefferies—who is nothing if not observant—tells us: † "One bee will come along, calling at every head of white clover. By-and-by you may see one calling at the heath-bells, and nothing else, as in each journey they visit only the flower with which they begin." But whether in ancient Greece or modern England, the fact appears more than doubtful in view of what has been seen, notwithstanding the unprejudiced nature of these witnesses, and their high character for accuracy.

The question above discussed is not the only one to

* Bekker's Edition, vol. i. p. 624.

† *Field and Hedgerow*, p. 69.

which the colour of flowers introduces us. The hues of different species, we are assured, are so various, because some are more attractive to bees than others, and those plants which have managed the development business best, have secured the best colours. Mr. Grant Allen, following Sir J. Lubbock, has drawn out this idea at great length, and he undertakes to tell us the exact order in which the different colours appeared, and consequently their order of merit in bee-estimation, for each one came into fashion only because it was judged better than its predecessor. The original colour, he tells us,* was yellow; then came successively white, pink, red, purple, lilac, mauve, violet, and finally blue, the bee's hue of predilection. That the colours vary thus in popularity with bees is held to be proved chiefly by Sir J. Lubbock's experiments. Taking pieces of variously coloured paper, and putting on each a drop of honey, he observed them carefully, and found that which was on blue paper more largely patronized by the insects than any other, next to it that on violet, and so of the rest. What—I have heard it asked—can be more conclusive than this? Well, undoubtedly it is conclusive enough, so far as paper is concerned, but the question is about flowers; and if we go to them, the matter is by no means so simple. In the first place, there is one example, easily observable, and witnessed to us by Mr. Wallace,† which by itself appears quite sufficient to shake our faith in the assertion we have heard. Many of the flowers of one of our common English families, the great Borage tribe, as for instance, the lungwort and the forget-me-not, have flowers which, when they first open, are pink, and later turn to blue. In one species, the particoloured scorpion grass, the new-opened blossoms are generally yellow. Yet it is the young flowers, not the old, which the bees prefer. In regard of lungwort Mr. Wallace writes: "H. Müller observed bees visiting many red flowers, but neglecting the blue." He adds another instance still more remarkable. "In South Brazil there is a species of *Lantana*, whose flowers are yellow the first day,

* *Colours of Flowers*, pp. 19, 59. † *Darwinism*, p. 317.

orange the second, and purple the third; and Dr. Fritz Müller observed that many butterflies visited the yellow flowers only, some both the yellow and the orange flowers, but none the purple." *

But besides this, we have not far to seek for examples where the superior attractiveness of blue is found to be conspicuous by its absence. Last summer there grew in close proximity two species of cruciferous plants, the one *Aubrietia*, blue or purple, the other, *Arabis*, white. The bees were constantly at work among the white flowers, seldom amongst the others. In a row of variegated sweet peas, white, pink, red, purple, and blue, the white blossoms were clearly the favourites. One may watch a mass of bright blue lobelias all day without detecting an insect visitor, while their many-hued neighbours of the garden are being rifled right and left. The periwinkle, which in matter of blueness need fear comparison with no flower, seems to be similarly neglected; while as to the sage, which is not only blue, but, as we are told, perhaps the most highly specialized of all flowers for insect purposes, it is, I think, more than doubtful whether it is, after all, as popular with the bees as the simple and colourless blossom of the wild raspberry, the sycamore, and the lime.

In reply to such facts as these it is sometimes said that the assertion as to the superior charms of blue applies only to those cases where the honey-stores of two flowers are equal. But how can we tell what these stores are, except by seeing which the bees prefer? Are we to discount the facts we meet; when a yellow flower is preferred, crediting the fact not to its yellowness, but to its honey, and when a blue flower, not to its honey, but to its blueness? This would be a strange method of investigating the secrets of

* Mr. Grant Allen tells the story of this *Lantana* (*Colours of Flowers*, p. 19) on behalf of the thesis that insects keep to one blossoms; but tells it with a difference which certainly makes it more suitable for his purpose than in its original form. This is his version, the italics being mine "Fritz Müller noticed a *Lantana* in South America, which changes its colour as its flowering advances; and he observed that each kind of butterfly which visited it *stuck rigidly* to its own favourite colour, *waiting* to pay its addresses *until that colour appeared*."

