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THE RELIGION OF MOSES.

BY PROF. C. H. CORNILL.

I MUST preface my remarks with the statement, which is to-day not superfluous, that I regard the traditions of Israel concerning its ancient history on the whole as historical. They are to be accepted with reserve and criticism, as all legends are, but at the basis of them is to be found a grain of historical truth, which it is the duty of the historian to disengage from the magic veil which legend has woven round it, and to understand. I believe, accordingly, that the forefathers of Israel under the guidance of Abraham wandered from Haran in Mesopotamia into Palestine; that after a long sojourn there and after many adventures they wended their way into Egypt and settled down in the reedy districts of the Eastern Nile-delta; that they met there at first with a friendly reception, or at least were tolerated, but at last were heavily oppressed, till under the guidance of Moses, who belonged to the tribe of Levi, but who through a special concatenation of circumstances had received access to the higher civilisation and culture of Egypt, they succeeded in freeing themselves from the Egyptian yoke. The entire Hebrew tradition with one accord regards this Moses, the leader of the exodus out of Egypt, as the founder of the religion of Israel. Our first question, therefore, must be: What sort of religion was that which Moses founded? In what does its novelty consist?

And now I must make an admission to you, which it is hard for me to make, but which is my fullest scientific conviction, based upon the most cogent grounds, that in the sense in which the historian speaks of "knowing," we know absolutely nothing about Moses. All original records are missing; we have not received a line, not even a word, from Moses himself, or from one of his contemporaries; even the celebrated Ten Commandments are not from him, but, as can be proved, were written in the first half of the seventh century between 700 and 650 B.C. The oldest accounts we have of Moses are five hundred years later than his own time. Nevertheless, this comparatively late record contains some special features which are important and require to be considered in the solution of the question now occupying our attention.

They are as follows. The work of Moses does in

no way appear as something absolutely new, but as a supplement to something already existing among the people. It is the "God of our fathers" that Moses proclaims. Likewise, it is certain, that the name of this God, whom we are wont to call Jehovah, and whose real Hebrew pronunciation is *Yahveh*, was first introduced by Moses, and that a priest from Sinai, whom tradition makes the father-in-law of Moses, had no mean share in Moses's work.

As regards the first of these points, all the internal evidence is in its favor. The relations and circumstances of the time were not suited to an entirely new creation; had the people at the time of Moses been common Semitic heathens or Egyptian animal-worshippers, his achievements would have been unintelligible. Moreover, I believe we can bring into organic connexion with this theory one of the most charming and touching narratives in Genesis, the narrative of how Abraham originally intended to sacrifice his only son, Isaac, to God as a burnt-offering, when an angel appeared and placed in his stead a ram. Among the Canaanites the sacrifice of children was an ancient and holy institution. The only purpose the narrative can have is to show how Abraham and his companions in their wholesome and unpolluted minds regarded this institution with horror, and that they kept themselves uncontaminated by the religious customs of the Canaanites among whom they lived, and whose language they adopted. To ascertain and establish the belief of Abraham is an utterly impossible task, but that Israel possessed before the time of Moses some distinct sort of religion, on which Moses could build, is a conclusion from which we cannot escape.

The two other points distinctly traceable in the Hebrew tradition regarding Moses, namely, that the name of God "Yahveh" was first introduced into Israel by him, and that a religious relationship existed with Sinai, where tradition places the foundation of the Israelitic religion by Moses, are also confirmed by closer examination and found to be connected.

In the first place, we are struck with the fact that the name of God "Yahveh" has no obvious Hebrew etymology. The interpretation of this word was a matter of difficulty and uncertainty even for the Old Testament itself. In Hebrew, the verb "to be"

alone could come into consideration. This in the Hebrew is *hajdh*, but in Aramaic *hewd*, with a *w* in the second place. We must, however, ask: Why did Moses, if he himself invented the name, derive it, not from the Hebrew, but from the Aramaic, form of the verb "to be," whilst we cannot prove, or even render probable, the least connexion or influence on the part of the Aramaic language? And, moreover, this derivation is in itself in the highest degree suspicious and doubtful. A name for God, that expressed nothing more of God than mere being, essence, pure existence, is hard to conceive of at such an ancient period; all this is the pale cast of philosophical speculation, but not the virile life of religion, and with such a purely speculative name of God, Moses would have given to his people a stone instead of bread. Feeling this difficulty the attempt has been made to derive the name from the causative form, which in Semitic is obtained by a simple vowel-change in the radical, as we form *set* from *sit*, *fell* from *fall*; in which case we should have to render "Yahveh," not as "He that is" but as "He that calls into existence." But no Hebrew, and no Semite, of those days, ever described the creative power of God as a "calling into existence"; a causative form of the verb "to be" is nowhere found in all the Semitic tongues.

