ERNST HAECKEL

THE HISTORY OF CREATION

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Complete Edition

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EAN 4064066397173

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Volume 1

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CHAPTER I.

NATURE AND IMPORTANCE OF THE DOCTRINE OF FILIATION, OR DESCENT-THEORY.

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THE intellectual movement to which the impulse was given, thirteen years ago, by the English naturalist, Charles Darwin, in his celebrated work, “On the Origin of

Species,”(1) has, within this short period, assumed dimensions which cannot but excite the most universal interest. It is true the scientific theory set forth in that work, which is commonly called briefly Darwinism, is only a small fragment of a far more comprehensive doctrine—a part of the universal Theory of Development, which embraces in its vast range the whole domain of human knowledge.

But the manner in which Darwin has firmly established the latter by the former is so convincing, and the direction which has been given by the unavoidable conclusions of that theory to all our views of the universe, must appear to every thinking man of such deep significance, that its general importance cannot be over estimated. There is no doubt that this immense extension of our intellectual horizon must be looked upon as by far the most important, and rich in results, among all the numerous and grand advances which natural science has made in our day.

When our century, with justice, is called the age of natural science, when we look with pride upon the immensely important progress made in all its branches, we are generally in the habit of thinking more of immediate practical results, and less of the extension of our general knowledge of nature. We call to mind the complete reform, so infinitely rich in consequences to human intercourse, which has been effected by the development of machinery, by railways, steamships, telegraphs, and other inventions of physics. Or we think of the enormous influence which chemistry has brought to bear upon medicine, agriculture, and upon all arts and trades.

But much as we may value this influence of modern science upon practical life, still it must, estimated from a higher and more general point of view, stand most assuredly below the enormous influence which the theoretical progress of modern science will have on the entire range of human knowledge, on our conception of the universe, and on the perfecting of man’s culture.

Think of the immense revolutions in all our theoretical views which we owe to the general application of the microscope. Think of the cell theory, which explains the apparent unity of the human organism as the combined result of the union of a mass of elementary vital units. Or consider the immense extension of our theoretical horizon which we owe to spectral analysis and to the mechanical theory of heat. But among all these wonderful theoretical advances, the theory wrought out by Darwin occupies by far the highest rank.

Every one of my readers has heard of the name of Darwin. But most persons have probably only an imperfect idea of the real value of his theory. If a reader estimates as of equal value all that has been written upon Darwin’s memorable work since its appearance, the value of the theory will appear very doubtful to him, supposing that he has not been engaged in the organic natural sciences, and has not penetrated into the inner secrets of zoology and botany. The criticisms of it are so full of contradictions, and for the most part so defective, that we ought not to be at all astonished that even now, after the lapse of thirteen years since the appearance of Darwin’s work, it has not gained

half that importance which is justly due to it, and which sooner or later it certainly will attain.

Most of the innumerable writings which have been published during these years, both for and against Darwinism, are the productions of persons who are entirely wanting in the necessary amount of biological, and especially of zoological, knowledge. Although almost all of the more celebrated naturalists of the present day are adherents of the theory, yet only a few of them have endeavoured to procure its acceptance and recognition in larger circles. Hence the odd contradictions and the strange opinions which may still be heard everywhere about Darwinism. This is the reason which induces me to make Darwin's theory, and those further doctrines which are connected with it, the subject of these pages, which, I hope, will be generally intelligible. I hold it to be the duty of naturalists, not merely to meditate upon improvements and discoveries in the narrow circle to which their speciality confines them, not merely to pore over their one study with love and care, but also to seek to make the important general results of it fruitful to the mass, and to assist in spreading the knowledge of physical science among the people. The highest triumph of the human mind, the true knowledge of the most general laws of nature, ought not to remain the private possession of a privileged class of savans, but ought to become the common property of all mankind.

The theory which, through Darwin, has been placed at the head of all our knowledge of nature, is usually called the Doctrine of Filiation, or the Theory of Descent. Others term it

the Transmutation Theory. Both designations are correct. For this doctrine affirms, that *all organisms* (viz., all species of animals, all species of plants, which have ever existed or still exist on the earth) *are derived from one single, or from a few simple original forms, and that they have developed themselves from these in the natural course of a gradual change*. Although this theory of development had already been brought forward and defended by several great naturalists, and especially by Lamarck and Goethe, in the beginning of our century, still it was through Darwin, thirteen years ago, that it received its complete demonstration and causal foundation; and this is the reason why now it is commonly and exclusively (though not quite correctly) designated as *Darwin's Theory*.

