The following papers were read :—

1. "Further Contributions to the Flora of Central Madagascar. I. Polypetalæ. II. Calycifloræ." By J. G. Baker, F.R.S., F.L.S.

2. "Notes on the Flora of Parasnath, a Mountain of N.W. Bengal," in a Letter from Mr. C. B. Clarke, F.R.S., F.L.S., to Sir J. D. Hooker, C.B.

3. "On a new Species of *Cœlacanthus* from the Yorkshire Cannel Coal." By J. W. Davis, F.L.S.

4. "Observations on a peculiar Mode of Development in the Lady Fern (*Athyrium Filix-fœmina*)." By Charles F. Druery. (Communicated by Dr. J. Murie, F.L.S.)

5. "The Morphology of *Cyclops* and the Relations of the Copepoda." By Prof. Marcus M. Hartog, F.L.S.

6. "On a new Species or forgotten Variety of *Chama*, allied to the *Arcinella* of Linnæus." By Sylvanus Hanley, F.L.S.

ADDRESS TO THE LINNEAN SOCIETY, 1884.

By Prof. P. Martin Duncan, M.B. Lond., F.R.S., F.G.S., Vice-Pres. Linnean Society.

The time which has elapsed since our esteemed President asked me to occupy his position, on the present occasion, has been much too short to admit of my offering you a carefully prepared Address on any special scientific subject. I must therefore ask for your kind consideration whilst I occupy your time with some remarks upon the works of the great naturalist whose name this Society bears, and upon some of the philosophical views of De Lamarck.

Every experienced naturalist is aware that three men have especially contributed to the present state and aspect of the knowledge of Animated Nature. To name Linnæus, De Lamarck, and Charles Darwin is to confirm this statement.

The wonderful and patient labours and the elaborate theories of Charles Darwin are fresh in our memories, and are constantly being brought before every student of nature; but it is consistent with truth to assert that the merits, methods, and recorded work of the two predecessors of our great naturalist, although they cleared the path for, and even foreshadowed, existing knowledge, have too often been forgotten. I propose to bring some of the labours of these two great men before you.

I need hardly remind you that Gesner and Cæsalpinus, those diligent botanists and foreshadowers of the Natural System of Classification, formed an epoch in their science which was followed by nearly a century of slow progress, marked, however, by the collection and description of many plants from the newly discovered or lately colonized foreign lands. The method of Cæsalpinus in classifying the great groups of plants was not

much cultivated: in one instance a retrogression occurred to the ancients; and in another the good work of the great Italian was mutilated and borrowed without acknowledgment. But Lobel, Ray, and Tournefort studied and wrote after a lapse of time; and the direction of their thoughts and the nature of their methods proved that the lessons of Cæsalpinus had not been forgotten. The number of plants which had been described was very considerable at that time. Genera were numerous and the great divisions were more or less recognized. But all this knowledge was in confusion when the genius of Linnæus arose. It has been well and truly said that Linnæus was the great reformer in the Classificatory Sciences; and it is evident that comparatively early in his career he grasped and elaborated the primary requirement of botanical science. He saw that a descriptive science (a branch of knowledge which compares and utilizes the idea of likeness, the most trivial as well as the most important details of which require unmistakable definition) cannot become stable, and indeed cannot advance without a descriptive language. The same word must be employed in the same sense, the same idea must be expressed by the same word, and terms must be fixed quantities.

Tournefort had comprehended the necessity for fixed terms; but, as De Candolle writes, Linnæus "really created and fixed this botanical language, and this is his fairest claim to celebrity. For by this fixation of language he has shed clearness and precision over all parts of the science."

The distinguished author of the 'Philosophy and History of the Inductive Sciences' remarks:—"The formation of an exact and extensive language for botany has been executed with a degree of skill and felicity which, before it was attained, could hardly have been dreamt of as attainable. Every part of a plant has been named; and the form of every part, even the most minute, has had a large assemblage of descriptive terms appropriated to it, by means of which the botanist can convey and receive knowledge of form and structure as exactly as if each minute part were presented to him vastly magnified. This acquisition was part of the Linnean reform."

There is no doubt that the establishment of a terminology and the reform of the descriptive part of botany were of *primary importance* to Linnæus, and that his systematic work and his vast industry in recording forms would have been impossible without those important matters which the previous generations of naturalists had barely considered.