Here again, as with the word *nabi*, prophet, the Arabic helps us out of our difficulties. The Arabic has still preserved the fundamental meaning of this root: *hawd* means "to fall," and of this meaning the root in Hebrew has still retained at least one distinct trace; the idea of "falling" is combined with "to be" by the intermediary conception, "to fall out," "to occur." Now observe the following facts. In olden times Sinai seems to have been looked upon as the special habitation of the God of Israel. In the oldest production of the Hebrew literature that we have, the glorious song of Deborah, God comes down from Sinai, to bring help unto his people, who are engaged in a severe struggle at Kishon with the Canaanites; and the prophet Elijah made a pilgrimage unto Horeb, as Sinai is known under another name, to seek the Lord in person. The Arabic, thus, gives us a concrete explanation of the name "Yahveh": it would mean "the feller," the god of the storms, who by his thunderbolts fells and lays low his enemies.

That Yahveh was originally a god of tempests may be shown by many additional vestiges, and this was distinctly recognised at a time when no one thought of thus explaining the name. When He first shows himself to Moses and to the people on Sinai, He appears in the midst of a terrible storm, and in the poetry of Israel it is also customary to depict the theophanies as storms. In the cherubs on which He rides, one skilled in the interpretation of mythological ideas sees at once

a personification of the storm clouds; and the seraphs, which, however, are mentioned only by Isaiah, are obviously a personification of the serpent of heaven, of the lightning.

And now I should like to call your attention to another very important fact. This strange form of the name of God, Yahveh, which is a verbal form, an imperfect, finds, in the whole populous Pantheon of the heathen Semites, analogies only on Arabian soil: among the hundreds of Semitic names of God known to us, we can point to but four such formations, and all of them occur on Arabian soil. The Sinai peninsula belongs linguistically and ethnographically to Arabia, and when we keep all these facts before us, the conviction is forced upon us that Yahveh was originally the name of one of the gods worshipped on Mount Sinai, which from the earliest times was considered holy, and that Moses adopted this name, and bestowed it on the God of Israel, the God of their fathers.

But now you will ask, with some astonishment, is this, then, really all we can conclude about Moses, even granting we *know* nothing about him? No, it is not. But, to learn more, we must go about it by a more circuitous road. Even the most exact of all sciences, mathematics, regards a so-called indirect proof as equally convincing with a direct one, if it be rightly worked out, and such an indirect proof we possess for determining the work of Moses. We may employ, in fact, the method of inference from effect to cause. Since, according to the universally accepted tradition of the whole people of Israel, Moses is the founder of the specifically Israelitic religion, we have only to establish what this was, and in doing so we establish at the same time the work of Moses.

To this end, we must first seek to discover the constituent elements of the religious consciousness as it lived in the minds of the people of Israel before the prophets gave to it wholly new impulses. We have, moreover, to compare this religious belief of the people of Israel about the year 800 B. C. with the religious ideas which we find elsewhere in the Semitic races, and with the conceptions of those purely or not purely Semitic races, with whom Israel came into direct contact, as the Egyptians and the Babylonians. What we find by such a comparison to agree completely with the conceptions of the other Semitic tribes, can in Israel also be a spontaneous production of the Semitic mind, just as in the other Semitic tribes; while that finally which corresponds with the conceptions of the Babylonians or Egyptians, can have been borrowed directly from them, because the conditions of such an origin exist in the long sojourn of the Israelites among those nations. Should, however, in the religion of Israel, about 800 B. C., things be found, which none of the

nations mentioned have in common with Israel, or such as are diametrically opposed to the conceptions and notions of those tribes, then we have in such things, according to all the rules of historical and religio-scientific reasoning, a creation of Moses.