The great and really inestimable value of the Theory of Descent appears in a different light, accordingly as we merely consider its more immediate connection with organic natural science, or its larger influence upon the whole range of man's knowledge of the universe. Organic natural science, or Biology, which as Zoology treats of animals, as Botany of plants, is completely reformed and founded anew by the Theory of Descent. For by this theory we are made acquainted with the active causes of organic forms, while up to the present time Zoology and Botany have simply been occupied with the facts of these forms. We may therefore also term the theory of descent a *mechanical explanation of organic forms*, or the science of the true causes of Organic Nature.

As I cannot take for granted that my readers are all familiar with the terms "organic and inorganic nature," and

as the contrast of both these natural bodies will, in future, occupy much of our attention, I must say a few words in explanation of them. We designate as *Organisms*, or *Organic bodies*, all *living creatures* or *animated bodies*; therefore all plants and animals, man included; for in them we can almost always prove a combination of various parts (instruments or organs) which work together for the purpose of producing the phenomena of life. Such a combination we do not find in *Anorgana*, or inorganic natural bodies—the so-called dead or *inanimate bodies*, such as minerals or stones, water, the atmospheric air, etc. Organisms always contain albuminous combinations of carbon in a semi-fluid condition of aggregation, which are always wanting in the Anorgana. Upon this important distinction rests the division of all natural history into two great and principal parts—*Biology*, or the science of Organisms (Zoology and Botany), and *Anorganology*, or the science of Anorgana (Mineralogy, Geology, Meteorology, etc.).

The great value of the Theory of Descent in regard to Biology consists, as I have already remarked, in its explaining to us the origin of organic forms in a mechanical way, and pointing out their active causes. But however highly and justly this service of the Theory of Descent may be valued, yet it is almost eclipsed by the immense importance which a single necessary inference from it claims for itself alone. This necessary and unavoidable inference is the theory of the *animal descent of the human race*.

The determination of the position of man in nature, and of his relations to the totality of things—this question of all

questions for mankind, as Huxley justly calls it—is finally solved by the knowledge that man is descended from animals. In consequence of Darwin's reformed Theory of Descent, we are now in a position to establish scientifically the groundwork of a *non-miraculous history of the development of the human race*. All those who have defended Darwin's theory, as well as all its thoughtful opponents, have acknowledged that, as a matter of necessity, it follows from his theory that the human race, in the first place, must be traced to ape-like mammals, and further back to the lower vertebrate animals.

It is true Darwin himself did not express at first this most important of all the inferences from his theory. In his work, "On the Origin of Species," not a word is found about the animal descent of man. The courageous but cautious naturalist was at that time purposely silent on the subject, for he anticipated that this most important of all the conclusions of the Theory of Descent was at the same time the greatest obstacle to its being generally accepted and acknowledged. Certain it is that Darwin's book would have created, from the beginning, even much more opposition and offence, if this most important inference had at once been clearly expressed. It was not till twelve years later, in his work on "The Descent of Man, and Selection in Relation to Sex," that Darwin openly acknowledged that far-reaching conclusion, and expressly declared his entire agreement with those naturalists who had, in the meantime, themselves formed that conclusion. Manifestly the effect of this conclusion is immense, and *no* science will be able to escape from the consequences. Anthropology, or the

science of man, and consequently all philosophy, are thereby thoroughly reformed in all their various branches.

It will be a later task in these pages to discuss this special point. I shall not treat of the theory of the animal descent of man till I have spoken of Darwin's theory, and its general foundation and importance. To express it in one word, that most important, but (to most men) at first repulsive, conclusion is nothing more than a special deduction, which we must draw from the general inductive law of the descent theory (now firmly established), according to the stern commands of inexorable logic.

Perhaps nothing will make the full meaning of the theory of descent clearer than calling it "the *non-miraculous history of creation*." I have therefore chosen that name for this work. It is, however, correct only in a certain sense, and it must be borne in mind that, strictly speaking, the expression "non-miraculous history of creation" contains a "*contradictio in adjecto*."