Linnæus appears to have seen, very early in his career, that loose and popular language are incompatible with scientific precision, and that scientific phraseology must be a rigid mechanism. Hence his terminology was really the instrument by which he effected all his reforms in Natural History, and which facilitated his wonderful descriptive work.

The 'Fundamenta Botanica' supplied a great want: it gave

Botany a fixed and complete terminology, and influenced the science of Zoology also. Its far-seeing author also utilized the principle upon which the work was founded in Materia Medica, in classifying diseases, and in mineralogy.

It is very true that men labour and others enter into their labours; and in exemplification of this old saw one might ask how many of us, when we use the terms incident to the study of forms, remember that our terminology has descended from the clear-headed Linnæus. The aptitude of most of the common botanical terms testifies to the brightness of conception, the judicious taste, and the linguistic power of the great Swede.

Some naturalists imagine that a scientific terminology can be readily produced, and that it does not infer much positive knowledge. But this is a very great mistake. The accurate and vast terminology of Linnæus testifies to his practical knowledge of an enormous number of plants and animals, the details of which he must have studied carefully.

Every experienced naturalist is aware that a fixed character, to be good for anything, can only be the result of many careful observations. It is, in fact, a scientific discovery; and the appropriate technical term being given, it is capable of being used in inductive reasoning.

The language of Botany was reformed and recreated by Linnæus, who thus gave a familiar tongue to all his followers, which, once attained, leads readily to the comprehension of any descriptive and classificatory systems.

The 'Fundamenta Botanica' gives the scientific terminology, and the 'Philosophia Botanica' carries its own description—*in qua explicantur fundamenta botanica.* This work is totally positive, and is a wonderful record of the explanation of terms with very little of what Lamarck would have called philosophy. Yet there is philosophy in the book without metaphysics, and it is possible to glean therefrom the ideas of Linnæus upon the great questions which began anxiously to be thought about towards the close of the century which the great naturalist brightened.

The last-mentioned work deals, moreover, with another subject, which, although it differs from terminology and its explanation, is closely allied and dependent. It refers to Linnæus's reform of botanical nomenclature. The old plan of giving a distinct name to plants for purposes of recognition had long given way to the use of the genus and an ill-defined specific phrase. The phrase with a multitude of ablatives became really a short specific diagnosis which the botanist had to commit to memory. Haller had tried the numerical method, and had species I., II., III., &c.; but Linnæus, impressed with what he called the circumlocution, desired to call every herb by a single trivial specific name. He did not, however, do this at once.

There was one great characteristic of Linnæus, and it was *the idea of rational sequence* which pervaded his constant labours. He was never hurried; and all his reforms were progressive,

and just in that order which would enable the scientific world to take advantage of and believe in them. He saw clearly enough that the trivial specific name, if it was to supersede the old-fashioned phrase, must really be associated with good and carefully recorded specific characters and satisfactory generic diagnoses.

His reform was conducted very gradually, and, first of all, in the 'Critica Botanica' rules were given for the adoption of the generic name and for the specific descriptive phrase. He clearly desired to exclude extravagant and barbarous generic names, and to adopt those which were convenient and elegant.

Then the descriptive phrase (the differentia) he decided should embrace the most fixed characters which can be found. Here the 'Fundamenta Botanica' came in, for the terminology of the phrase was regulated by its rules, and the 'Philosophia' was the glossary. He enlarged earnestly on the necessity for using the correct and proper specific phrase, and wrote:—"I beseech all botanists to avoid most religiously ever proposing a trivial name without a sufficient specific distinction, lest the science should fall into its former barbarism." In the 'Species Plantarum' the trivial names are introduced in the margin; and this tentative plan soon received the sanction of the botanical world. The phrase disappeared, and the trivial name stood next to the genus, which, with the species, was carefully diagnosed according to the Linnean method and with the selected terminology.

An ordinary botanist would not have had the proposed revolution in Botanical nomenclature accepted; but Linnæus had such a vast practical knowledge of plants, had explored the floras of such large districts and countries, had examined so many herbaria, and had had such collections sent to him from foreign countries for his study, that he stood alone in his knowledge of species. Again, his definitions of genera and species commended themselves to practical botanists. So the trivial names gradually became the recognized specific terms; and this revolution has produced lasting results in Natural History.

