

than a painter,—he is an artist, and one of the greatest in the world!" "And yet he is no painter," said the king, excitedly. "He wants to go away! Let him go! I will not detain him!" "Your majesty," said the artist, "it will be a sad day for Munich and for us all, and you, your majesty, will lose in him a gem from your crown." These last words aroused Ludwig to a high degree: "What!" said he, "who is Art in Munich? Is it Cornelius? I! the king!" But Ludwig found out his loss afterward, and deeply regretted the slight that he had given him; but all his efforts to re-establish the old friendly relation between them were futile, for the noble spirit of Cornelius was as independent as it was gigantic.

Cornelius had long been the acknowledged and honored master of German art when death called him so suddenly away. His life-long enthusiasm had not been confined to his own soul, however; but by word and deed he had kindled it in the hearts of all who knew him. If his motto was, that art should represent life, he took care that his should not represent common life, but human life and human nature in its highest and noblest potencies. He himself had wandered through the whole history of man; he had studied him as he found him personified in Faust, in the Olympic paganism of the Greeks, in Homer's ideal songs, and among the wild romantic legends of his fatherland; and everywhere his lofty spirit appreciated whatever had the true ring of humanity; that represented man in his most exalted truthfulness; and these he wove into epic and dramatic scenes which are not less remarkable for their pureness of embodied thought than for their idealistic enchantment. His works are stamped throughout with the genius of originality; his spirit was full of the deepest poetic feeling, and from the fountain of his inexhaustible imagination his creations became ever newer, more elevated, and more beautiful.

Though Roman Catholic in religion, he was truly catholic in spirit; and whether in decorating the churches of the Protestant capital of North Germany, or the halls of Catholic Munich, he strove only for truth, and nothing but the truth—for a mind like his could not be bound by any narrow dogma of faith. In the annals of the history of German art his name will stand forth for all time among the greatest of German painters.

**THEORY OF TRANSMISSION.**—The physical characteristics, the intellectual traits, and the moral qualities and proclivities descend from sire to son. Upon seeing a man's children we instinctively begin to trace the resemblance to the father and mother, and sometimes discover a remarkable likeness to some grandparent or perhaps great-grandparent. That was the first series of observation in this line. Subsequent comparisons of phenomena established what is now generally accepted as the law of the transmission of mental and moral qualities.—*C. F. Deems, D.D.*

#### A FRENCH EDUCATOR ON AMERICAN FREE SCHOOLS.

THE intelligent reading classes in America are so much accustomed to seeing our systems of education censured and depreciated when reviewed in comparison with the English foundations and the French academies, and that, too, in newspapers and periodicals boasting the highest literary excellence in both the editorial and contributory departments, that they have generally become convinced that the methods in common use for training the young idea are faulty and even pernicious.

If we were to believe the strictures on American education which we recently read in a prominent New York weekly, we would denounce our prevailing system as superficial and fragmentary in its practical results. But we countenance no such view. The grand system of free education, which is one of the noblest outgrowths of our democratic republican policy, commands our warmest approval, and must be acknowledged by every candid mind as the surest way yet discovered to the education and improvement of an entire nation. In literature, science, and art, it must be acknowledged that old Europe is somewhat in advance of young America. Our literature, *i. e.*, the perfected expression of cultured minds, is young; it has no centuries of learned authorship to refer to as have the literatures of Germany, France, and England; yet it has already challenged the respect of foreign literati, and its vigor, boldness, ambition, and ardent hope are the earnest of future growth and excellence. The public school has proved, and will prove, a potent auxiliary to its growth, awakening to powerful endeavor, not a few scattered intellects, as in the case of schools on a private footing, but many, which are necessarily brought into conjunction and competition by a universal free system. But are American schools so faulty, so ill organized, and superficial? Let foreign testimony have its weight in answering this question, especially if such testimony be based on the only practical basis of comparative investigation. It will be scarcely necessary to remind our readers that at the Paris Exposition of 1867 there was a school building, with all the interior arrangements and apparatus generally found in American public schools of the primary grade. It was, in fact, "an exact reproduction of one of numerous free primary schools" of the West. This "curiosity" attracted no little attention, especially from the Continental educators and savants, and led to the publication of a very interesting paper on the American public school system in the *Manuel General de l'Instruction Primaire* of Paris, the chief French educational organ, by M. H. Ferte, late Chief of Instruction in Paris.

After a brief statistical review of the state of educational matters in Illinois, in the course of which he calls particular attention to the fact that a large portion of the teachers employed are females, "a singularity of which France

offers no example," attributing to this organization of teaching the well-known manly intellect for which the present generation of women in America are distinguished, M. Ferte proceeds to consider the general school system of the United States. The high-ceiled, commodious, and well-ventilated school-buildings, with their convenient furniture, challenge his admiration. The arrangement of the windows, so that a part of the sash can be readily opened to admit fresh air without creating a strong draft, the plan of the desks, and the adaptations of the maps, globes, books, and other apparatus are pronounced vastly superior to those in common use in France. To use his definite language: "While we have long tables, accompanied by long benches, for accommodating ten or twelve pupils, who crowd, elbow, and hinder each other, in this American school we find the desks or tables neatly arranged for either one or two scholars, with a seat having a support for the back of the pupil. The teachers who read this will understand at once the advantages of such an arrangement. Does a scholar need to leave his seat, he can do so without disturbing his neighbor, or without being obliged, to the great detriment of discipline, to pass before seven or eight of his fellow-students, who never fail to make good such an occasion for mischief. It would be highly desirable to have these American desks introduced in our schools. The discipline would be benefited by it, the children could prosecute their studies without disturbance, and be very much more comfortable. We wish the same for the introduction of the ink-stand, with which each table is provided. The calculators, geometrical figures, globes, charts, and other school apparatus, resemble much those in our best schools.

"Among the books we have examined, we find many deserving of high commendation. We notice improved methods of teaching penmanship, excellent and simple spelling, reading, and drawing books, quite superior in every respect, and also conveniences for cleaning black-boards, carrying books, and methods of object-teaching, quite unknown with us."

The sheets of moral mottoes hung up on the walls are regarded as no inconsiderable feature of the school apparatus. The essence of civil virtue and integrity contained in them exerts an influence most favorable to developing in youthful minds those principles which, if practiced, can not fail to make the children good men and women and worthy citizens.

The effects of such universal education are thus grandly described:

"The free primary school in America is truly the common center whence have sprung up the greater number of the men who have shed luster upon the commonwealth. It is there that were formed those energetic nations who have developed, in such a prodigious manner, the power of the United States. It is there that were blended together the Saxon, French, German, Spanish, Italian, and other races

which people the New World. Each one, on landing on these remote shores, brought his own manners, his language, his national spirit, his opinions and tastes. All these unevennesses and differences disappear in the new educated generation, to form only one great nation—homogeneous in its patriotism, persevering and enlightened in the accomplishment of its political and other duties, audacious and powerful in the realization of its gigantic purposes and destiny.

"All these wonderful results are due in a great degree to the primary school, where the young generations are molded and where they have learned that *equality* and *liberty* can live together in perfect harmony."

M. Ferte goes on to describe the higher departments of free education as they are graded in most of the States, viz., the grammar-school, the high school, showing that not only does America aim to afford a substantial basis for the mental development of all her citizens in the way of a thorough *primary* education, but she also seeks to cultivate a general taste for a high intellectual culture by providing liberal means for "all, without reference to race, color, or religious opinions," who may desire to improve themselves.

The equality of the sexes in mental culture as promoted by the free system is commented upon in the following terms:

"The American system can not be blamed for keeping females in a deplorable inferiority, as is often witnessed in the Old World. Far from it; instead of having not enough knowledge, men of sense have held the opinion that the American ladies have too much, and that they neglect, for abstract sciences, those home and house duties which in a woman ought to receive the first consideration.

"Experience, however, shows that American women are excellent mothers and devoted wives, no less than the women of the Old World; indicating, in another view, that the education so free, universal, and ample, exerts its beneficial influence upon all classes of society. It is the sanctuary of the family which becomes so admirable in America, and is another school where the young girl learns by her mother's side the lessons of domestic economy which go hand in hand with her school privileges, and which secure such capable and intelligent women as reflect great honor upon the American country and its institutions."