Nature. Moreover, which is far more important, what business has a flower, on the above theory, to be blue, unless it contains more honey than others that are not blue? Why should the bees prefer this colour, unless it be the trade-mark of the superior article? Are we to credit them with a taste in colours for their own sake? If so, whence did that taste come? How have flowers been made blue by the selective preference of insects, if, as a matter of fact, insects do not prefer them?

All this is puzzling enough, and there is more beyond. Sir J. Lubbock found, in his paper experiments, as Mr. Grant Allen tells us,* that bees "do not so easily discriminate between blue and green as between other colours," and Mr. Allen adds that this is very natural, considering how small is the difference between these shades. But if there be little difference between these colours, there is all the difference in the world between the flowers that wear them. Flowers which are green are to our notions so unflowerlike, that most people are unaware of their existence—those, for example, of the oak, the nettle, and the grasses, being always comparatively small and of exceedingly simple construction. We are told, on the other hand, that blue flowers are the most highly developed, not in colour only, but in form and arrangement. It seems, therefore, that the progress must have been away from a hue which the insects cannot distinguish from that which they most affect, through all less-favoured shades, and back to the favourite again. And this is by no means all. Green should, being undistinguishable from it, be as attractive as blue; but when we have to consider the fact that some flowers do not attract bees at all, we are told, in an explanation, to observe that they are *green*. These are the great tribe of wind-fertilized flowers, the blossoms of most of our trees, and a large number of herbs, even without counting the vast host of grasses and sedges. We are told that as they gain nothing from insects, they do nothing to attract them, and are consequently inconspicuous. But the strange thing is that, apparently, being inconspicuous,

* *The Colour-sense*, p. 85.

means being green. "Petals, however small, or green, or inconspicuous," says Mr. Grant Allen.* "It is, I think, a strong argument," says Sir J. Lubbock, † "that while large flowers are almost always coloured, small ones are usually greenish." But if greenish be, for practical purposes, the same as bluish, where is the point of the argument?

There remains another proof offered to us, besides that of the coloured paper, to show that blue is the highest in the list of colours. This is the fact, already alluded to, that we find in connection with it the most wonderful machinery for securing the carrying of pollen from one blossom to another, and the most remarkable varieties of form. As to machinery, this, we are told, is to be found most perfect in "the sage and other labiates, perhaps the most specialized of any flowers so far as regards insect fertilization." This machinery as it exists in the sage is illustrated by a beautiful woodcut in Sir J. Lubbock's book,‡ whence it has been extensively copied into other works. But it is by no means so easy to find the arrangement thus described and delineated, actually working in a sage blossom; I have never, in fact, found one where the *modus operandi* was as clear as in the picture. As to the varieties of shape found in the highest forms of flowers, and coupled, according to Mr. Grant Allen, with blueness, the matter is proved by the help of a good deal of what looks rather like special pleading. We are, for example, referred to § one of these highly developed forms, the *Iris fœtidissima*, described for us as the 'common flag,' and are invited to notice that it is violet-blue. This is true of the common flag of our gardens (*Iris germanica*), which is perhaps the plant Mr. Allen means; the flowers of *I. fœtidissima* hardly accord with his description. The common *wild* flag, however, is *Iris Pseudacorus*, which has *yellow* flowers, and these, though just as highly developed in form, affect the lowest instead of the highest in the scale of colours. Apparently a still higher development is the monkshood, which is "specially adapted to the very highest class of insect visitors," ‖ and moreover of ultramarine hue,¶

* *Vignettes from Nature*, p. 15. † *Flowers and Insects*, p. 158.
‡ P. 148. § *Colours of Flowers*, p. 59. ‖ *Ibid.*, p. 37. ¶ *Ibid.*, p. 38.

which among colours "probably marks the highest level of all."* But if we study the monkshood not merely in our gardens, but in a wild condition, we shall find that some of the species have yellow flowers, others have blossoms dappled with a great deal of white; while in no species can the blue be styled ultramarine. Mr. Allen's notions of colour were somewhat severely criticized at the time his book appeared.†

Once again, therefore, we find speculation in the foreground, and observation lagging behind, and the eyes of the naturalist in scanty requisition as compared with the ingenuity of the historian.