The 'Philosophia Botanica' contains here and there some of the sayings and maxims of Linnæus which explain his beliefs on interesting questions.

Thus we find, "Confusis generibus, confundi omnia necesse est. Genus omne est naturale, in primordio tale creatum. Species constantissimæ sunt. Species tot numeramus, quot diversæ formæ in principio sunt creatæ." "Varietas est planta mutata a causa accidentali: climate, sole, calore, ventis &c. reducitur itaque in solo mutato. Species varietatum sunt magnitudo, plenitudo, crispatio, color, sapor, odor."

"Botanists do not consider slight variations."

It is perfectly evident that transmutation was not in the Linnean philosophy, and yet he quotes "Natura non facit saltus."

The scientific botanist will pass over some of the statements of Linnæus concerning the physiology of plants without criti-

cism, for the microscope and the necessary weapons of research were incomplete and comparatively useless in his day. Any deficiency of such knowledge is compensated by the reform in the terminology, the establishment of a rational nomenclature, and the careful work of the illustrious man, whose fame amongst the general public rests alone upon the artificial system of classification he elaborated in the 'Systema Naturæ.' It is the custom to pass this classificatory system by as antiquated; but it must be remembered that Linnæus never considered it as a final work. He speaks, in the 'Classes Plantarum' (1747), of the difficulty of discovering the natural orders, and wrote:—"I, too, have laboured at this, have done something, have much still to do, and shall labour at the object as long as I live." In the 'Philosophia Botanica' he proposed sixty-seven orders as the fragments of a natural method, always professing, however, their imperfection. He stated elsewhere, "The natural orders teach us the nature of plants; the artificial orders enable us to recognize plants. The natural orders without a Key do not constitute a method; the method ought to be available without a master."

It must be remembered that at the time of Linnæus systematic botany was in its infancy. Cæsalpinus had taken the science out of the mediæval darkness and foreshadowed the post-Linnæan age. He was indeed, to use the language of Linnæus, "Primus verus systematicus;" and his system was very natural. Ray, and Jung of Lübeck, and Tournefort had written in the same direction; but their methods were difficult and could only bear fruit in after years. What was required was an easy method of distinguishing a species so that subsequent study could be directed to known forms.

When any one of the natural systems which was published after the age of Linnæus is critically examined, much of it will be found to be artificial; but there is, or ought to be, a physiological foundation which has barely a place in the artificial method. Physiological botany was in its infancy, and it was impossible to tabulate parts of the plant according to their biological value.

One thing is very certain, and it is, that if every decrier of the Linnean system, as exemplified and elaborated in the 'Systema Naturæ,' told the truth, he would admit that he had often found out the names of plants by its process, when some difficulty in the natural system intervened. It will be noticed further on that Lamarck utilized a combination of the artificial and natural methods in the 'Flore Française.'

It is remarkable how little credit is given, at the present time, to Linnæus as a zoologist. He has been overshadowed by Cuvier, Agassiz, and others; but it must be remembered that it was the application of a correct and rigid terminology to a classification, parts of which are in constant use at the present day, that enabled the science to make its great strides after the time of the great Swede. It is interesting to note how, in the 'Systema Naturæ,'

the natural character is constantly used in the artificial zoological system, and how really natural much of the primary part of the classification is. Dividing the Animalia into six classes, Linnæus characterizes each one by the positive characters of its organs of assimilation and respiration. He considered also the masticatory and digestive apparatus, the locomotive and generative powers, and the nature of the outward covering. He gives the natural characters of the orders, but arranges them for classificatory purposes by the distinction of the three kinds of teeth. That idea was not Cuvier's, as is believed and constantly taught. Moreover, Linnæus did not forget to consider the extremities as possible classificatory elements. He was the first who, after establishing the order Primates, placed Man amongst the animals. This was naturally resented; and it led in after years to a bitter criticism on the part of M. Lamettrie, who complained to Voltaire that Linnæus had associated man with the pig and horse. Indignant, he shouted "He is a horse himself;" and he got the reply, "Vous conviendrez que, si M. Linnæus est un cheval, c'est le premier de tous les chevaux."