In order to understand this, let us for a moment examine somewhat more closely what we understand by *creation*. If we understand the creation to mean the *coming into existence of a body* by a creative power or force, we may then either think of the *coming into existence of its substance* (corporeal matter), or of the *coming into existence of its form* (the corporeal form).

Creation in the former sense, as the *coming into existence of matter*, does not concern us here at all. This process, if indeed it ever took place, is completely beyond human comprehension, and can therefore never become a subject of scientific inquiry. Natural science teaches that

matter is eternal and imperishable, for experience has never shown us that even the smallest particle of matter has come into existence or passed away. Where a natural body seems to disappear, as for example by burning, decaying, evaporation, etc., it merely changes its form, its physical composition or chemical combination. In like manner the coming into existence of a natural body, for example, of a crystal, a fungus, an infusorium, depends merely upon the different particles, which had before existed in a certain form or combination, assuming a new form or combination in consequence of changed conditions of existence. But never yet has an instance been observed of even the smallest particle of matter having vanished, or even of an atom being added to the already existing mass. Hence a naturalist can no more imagine the coming into existence of matter, than he can imagine its disappearance, and he therefore looks upon the existing quantity of matter in the universe as a given fact. If any person feels the necessity of conceiving the coming into existence of this matter as the work of a supernatural creative power, of the creative force of something outside of matter, we have nothing to say against it. But we must remark, that thereby not even the smallest advantage is gained for a scientific knowledge of nature. Such a conception of an immaterial force, which at the first creates matter, is an article of faith which has nothing whatever to do with human science. *Where faith commences, science ends.* Both these arts of the human mind must be strictly kept apart from each other. Faith has its origin in the poetic imagination; knowledge, on the other hand, originates in the reasoning intelligence of man.

Science has to pluck the blessed fruits from the tree of knowledge, unconcerned whether these conquests trench upon the poetical imaginings of faith or not.

If, therefore, science makes the “history of creation” its highest, most difficult, and most comprehensive problem, it must accept as its idea of creation the second explanation of the word, viz., *the coming into being of the form* of natural bodies. In this way geology, which tries to investigate the origin of the inorganic surface of the earth as it now appears, and the manifold historical changes in the form of the solid crust of the earth, may be called the history of the creation of the earth. In like manner, the history of the development of animals and plants, which investigates the origin of living forms, and the manifold historical changes in animal and vegetable forms, may be termed the history of the creation of organisms. As, however, in the idea of creation, although used in this sense, the unscientific idea of a creator existing outside of matter, and changing it, may easily creep in, it will perhaps be better in future to substitute for it the more accurate term, *development*.

The great value which the *History of Development* possesses for the scientific understanding of animal and vegetable forms, has now been generally acknowledged for many years, and without it it would be impossible to make any sure progress in organic morphology, or the theory of forms. But by the history of development, only one part of this science has generally been understood, namely, that of organic individuals, usually called Embryology, but more correctly and comprehensively, *Ontogeny*. But, besides this,

there is another history of development of organic species, genera, and tribes (phyla), which has the most important relations to the former.

The subject of this is furnished to us by the science of petrifactions, or palæontology, which shows us that each tribe of animals and plants, during different periods of the earth's history, has been represented by a series of entirely different genera and species. Thus, for example, the tribe of vertebrated animals was represented by classes of fish, amphibious animals, reptiles, birds, and mammals, and each of these groups, at different periods, by quite different kinds. This palæontological history of the development of organisms, which we may term *Phylogeny*, stands in the most important and remarkable relation to the other branch of organic history of development, I mean that of individuals, or Ontogeny. On the whole, the one runs parallel to the other. In fact, the history of individual development, or Ontogeny, is a short and quick recapitulation of palæonto logical development, or Phylogeny, dependent on the laws of Inheritance and Adaptation.