Those things which M. Ferte thinks amenable to improvement are the privilege exercised by teachers or single schools in selecting text books for use, and the almost exclusive adoption of American works in the school libraries. The former practice he regards as conducive to irregularity and detrimental to progress, though some benefit may result from such experimenting; the latter he considers unhappy, because so many valuable foreign authors are not brought to the notice and appreciation of American youth.

The methods of discipline and order are

highly commended, and on them, it is remarked, depends in a great measure the rapid progress made by children in their studies. The closing paragraphs of M. Ferte's review, which are a summary of what has been said, are worthy of reproduction as he framed them.

"It is found that the average expenses for the education of each child in the United States amounts to about sixty-two and a half francs (or \$17 currency) per annum. Five hundred thousand teachers, male and female, spread in these vast regions the benefits of education to millions of children.

"This immense army of instructors is far from being composed, as a rule, of men. Women occupy the first rank in their number, devotion, and talent. Their salary is not large, but in return, the teachers (both male and female) enjoy a respect and esteem which adds very much to their moderate compensation. They are welcome among the wealthy and most respectable families, who extend to them every social advantage and consideration. This distinction is conferred with high satisfaction as a tribute to instruction, which is considered the basis of the social edifice. Professorships are esteemed so highly, that the most substantial families allow their sons and daughters to hold the position, and numerous persons occupy the place of teachers during preparation for college or a profession, while large numbers rise to eminence from beginning as teachers in the primary schools.

"The changes which are thus influenced among teachers must result in many abuses, which would not occur if the teachers found in their occupation an object for its permanent adoption as their definite career. But in the United States, as everywhere, teaching is, and will always be, a condition requiring great sacrifices in return for very small compensation.

The youth among this enterprising and ambitious people are more able amid the carelessness of material interests given by the hope of a long life to offer the commonwealth the ardor and abnegation which are the necessary conditions of good teaching. Everything is then for the best in this apparent disorder, and without admiring all that pertains to primary instruction in America, we can not help praising a system which from so many heterogeneous elements has been able to form such a great nation."

AMERICAN LITERATURE.—The following is an estimate of the books, pamphlets, etc., published in this country during the year 1867:

	Vols.		Vols.
Fiction.....	741	Sociology and House-	72
Religion and Theology.....	257	holds.....	17
History.....	107	Amusements.....	17
Poetry.....	120	Philosophy, Morals, Tem-	25
Law.....	121	perance.....	21
Medicine.....	70	Science.....	38
Travels and Geography.....	74	Government.....	109
Belles-lettres, etc.....	80	Biography and Genealo-	95
Fine Arts.....	31	gy.....	11
Arts, Trades, Occupa-	142	Learned Literature, etc.	34
tions.....	142	New Periodicals.....	11
Education.....	75	Other Books.....	34
Total.....	2,194		

THE DEVELOPMENT THEORY.

[A Lecture delivered at Washington by Dr. THEODORE GILL, of the Smithsonian Institution, and expressly reported by SAMUEL BARROWS, phonographer, for the PHRENOLOGICAL JOURNAL.]

THE TWO SCHOOLS DEFINED.

In considering this subject, it is first necessary to take cognizance of the two different schools which exist among naturalists. One may be called the *Creatory* school, and the other the *Development* school. Of the *Creatory* school, the most prominent advocate is Professor Agassiz. Of the *Development* school, the chief, as you are well aware, is Mr. Darwin. By the *Creatory* party it is generally maintained that all animals, as well as plants, have been created as they now are. The *Development* theory requires the belief that all animals, as well as plants, have sprung from one or few primordial germs. Most of the advocates of the *Creatory* theory further believe that all animals and plants have sprung from a pair or a combination of sexes; but it is not by any means granted by all who oppose the *Development* theory that this is the case.

AGASSIZ' OPINION.

Professor Agassiz is the one who carries to the greatest extreme this *Creatory* theory, and, it may be added, carries it to its logical conclusion. He maintains not only that all animals and plants are descended from like ancestors, but that they have descended from communities; that, for example, man did not come into existence as a single pair; but that when the fiat of the Creator was given, he sprang upon the earth in communities such as we now find them. As Mr. Agassiz may be considered the chief representative of the *Creatory* theory, and has very clearly presented the alternatives of belief and non-belief thereon, I may be permitted to read his views on that subject as published in Nott and Gliddon's "Types of Mankind," for they have relation to the subject of preceding lectures. Treating of the word *species*, and accepting the definition of Dr. Morton, that species are primordial forms, he says: "I am prepared to show that the differences existing between the races of men are of the same kind as the differences observed between the different families, genera, and species of monkeys or other animals, and that these different species of animals differ in the same degree one from the other as the races of men; nay, the differences between distinct races are often greater than those distinguishing species of animals one from the other. The chimpanzee and gorilla do not differ more one from the other than the Mandingo and the Guinea negro; they together do not differ more from the orang than the Malay or white man differs from the negro."

"I maintain, distinctly, that the differences observed among the races of men are of the same kind, and even greater than those upon which the anthropoid monkeys are considered as distinct species." At another place he resumes: "The coincidence between the circumscription of the races of man and the natural limits of different zoological provinces charac-



terized by peculiar distinct species of animals, is one of the most important and unexpected features in the natural history of mankind which the study of the geographical distribution of all the organized beings now existing upon the earth has disclosed to us. It is a fact which can not fail to throw light at some future time upon the very origin of the differences existing among men, since it shows that man's physical nature is modified by the same laws as that of animals, and that any general results obtained from the animal kingdom regarding the organic differences of its various types must also apply to man."

"We find upon Borneo (an island not so extensive as Spain) one of the best known of the anthropoid monkeys, the orang-outang, and with him as well as upon the adjacent islands of Java and Sumatra, and along the coasts of the two East Indian peninsulas, not less than ten other different species of *Hylobates*, the long-armed monkeys, a genus which next to the orang and chimpanzee ranks nearest to man. One of these species is circumscribed within the island of Java, two along the coast of Comandul, three upon that of Malacca, and four upon Borneo. Also eleven of the highest organized beings which have performed their part in the plan of the creation within tracts of land inferior in extent to the range of any of the historical nations of men! In accordance with this fact we find three distinct races within the boundaries of the East Indian realm: the Telingan race in anterior India, the Malays in posterior India and upon the islands, upon which the Negrilles occur with them."

In closing he says: "Now there are only two alternatives before us at present—1st. Either mankind originated from a common stock, and all the different races with their peculiarities in their present distribution are to be ascribed to subsequent changes, an assumption for which there is no evidence whatever, and which leads at once to the admission that the diversity among animals is not an original one, nor their distribution determined by a general plan, established in the beginning of the creation; or, 2d. We must acknowledge that the diversity among the animals is a fact determined by the will of the Creator, and their geographical distribution part of the general plan which unites all organized beings into one great organic conception; whence it follows that what are called human races, down to their specialization as nations, are distinct primordial forms of the type of man. The consequence of the first alternative, which is contrary to all the modern results of science, runs inevitably into the Lamarckian development theory, so well known in this country through the work entitled 'Vestiges of Creation,' though its premises are generally adopted by those who would shrink from the conclusion to which they necessarily lead."

#### THE QUESTION AT ISSUE STATED.

Such are the alternatives presented, and fairly presented, I think, to us. Whether the community of origin of man and the alleged consequence—a Development theory—or a

Creatory one is most accordant with "all the modern results of science," is the question for examination. The advocates of the Development theory, as I have before said, instead of admitting that all men descended from a single pair, or instead of supposing, like Professor Agassiz, that all animals and plants are descended from communities or aggregations of individuals, insist that all animals and plants are descended, with modifications, from few primordial types. Although there are certain gradations of belief, yet they are not held by men most eminent in science. There are those who are willing to admit that all of the equine or horse tribe, for example, may have descended from a single horse-like animal, or all the feline tribe from a single cat-like one; yet the naturalist of wider experience, conversant with the classification of organic beings, contemplating all the conditions of existence, and going back to the times of the past and recognizing the fact of development among animals and plants, is logically and almost inevitably forced to the conclusion, if he admits these variations at all, that all are descended from a few primordial types.