Now, as a fact, the religion of Israel exhibits a large number of such features. Israel is the only nation we know of that never had a mythology, the only people who never differentiated the Deity sexually. So deep does this last trait extend, that the Hebrew language is not even competent to form the word "goddess." Where the Book of Kings tells us of the supposed worship of idols by Solomon, we find written: "Astarte, the *god* of the Phœnicians." Not even the *word* "goddess" is conceivable to the Israelites, much less the thing itself. Similarly, the cult of Israel is distinguished by great simplicity and purity, as may be proved by such old and thoroughly Israelitic feasts as the Passover, the offering of the firstlings of the flock during the vernal equinox, and the New Moons. Israel denounces with abhorrence the sacrificing of children, and especially that religious immorality, which held full sway among the immediate neighbors of Israel, that most detestable of all religious aberrations, which considered prostitution as an act of worship. In fact, Israel, even in its earliest days, possessed in comparison with the neighboring tribes, a very high and pure morality. For sins of unchastity the ancient Hebrew has an extremely characteristic expression: it calls them *nebalah*, "madness," something inconceivable, unintelligible, which a reasonable and normally organised man could never commit.

But the most important feature of all is the manner in which Israel conceives its relations to God. Monotheism, in a strictly scientific sense, ancient Israel had not; Yahveh was not the only existing God in heaven and on earth; He was only the exclusive God of Israel. Israel had henotheism, as Max Müller has termed this idea to distinguish it from monotheism, and monolatry only. The Israelite could only serve Yahveh; to serve another god was for the Israelite a crime deserving of death. Thus was the relation of the Israelites to this their only God especially close and intimate; the religious instinct concentrated itself on one object, and thereby received an intensity, which is foreign to polytheism, and must ever remain foreign to it. And this one and only God of Israel was not a metaphysical Being floating about in the grey misty distance on the other side of the clouds, but He was a personality, He was everywhere, and present in all things. The ways both of nature and of daily life were God's work.

And this brings us to an extremely important point. No distinction was known between divine and human law; both were God's institutions and commands,

civil as well as church law, to express ourselves in more modern terms. That any valid law might be merely a human formulation and a human discovery, is for the ancient Israelite an utterly inconceivable idea; therefore, every one that sins against the civil law sins against God—ancient Israel knew only sins, and no crimes.

Moses also understood how to render God accessible for practical life. The old Israelitic priestly oracle, which played so important a part in ancient days, we must also look upon as a Mosaic institution. And practically this is of the utmost importance; for by it the approach to God at every moment was made easy, and all of life was passed in the service and under the supervision of Yahveh. This is indeed much and great. Yahveh, alone the God of Israel, who suffers no one and nothing beside Him, who will belong entirely and exclusively to this people, but will also have this people belong entirely and exclusively to Him, so that it shall be a pure and pious people, whose whole life, even in the apparently most public and worldly matters, is a service to God, and this God source and shield of all justice and all morality—these must have all been the genuine and specific thoughts of Moses. Moreover, the importance of these thoughts reaches far beyond the province of religion in the narrower sense of the word. By giving to Israel a national Deity, Moses made of it a nation, and cemented together into a unity by this ideal band the different heterogeneous national elements. Moses formed Israel into a people. With Moses and his work begins the history of the people of Israel.

This work was soon to be put to the test. About a generation after the death of Moses, Israel forced its way into Palestine and found itself before a terrible danger. The Canaanites were far superior in civilisation to the primitive sons of the desert. Israel adopted this civilisation, and passed in Canaan from the nomadic mode of life to the agricultural, finally taking up a permanent residence there. It even took from Canaan the outward forms of religion, and in a measure adopted its holy places. The Sabbath, which the ancient Babylonians had, and which was designated as a "day of recreation for the heart," and the three great yearly festivals of the Passover, of the Weeks, and of the Tabernacles, are borrowed from the Canaanites; while the holy places of worship, Bethel, Dan, Gilgal, Beersheba, Sichem and Gibeon, Shiloh and Ramah, and others are all adopted outright from the Canaanites. But if Israel preserved its identity during this mighty process of transformation, was not mentally overcome and conquered by the Canaanites, but, on the contrary, knew how to absorb the Canaanites themselves, so that in the end Israel remained the decisive and dominant factor, it owes this solely to Moses and his

work, which gave to the Israelite nation its religious consecration and religious foundation, and made it competent, not only to preserve itself, but also to expand and to press onward to conquest.

THE PHYLOGENY OF THE PLANT SOUL.

BY PROF. ERNST HAECKEL.