As I shall have, later, to explain this most interesting and important coincidence more fully, I shall not dwell further upon it here, and merely call attention to the fact that it can only be explained and its causes understood by the Theory of Descent, while without that theory it remains completely incomprehensible and inexplicable. The Theory of Descent in the same way shows us *why* individual animals and plants must develop at all, and why they do not come into life at once in a perfect and developed state. No supernatural history of creation can in any way explain to us the great

mystery of organic development. To this most weighty question, as well as to all other biological questions, the Theory of Descent gives us perfectly satisfactory answers—and always answers which refer to purely mechanical causes, and point to purely physico-chemical forces as the causes of phenomena which we were formerly accustomed to ascribe to the direct action of supernatural, creative forces. Hence, by our theory the mystic veil of the miraculous and supernatural, which has hitherto been allowed to hide the complicated phenomena of this branch of natural knowledge, is removed. All the departments of Botany and Zoology, and especially the most important portion of the latter, Anthropology, become reasonable. The dimming mirage of mythological fiction can no longer exist in the clear sunlight of scientific knowledge.

Of special interest among general biological phenomena are those which are quite irreconcilable with the usual supposition, that every organism is the product of a creative power, acting for a definite object. Nothing in this respect caused the earlier naturalists greater difficulty than the explanation of the so-called "*rudimentary organs*,"—those parts in animal and vegetable bodies which really have no function, which have no physiological importance, and yet exist in form. These parts deserve the most careful attention, although most unscientific men know little or nothing about them. Almost every organism, almost every animal and plant possesses, besides the obviously useful arrangements of its organization, other arrangements the purpose of which it is utterly impossible to make out.

Examples of this are found everywhere. In the embryos of many ruminating animals—among others, in our common cattle—fore-teeth, or incisors, are placed in the mid-bone of the upper jaw, which never fully develop, and therefore serve no purpose. The embryos of many whales—which afterwards possess the well-known whalebone instead of teeth—yet have before they are born, and while they take no nourishment, teeth in their jaws, which set of teeth never comes into use. Moreover, most of the higher animals possess muscles which are never employed; even man has such rudimentary muscles. Most of us are incapable of moving our ears as we wish, although the muscles for this movement exist, and although individual persons who have taken the trouble to exercise these muscles do succeed in moving their ears. It is still possible, by special exercise, by the persevering influence of the will upon the nervous system, to reanimate the almost extinct activity in the existing but imperfect organs, which are on the road to complete disappearance. On the other hand, we can no longer do this with another set of small rudimentary muscles, which still exist in the cartilage of the outer ear, but which are always perfectly inactive. Our long-eared ancestors of the tertiary period—apes, semi-apes, and pouched animals, like most other mammals, moved their large ear-flaps freely and actively; their muscles were much more strongly developed and of great importance. In a similar way, many varieties of dogs and rabbits, under the influence of civilized life, have left off “pricking up” their ears, and thereby have acquired imperfect auricular

muscles and loose-hanging ears, although their wild ancestors moved their stiff ears in many ways.

Man has also these rudimentary organs on other parts of his body; they are of no importance to life, and never perform any function. One of the most remarkable, although the smallest organ of this kind, is the little crescent-like fold, the so-called “plica semilunaris,” which we have in the inner corner of the eye, near the root of the nose. This insignificant fold of skin, which is quite useless to our eye, is the imperfect remnant of a third inner eyelid which, besides the upper and under eyelid, is highly developed in other mammals, and in birds and reptiles. Even our very remote ancestors of the Silurian period, the Primitive Fishes, seem to have possessed this third eyelid, the so-called nictitating membrane. For many of their nearest kin, who still exist in our day but little changed in form, viz., many sharks, possess a very strong nictitating membrane, which they can draw right across the whole eyeball, from the inner corner of the eye.

Eyes which do not see form the most striking example of rudimentary organs. These are found in very many animals, which live in the dark, as in caves or underground. Their eyes often exist in a well-developed condition, but they are covered by membrane, so that no ray of light can enter, and they can never see. Such eyes, without the function of sight, are found in several species of moles and mice which live underground, in serpents and lizards, in amphibious animals (Proteus, Cæcilia), and in fishes; also in numerous invertebrate animals, which pass their lives in the dark, as do many beetles, crabs, snails, worms, etc.

An abundance of the most interesting examples of rudimentary organs is furnished by Comparative Osteology, or the study of the skeletons of vertebrate animals, one of the most attractive branches of Comparative Anatomy. In most of the vertebrate animals we find two pairs of limbs on the body, a pair of fore-legs and a pair of hind-legs. Very often, however, one or the other pair is imperfect; it is seldom that both are, as in the case of serpents and some varieties of eel-like fish. But some serpents, viz., the giant serpents (Boa, Python), have still in the hinder portion of the body some useless little bones, which are the remains of lost hind-legs.