Another illustration of the same kind is suggested by the question of flower-fertilization, and connects itself with the name of Mr. Darwin himself. In his greatest work, the *Origin of Species*, he writes as follows ‡ :—

From experiments which I have lately tried, I have found that the visits of bees are necessary to the fertilization of some kinds of clover; but humble-bees alone visit the red-clover (*Trifolium pratense*), as other bees cannot reach the nectar. Hence I have my little doubt that if the whole genus of humble-bees became extinct or very rare in England, the red-clover would become very rare or wholly disappear. The number of humble-bees in any district depends in a great degree on the number of field-mice, which destroy their combs and nests, and Mr. H. Newman, who has long attended to the habits of humble-bees, believes that more than two-thirds of them are thus destroyed all over England. Now the number of mice is largely dependent, as every one knows, on the number of cats, and Mr. Newman says: "Near villages or small towns I have found the nests of humble-bees more numerous than elsewhere, which I attribute to the number of cats that destroy the mice." Hence it is quite credible that the presence of a feline animal in large numbers in a district might determine, through the intervention first of mice and then of bees, the frequency of certain flowers in that district.

The idea thus suggested has been enthusiastically received by Mr. Darwin's followers, and we find his statement of the

* *Ibid.*, p. 23. † See *Journal of Botany*, 1883, p. 59.
‡ *Origin of Species*, p. 73.

case continually quoted, sometimes with a eulogium of the method of argumentation therein illustrated, and disparaging remarks on the ineptitude of the processes employed by previous philosophers. Nor do his disciples merely assume that the statement above given is absolutely convincing—they proceed to add fresh links to the chain of causes and effects, at either end. Thus Dr. A. Wilson writes * :—

> The scientific demonstration of the interdependence of living things becomes in this fashion perfectly clear. Carried out to its ultimate result such demonstration becomes sufficiently startling. British brain and sinew depend (according to a foreign estimate) on home-fed beef, whilst the quality of the nutriment is said to depend on the clover on which the ox subsists. But clover owes its continuance to humble-bees, humble-bees in turn are killed by field-mice,† whilst cats exterminate the rodents. As old maids conserve the feline race, it is alleged that the continuance of British intellect is dependent upon such conservation—so that a scientific justification of spinsterhood is thus rendered possible.

Thus is natural history evolved, and such are the products of British intellect for which the poor clover is made responsible; for neither in the above passage, nor in its context, is there the faintest indication of any wish to be humorous, it is but an illustration of the mode in which scientific demonstration becomes perfectly clear. One would naturally suppose that there was no possibility of doubt as to the simple primary facts, which serve as foundation to so vast a superstructure. But red-clover and bumble-bees are familiar objects enough, and the observation of them a matter of no difficulty if we are minded to observe. Let us go out to the nearest grass-plot and watch the history in action. Unless future experience be at variance with all my observations of the past, this is what we shall find. Bumble-bees do indeed come to this plant, and they alone, and it may be that they have trunks long enough to reach down

* *Chapters on Evolution*, p. 338.

† It may be remarked that according to some observers cats do not eat field-mice.

the tube of the flower and so get at the honey. But whether capable of such an operation or no they never seem to attempt it, but thrusting their head down amongst the blossoms, they quickly bite a hole through the base of each, and through it extract the honey. All the bees I have observed acted thus, and all the clover heads, the flowers of which had been open for any time, had been thus tapped. But, visiting them thus, the bees can do nothing at all to help the fertilization of the plant, least of all its cross-fertilization, for no part of their body comes in contact with either pollen or pistil, and it is impossible for them to convey the one to the other. Yet the clover obstinately continues to flourish, though the insects, selfishly intent upon their own convenience, grudge it the service which they might possibly render, and which is, we have been told, essential to its wellbeing.