THE OLD biology found the most important difference between the plant kingdom and the animal kingdom in the "ensoulment" or empsychosis of the latter—in that power of sensation and voluntary motion which was supposed to be totally wanting to the plant kingdom. This antiquated view, which is now only rarely upheld, found its classical expression in that well-known sentence of the *Systema Naturæ* (1735): "*Lapides crescunt, Vegetabilia crescunt et vivunt, Animalia vivunt, crescunt et sentiunt.*" Modern biology has definitively refuted this fundamental doctrine, which was the source of numerous grave errors. Comparative physiology has shown that organic irritability is a common vital property of *all* organisms, that sensibility and motility are properties of *all* living plasma. The same physiological functions which in man and the higher animals we include under the notion of the "soul" belong in a less perfect form not only to all lower animals, but also to all plants. A more precise knowledge of the protists has taught us that the same ensoulment exists even in these lowest, unicellular forms of life, and that their cell-soul exhibits a respectable series of psychological differentiations, of progressive and regressive changes.

Of highest importance for the monistic psychology is, further, the phylogenetic comparison of the unicellular protist-organism with the ancestral cell (*cytula*) of the histones; for this ontogenetic ancestral cell of the metaphyta and the metazoa (or the fecundated ovum cell, *ovospora*) possesses a "hereditary cellular soul," that is, a sum of psychical potential energies which have been gradually acquired by adaptation in long and many generations of ancestors and been stored up as "instincts" by heredity. The individual psychic life of every single multicellular and tissue-forming organism is, in its special quality and specific tendencies, conditioned by that hereditary patrimony, and its psychical activity consists in great measure merely in the unfolding of that inherited cellular soul. The psychical potential energies contained in it are re-transformed in the course of its actual life into the living forces or kinetic energies of motion and sensation. Our fundamental biogenetic law preserves here also its universal validity. This appears with special distinctness in the lowest metaphyta, the *Algae*; for their psychical activity, for example in fecundation, is only slightly different from that of their unicellular ancestors, the *Algetta*.

Further knowledge of the phenomena of this significant but as yet little trodden field is supplied by the comparative psychology of the metaphyta and metazoa. For, in the lowest divisions of the metazoa, especially in the *Spongia* and other *Coelentera*, the psychical activity or irritability does not rise above that low stage of development which we meet with in most metaphyta. Like the latter the *Spongia* also lack nervous and sensory organs. Their vital activity is limited mostly to the vegetative functions of nutriment and propagation. The old conception of sponges as plants was to this extent physiologically justified. But their animal form of metabolism and their incapacity for plasmodomy they share with many real metaphyta, that in consequence of parasitic modes of life have suffered metasitism (*Cuscuta*, *Orobanchæa*, etc.)

On the other hand, we now know of many higher "sensitive plants," whose high degree of irritability far surpasses that of many lower animals. The "nervousness" of these *Mimosæ*, of the *Dionæa*, *Drosera*, or other carnivorous plants, the energy of their sensations and motions, reveals in these metaphyta a much higher degree of psychic life than in numerous lower animals, even in such as already possess nerves, muscles, and sensory organs (for example, lower *Coelentera*, *Helmintha*). Especially such metazoa as have suffered profound retrogression by adaptation to sedentary modes of life (*Ascidia*) or parasitism (*Cestoda*, *Entoconcha*, *Rhizocephala*), may, psychologically, be placed far below such sensitive plants.

The criticism is often made upon this objective comparison of plant-soul and animal-soul, that the similar phenomena in the two kingdoms rest on entirely different structural bases. Nor is the objection unfounded, so far as the special mechanism for conducting the irritations, and the organs of reaction, may be widely different in the two cases; in fact, in most instances they *must* be widely different, for the reason that the enveloped cells of plant-tissues, surrounded as they are by solid membranes, remain much more independent than the intimately connected cells of animal-tissues. Still, recent histology has demonstrated a continuous connexion between all the cells of the histone organism; the apparently immovable cells in the republican cellular state of the metaphyta, locked up in their cellular prisons, are connected by countless delicate plasma-filaments, passing through the rigid membrane, just as are the more freely movable and mostly naked cells in the centralised monarchical cell-state of the metazoa. Besides, the development of a centralised nervous system, even among the latter, is a subsequent acquisition, unknown to their older ancestors. But organic irritability, as such, the capacity to receive physical and chemical effects from the outer world in the form of

excitations, to feel and to react upon them by internal or external motions, is a property of *all* living plasma, of the plasmodious phytoplasm as well as of the plasmophagous zoöplasm.