In like manner the mammals of the whale tribe (Cetacea), which have only fore-legs fully developed (breast-fins,), have further back in their body another pair of utterly superfluous bones, which are remnants of undeveloped hind-legs. The same thing occurs in many genuine fishes, in which the hind-legs have in like manner been lost.

Again, in our slow-worm (Anguis), and in some other lizards, no fore-legs exist, although they have a perfect shoulder apparatus within their bodies, which should serve as a means of affixing the legs. Moreover, in various vertebrate animals, the single bones of both pairs of legs are found in all the different stages of imperfection, and often the degenerate bones and those muscles belonging to them are partially preserved, without their being able in any way to perform any function. The instrument is still there, but it can no longer play.

Moreover, we can, almost as generally, find rudimentary organs in the blossoms of plants, inasmuch as one part or another of the male organs of propagation—the stamen and anther, or of the female organs of propagation—the style, germ, etc.—is more or less imperfect or abortive. Among these we can trace, in various closely connected species of plants, the organ in all stages of degeneration. Thus, for example, the great natural family of lip-blossomed plants (Labiatæ), to which the balm, peppermint, marjoram, ground-ivy, thyme, etc., belong, are distinguished by the fact that their mouth-like, two-lipped flower contains two long and two short stamens. But in many exceptional plants of this family, *e.g.* in different species of sage, and in the rosemary, only one pair of stamens is developed; the other pair is more or less imperfect, or has quite disappeared. Sometimes stamens exist, but without the anthers, so that they are utterly useless. Less frequently the rudiment or imperfect remnant of a fifth stamen is found, physiologically (for the functions of life) quite useless, but morphologically (for the knowledge of the form and of the natural relationship) a most valuable organ. In my “General Morphology of Organisms,”(4) in the chapter on “Purplessness, or Dysteleology,” I have given a great number of other examples (Gen. Morph. ii. 226).

No biological phenomenon has perhaps ever placed zoologists or botanists in greater embarrassment than these rudimentary or abortive organs. They are instruments without employment, parts of the body which exist without performing any service—adapted for a purpose, but without in reality fulfilling that purpose. When we consider the

attempts which the earlier naturalists have made in order to explain this mystery, we can scarcely help smiling at the strange ideas to which they were led. Being unable to find a true explanation, they came, for example, to the conclusion that the Creator had placed these organs there “for the sake of symmetry,” or they believed that it had appeared unwise and unsuitable to the Creator (seeing that their nearest kin did possess such organs) that these organs should be completely wanting in creatures, where they are incapable of performing a function, and where it cannot be otherwise from the special mode of life. In compensation for the non-existing function, he had at least furnished them with the outward but empty form; nearly in the same manner as civil officers, in uniform, are furnished with an innocent sword, which is never drawn from the scabbard. I scarcely believe, however, that any of my readers will be content with such an explanation.

Now, it is precisely this widely spread and mysterious phenomenon of rudimentary organs, in regard to which all other attempts at explanation fail, which is perfectly explained, and indeed in the simplest and clearest way, by Darwin’s *Theory of Inheritance* and *Adaptation*. We can trace the important laws of inheritance and adaptation in the domestic animals which we breed, and the plants which we cultivate; and a series of such laws of inheritance have already been established. Without going further into this at present, I will only remark that some of them perfectly explain, in a mechanical way, the coming into existence of rudimentary organs, so that we must look upon the

appearance of such structures as an entirely natural process, arising from the *disuse of the organs*.

By *adaptation* to special conditions of life, the formerly active and really working organs have gradually ceased to be used or employed. In consequence of their not being exercised they have become more and more imperfect, but in spite of this have always been handed down from one generation to another by *inheritance*, until at last they vanish partially or entirely. Now, if we admit that all the vertebrate animals mentioned above are derived from one common ancestor, possessing two seeing eyes and two well developed pairs of legs, the different stages of suppression and degeneration of these organs are easily accounted for in such of the descendants as could no longer use them. In like manner the various stages of suppression of the stamens, originally existing to the number of five (in the flower-bud), among the Labiatæ is explained, if we admit that all the plants of this family sprung from one common ancestor, provided with five stamens.