One instance, indeed, I met last summer, where examination of the flowers contradicted my wonted experience. It was among the Bavarian highlands, where I found red-clover growing in such unusual profusion as to attract my attention. Desiring to see whether the ways of German bees are the same as those of our own, I gathered a head, and looked for the usual incisions in its blossoms. But they were not to be found; every floret was whole and intact, which perhaps was the reason that, although we were past the middle of August, the flowers showed, through the whole field, with such singular brightness and freshness. The thought naturally suggested itself, that here was an instance where the familiar account of the matter was a true one, and I started, determined to verify it. Presently, however, a somewhat different explanation obtruded itself—there were no bumble-bees, not one could I find amid acres of the flowers.

The problem thus suggested by clover is by no means solitary; we meet with it in other and even stranger forms elsewhere. No flowers have more elaborately prepared themselves to secure the services of insects—so we are told—than the higher members of the buttercup tribe—as, for instance, the larkspur and the columbine, for they have both donned the winning colours, and devised wondrous complications of their organs for the purpose. "Columbines," says Mr. Grant Allen,* "are very specialized forms of the buttercup type. Both sepals and petals are brightly coloured, while the former organs" (it should be "the latter") "are produced above into long, bow-shaped spurs, each of which secretes a drop of honey." But the plant would appear to have overreached itself in its ingenuity, for these spurs are so narrow and so long that bees cannot get down them within reach of the honey. Sir J. Lubbock † quotes the case of one that made the attempt and failed. Those observed by myself appeared to know that the attempt was useless, and did at first what the other ended by doing—going to the base of the spurs and boring through for the honey. Moreover, here again the plant, strange to say, appears no whit the worse in consequence, ripening its seeds in quite remarkable profusion, while of all kinds of columbine none is more prolific than the *Aquilegia Skinneri*, which is not blue, but yellow. The success of the larkspur's labours in the same direction appear to be scarcely less dubious, for according to Sir J. Lubbock, ‡ only two insects have a proboscis long enough to reach to the end of its spur, and as one of these two has disappeared before the plant flowers, the net result of all its trouble is to make it wholly dependent upon the other. As though to complete the perplexity of the matter, Sir John concludes his review of these flowers thus: § "The honey is in some cases easily accessible, in others it is situated at the end of a long spur. The former species are capable of self-fertilization, the latter are said by H. Müller to have lost that power." So that those plants which bees enter can get on without them, and those which bees do not enter, cannot; while, nevertheless, somehow they do.

We are now, perhaps, in a position to form some estimate of the scientific advantages enjoyed by a young observer whose base of operations is a botanical primer, who is taught that the proper mode of regarding Nature is through

* *Colours of Flowers*, p. 35.

† *Flowers and Insects*, p. 20.

‡ *Ibid.*, p. 53.

§ *Ibid.*

the medium of doctrines such as we have seen, and that it is beneath the dignity of science merely to look with his own eyes.

The case becomes still more bewildering when from the individual instances, in which illustration has been sought, we recur to the fundamental principle on which all the above doctrines are based; namely, the necessity of cross-fertilization. It is to secure this that all complicated machineries have been constructed, strange forms elaborated, and various hues developed. Therefore, obviously, it must be worth securing, and that it is so, testimonies abound. "I will not enter," says Sir J. Lubbock,* "into the large question why this cross-fertilization should be an advantage; but that it is so has been clearly proved." "Nature tells us in the most emphatic manner," says Mr. Darwin,† "that she abhors perpetual self-fertilization." "Self-fertilization with its resultant puny and feeble off-spring," observes Mr. Clodd;‡ "poor, weak, self-fertilized seeds," re-echoes Mr. Grant Allen;§ "all the various adaptations of flowers to insects are in view of inter-crossing," and "no continuously self-fertilized species would continue to exist," Dr. Asa Gray tells us,|| are aphorisms of the school; while Dr. A. Wilson thus sums up the whole matter:¶ "Sprengel laid down the axiom that Nature does not wish any complete flower to be self-fertilized. Darwin in turn improves upon this dictum, in his assertion that Nature abhors perpetual self-fertilization. That cross fertilization is generally beneficial, and self-fertilization injurious, is thus a stable result of botanical investigation."