The classification of the Insecta alone would have carried down the name of Linnæus to posterity. It was the result of his usual careful study of very many species, and of a critical analysis of their most important external organs.

The class was in dire confusion before Linnæus studied it, and he founded those seven orders which have lasted, with some trifling alterations, to the present day. Each order was founded mainly on the nature, texture, and number or absence of the wings; and the generic characters relied upon were the differences of the antennæ, the elytra, the head, rostrum or mouth, in the case of the Coleoptera. In the Hemiptera the rostrum was of primary classificatory importance; in the Lepidoptera the antennæ and wings; and in the Neuroptera the mouth, wings, and tail. In the Diptera the mouth or proboscis was considered; and in the Hymenoptera the mouth, wings, and sting.

The Aptera contained many forms which are now placed beyond the Insecta; and the eyes, tail, and number of feet were made of primary classificatory importance.

Possibly Linnæus knew some of the other classes as well as he did the Insecta; but the impression left on most naturalists will be that this one was his special study.

He clearly recognized the relation of plant and insect; and, indeed, one of his pupils, Forskål, wrote a work on the Insecta, classifying them by their being found upon, or being destructive to, certain special plants.

The excellent terminology and the method of using it by Linnæus influenced the zoological work of Artedi, his early friend, who established a number of genera of fish, making also progress towards a natural arrangement of them. Linnæus did not improve on this classification; and it appears that Cuvier considered his work retrogressive.

In his 'Conspectus Materiæ Medicæ' Linnæus gives the usual proofs of exceeding care, and of the accuracy and similarity of method, which are found in all his works. The amount of painstaking observation, deep research, and compilation is indeed great in this book. Nothing is out of place; every thing relating to the subject is recorded; and the few omissions are rectified in the copy belonging to this Society, and appear as marginal notes; so that the students of that age had before them all the weapons of the healing art readily distinguishable, and with their uses and operations tabulated. Much of the first part of this 'Conspectus' is more of antiquarian interest than directly useful. Nevertheless many a household word of physic is found, if not for the first time, in the 'Conspectus' very carefully explained; and, in parts, the work may be called a book on therapeutics.

The sufferings of humanity have been great at the hands of physic and physicians; and it was hard on the human race that whilst it was struggling in the rise of rationalism, it should have had such horribly unpalatable remedies for nature's ills. But whether the *materiæ* were nice or nasty, useful or innocuous, Linnæus classified them tersely, yet positively, enough. He treated the drug-yielding plant or animal or mineral as a something to be brought within a higher therapeutical group, and this into one of a series of grand divisions which related to the manner in which the drug acted. Old names are found in these divisions which were used in physic half a century ago, but which have been eliminated since, such as Borborygmia, Sternatutoria, Sophisticantia; and one can believe that Linnæus enjoyed recording these loud-sounding terms for matters which are less elegantly expressed in the vulgar tongue. He conscientiously states how each drug tastes, smells, and looks.

As a curiosity one may take a Rodent, or rather one of the Glires, as a remedy given:—

"*Lepus timidus.* Cauda abbreviata, auriculis apice nigris.
" *Locus.* Europa.
" *Pharm. prep.* Leporis Tali.
" *Comp.* Pulv. pleuriticus.
" *Qual.* Os primum metatarsi in suffragine posteriori.
" *Vis.* Absorbens.
" *Usus.* Colica, Pleuritis, Epilepsia, &c."

Amongst the Animalia which contributed to the Materia Medica of the age of Linnæus was, according to him, *Homo sapiens*, placed at the head of the Primates:—" *Locus.* Per totum terrarum orbem, at Mumia in Ægypto.
" *Pharm.* Hominis. 1. Cranium: raspatum, præparatum.
" 2. Ossa.
" 3. Axungia, Sal Sanguinis, Urinæ.
" *Comp.* Pulv. de Guttata, Arthetic. Specific. cephal.; Mumia.
" *Qual.* 1, 2 insipida, inodora, terreo-gelatinosa. 3 pinguis.
" *Vis.* 1, 2 absorbens. 3 emolliens.
" *Usus.* 1 Epilepsia."

It will interest some ornithologists now present to know that even *Corvus* contributed to the Materia Medica:—

"*Corvus pica.* Albo nigroque varius. Cauda cuneiformi."