It will now be the task, as yet scarcely begun, of botanical psychology to subject to critical comparison and investigation the countless phenomena of irritability which the kingdom of the metaphyta offers, to reach a knowledge of the manifold developmental stages of that kingdom in all their phylogenetic connexions, and to establish in every single phenomenon adaptation and heredity as the efficient causes.

INSTINCTS OF PLANTS.

Those psychical activities of animals which it has long been the custom to include under the notion of *instinct*, are also found generally in plants, either in the restricted or in the extended sense of that variously interpreted and variously defined idea. In its restricted sense we understand by instinct definite psychical activities, involving three essential properties: (1) the action is unconscious; (2) it is directed purposefully to a definite physiological goal; (3) it rests on *heredity* from ancestors and is consequently potentially innate. In man and the higher animals, many habitual acts which were originally performed with consciousness and "learned," are transformed into unconscious instincts. In the lower animals and plants which lack consciousness, the primitive habits were also acquired unconsciously by adaptations, originally evoked by reflex activities and in consequence of frequent repetitions definitively fixed and made hereditary. Precisely this phenomenon, namely, the indubitable origin of hereditary instincts by the frequent repetition and exercise of definite psychical actions, furnishes us a mass of inexpugnable evidence for the important *law of progressive heredity*, for the "inheritance of acquired characters."

Innumerable are the forms in which inborn instinct expresses itself in all plants and in all animals—in all protists as well as in all histones. In every cellular division the karyoplasm of the cell reveals its innate or congenital instincts. In every copulative process, the two generating cells are brought together and impelled to union by sexual instincts. Every protist that builds for itself a definitely shaped shell, every plant-cell that envelops itself in its specific cellulose membrane, every animal cell that transforms itself into a definite tissue-form, acts from innate "instinct."

Of the highest phylogenetic import, both for the multicellular organism of the metaphyta and for that of the metazoa, are the *social instincts* of cells; for we recognise in them the fundamental cause of the formation of tissue. The single isolated cells which in most protists increase simply by fission and continue life inde-

pendently as monobionts, are found connected together in social masses of varying cohesiveness even in some divisions of protophyta (for example, in *Melethallia*) and in some of protozoa (for example, in *Polycyttaria*). The attraction of allied cells of the same family for one another, which rested originally upon some chemical sensory activity, causes them to form permanent cellular societies or cœnobia. By heredity this social chemotropism is established more and more firmly and finally developed into an instinct. Then, by a division of labor between the like-constituted cœnobionts, the foundations are laid for the tissues, those rigid cellular bonds in whose further development the polymorphism of cells plays the most important part.

The erotic chemotropism which brings the two copulating cells together in the sexual generation of metaphyta and metazoa is in its origin a special form only of that general social chemotropism. The "sensual inclination" of the conjugating cellular individuals is in both instances to be traced back to a chemical sensory activity allied to smell or taste. This unconscious sensual affection, and the motion produced as its reflex, are in every individual species fixed by habit in their special differentiated form and by heredity converted into sexual instinct. In many higher metaphyta bionomical relations have been developed which in the marvellous degree of differentiation and complication attained are not inferior to the similar sexual institutions of "marriage" in metazoa.

THE PHYLOGENETIC SCALE OF THE SENSATIONS.

The sensations of plants are generally regarded as unconscious, as are those of the protists and most animals. That special physiological function of the ganglion-cells which in men and the higher animals is called consciousness is associated with very complex and subsequently acquired structures of the brain. The special relations in the minute structure, composition, and combination of the nerve-cells that make these highest psychical functions possible, are wanting both to the plants and to the lower animals. Nevertheless, in the metaphyta as well as in the metazoa, it is possible to trace out a long, graduated scale in the development of the psychic activities and more especially of the sensations. Certain fundamental phenomena of irritability—relating to unconscious sensations—are shared in common by all plants (and all animals), whilst others reach development only in individual groups.

All metaphyta are more or less sensitive to the influence of light (heliotropism), heat (thermotropism), gravity (geotropism), electricity (galvanotropism), and various chemical excitations (chemotropism). The quality and quantity of the sensation due to the irrita-

tion, as of the motor or trophic reaction produced by it, varies, however, exceedingly in the different groups of plants and frequently even in closely allied species of one genus or family. It is very small or hardly perceptible in many lower "sense-blunted" plants and especially in parasites. On the other hand, in some higher plants of very delicate sensibility (*Mimosa*, *Dionaea*, etc.) it reaches a degree of irritability that far surpasses the slight "nervosity" of many lower metazoa provided with nerves and sensilli (for example, *Cestoda* and *Ascidia*). It will be a highly interesting task, as yet untouched, for botanical psychology to follow out the physiological scale of these manifold forms of sensation and to show in every single group of plants by what special adaptations they were originally acquired and within what ancestral series they were converted by heredity into instincts.