#### THE THEORY OF DEVELOPMENT.

A statement of a few arguments for this belief may now be submitted. It has been shown in previous lectures that there is an identity of plan among all animals; that the plans are few in number; that there is also a regular subordination; that we find species that agree with each other in almost all essential characteristics, but differing in different ratios; that these species are combined into genera, these genera characterized, as is generally said, by ultimate modifications of structure, and differing also in various degrees. These genera are likewise combined into other groups, into sub-families and families, characterized in a greater or less degree by fundamental similarity of form, and these families are combined again into orders, these orders into classes, these classes into branches, of which we have admitted five. In the vegetable kingdom we find nearly the same gradation, but with different names attached to some of the groups.

In examining these groups, we find as we ascend from the simple to the more comprehensive that it becomes more and more difficult to find distinctive characteristics for them; that is, it does in the main; there are exceptions. Although these different categories, these different combinations of individuals, of species, are recognized by the naturalist, it is by no means the case that they are clearly and distinctly defined in nature. Every practical naturalist is well aware of that, and the history of science shows well what a conflict there has always been, and still is going on, as to the limits of species and the limits and variations of groups. Take, for example, man himself. It is generally admitted that man forms one species; but Professor Agassiz will maintain that there is an indefinite number of species, for he is not decided upon the number, reserving the question for further study. But though we may variously estimate the varieties or

species, calling them three, accepting the views of Blumenbach; or five, accepting the views of Cuvier; or eleven, with Pickering; or many, with Professor Agassiz, it is impossible to give to each one of those species characteristics which will differentiate them from all others. If we look at the skull, we will find in the same race in the same tomb-yard those which are characterized by both brachycephalous and dolichocephalous forms. And take what character you will and run it through a long series of skulls, and it is impossible to find any one character which will hold good as defining any race. We can call in hybridity to account for this, but the facts exist nevertheless.

Take also the monkeys of the genus *Hylobates*. We find that Professor Agassiz admits ten species, while it is generally supposed that there are not more than seven or eight. There is, however, a reason for this latitude of opinion. These species of *Hylobates* are related together in various degrees. We have one type very distinct from any of the others. We have that one group equivalent in its value, although containing only a single species, to another containing, we will say, seven species, and those seven species so related to each other that they can be variously combined. The differences existing between the most nearly related of these aggregates of individuals have in one case been considered specific, and in the other varietal or individual. There is a difference of opinion also regarding the number of species of the orang-outang, or the genus *Simia*. Some say there are two, some three, and some that all are only varieties of a single species. With regard to the chimpanzee, some say there are three species, others that there are two, and others, again, that there is only one. There is also doubt about the value of the characters differentiating this animal from the gorilla. Some say that the characters are of generic value, others that they are only of specific value. In this case, likewise, difference of opinion prevails with regard to the interpretation of value rather than to the exact form of difference. It is acknowledged by all that difference exists. There is no doubt that the chimpanzee is separated from the gorilla by its smaller size, its less robust frame, its more rounded cranium, the number of the ribs, and the relative size of the incisors. There is no doubt that these differences exist; the only difference between naturalists relates to the interpretation of their value. So, in the same way, there is no doubt of the distinctions between representatives of the groups to which the name of genera, families, orders, and classes have been given; but there are doubts as to the interpretation which is to be given of these differences. Again, we see that although the differences between certain animals are extremely wide, there is still a recurrence in these extremes of the same elements; and though it becomes difficult in extreme cases for one who has not made a thorough study of comparative anatomy, of embryology, and geology to see these similarities, yet to one who is acquainted with these sciences, and who is endowed with

a proper scientific spirit, it is easy to see the transitions from one to the other. But if we limit our studies to one homogeneous group, it becomes easy to institute a comparison. A mere tyro in anatomy can institute a comparison between the various forms of the mammalia. It will be easy for him to recognize in the lowest forms the same bones that are developed in the highest; he will be led to observe the perfect identity of type in animals most widely separated externally.

#### THE TYPES IN NATURE.

The great types in nature generally recognized are five. These five, as I have said, are distinguished by difference of plan from each other; but even here we find it difficult to say how great is the value of those differences. In the highest forms there is no difficulty whatever in perfectly appreciating the great distinction existing between the groups; but when we descend in the scale, when in every group or branch we go from the high to the low, from the complex to the simple, then distinguishing characteristics become one by one so diminished there is an atrophy of certain organs, or the differentiating characteristics are not manifested on account of the simplicity, that it is difficult to ascertain what are the great groups and branches to which these lower forms belong. At present there is no doubt concerning the vertebrates; that group is well defined. There is no transition between the vertebrates and any other of the branches. But there is difficulty concerning the articulates, and the mollusks, and the radiates. The manner in which the relations of the lowest forms to their respective branches is ascertained is rather by a series of consecutive inductions than by the perception of any single character.

Another matter to be taken into consideration, and which logically follows the consideration of conformity to type, is the existence of rudimentary organs. As has been shown in former lectures with reference to the different forms of the vertebrata, all the important bones are represented to a greater or less extent; but there are some of the bones which are represented in a very rudimentary condition. Take for example the horse. We find that his feet end in single hoofs. We find two small slender bones, one upon each side of the carpal and tarsal bones, that are not apparent externally, which are called the splint bones. Now these bones are nothing but rudimentary metacarpal and metatarsal bones. The single hoof is not the homologue or correspondent of the double hoof of the cow, or the double hoof of the pig. It is rather the homologue of the external of these, and it is the homologue of the third digit in the hand and foot of man; and the two splint bones on each side are respectively the homologues or the representatives of the second and fourth. Now there is no transition in living forms between that type and the type with multiplied hoofs. But let us go back into the past. We find in the early tertiary an animal which in

the general features of its skeleton almost completely resembles the horse; but on each side of the metacarpal and metatarsal bones, instead of small splint bones existing, there are larger and quite well-developed bones which are evidently metacarpal and metatarsal bones, and these are capped by phalanges with hoofs. The rhinoceros on comparison with this animal (which is called hipparion) is found to exhibit the same number of bones in the feet, but then there is a greater hypertrophy of the splint bones of the horse, for instead of being small comparatively, as in the hipparion and the related types, they are very large, so that a hoof with three well-defined toes is the result. Now there is a striking affinity between the equine race and the rhinocerotal race. But if we study the group to which these forms belong in the living world, we find only the tapir, the rhinoceros, and the horse tribe, representing compact, strongly-marked families; but when we examine the animals of the past we find that between these families—trenchant as are their differences in the living world—there exist so many intermediate types that their close affinities can not for a moment be called into question. And this is only one out of many examples. Few groups can be named which can not be taken up in the same way.

#### AFFINITIES OF SPECIES.

Let us take another illustrating the presence of rudimentary parts. Among the animals of the present day we find that there is a division of ungulate animals into the two groups of the Astrodactyles and the Perissodactyles; that is, those having the hoofs in even number, as the cow and pig, and those having them in odd number, like the horse, tapir, and rhinoceros. If we go back into past times, we find that these forms are not so well defined as in those of the present day. In examining those of our own day, we find that those animals having the toes in even number are again divisible into two well-defined groups, ruminants and non-ruminants. Of the ruminants, the cow is a good example; of the non-ruminants, the pig. These groups among existent animals are strongly distinguished. One of the distinguishing characters, in addition to that of the structure of the stomach and intestinal canal, is the presence or absence of teeth in the upper jaw. All those animals that have a stomach and intestinal system adapted for rumination are likewise distinguished by an atrophy of incisor teeth in the upper jaw; the camel is a partial exception, and retains the external incisors. All those that have a simple intestinal canal have incisor teeth in the upper jaw as well as in the lower. The pig is a well-known example, and to the same group belongs the hippopotamus. Now if we examine the animals of past days, we do not find that these combinations of characteristics exist. Of course we can not know the condition of the intestinal canal; it is only by analogy from comparison of the skeletons that we are able to judge. But the comparison that we are able to make

between the skeletons shows quite a regular gradation of characters from one to the other. Bearing in mind also what has been said of rudimentary organs, in examining these animals of the ruminants, we find that in the young cow or the young sheep there are front teeth developed in the upper jaw, but they do not become functionally developed, and are early absorbed in the gums.