Patients in those days drank "Aqua Picarum composita."

The Amphibia were considerable contributors, and were recorded after the invariable practice seen throughout the book. First came the name and specific diagnosis; then the habitat; then the Pharmacopœial preparation; then the quality, taste, smell, &c.; then the action; and finally the uses.

It is of course the botanical part of this Conspectus which is the most valuable; and it is a conscientious record and abstract of the qualities, uses, and medicinal preparations of every known plant which had, up to the time of the writer, been used in the healing art. The classification is his own, and the terse generic and specific diagnoses are eminently Linnean.

How well Linnæus was read in the lore of therapeutics can be appreciated after looking through a few pages of this book; and it is evident, from the notes to many of the species, that he was eminently qualified to judge about the medicinal actions or inertness of many vegetable drugs. The most remarkable part of the book is the total absence of speculation; it is all record, on a uniform plan, whether the object be animal, vegetable, or mineralogical. The time which the compilation of this Conspectus must have consumed was great; and its extraordinary correctness is one of the many testimonies of the exactitude and painstaking of the great naturalist.

The necessity for writing this Materia Medica did not arise from a desire to publish works on every subject capable of classification, but from the possibility of giving a practical bearing to a course of lectures on the Diagnosis morborum. This was a course which formed a part of Linnæus's duties as a Professor at Upsala; and it was not likely that he would deliver it in a perfunctory manner. He classified the whole of the known maladies of his day, 535 in number, as if they had been objects of natural history. Linnæus's work arranged diseases in eleven classes and each one of these into orders and genera.

There is no doubt that his correspondence with Sauvages of Montpellier was mutually beneficial; and Linnæus was lecturing on the subject when the work 'Les Nouvelles Classes des Maladies' appeared. In this work Sauvages endeavoured to define and classify diseases from their constant and evident symptoms only. His friend found this classification congenial, and indeed the Art of Medicine admitted of no other scheme at that time, for the causes of disease were very little understood. There were many excellent points about the classification, which were gradually accepted by subsequent nosologists. The definitions of the genera were terse and very correct; and it is interesting to note that some severe diseases of that day are no longer recognized amongst the ills that flesh is heir to.

One part of the classification may be of interest to those

who care more about the natural-history studies of Linnæus than the doubtful medical lore of his day. He classified fevers under two classes—the Exanthematici, subdivided into Contagiori and Sporadici; and the Critici, including continued, intermittent, and remittent fevers. In a brief view on the Theory of Physic, Linnæus supposes the circulating fluids to be capable of being vitiated by principles which he considers as putrid ferments. The exanthematic class he considers to be excited by some external causes which are called contagion, and which he hypothetically asserts to be Animalcula. At the present day we say Bacteria.

As might be expected, Linnæus had some original ideas about Geology. He writes:—"The globe which was covered with water has dried insensibly: the continents have appeared, and the seas have been restricted within their basins. The traces of a slow and successive retreat of the ocean are seen everywhere: the traces of the universal deluge are not apparent anywhere. Water, the earth, and its salts are the only 'principles' which have contributed to the formation of animals and vegetables. These, after a more or less short life, are reduced into an earthy substance proper for the formation of new organisms, which perish in their turn." He notices the layers of different kinds of rock, the presence of fossils and petrifactions, and considers that water alone acted, and not fire.

Lamarck, the founder of Philosophical Zoology, came before the scientific world, in the first instance, as a botanist. Like many naturalists of his century, he studied nature in preference to disease after having passed the portals of the medical profession. His love of anatomy, however, never ceased, and bore great fruit in subsequent years; but in the first instance he studied plants, and became practically acquainted with those of large districts in France. He passed some ten years working patiently at his 'Flore Française,' and gradually elaborated a classification which was the result of much consideration.

Many years had elapsed since the artificial method of Linnæus had been founded, and in the meanwhile the natural system of the Jussieus had been used and appreciated. Lamarck very properly considered the first method of great use in finding out the name of a plant, and gave the last its true value as a scientific classification, which alone could serve as a fixed base for any anatomical and physiological investigations. He considered that the natural method placed a plant or animal in the *midst of those with which it had the greatest number of important structural resemblances*, and that the artificial system isolated and distinguished a form from all others. He saw clearly that the natural method must be true, and that it must be founded upon the nature and structure of the most important organs without considering whether they were to be readily observed and recognized.