A second series of sensorial phenomena is developed, or at least is distinctly noticeable, only in individual groups of metaphyta. Here belongs especially the feeling of contact (thigmotropism) which is developed to such an astonishing degree in many clinging and climbing plants, and which, taken together with their nutational movements, has produced the special form of their tendrils, twiners, claspers, etc. Also the roots of many plants which are very sensitive to the different physical composition of the soil, give evidence of a high power of thigmotropism; one kind will seek out in a mixed soil the soft earths, another fine sand, another hard rock, etc. Similarly the penchant for water (hydrotropism) varies much; some plants are almost indifferent, while others are extremely sensitive to the varying degrees of water in the air and soil.

Extremely complex in the plant kingdom is the development of those sensorial affections which are known in the animal kingdom as smell and taste, and which rest on chemical irritations (chemotropism). As especially high stages of these senses appear to us "the taste" of carnivorous plants, the saline predilections of maritime metaphyta, and the calcareous predilections of the calcophilous plants, etc. But by far the most interesting and remarkable phenomena here are revealed to us by the sexual life, both in the plant and in the animal kingdom. Whether we are astonished at the copulation of gametes in the *Algæ* or the zoidogamous fecundation of the *Diaphyta*, or the siphonogamous fecundation of the phanerogamic blossoms, everywhere we stumble upon "sexual instincts" whose earliest and common origin is to be sought in the erotic chemotropism of their protophytic ancestors, the *Algetta*. In the siphonogamous chemotropism, as in the metazoa conjugating *per phallum*, this is associated with a special erotic thigmotropism (frictional sense). The fine qualitative and high quantitative

development of these erotic sensations, which in the higher animals are characterised as "sexual love," the most copious source of poetry in man, is also of the highest biological importance for many amphigynous plants. It is not only the cause of the highest physiological achievements of the metaphyta (in blossoming, generating, bearing of fruit, etc.), but also of the most manifold morphological arrangements developed in correlation with the latter (in the structure of the blossom, the seed, the fruit, etc.). The mutual relations which plants enter, in this connexion, with animals, (particularly blossoming plants with the insects fecundating them,) have in the course of time by heredity become for both sides a source of the most marvellous instincts.

THE PHYLOGENETIC SCALE OF THE MOTIONS.

Of much less phylogenetic interest than the scale of the sensations is that of the motions in the organism of the metaphyta. Whilst the former taken together are not inferior to the corresponding functions of the lower metazoa, the latter cannot bear comparison with them. The reason of this is, first, that most plants are firmly rooted in the soil, and, secondly, that the rigid and closed membrane of the plant-cell does not allow the living cellule or protoplast confined in its prison-walls that freedom of motion which is permitted to the free and often naked cellular body of the animal-tissue.

As in the protophyta, so also in the metaphyta, we may take up first the motions of the individual cells and distinguish two groups of these motions as spontaneous and irrital; the latter are produced by definite irritations, the former not. The spontaneous motions of the metaphyte cells are subdivided into inner (plasma-streamings within the cellular tegument) and outer. The most important outer spontaneous motion is the ciliate motion, which is produced by contractile lashes or cilia; it is found in the swarming spores of the *Algæ* and in the swarming spermatazoids of the *Diaphyta* (*Bryophyta* as well as *Pteridophyta*). As the natatory flagellate cells show the same kind of ciliate motion as is found in the *Algetta*, from which these metaphyta are descended, we may assume that they have been directly transmitted by heredity from the former to the latter. In the *Floridæ*, *Fungi*, and lichens, as also in all *Antophyta*, this form of spontaneous cellular motion has been lost by adaptation to a different mode of life.

The spontaneous or autonomous motions of whole organs (leaves, blossoms, anthers, tendrils), the pendulous and rotatory nutations of stems, leaves, etc., rest for the most part upon inherited instincts. On the other hand, many special forms of motion that appear here and there in the kingdom of metaphyta

are probably to be explained directly by adaptation to special conditions of life. They possess only a special physiological but no phylogenetic interest; as is the case also with the motions of growth and irritation that occur everywhere (paratonic, irrital, or induced motions). The mechanics of these motions (turgescence, tension of tissues, growth, elasticity, etc.) varies much. The graduated scale of their development is of no special interest for the phylogeny of metaphyta.