In embryology we have another series of facts which it is important to take into consideration. We find that the animal of a high type, man for example, goes through a series of changes, and that those changes assimilate him for the time being to the various animals which are below him in the scale of nature in a certain ratio to their rank and conformity with type. We do not find, however, exact similarities, and we should not expect to find them; for if Darwinism is true, we should rather expect that there should not be a gradation through a single series, but that there should apparently be divergences from a common type, and that these divergences should increase in ratios approximate to the dissimilarities of the adult forms. Such we find to be the case. The fetus of man at one time is very similar to that of the dog, hog, or porpoise, but not to the adult animals.

#### COMPARATIVE ANATOMY OF BRAIN.

We compared, on a former occasion, the condition of the brain of man with those of the ape and the lower animals. We see in the marsupials that the corpus callosum is almost entirely wanting, that functionally it might be said to be insignificant; that there is, however, a great commissure which takes its place functionally. Now, if we could examine the brain of foetal man, we should find that almost the same characteristics are represented in him. The brain, instead of being connected by a well-developed corpus callosum, is similarly connected by a rudiment of the corpus callosum, as in the marsupials; and the anterior commissure, as in the marsupials, is likewise well developed. But the resemblance would be still greater between the brains of the young of both forms; the more advanced development, however, causes the likeness to be lost in the adult man. You may also observe the difference in the combinations of bones. In the lower forms the elements of the occipital bone and the elements of the temporal bone of man are separated in all periods of life and persist as true independent bones. In man these elements combine at a very early period and form single compound bones.

#### GEOGRAPHICAL DISTRIBUTION OF TYPES.

Now let us take into consideration a few facts with reference to the geographical distribution of animals. In the first place there is a distinction of types in proportion to the isolation of areas. We find that in America we have one combination of animals, in Europe we have another; that as we go from the warmer regions of those countries—from this portion, for example, of America, and from England in the Old World—as we go upward



## THE DEVELOPMENT THEORY.

SECOND LECTURE BY DR. THEODORE GILL, OF  
THE SMITHSONIAN INSTITUTE.

### RETROSPECT.

In appearing before you for the last time, ladies and gentlemen, and in continuation of the subject that engaged our attention on the last evening, it will be necessary to recapitulate some of the propositions then referred to; but I shall have to rely upon your memory to recall much of that which was said on not only that but on previous evenings. In reference to the classification of animals, we took into consideration the conformity to plan of animals now living and in times past, and their various relations as individuals, varieties, species, genera, families, orders, classes, and branches. We found, on examination of the animals of the past, that the same principles which are applicable to the classification of animals now living are also applicable to them. We then took into consideration the rudimentary organs, referring to the fact that in many animals there were rudiments of parts which subserved no evident purpose in the economy of the animal, but which, in animals nearly related to them, were found to be well developed and assuming functional characteristics.

On examining embryology, we found that animals all originate from eggs, which in their earliest condition are similar throughout all of the branches. In their development, we found that they all start from one point and take specific directions; that the representatives of each group, with some limitations, undergo similar changes in development, and that the animals that are lowest in the scale seem to correspond in some manner to a certain stage of the development of animals that are above them in the scale. In considering the facts of the geographical distribution of animals, we found that they are distributed in space and congregated in various assemblages called faunas; that the diversity of species is generally in ratio to the extent of the area inhabited, and that it was also in ratio to the isolation of areas; that intermediate types inhabit different areas, and that when intermediate types do not occur in these times, they did exist in times past. For, in determining the laws of geographical distribution, we are necessarily obliged to take into consideration, not only animals and plants now living, but also all that have lived. We found, also, that the variability of species is more or less in proportion to the extent of the area that they cover; and when we more especially questioned paleontology, we found not only that the same type was apparent in the animals of former days, but that those that are now widely separated were connected by intermediate forms, which combined characters now characteristic of very different groups; and further, that the differentiation of animals now living from those that were, is, in the main, in ratio to their separation in time; and that in differentiation, time and space bear inverse ratios to each other.

I have drawn up a series of propositions embodying these facts presented in the last lecture and in those preceding it; and the inferences or suggestions deducible from these propositions may be regarded as corollaries. Considering them in the order in which we have discussed and expounded them, we have, first, systematic or classificatory zoology. Our studies have furnished us with the basis for these propositions or laws:

### SYSTEMATIC ZOOLOGY.

1. The differences between animals are the resultants of modifications of the same elements common to a few great groups.

In zoology such groups are called branches or sub-kingdoms. In botany, there are no groups with these designations; but the division of the phanerogams and cryptogams may be taken as correspondent to the branches of the animal kingdom.

2. Animals exhibit all degrees of affinity and all degrees of subordination from relationship as individuals upward.

3. Groups widely differentiated, so far as living animals are concerned, are connected by extinct intermediate forms.

These propositions being admitted, and they are tacitly admitted by all competent naturalists, we may embody the inference which follows in a quasi-corollary.

The affinities and subordination of animals and conformity to plan suggest genetic relationship.

That this suggestion is not a mere assumption is evident from the fact that from the very earliest times, and before the relations of animals and conformity to types were known so well as now, that relationship was expressed by the same terms; for the divisions and subdivisions of the realm of organic nature we have borrowed the designations of the social distinctions of mankind—that is, the family, the order, the class, the kingdom, etc.; and there are other but less generally admitted groups that have been named in analogy with the same idea.

### RUDIMENTARY ORGANS.

In connection with the systematic natural history and the consideration of plan, we must consider the subject of rudimentary organs. The results of our examination may be embraced in another proposition.

Elements or organs are developed or exist in a rudimentary condition and are functionless, but represent elements or organs specially functionalized in allied groups.

Of course, this is a fact too obvious to be denied. The statement which might be volunteered, that the presence of such rudiments is in accordance with plan, would furnish no explanation whatever, but would only substitute one fact for another. We are indeed compelled to adopt this corollary.

The presence of rudimentary functionless organs is only explicable by the theory of genetic relationship with animals in which such organs are functionalized.

### EMBRYOLOGY.

Passing now from the consideration of ani-

mals in their general relations to animals in their stages of growth, the facts we have gleaned may be resolved into these propositions:

1. All animals originate from eggs.

This is simply another form of that old adage that has been proverbial from the time of Harvey, "*Omne vivum ex ovo.*"

2. All eggs in the beginning are similar.

3. All eggs develop from a common point and in specific directions.

4. The similarity of an adult to an embryo of a higher type is the result of arrest of development at an earlier stage.

But this proposition must be viewed in connection with the facts embodied in another proposition, viz.:

5. The similarity or dissimilarity of the adult to the embryonic condition is partly determined by teleological considerations.

Certainly, in view of these facts, it is permissible to accept this corollary.

The modes of development of animals suggest genetic derivation from few primordial types.

### GEOGRAPHICAL DISTRIBUTION.

Reverting to the relations of animals to space, we may embody the facts gained concerning the geographical distribution of animals under the following propositions:

1. The differentiation of faunas is in ratio to the differentiation of areas.

2. The specialization of faunas is in ratio to the isolation of areas.

3. Intermediate areas are characterized by intermediate types.

4. The variability of forms is (*ceteris paribus*) in ratio to the extent of areas.

5. The types now common to remote areas were formerly existent in intermediate areas.

Against one or more of these laws or propositions objections might be urged; but when we take into consideration the geological as well as geographical relations of the several bodies of land and water, and the indications of the length of time during which those relations have existed, such objections are at least very much weakened; and it must be admitted that they have ever been tacitly recognized and accepted by naturalists in explanation of various anomalies of geographical distribution. It is quite true that if living animals were only considered, there would be found to be glaring discrepancies between facts and the present propositions; we would have exceptions without number to the third proposition—that intermediate areas are characterized by intermediate types. But when, taking a view more comprehensive and complete, we revert to the geological record, a vast number of these objections are nullified at once, and we are perfectly authorized in assuming—and naturalists, before the development theory was as prominent as it now is, constantly worked upon this assumption—that the gaps which exist did not always exist. The evidence which may be brought against the proposition is only of a negative character, and the admission of the propositions suggests to us this corollary:



The relations of animals in space suggest community of origin.

#### GEOLOGICAL DISTRIBUTION.

In geology we will group our facts under four propositions:

1. Groups have had a continuous (*i. e.*, uninterrupted) existence.
2. Groups now distinguished by peculiar characters were preceded by groups more comprehensive, and combining characters non-differentiating and limited to special groups. Such groups are called "synthetic" or "comprehensive" types.