But on the back of all this it is sufficiently startling to find Mr. Wallace writing as follows, and this too in his matured apology for the Darwinian doctrine**:—

We have direct proof of the beneficial results of intercrossing in a great number of cases; we have an overwhelming mass of

* *Flowers and Insects*, p. 6. † *Fertilization of Orchids*, p. 359.
‡ *Story of Creation*, p. 84. § *Vignettes from Nature.*
|| *Contemporary Review*, April 1882, p. 600.
¶ *Chapters on Evolution*, p. 339.
** *Darwinism*, p. 325. The italics are mine.

facts as to the varied and complex structure of flowers evidently adapted to secure this intercrossing by insect agency; yet we see many of the most vigorous plants which spread widely over the globe, with none of these adaptations, and evidently depending on self-fertilization for their continued existence and success in the battle of life. Yet more extraordinary is it to find numerous cases in which the special arrangements for cross-fertilization appear to have been a failure, since they have either been supplemented by special means for self-fertilization, or have reverted back in various degrees to simpler forms in which self-fertilization is the rule.

He proceeds to tell us, with regard to the highly complex modes by which cross-fertilization is brought about, that the result thus laboriously attained is after all "by no means an unmixed good," nay, that it "is far *less* certain in securing the perpetuation of the species, than is self-fertilization." In another place* he adds: "That self-fertilization has some great advantages is shown by the fact that it is usually the species which have the smallest and least conspicuous flowers which have spread widely, while the large and showy flowered species of the same genera, or families, which require insects to cross-fertilize them, have a much more limited distribution." All of which, as he justly observes, is "most puzzling."

Such, then, is the hopeless tangle of enigmas into which our "stable result" of botanical investigation would appear to resolve itself, and this it is which we are bidden to take as the guiding line which shall alone conduct us aright into the labyrinth of Nature's secrets, enabling us at the very outset easily to understand what to our forefathers was a mystery.

It must likewise be remembered that plants with flowers are, after all, but one section of the vegetable kingdom, and when we come to consider the other section, of plants reproducing their kind by *spores*, we find—as, for example, among ferns—that all the arrangements are such as to make self-fertilization a practical necessity; it requires, in fact, a good deal of delicate manipulation artificially to

* *Ibid.*, p. 323.

secure a cross. It may be that these plants are lower in the scale of life than the others,—still there they are, and seem likely to remain; and on a full view of the whole field, it would rather seem, as I have heard it suggested, that the utterances to which we have listened amount in reality to no more than this—that Nature abhors self-fertilization in those cases where cross-fertilization is produced. But such a conclusion scarcely warrants us in adjudging to the bee the office of Nature's head-gardener, and in crediting him with all the infinite beauty which we behold. Yet this it is that Mr. Grant Allen does in the following passage, quoted with approbation by Mr. Wallace *:—

> While man has only tilled a few level plains, a few great river valleys, a few peninsular mountain slopes, leaving the vast mass of earth untouched by his hand, the insect has spread himself over every land in a thousand shapes, and has made the whole flowering creation subservient to his daily wants. His buttercup, his dandelion, and his meadow-sweet grow thick in every English field. His thyme † clothes the hillside; his heather purples the bleak grey moorland. High up among the Alpine heights his gentian spreads its lakes of blue; amid the snows of the Himalayas his rhododendrons gleam with crimson light. Even the wayside pond yields him the white crowfoot and the arrow-head, while the broad expanses of Brazilian streams are beautified by his gorgeous water-lilies. The insect has thus turned the surface of the earth into a boundless flower-garden, which supplies him from year to year with pollen or honey, and itself in turn gains perpetuation by the baits which it offers for its allurement.

A writer should be very sure of his ground who indulges in such a rhapsody as this, and from what has been said we are able to judge as to the solid foundation underlying these sonorous phrases. Strange to say, I have heard it argued by a disciple of the same philosophy that even our British wild flowers must have been affected by cultivation—on the

* *The Colour-sense*, p. 95, quoted in *Darwinism*, p. 333.