TELEOSIS IN THE HISTORY OF PLANTS.

The ancestral history of the plant kingdom, surveyed from its highest and most general point of view, like that of the animal kingdom, presents to the vision a stupendous process of progressive development. The constantly advancing historical separation or *divergence* of its forms, their increase in number and multiplicity, is accompanied upon the whole with a distinct *perfection* of organisation (*teleosis*). This result is deducible with absolute certainty from the critical elaboration and comparison of the three great phylogenetic muniments—palæontology, ontogeny, and morphology. By this inductively established fact the erroneous assertion is definitively refuted that the great main groups of the plant kingdom, or any considerable number of separate types, have subsisted from all time and developed independently by the side of one another. As this mystical view has been upheld even in recent times by eminent botanists, and with it a supernatural "creation" of the entire plant world has been asserted, we cannot emphasise too strongly here the remark that such a view is diametrically opposed to all the general results of inductive botany and especially of morphology.

The same remark holds true of the repeated attempts made until very recently to explain the progress in the historical development of the plant and animal world *teleologically*, whether by means of the direct conscious and premeditated constructive activity of a personal creator, or by the unconscious activity of a purposeful final cause or so-called "tendency to an end." Every critical and unbiassed comparison of the empirically established phylogenetic facts demonstrates that such a tendency to ends exists in organic nature as little as does a personal creator. On the contrary, we discover in the history of the plant world as clearly as in that of the animal and human worlds that *everything develops of its own accord*, and that the laws of its evolution are purely *mechanical*. The adaptiveness actually present in the corporeal structure of organisms, no less than the constant historical increase of their perfection, is the necessary result of natural selection, that tremendous process which has been uninterruptedly active for millions of

years. The unceasing interaction of all organic beings, their competition in the struggle for existence, determines with absolute necessity a constant average increase of their divergence and teleosis,—which is not neutralised by the numerous minor retrogressions that are constantly taking place in individual details.

Teleosis, accordingly, in the history of the plant world, as also in that of the animal world, is to be reduced to *teleological mechanics*. This fundamental principle of phylogeny stands everywhere in the most intimate causal connexion with the great principle of epigenesis as revealed in ontogeny. The explanation of the fundamental causal nexus between the two yields our fundamental biogenetic law, supported by the theory of progressive heredity. Precisely for this "heredity of acquired characters"—one of the foundation-stones of the monistic theory of evolution—we find countless salient and decisive proofs in the phylogeny of the metaphyta.

SCIENCE AND REFORM.

"ELBE" ECHOES.

THE testimony before the court of inquiry into the causes of the "Elbe" disaster tends to exculpate the captain of the "Cra-thie" from the charge of wilful neglect, but there is no doubt that nine-tenths, if not *all*, the passengers of the ill-fated steamer could have been saved if help, in the form of a sea-worthy vessel, had been near at hand. The compartment system is evidently no infallible protection against the risk of total shipwreck; within three minutes after the first shock the sea streamed through the gap at the rate of a ton per second; still the steamer kept afloat for at least twenty minutes longer—a respite sufficient to disembark a regiment of artillery with all its horses and ammunition-waggons. Again and again the costly lessons of experience illustrate the wisdom of Captain Wetzel's plan, to *let passenger steamers start pairwise*, and keep up a constant interchange of audible and visible signals.

OUR LOST ITALY.

Prof. E. R. Rhodes, in his *Cruises Among the Antilles*, calls attention to the fact that the geology of several West Indian mountain ranges bears a striking resemblance to that of Virginia and the Carolinas, and that the Cuban Sierras, for instance, are probably a continuation of our Southern Alleghanies. It is a pity that the connecting link has been so irretrievably lost. Our Appalachian mountain system ends just where it begins to reach the region of perpetual Spring. We have an American Jura and an American Atlas, but the Apennines of the New World seem to have been submerged, like the chain of uplands which once appears to have connected Scandinavia with Newfoundland and Labrador.

HALF-TRUTHS.