3. The differentiation of living and extinct animals is in ratio to their separation in time.

4. The relations of faunas in time and in space are in inverse ratio to each other.

Against one or more of these propositions objections likewise might be urged, but competent naturalists, whether accepting the development theory or not, would not consider them as unauthorized by facts; and, indeed, some of the most distinguished opponents of the development theory have, in a certain form, not only admitted, but, under different phraseology, urged all of them, and the objections are again, in this case, only negatives. It is true that there are groups whose representatives are separated by more or less wide geological epochs; but I believe I am safe in asserting that there is not one naturalist worthy of the name who would not, without demur, admit that representatives of the group lived in the epochs for which we have found no remains. For example, we have very few remains of mammalia in the older beds, and the older representatives are separated by wide intervals; but who is there that will not admit that the existence of the class has been uninterrupted since its introduction on the globe, and that the absence of representatives is solely due to their mode of life and the obstacles which exist to the preservation of their remains? The evidence against this view is purely negative, and of such a character as to be of the slightest possible value, and which would not be urged by any scientific naturalist as proof against the development theory. We are therefore fully justified in accepting these propositions as the expressions of facts, and as a resultant, or corollary, their deduction.

The relations between animals of the present and the past suggest genetic succession.

In all these propositions you will see that I have been very careful in my presentation of the results. I have never said "these prove," but "these suggest;" and that word is certainly not too strong; I repeat that the propositions themselves are essentially admitted, and naturalists explain anomalies occurring in the several departments under which these propositions are grouped, by referring to the facts which they express. They have never been drawn out exactly in the form in which they are now presented; but they are simply the embodiment of results which have been already attained. I have been extremely careful in eliminating such propositions as might be regarded as exceptional, or against which *positive*

evidence could be brought; so careful, indeed, that in the case of embryology I have even suppressed the proposition that animals of like type undergo like changes, for the reason that in crustaceans, hydroids, and others, we have several instances of groups and species very closely related in the adult condition, passing through quite different stages of growth. But, *en passant*, I may remark that this is no more inconsistent with the theory of development than with the theory of plan.

#### CONSEQUENCES—SPECIAL CREATION.

Now, let us pause and reflect where we have been brought, if these facts and indications have any meaning, and if so, what that meaning may be. Hitherto we have been dealing with facts, and have traveled in company with advocates and opponents of the development theory. If we now examine these facts with reference to the idea of miraculous intervention or creation, we find no explanation. The utmost that the advocates of a special creation have given in explanation is, that these facts are in accordance with "plan." But what is this plan? It is at most the mere expression of the assemblage and relations of the facts; it is no explanation of the facts themselves. It must be conceded that plan for any wise end must have a purpose; but here we have plan without any evident purpose, for it is not at all obvious what purpose, physiological or otherwise, could be better subserved by this adherence to plan and by these trivial modifications than by the creation of a few special organisms for special ends. We would have, in like manner, imitation without object, and we have this vast amount of unessential modification of the same elements without evident reason, or subservient to any evident advantage. In other words, we have a great and useless expenditure of force and waste of power, and yet one of the beauties of "plan" to some had been the economy of the Creator in the use of means to ends. We should have a series of special creations and subsequent extinctions without apparent aim; such creations to be succeeded by others whose *tout ensemble* would be so little different from the preceding as to suggest no apparent gain. These alone are positive objections to the idea of special creation; for in our arguments in natural theology we assume that the Deity works in a manner analogous to man, without undue expenditure or manifestation of power. The theory of special creation, then, offers us no explanation, or no reason whatever for all these facts. Science demands explanations, and natural explanations, of natural phenomena.

Now we are brought face to face with the alternatives which were presented to us in the beginning of the preceding lecture—whether all the facts of modern science are in accordance with or are opposed to the theory of progressive development. These facts of modern science have been embodied in the propositions submitted. How are the facts in accordance with the development theory? If we assume that all animals have sprung from one or few primordial germs, we should expect to find that they would all exhibit more or less con-

formity to plan; that there would be gradations between them; that as the descendants diverged more and more from the original stock, they would exhibit among themselves proportional differences; and that the earliest in time, or those nearest to the primitive stock, would exhibit less difference, and combine characters distinct in their descendants. All these are found in animals now living, and that have lived in times past. Without repeating the facts that have been already presented, it is enough to say that they are all consistent, and such as would be naturally expected to be found, if all animals had originated in the manner suggested. We have, in all the modern results of science, no facts that militate against the supposition of derivation from a few stocks, but they rather all point in that direction. If, then, we can prove that there is a power of variation inherent in animals, which is analogous to the variations that exist between species and higher groups existent in a state of nature, we shall have the element requisite for the reception of the development theory as a true theory of creation in the highest sense of the word.

#### VARIABILITY OF ANIMALS.

And now we will briefly question nature, to see whether this variability is existent. We have already seen that it is difficult to find marked distinctions between the various assemblages of animals; that the more perfect our acquaintance with any group becomes, the greater we find to be the extent of variation between its individual members, and the more difficult becomes the task of obtaining characters which differentiate trenchantly the more closely allied forms. This is the cause of the discussions that are constantly engaging the attention of naturalists with respect to the value of groups and the importance of characters; and the reason that naturalists who have access to vast materials are generally more prone to reduce the number of species than those who have comparatively limited material. Let us examine now one of the many forms with which man has interfered, and has subdued and brought into a condition of domestication. For this object we may take the group of dogs; and let us recall that this examination has for its view to ascertain whether the differences existing between the various dogs are analogous to, or of the same character as, those differences which we find between wild representatives of the family.

#### WILD CANIDÆ.

Let us take, then, the family of Canidæ and its representatives, existing in a wild condition. To save time and to avoid complication, we will simply consider the forms now living, and not even all of these. This family, Canidæ, is a very natural group, composed of representatives agreeing generally in form, which are all more or less similar to the ordinary type of the dog; and the differences existing between them as to form are less than those which distinguish the different races of dogs. In dentition, they agree as to the number of incisors and canine teeth, as well as in the trenchant teeth and the



premolars. They differ, however, in the number of the posterior or true molar teeth, most having two molar teeth in the upper jaw and three in the lower. The dog, the wolves, and jackals agree as to the dentition; the number of toes—having five in the fore and four in the hind feet, and in all other essential characteristics. Together, they form the genus *canis*. The wild species of this genus are distinguished by very slight differences, incomparably less in appearance than those distinctive of the domesticated races of dogs. The foxes agree with the dogs and their congeners in dentition and the number of toes, but are distinguished by eyes adapted more especially for seeing at night—this adaptation being exhibited in the vertical pupils; with this character is also associated a bushy tail. The foxes are themselves divisible into two genera—*Vulpes* and *Urocyon*—which exhibit osteological characters of greater value than those which exist between the red foxes and the true dogs. Very closely related to the foxes, and especially to some African foxes, is a genus called *Otocyon*, which chiefly differs in having one more posterior molar tooth in each jaw; and there are wild forms, *Cuon* and *Cynalicus*, which are, on the other hand, more nearly related to the dogs, but which are distinguished by the suppression of one or more posterior molars. Such are *Cuon*, which has two posterior molars in each jaw, and *Cynalicus*, which has one posterior molar in the upper and two in the lower jaw. But all these forms we have been considering agree with the dogs in the number of toes, that is, five toes in the fore feet and four in the hind ones. There is, however, a large canine animal found in southern Africa called *Cynhyena*, which exhibits form and dentition like those of the dog, but which depart from all the other representatives of the family in the possession of four toes in the fore feet as well as in the hind ones; and it is a very interesting fact, which, however, I will only thus allude to, that this animal agrees not only in the number of toes, but also in the pattern of coloration with the hyena, which is found associated with it nearly in the same geographical area, and that this similarity is so strong that the animal was at first considered to be one of the hyenas. We find them, in reviewing the distinctive character of the several groups, that these groups differ in dentition, in osteological characters, in the development of the tail—or more especially of the hair of the tail, in the number of toes, and, it may be added, in the pelage or hair generally.