Giving both methods their due, he utilized them. In the

'Flore Française' the classification was a combination of the systems of Linnæus and Jussieu, and was analytical. The student was led to the required result by choosing between two contradictory characters taken from the most apparent and most readily seen structures. This analytic or dichotomous method was enlarged upon by De Candolle; and it has even been used in other branches of natural history. For instance, M. de Fromentel employed it in his work on the Fossil Corals. There is no doubt that the plan has not the simplicity of the Linnean system; and it may be said that it is more easily used by the advanced botanist than by the student. When the 'Flore Française' appeared, France, thanks to Rousseau, was botanically inclined, and the work, a very admirable one, at once placed its author high up in scientific estimation. He was a Member of the Académie des Sciences, and subsequently was associated with Daubenton, who had charge of the Herbaria of the Cabinet du Jardin du Roi.

Years rolled on, and the future zoologist reached the age of fifty, when, *nolens volens*, he was made a Professor in the Museum of Natural History and had the Vermes, of which he knew nothing, given to him as his special objects of study and charge. Lamarck, however, entered his new studies admirably trained, and very shortly afterwards he began to classify and teach. As years rolled on, he wrote his great work 'Les Animaux sans Vertèbres,' having evolved the great idea that the Animal Kingdom must be subdivided into the Vertebrate and Invertebrate divisions. Of the merits of that work, every student of the lower animals who cares to seek the origin of what is now common knowledge must entertain the highest opinion. It is not a *Systema* like that of Linnæus, but, in addition to being a careful classification on the natural system, it comprehends some remarkable chapters on philosophical natural history, which are also elaborated in the 'Philosophie Zoologique.'

The 'Philosophie Zoologique' is a work rarely read; but it was far in advance of its day, and it dealt with those great questions which were subsequently so thoroughly thought out and published by Charles Darwin. The book contains:—

1. The general principles relating to the study of the Animal Kingdom.

2. The observed and essential facts which are necessarily considered in the study.

3. The considerations which relate to the non-arbitrary distribution of animals and to the best methods of classification.

4. Inductions and deductions founded on received facts, and which are the foundations of a true philosophy in science.

In the first part Lamarck treats of Art in Natural Science, such as the details of classification by which we arrange, divide, and write. He treated of the great groups and wrote:—"That amongst her productions Nature has not really formed classes, orders, families, and genera, neither has she created *constant*

species, but only individuals which succeed each other, and resemble those which produced them. But these individuals belong to infinitely diversified races which present shades of distinction in all their forms and in all their degrees of organization, and each one of which maintains its character without mutation *so long as no cause of change acts upon it.*"

He wrote :—" There is an order in Nature, and it can be recognized by the structural affinities of living bodies. It is the least recognizable when forms are at the extremities of a scale, and when their organization presents the greatest possible differences. This order, recognized by relations of structures, should replace all artificial systematic classifications."

Lamarck proceeds to define the primary classificatory terms, and recognizes the beauty and value of the orders of Linnæus.

In considering the structural relationships of animals, Lamarck places the organs in the following order in reference to their importance—those of locomotion, respiration, circulation. With regard to the Vegetable Kingdom, he considered the order to be —the embryo and its accessories, the sexual parts of the flower, the floral envelopes, the envelopes of the seed, and the reproductive bodies, " qui n'ont point exigé de fécondation." It was after studying their structural relations that Lamarck stated he recognized that the Infusoria could not be associated with the Polypes in the same class, and that the Radiata could not be confounded with these last—that the Vermes were an isolated section, that the Arachnida could not be classified with the Insecta. He was able to point out, on this plan, that the break was vast between the highest Invertebrate, which he considered might be one of the Heteropoda, and the possessor of the simplest osseous or cartilaginous spinal column.

Lamarck then considers the genus; but time will only permit me to select passages from his works relating to species. He suggests that the endeavour to define what is called a species and the attempt to discover whether species are absolutely constant and as ancient as Nature herself—having lasted on, as they now are—are not necessarily futile undertakings. On the other hand, he says it is worthy of consideration whether species have or have not been subjected to changes of circumstances which have been relational to them, although acting with exceeding slowness, and whether specific forms have or have not changed in character and shape during lapse of time.