The society of theocratical agitators known as the National Reform Association is dropping its mask and is beginning to define its notions of "reform." At the New England convention (Boston, February 19 and 20) the pious reformers proposed to enlighten the nation on "The Right and Duty of the Government to Teach the Principles of the Christian Religion in the Public Schools," and the desideratum to "Recognise Christ as the King of Our Government." At the Newcastle convention, the Rev. H. H. George proposed, among other ideals of the reform movement, that "The State should be subservient to the Church"; "The

State should require scriptural qualifications in her rulers"; "The State should support the Church by timely gifts." Still, we have not yet reached the fulness of revelation; but the veil may be lifted when the State has been induced to "protect the Church and restrain practices that are injurious to religion"—such as free speech, the licence of the secular press, and the teaching of scientific tenets at variance with the Hebrew Scriptures. The Rev. Schaff is treating us to a glimpse behind the curtain from another point of view, and is quoted as saying that the State rests on three pillars: "The Church of God, the Book of God, and the day of God." A fourth corner-post may be reserved for the "Holy Inquisition of God," but even at the present stage of developments important truths of this sort should not be permitted to languish in a twilight of half-expression, and the Rev. Schaff ought to avoid misconstructions by explaining that he referred to the state of clerical finances.

MORE LIGHT.

The predicted exhaustion of our coal mines may force the cities of the future to economise their fuel-supply; but Frost's twin-sister, Darkness, has lost her power of discomfort, if the recent reports from the laboratory of a New York inventor are but half true. Prof. T. L. Wilson, in a communication to the Society of Chemical Industries, claims to have discovered a new illuminating material that can be manufactured from the refuse of coal-tar and crude petroleum, at a cost of 7 (seven) cents per thousand feet, and which, in a modified gas-burner, will produce a brilliant flame, almost equal to a calcium light. "These burners," says the report, "allow the passage of about one foot of the gas per hour, and give a light of nearly fifty candle-power." In other words, an equivalent of five ordinary coal oil lamps can hereafter be enjoyed at an expense of $\frac{7}{1000}$ cents per hour, plus the costs of the burner and the possible royalty of the inventor. Moreover, his inexpensive gas ("acetylene," as Professor Wilson calls it) can be changed into a liquid and carted about to customers like gasoline.

AN UNPROFITABLE TRADE.

The business of train-robbery has been over-worked to a degree that appears to have discouraged the enterprise by lessening its profits. Passengers and express-agents have learned to bide their valuables; and Hold-up Champion Cummins, recently captured at Mt. Vernon, Mo., states that the robbery of five different trains netted his syndicate less than two hundred dollars. On one occasion they secured only two and one-half dollars and a few watches.

DOUBTFUL REFORMATORIES.

A strange report comes from Naumburg, Germany, where several pupils of a reform school plotted to effect their deliverance from the discipline of the superintendent by getting themselves indicted on a charge of murder. In pursuit of liberty men have walked fearful roads; but the young conspirators of the Saxon reformatory had not the least hope of regaining their freedom. The object of their enterprise was their *transfer to a State penitentiary*, and with that object and even a risk of the scaffold in view, they smothered one of their young fellow-prisoners and strangled another. A rumor of the plot had spread among the inmates of the institute, and the groans of one of the victims were heard by a whole dormitory full of youngsters; but fear, or the desire to give the experiment a fair chance, prevented them from giving the alarm. As Edmond About said of the reported self-cremation of three Toulon galley-slaves, a place must, indeed, be the reverse of a paradise, if its inmates will attempt flight by such gates of escape.

CLIMATIC RESOURCES.

The proposed introduction of the whipping-post in the State of New York has been denounced as a relapse into worse than

Oriental barbarism, in view of the fact that the young Czar has just abolished the punishment of the knout. But it should be remembered that the new Czar is a Utilitarian, and that he has taken care not to abolish the penal colonies of Siberia. With such substitutes for mechanical torture as a winter-frost of sixty degrees Fahrenheit below zero, reform-legislators can afford to be very generous.

AVALON.

The ornithologist Gilmore admits that North America can boast three times as many different species of birds, as Europe or western Asia under the corresponding isotherms. Of woodpeckers, for instance, we have eleven kinds to three in France; of owls nine, to four in Italy. The name of Avalon, the Celtic Atlantis, was once derived from the Latin *avis*, but is now supposed to have something to do with the Gaelic *aphall*, an apple, hence "Apple-land," or orchard country. If the elder derivation should, however, be correct, it might really be conjectured that the aborigines of Gaul or Britain had preserved a tradition about the existence of a great *bird-land* in the far West.

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