#### DOMESTICATED CANIDÆ.

If we now refer to the *races* of dogs, we shall find that there are very numerous forms, and these we may group with some naturalists in six tribes, viz., the wolf-dogs, including the Esquimaux, Newfoundland, and others; the watch and cattle-dogs; the true hounds, including the bloodhounds, pointers, and setters; the curs, including terriers and the Pariah dogs of the East; the mastiffs, including the bulldogs; and, lastly, the greyhounds. Each of these has numerous varieties. The differences

between the greyhounds and the mastiffs, as well as between those and the other forms, are as great as have been made use of by some naturalists for the generic differentiation of various *groups* of mammals; and were they existent in a state of nature, it is more than probable that they would have been long ago differentiated as distinct genera. In form, then, we have differences not only as great, but greater, exhibited between derivatives of a generally admitted common stock—at least generic—as between, not only *species*, but *genera*, existent in a state of nature. And here it may be advisable to recall that although there are some, but excessively few, naturalists who believe in the creation of our domesticated animals as they now are, and solely for the use of man, almost all admit that they are derivatives of a few primitive forms, which are still existent in a wild condition. In dentition there is comparatively little difference between the races of dogs, but there are forms—how constant I am unable to say—which exhibit deviations from the type. One has one more molar in both the upper and lower jaw than the normal number, and thus resembles *Otocyon*; another at least occasionally exhibits only three premolars in the upper and two in the lower jaw, representing the three posterior of the upper and two posterior of the lower molars of the typical dogs, and in the lower jaw there is one posterior molar. In a Turkish form, one deprived of hair also, we find almost all of the molar teeth to be lost, there being only a premolar above and below. These differences in number are greater than those between any of the wild forms, and it must be recalled that it is in number alone that these essentially differ.

The differences between domestic races are analogous to those between wild ones. But it may be urged that the differences in dentition are only casual, and that they are ever monstrosities. As I hinted, I am unable to say how constant or inconstant to the race they may be, although constancy has been claimed, at least in form. As to the objection of monstrosity, it may be replied that any character which is not normal to a type is, more or less, monstrous for it; but what is monstrous for one group is normal for another. And it is not improbable—I would scarcely dare to use a stronger term—that the deviations from a type exhibiting such excessive differences as to be considered, and properly considered, as monstrosities, may be enabled, after a more or less prolonged strife, to perpetuate themselves; and this may account for the fact that there are so many groups between which there are not more decided gradations or connecting links. I, however, offer this as a bare possibility. The wide external differences between the various *races* presupposes, and is, indeed, the result of corresponding differences in the skeleton. Those differences are, however, differences of degree, but yet quite as great as those which exist between the representatives of any natural *genus*, although not as great as those which exist between *Urocyon* and *Vulpes*,

yet quite as great as those between *Vulpes* and *Canis*.

In another of the characters enumerated as differentiating the genera and species of wild *Canida*—the tail—it is almost superfluous to remark that we have very wide differences. I need only call to your memory the difference between the tails of the Newfoundland dog and of the greyhound. The ears are also notably different, and, as a contrast, we may cite the ears of the Esquimaux dog and the King Charles spaniel; in the former being moderate and erect, in the latter very largely developed, pendant, and covering the sides, and with the muscles atrophied. In the number of toes we likewise find differences, and recalling the fact that there are five toes to the fore and four to the hind feet of the dogs generally, we may cite as an exception the Lassa variety of the mastiff of Thibet, which exhibits five toes in the hind feet as well as in the fore feet. As to the last character mentioned, the character of the pelage or hair, we have all varieties in texture and development in the races of dogs, from the shaggy coat of the Newfoundland and some of the cur dogs to the thin, appressed coat of the typical greyhounds, and the hairless condition of the Turkish dog. It is then demonstrated that all differences in parts and organs which are met with in a state of nature are susceptible of selection and exaggeration by man.

Now, this power of variation being granted, and divergence taking place in all directions, what bounds are we able to set as to the extent of divergence? Objections have been brought forward against the consideration of animals in a state of domestication, and a comparison of the differences existing between the races and those existing between wild species; but I am unable to appreciate the pertinence of such objections. The fact of the modification of the same elements in the domesticated condition and in the wild condition, is presumptive proof of their being induced by analogous or comparable causes. There are indeed differences between natural and artificial selection, but only as to the objects to be gained. In artificial selection, or selection by man, the object in view is utility to man or subservience to his use; in nature, the object is subservience to the use and good of the animal. Man, however, only avails himself of the variations which nature affords, and does not himself cause variation. He selects, but he selects those, however, which might not, and probably would not, be in most cases selected by nature. It is in this respect that natural and artificial selections chiefly differ.

#### REVERSION TO ORIGINAL FORMS.

It has been urged that as soon as the influence of man is withdrawn, the races which he has cultivated revert to the original condition of the stock whence they descended. Happy in some respects would it be if such were the case; for we should then have the means of deciding, in a very short time, what were the original progenitors of our domesticated forms of animals and plants; as concerning many



forms we are in great doubts as to their origin. Notwithstanding the repeated assertions of many, that domesticated stocks do revert to their original condition so soon, the very fact that we have never been able to ascertain positively the parentage of some of our domesticated animals would serve to show that such reversion does not take place. And there are besides positive proofs against that hypothesis. In illustration, we may allude to the horses and cattle which have been introduced into the Americas. Although horses did exist in the Tertiary period in America, none lived in recent periods until the advent of the Spaniards, who carried them to America. Some of these escaped, and bred, and their progeny increased in vast numbers, especially on the pampas of South America. These, without any interference of man, existing in a wild condition as completely as any of the originally wild animals on the continent, they had all the conditions that would favor reversion to their original stock. It may be even true that the horse on the pampas now exhibits a homogeneous character; and if homogeneity were the test of reversion, it might be impossible to say that that was not a reproduction of the original form. But we have another test for determining the question. On the plains of Asia we have likewise large herds of horses. Call them feral (that is, horses that have escaped from man and propagated), or wild (such as have always existed untamed), as you will, we still have one or several homogeneous races in certain areas. But none of those races agree with the race or races now found on the American plains. If we compare the animal of the Tartarian plain with that of the pampas, we find difference in color as well as in form. The animal of Tartary has a dun color and a barrel-shaped head; that of the South American pampas is of rather a chestnut color, and has a head differing from the Tartarian animal, and is distinguished by other characteristics. Now, if the hypothesis of reversion to the primordial type were true, we should expect to find both of these races exhibiting the same characters.

To account for non-reversion, the argument based upon the influence of climate and external changes which has been brought forward to lessen the weight of this non-reversion is rather an argument in support of the theory of progressive development; for if space is the co-efficient of certain conditions influencing the characteristics of animals, time is another coefficient as valuable. But we must remember the view already referred to, that while man would select animals of certain characteristics, the propagation of those characteristics would not be at all essential to the animal, and might, and doubtless would, in most cases, be rather impediments. In such cases those animals, when the influence and protecting care of man were withdrawn, would either cease to live, or the descendants of such approximating more to the original type, and, consequently, not exhibiting characters thus inconvenient—if I may use this word—would be propagated at the ex-

pense of such as exhibited characters of the immediate progenitor. Animals like the latter, therefore, would very soon die out. This is as might be expected, and is in perfect harmony with the theory of natural selection of Mr. Darwin. And here I may remark that the statements as to reversions of some types are simply absurd. When it is affirmed, for example, that the common domesticated cat, that, becoming feral, it reverts to the type of the common wild cat of Europe or this country, it is evident that an unsupported statement is made, and that the assessor is not acquainted with the fact, that the wild cat and the tame cat belong originally to entirely different species; the tame cat being a descendant of the Egyptian cat, and not of the wild cat of Europe, much less of this country. Many statements have been made as to reversion of animals that will bear the test of criticism as little as does such a statement.

I would again repeat that the difference between natural selection and artificial selection by man, as to time, at least, is one of degree. In nature, the variant forms commingle with the more normal types, and by reason of atavism, the tendency to perpetuate the abnormal form is more or less counterbalanced. In artificial selection, however, the variant form is set aside by man, and its offspring is again selected in ratio to the exhibition of the characters for which the original selection was made, and the aid of man thus rapidly brings into prominence the characters which are desired. Thus a few years enable man to do that which nature, unaided, would require centuries or ages to do.