I have here spoken somewhat fully of the phenomena of rudimentary organs, because they are of the utmost general importance, and because they lead us to the great, general, and fundamental questions in philosophy and natural science, for the solution of which the Theory of Descent has now become the indispensable guide. As soon, in fact, as, according to this theory, we acknowledge the exclusive activity of physico-chemical causes in living (organic) bodies, as well as in so-called inanimate (inorganic) nature, we concede exclusive dominion to that view of the universe, which we may designate as the *mechanical*, and which is

opposed to the *teleological* conception. If we compare all the ideas of the universe prevalent among different nations at different times, we can divide them all into two sharply contrasted groups—a *causal* or *mechanical*, and a *teleological* or *vitalistic*. The latter has prevailed generally in Biology until now, and accordingly the animal and vegetable kingdoms have been considered as the products of a creative power, acting for a definite purpose. In the contemplation of every organism the unavoidable conviction seemed to press itself upon us, that such a wonderful machine, so complicated an apparatus for motion as exists in the organism, could only be produced by a power analogous to, but infinitely more perfect than, the power of man in the construction of his machines.

However sublime the former idea of a Creator, and his creative power, may have been; however much it may be attempted to divest it of all human analogy, yet in the end this analogy still remains unavoidable and necessary in the teleological conception of nature. In reality the Creator must himself be conceived of as an organism, that is, as a being who, analogous to man, even though in an infinitely more perfect form, reflects on his constructive power, lays down a plan of his mechanisms, and then, by the application of suitable materials, makes them answer their purpose. Such conceptions necessarily suffer from the fundamental error of *anthropomorphism*, or man-likening. In such a view, however exalted the Creator may be imagined, we assign to him the human attributes of designing a plan, and therefrom suitably constructing the organism. This is, in fact, quite clearly expressed in that view which is most sharply

opposed to Darwin’s theory, and which has found among naturalists its most distinguished representative in Agassiz. His celebrated work, “An Essay on Classification,”(5) which is entirely opposed to Darwin’s , and appeared almost at the same time, has elaborated quite consistently, and to the utmost extent, these anthropomorphic conceptions of the Creator.

I maintain with regard to the much-talked-of “purpose in nature,” that it really has no existence but for those persons who observe phenomena in animals and plants in the most superficial manner. Without going more deeply into the matter, we can see at once that the rudimentary organs are a formidable obstacle to this theory. And, indeed, everyone who makes a really close study of the organization and mode of life of the various animals and plants, and becomes familiar with the reciprocity or interaction of the phenomena of life, and the so-called “economy of nature,” must necessarily come to the conclusion that this “purposiveness” no more exists than the much-talked-of “beneficence” of the Creator. These optimistic views have, unfortunately, as little real foundation as the favourite phrase, the “moral order of the universe,” which is illustrated in an ironical way by the history of all nations. The dominion of the “moral” popes, and their pious inquisition, in the mediæval times, is not less significant of this than the present prevailing militarism, with its “moral” apparatus of needle-guns and other refined instruments of murder.

If we contemplate the common life and the mutual relations between plants and animals (man included), we

shall find everywhere, and at all times, the very opposite of that kindly and peaceful social life which the goodness of the Creator ought to have prepared for his creatures—we shall rather find everywhere a pitiless, most embittered *Struggle of All against All*. Nowhere in nature, no matter where we turn our eyes, does that idyllic peace, celebrated by the poets, exist; we find everywhere a struggle and a striving to annihilate neighbours and competitors. Passion and selfishness—conscious or unconscious—is everywhere the motive force of life. The well-known words of the German poet—

> “Die Welt ist vollkommen überall Wo der Mensch nicht hinkommt mit seiner Qual.”[1]

are beautiful, but, unfortunately, not true. Man in this respect certainly forms no exception to the rest of the animal world. The remarks which we shall have to make on the theory of “Struggle for Existence” will sufficiently justify this assertion. It is, in fact, Darwin who has placed this important point, in its high and general significance, very clearly before our eyes, and the chapter in his theory which he himself calls “Struggle for Existence” is one of the most important parts of it.