† This appears to be Mr. Wallace's emendation. In Mr. Grant Allen's own work the reading is "mint." Mr. Wallace's version is an improvement, as mint certainly does not clothe hill-sides.

ground that they are more highly developed than would be possible under the influence of insects alone; the high development being visible, amongst other things, in the fact that so many of them are blue. If anything were needed at this stage of our investigation to obscure any gleam of light which may have remained to us, this suggestion would amply suffice for the purpose. The vast majority of wild flowers are for the cultivator simply "weeds," and his only treatment is to destroy them; and even if this were not so, how should our influence affect flowers in the same direction as that of bees, unless we, like them, quested for honey and admired blue? The idea is not worthy of mention for its own sake, but it serves to exhibit one more specimen of the sort of thing which nowadays is made to pass muster under the name of science.

Examples from the field of botany have occupied us so long that there is little space for any others, but I cannot refrain from adducing at least one from the realm of animal life. As the colours of flowers, so the colour of everything else must be accounted for on utilitarian principles, and amongst the rest that of birds' eggs. Why are the thrush's blue, the dipper's white, the blackbird's green and brown, the robin's white and red? Into such manifold complexities does this question lead that it has been found impossible to do more than indicate the general principle which, in modes infinitely various, is supposed to be illustrated. This principle is that of "protective coloration." Eggs laid in a covered nest, we are told, are white, but this colour would be too conspicuous in the open, so it is exchanged for others which by assimilation to the surroundings help to guard against detection. But besides the difficulty, immediately arising, that the ringdove, for instance, lays eggs of pure white in a nest absolutely flat and open, and moreover, so loosely constructed that they can often be seen through it from beneath, there is the farther fact to be explained, that the bright colours of many eggs would appear more likely to advertise their situation than to conceal it. Into the consideration of this point I do not wish to enter; my object is merely to illustrate the ways of the modern naturalist, by observing how he approaches it. Mr. Wallace, then, thus writes *:—

The beautiful blue or greenish eggs of the hedge-sparrow, the song-thrush, the blackbird, and the lesser redpole, seem at first sight especially calculated to attract attention, but it is very doubtful whether they are really so conspicuous, when seen at a little distance among their usual surroundings. For the nests of these birds are either in evergreens, as holly or ivy, or surrounded by the delicate green tints of our early spring vegetation, and may thus harmonize very well with the colours around them. The great majority of the eggs of our smaller birds are so spotted or streaked with brown or black on variously tinted grounds that, when lying in the shadow of the nest, and surrounded by the many colours and tints of bark and moss, of purple buds and tender green or yellow foliage, with all the complex glittering lights and mottled shades produced among these by the spring sunshine and by sparkling raindrops, they must have a quite different aspect from that which they possess when we observe them torn from their natural surroundings.

When we observe them torn from their natural surroundings! Are birds' eggs to be seen only in museums? Are there no banks and bushes where we may go and look at them, and so satisfy ourselves not only how they may look, but how, in fact, they do? Are our possibilities of describing the actual face of Nature limited to the potential mood?

O weak Might Be!
  O May, Might, Could, Would, Should!
How powerless ye
  For evil or for good!

If this be really the plight of naturalists, then is our friend the schoolboy qualified to be their teacher rather than their disciple, for he, depend upon it, is well acquainted with the look of a thrush's nest.

It is, perhaps, not without significance that such a passage as we have heard should have Mr. Wallace for its

* *Darwinism*, p. 215.

author. He is by no means a closet-naturalist only, and has done most wonderful work in the way of field observation. But the scene of his labours was the Indian Archipelago, not the thickets and hedgerows of his native land, and it would almost appear as though he illustrated in his own practice a superstition whereof many symptoms are to be found elsewhere. It seems, indeed, commonly to be assumed that the only objects really worth observing are those which, in one way or another, are so removed from the vulgar gaze, as to be observable by the specialist alone. Unless a man can use a dissecting-knife, or be prepared to pore for long hours through a microscope, or can afford to go to the ends of the earth to seek exotic species under other stars, he is not held to be capable of contributing anything of value to the stores of science; while as for the common objects around us, they are so utterly insignificant that we do the kindest thing on their behalf by constructing their history for them upon those scientific principles which, left to themselves, they fail to exhibit as plainly as they should. The resulting product may or may not have its merits as work of the imagination, but it appears to be clear that, whatever it may be, it is not natural history.

PRINTED AND PUBLISHED BY
THE CATHOLIC TRUTH SOCIETY, LONDON.

Gerard QH
369
Essays on un-natural .G35
history