#### CONDITIONS OF EXISTENCE.

Without further reference to man's influence, and the objects of his selection, we may consider—as we shall be obliged to be brief—those conditions of existence which in a state of nature exercise an influence analogous to that of man. These we may consider under the head of organic and inorganic. Under inorganic, *climate* may be viewed as one of the chief modifying agents. The influence of this agent is exhibited not only in physiological but in structural characteristics. The bulldog, for example, so noted for its fierceness and boldness in the Northern Hemisphere, in the course of a very few generations is said to degenerate in the tropics into a comparatively cowardly, worthless cur. We all know the difference which the covering of dogs and sheep exhibits in cold and warm countries, and some animals are apparently incapable of withstanding transportation from a cold to a warm climate, or the reverse; and others are either incapable of propagating, or their progeny soon die out. Those forms which should be best adapted to climate, or which could best withstand the changes of climate, would be most apt to be perpetuated. *Station* is analogous to climate, and is a name given to the special position with reference to land or water, or the character of either, which an animal in its faunal area may inhabit. Thus a land animal may have an elevated station, living on the high mountains or on the lowland

plains, on a rocky, a sandy, or a marshy surface; and the aquatic animal may inhabit either the fresh or the salt water, and at various depths and at various bottoms in such waters.

Considering the organic conditions of influence, we may, with the excellent Professor Huxley, divide them into the opponents or helpers; and the opponents may again be divided into those which exert an indirect influence, and those which consequently be called rivals, and those which exercise a direct influence, and which may therefore be called enemies. The helpers may likewise be divided into those which exert an indirect and those which exert a direct influence. Now all of these elements, as well as food, which holds an intermediate rank between the organic and inorganic, have to be considered in determining the conditions which may be favorable or otherwise to the existence of an animal.

It may be well to explain how some of these elements, especially the organic, exert an influence. A rival, for example, would be any animal that would be found in the same country, affecting the same climate, and in the same station, and which would prefer the same food. Such would be a rival in a marked degree. An enemy of course would be one that would prey upon such a one, and select it as the special object of its food, or otherwise war against it. The animal, the greater its strength, the better adapted would it be to combat against and outrival its rival, or to escape from and contend with its enemies. In this connection I may refer to the well-known fact of the rats. It is a familiar fact that in earlier times the black rat prevailed over Europe, and also was common in America, and at that time the so-called Norway, or the common brown rat, was not known in these regions; but now the former has become almost exterminated in most regions, and has been entirely replaced by the Norway rat. These are both species of the same genus, and closely related to each other; and in this instance we probably have not only a rival, but also an actual enemy in the Norway rat as compared with the black rat. Species of the same genus may, however, exist in comparative harmony and without much interference; for while the Norway rat thus drives before it the black rat, with it is found associated the common house-mouse in all regions. Although there is some interference of the one with the other, it is slight.

As an illustration of what is meant by helpers, indirect and direct, for the former we may consider food. For example, a carnivorous animal will feed upon a herbivorous one; and the greater the quantity of herbage upon which the herbivorous animal may feed, the more favorable will be the conditions for the existence and multiplication of that herbivorous animal.

Thus the growth of the plant will be an indirect helper of the carnivorous animal. With regard to the direct helper, one of the best instances that has been given is that of the animals which serve as the hosts of the inter-



tinal worms. Man and the hog, for instance, have the joint honor of supporting the tape-worm in its several conditions of existence; and here we have a case which may be aptly brought forward for the benefit of those who are constantly asserting the adaptation of nature with reference to man. If the tape-worm and the various other intestinal worms which use man as their dwelling-place are of any use to him, it has not yet been discovered; but the use of man and the hog to the tape-worm is very obvious. If we accept, then, the special creation and adaptation theory, we must consider that man and the hog were created for the benefit of the tape-worm.

#### EVIDENCE IN FAVOR OF DEVELOPMENT.

We have questioned nature, then, in all her departments, and have found that the answers she has given to our inquiries are in accordance with what we might expect were the development theory true. There is no other explanation for the vast number of facts than the theory of genetic connection of the types living in the past with, at the most, a few primordial forms. All the facts that have been adduced are in conformity with such development. We have on the principle of variability that which would explain how these divergences could take place, and on the principle of atavism we have another agent which serves as a check to variability and which preserves the conformity with type. The two are antagonistic to each other. While atavism is conservative and reproduces as nearly as possible in the descendant likeness to the progenitor, variability contends against it, and diversity of the descendant and progenitor is constantly being effected. In the long run, and in the struggle between these two antagonistic principles, variability gains slowly but surely on its opponent atavism.

It would be easy had we only variability to take into consideration to express in a series of propositions the results of that principle, as, for example:

1. The offspring of animals are more or less unlike those of the parents.
2. Differentiation is indeterminate and tends in all directions.
3. Differentiation from the primitive type progressively increases.
4. Time being a factor, there is no necessary limit to the range and extent of variation.

And such facts would lead us to this deduction:

Forms isolated and non-communicating exhibit in their descendants difference in ratio to time and isolation.

The principle of atavism, however, may be regarded as forbidding the enunciation of those propositions as perfectly correct expressions of natural laws.

With the explanation that in the condition of existence we have the causes which influence natural selection, and that it is the view of natural selection of varieties spontaneously arising that constitutes what is called Darwinism, I must test the argument in order to

be enabled to arrive at the theological consequences of the theory.

#### DEVELOPMENT AND NATURAL THEOLOGY.

The charge of materialism has been brought against this, as it has been by well-meaning but injudicious persons against almost every utterance of science. But is materialism a necessary result of a belief in the development theory? I think not; because it furnishes a clew to the reason why the charge of materialism is so often brought against scientific doctrine. Let me recall the words of a learned divine of the English Church, the Rev. Dr. Frederick Temple, the worthy successor of Arnold of Rugby. He has commented upon and regretted the disposition "to trace the power of God, not in that which is universal, but in that which is individual; not in the laws of nature, but in any apparent interference with those laws; not in the maintenance, but in the creation of the universe." And he who believes in the adherence of Deity to the laws which he has ordained rather than in his interference with and infraction of such laws is forsooth called materialist! The great legislator is distinguished, not by the suitability of the laws which he exacts, but by the infraction of such laws.

I know not how I can better present the anti-materialistic nature of the development theory than in the form of a paraphrase of the arguments of Paley in his *Natural Theology*. That divine, you will remember, takes a watch and considers that its peculiarity and construction exhibit inherent evidence of workmanship and special design on the part of the maker. He enters into a series of arguments in proof thereof. He further takes up the watch and assumes what would be the effect of supposing a power in it of reproducing itself, and what would be the effect of such a discovery on the examiner.

1. "The first effect would be," he says, "to increase his admiration of the contrivance and his conviction of the consummate skill of the contriver.

2. "He would reflect that though the watch before him were in some sense the maker of the watch which was fabricated in the course of its movements, yet it was in a very different sense from that in which a carpenter, for instance, is the maker of a chair.

3. "Though it be now no longer probable that the individual watch which our observer had found was made immediately by the hand of an artificer, yet does not this alteration in any wise affect the influence that an artificer had been originally employed and concerned in the production. The argument from design remains as it was.

4. "Nor is anything gained by running the difficulty farther back, that is, by supposing the watch before us to have been produced from another watch, that from a former, and so on indefinitely. Our going back ever so far brings us no nearer to the least degree of satisfaction upon the subject. Contrivance is still unaccounted for.

5. "Our observer would also reflect that the

maker of the watch before him was in truth and reality the maker of every watch produced from it; there being no difference, except that the latter manifests a more exquisite skill between the making of another watch with his own hands, by the mediation of files, lathes, chisels, etc., and the disposing, fixing, and inserting of these instruments, or of others equivalent to them, in the body of the watch already made in such a manner as to form a new watch in the course of the movements which he had given to the old one. It is only working by one set of tools instead of another."

Now let us apply an analogical mode of reasoning to the development theory.

1. The first effect of our conviction of the truth of the development theory, and that a few primordial types have given birth to all the animals that have existed and do now exist, and that in the beginning provision was made for the adaptation of such primordial animals and their descendants to all the varying conditions of climate, station, and food, would be to increase our admiration of the contrivance and the conviction of the omniscient skill of the contriver.

2. We would reflect that though such animals were, in some sense, the originators of those which sprung from them, that they were not originators as creators.