Whilst, then, we emphatically oppose the vital or teleological view of animate nature which presents animal and vegetable forms as the productions of a kind Creator, acting for a definite purpose, or of a creative, natural force acting for a definite purpose, we must, on the other hand, decidedly adopt that view of the universe which is called the *mechanical* or *causal*. It may also be called the *monistic*, or *single-principle* theory, as opposed to the *twofold principle*, or *dualistic* theory, which is necessarily implied in the teleological conception of the universe. The mechanical view of nature has for many years been so firmly established in certain domains of natural science, that it is here unnecessary to say much about it. It no longer occurs to physicists, chemists, mineralogists, or astronomers, to seek to find in the phenomena which continually appear before them in their scientific domain the action of a Creator acting for a definite purpose. They universally, and without hesitation, look upon the phenomena which appear in their

different departments of study as the necessary and invariable effects of physical and chemical forces which are inherent in matter. Thus far their view is purely *materialistic*, in a certain sense of that “word of many meanings.”

When a physicist traces the phenomena of motion in electricity or magnetism, the fall of a heavy body, or the undulations in the waves of light, he never, in the whole course of his research, thinks of looking for the interference of a supernatural power. In this respect, Biology, as the science of so-called “*animated*” natural bodies, was formerly placed in sharp opposition to the above-mentioned inorganic natural sciences (Anorganology). It is true modern Physiology, the science of the phenomena of motion in animals and plants, has completely adopted the mechanical view; but Morphology, the science of the forms of animals and plants, has not been affected at all by it. Morphologists, in spite of the position of physiology, have continued, as before, in opposition to the mechanical view of functions, to look upon the forms of animals and plants as something which cannot be at all explained mechanically, but which must owe its origin necessarily to a higher, supernatural creative power, acting for a definite purpose.

In this general view it is quite indifferent whether the creative power be worshipped as a personal god, or whether it be termed the power of life (vis vitalis), or final cause (causa finalis). In any case, to express it in one word, its supporters have recourse to a *miracle* for an explanation. They throw themselves into the arms of a poetic faith, which as such can have no value in the domain of scientific knowledge.

All that was done before Darwin, to establish a natural mechanical conception of the origin of animals and plants, has been in vain, and until his time no theory gained a general recognition. Darwin's theory first succeeded in doing this, and thus has rendered an immense service. For the idea of the *unity of organic and inorganic nature* is now firmly established; and that branch of natural science which had longest and most obstinately opposed mechanical conception and explanation, viz., the science of the structure of animate forms, is launched on to identically the same road towards perfection as that along which all the rest of the natural sciences are travelling. The unity of *all* natural phenomena is by Darwin's theory finally established.

This unity of all nature, the animating of all matter, the inseparability of mental power and corporeal substance, Goethe has asserted in the words: "Matter can never exist and be active without mind, nor can mind without matter." These first principles of the mechanical conception of the universe have been taught by the great monistic philosophers of all ages. Even Democritus of Abdera, the immortal founder of the Atomic theory, clearly expressed them about 500 years before Christ; but the great Dominican friar, Giordano Bruno, did so even more explicitly. For this he was burnt at the stake, by the Christian inquisition in Rome, on the 17th of Feb., 1600, on the same day on which, 36 years before, Galileo, his great fellow-countryman and fellow-worker, was born. Such men, who live and die for a great idea, are usually stigmatized as "materialists"; but their opponents, whose arguments were torture and the stake, are praised as "spiritualists."

By the Theory of Descent we are for the first time enabled to conceive of the unity of nature in such a manner that a mechanico-causal explanation of even the most intricate organic phenomena, for example, the origin and structure of the organs of sense, is no more difficult (in a general way) than is the mechanical explanation of any physical process; as, for example, earthquakes, the courses of the wind, or the currents of the ocean. We thus arrive at the extremely important conviction that *all natural bodies* which are known to us are *equally animated*, that the distinction which has been made between animate and inanimate bodies does *not* exist. When a stone is thrown into the air, and falls to earth according to definite laws, or when in a solution of salt a crystal is formed, the phenomenon is neither more nor less a mechanical manifestation of life than the growth and flowering of plants, than the propagation of animals or the activity of their senses, than the perception or the formation of thought in man. This final triumph of the monistic conception of nature constitutes the highest and most general merit of the Theory of Descent, as reformed by Darwin.