3. Though it be now no longer probable that the animal forms which we now find were made immediately by a creator, yet does not this in any wise affect the inference that a creator had been originally employed and concerned in their production.

4. Nor is anything gained by running the difficulty farther back, that is, by supposing the animals before us to have been produced from other animals, those from former, and so on indefinitely; our going back ever so far brings us no nearer to the least degree of satisfaction upon the subject.

5. We would also reflect that the creator of the primordial animal was, in truth and reality, the creator of every animal produced from it; there being no difference—except that the latter manifest a more exquisite skill—between the creation of each individual species and the creation of one form which should be generated and propagated by means of the provision of adaptability in the one primordial animal and its descendants. And it may be added, that if ability to create a form capable of reproducing itself is evidence of greater power than the ability to create a form complete in itself, then it must be admitted that the ability to create a form which should be able not only to reproduce itself, but to produce forms capable of adapting themselves to all the varying circumstances which might thereafter arise, is evidence of immeasurably greater power. Indeed, it seems to me that one of the noblest arguments in natural theology might be based upon the development theory. So far from this theory being antagonistic to belief in the Deity and his agency, it rather elevates our conceptions of the Deity, and



omnipotence truly worthy of the name is revealed.

To recur again to Paley's argument, and to that portion in which he demonstrates the watch to be the work of a maker, you may remember that he assumes that an argument might be urged, that the mechanism of the watch was no proof of contrivance, but only a motive to induce the mind to think so, and he expresses the surprise which would be manifested to hear such an argument. With equal surprise would we hear that all the facts that have been made known to us in the various departments of zoology, the development of animals, and their geographical as well as geological distribution, which all point to one result, namely, that all animals have descended from a few primordial forms, is no proof that such was the case, but only a motive to induce the mind to think so. And again, if surprise would be the result of information that the watch was nothing more than the result of the laws of metallic nature, equally meaningless and unsatisfactory is the explanation that all these facts are in accordance with "plan," or the "laws of plan," and involuntarily we may associate such an explanation with the preceding, and connect the plan with some purpose, even if it be to deceive, rather than to entertain the idea of plan without purpose.

It might be expected that, as I have considered the theological aspects of the development theory, I might say something of its relation to the record of Genesis. But the time is too far gone. I would, however, remark that I see no more conflict between the theory of natural selection and the account given of creation in the Bible, than I do between the same account and the theory of special creation, or the facts of zoology, geology, and geographical distribution admitted by all naturalists, whether believers in development or special creation. We may safely leave to the learned divines who have harmonized the truths of science and revealed religion to perform the office in this case, when the truth of the development theory shall be admitted as proved by physical consideration.

Lastly, if we consider the development theory with reference to man himself, so far from being repugnant to our senses or ideas, even admitting our descent from a stock in common with the modern monkeys, does not the thought that we have developed from such an humble origin rather afford us expectations for a more exalted future? for if improvement so great has been possible, what limit shall we assign to future improvement! And may we not with reason hope for descendants of our race in a distant future a condition which shall assimilate them to angels in all except immortality?—for a physical form and immortality are as incompatible with each other as fire and water. I must admit that I can not at all appreciate the reasons for the horror with which many good persons regard their idea of the humble origin supposed. The old adage, that persons like their opposites, and the converse, which I will leave to yourselves to frame,

may help us to understand the sentiment, and still further may we appreciate the reasons therefor in those who insist on believing in the reversion to the original type. But if we acknowledge the differences that do exist between us and the monkeys, and do not insist on reversion, our equanimity need not be disturbed.

### INTELLECTUAL UNFOLDINGS OF THE AGE.

[In a "Master's Oration," with the above title, pronounced at the Fourteenth Commencement of the Waynesburg College, by Mr. J. J. Purman, occurred the following emphatic indorsement of Phrenology.]

PASSING from Biblical criticism to the department of the philosophy of mind, I come to notice another prominent intellectual unfolding of the age. Mental philosophers in our day have cast aside the dictum of Locke, that the human mind at infancy is a sheet of white paper on which circumstances write our future characters. A new philosophy of mind, founded in observation and experiment, and arrived at by a diligent and careful induction of thousands of isolated facts, has been given to the world. This philosophy, which owes its origin to Dr. Gall, a native of Austria, after receiving various inappropriate names, is now well known by the expressive and beautiful name of Phrenology. Discovered and promulgated to the world near the close of the last century, it now stands forth as a prominent fact of this century; and is pre-eminently the psychological interpreter of the age. Founded by Dr. Gall, this science—philosophy, perhaps, I should call it—has been greatly advanced and perfected by Dr. Spurzheim and Messrs. Combe in Europe, and by Dr. Charles Caldwell, Andrew Boardman, and Messrs. Fowler and Wells in America. Like the discoveries of Galileo, Harvey, and Newton, the Gallian philosophy was much at first opposed. The Austrian Government commanded Gall to cease lecturing on Phrenology or leave his native city and country. He chose the latter alternative, and was willing to leave home, friends, and an extensive practice, that he might investigate and teach his new discovery. The public prints treated him and his science with supreme ridicule and contempt. *Blackwood's Magazine* called him "an infernal idiot," and added, that "fool and phrenologist are terms as nearly synonymous as can be found in any language." But like Galileo, before the Roman Inquisition, declaring "the world does move," or Luther before the Diet at Worms, affirming, "I can not act otherwise; God be my help!" so Gall, in the face of vituperation, continued sublimely to assert, "This is truth, though at enmity with the philosophy of ages." And like the doctrines of Galileo and Luther, that of Gall has now, in a great measure, overcome all opposition, and its truths are accepted by every capable and candid man who will give it a careful examination. It would, perhaps, be out of place in this connection to give an exposition of the doc-

trines of Phrenology; besides, it would be insulting to the intelligence of this audience to suppose that they are not informed in the leading truths of the science. But I would respectfully but candidly say to those who are accustomed to scoff at Phrenology: You may laugh, but laughter is not wit; you may shut your eyes, but it will not, therefore, be dark; you may raise clouds of dust, but you will merely obstruct your own vision, not extinguish the radiance of truth. Be candid and generous, therefore, and until you have examined the subject in an adequate manner, acknowledge that on what you have not properly investigated you have no right to decide. And to those who love to follow in the wake of great names, permit me merely to add, that the doctrines of Phrenology are indorsed by no less personages than the Hon. Horace Mann, late President of Antioch College, Ohio, where he introduced it as his text-book on mental science, declaring that it was the "guide of philosophy and the handmaid of Christianity;" and by Henry Ward Beecher, who acknowledges that he has stolen his pulpit thunder from the once despised science of Phrenology. But I am not here to defend this science this evening, and will close this branch of my subject by merely adding, that the discovery of Phrenology as the true science of mental phenomena, is now, and must remain, one of the great, unique, and salient facts in the intellectual unfoldings of the present age.

### Communications.

Under this head we publish such voluntary contributions as we deem sufficiently interesting or suggestive to merit a place here, but without indorsing either the opinions or the alleged facts.

#### MAN AND WOMAN PHYSICALLY.

Mrs. ELIZABETH OAKES SMITH says: "The sexes are fully equal in intellect, in moral sense, and even physique (admitting that women are designed to be more delicately organized), taking the stand-point from the best models, which is the true criterion, all others being exceptional."

Mrs. Smith then equates the physiques of the sexes by putting the excess of woman's delicacy—which is only a compensation in her for her want of physical—equal to man's excess of every physical element above hers.

Delicacy in this connection is very desirable, very pleasant, and charming indeed. In "the best models" it is one of those things truly that gives her form its beauties of grace, its heavenly loveliness, and makes her the admiration of the world. This it is indeed; while, nevertheless, it subtracts—instead of adding more—just so much from her physically, rendering her so much less capable of doing *physical* things.

Is she, then, in any physical sense man's equal? Can she do physical things as he can? We mean to include the whole range of physical things, from the making and running the steam-engine to the construction and running of the machinery for the manufacture of the finest goods; from the most perfect astronomical telescope to the most discerning microscopic lens; from the most stupendous engineering operations to the most delicate, spirited, and perfect sewing-machines; from Morse's telegraphic utterances to the gentle pippings of the Æolian harp.

Undoubtedly in the purpose and end of her creation her physical form, in its delicacy so exquisite and beautiful, is the very best and most perfect it could be. But