He states that the elucidation of this question of modification is not only of interest to our zoological and botanical knowledge, but is necessary for our comprehension of the history of the earth.

Then comes the celebrated definition of species :—"A collection of similar individuals which were produced by other and similar individuals." Lamarck proceeds: " This definition is exact; for every living creature *nearly* resembles those which produce it." " That the species," he writes, " is constant is not true; it is not

distinguishable by invariable characters; and the old idea of the duration of species from the beginning is readily disproved by the naturalists who study the treasures of the museum."

"Everybody," he says, "knows how difficult it is to recognize or to determine species, on account of the existence of races and varieties which merge, shade by shade, into neighbouring species."

"Species only have a constancy relational to the duration of the circumstances under which the individuals have lived. Many genera of plants and animals are of such magnitude, on account of the number of species, that the study and distinction of the species are almost impracticable. The species of these large genera arranged in series and allied by their structures show such slight differences with those which could be placed next to them, that they merge and shade into each other; and thus the species become, as it were, more confounded. The isolated species only exist because the gaps between them are not yet filled up." "I do not," Lamarck continues, "assert that animals form a simple series, everywhere equally intershading; but I would say that the series is a branching one, gradating irregularly, and which has no discontinuity in its parts, or which, at least, has not always been discontinuous; for there are lost species to account for."

"A mass of facts," he says, "teach us that when individuals of a species change their localities, climate, and habit of living, they are influenced thereby, and change little by little in the consistence and proportion of their parts, shape, and organization, so that every part participates, in time, in the mutation. Simple variation of individuals is produced, at first, under varying conditions under the same climate; but in long periods these constant vicissitudes operate upon succeeding generations, and lead to structural and necessary distinctions. After many generations, the individuals which were once in one species would find themselves transformed into another and distinct one." Lamarck wrote that he perceived the importance of a method in Nature which consists in preserving in newly reproduced individuals *all that the results of life and its conditions have produced in the organization of the ancestral forms.*

The influence of hybridity and the ability of hybridization to perpetuate species is denied. He disposes of the argument against variability used by certain naturalists in consequence of M. Geoffroy's Egyptian collection showing no specific changes. He states that the conditions have not altered, and therefore the forms have remained as they were. He adds:—"But we may rest assured that this appearance of stability of things in Nature will always be taken 'par le vulgaire des hommes' as a reality, because in general they only judge from personal experience."

Lamarck did not recognize life to be any thing else than a natural process. He speculated on the probability of sponta-

neous generation in the most simple forms of life only. He says it is not proved not to be the case.

A most extraordinary passage deals with the kind of matter which should most readily receive the first traces of organization. It should be of gelatinous or muco-gelatinous consistence, coherent, but verging on fluidity. Here is Lamarck's physical basis of life.

There is a short paper in the 'Philosophie Zoologique,' "Des Espèces dites perdus." He notices that very few fossils are exactly like existing species, that it is not safe to argue that the floor of the sea and the remote parts of the earth may not yield species hitherto considered to be extinct. He states that when any fossils belong to recent species, they are found in the newest strata; and he asks, May not extinct species be really existing in the form of recent ones into which they have passed by modification during long periods of time?

Then he takes up the argument that altered conditions, climate, and the necessary wandering over the earth necessitate *changes in the besoins* (*wants and habits*) *of animals*. That if organs are not used as much as formerly they degenerate, and, on the contrary, they increase and alter with extraordinary use. So that in long periods the *besoin* leads to specific modifications.

It is perfectly evident to every student of Lamarck who reads for information and not to jest, that the *besoin* (*want, requirement*) is not a *positive active wish* on the part of the animal.

With regard to the Vegetable Kingdom, Lamarck accounts for variation by alterations in the nutritive and circulatory processes. He stated that the Animal Kingdom arose with the lowest forms, and that the wonderful complexity of the highest is due to progressive modifications due to changes in external conditions during long periods. The earth itself has been subject to a law of general progress; and it is not necessary to suppose universal catastrophes.

As if to complete the argument, Lamarck treats of the influence of cultivation on plants, and writes, as regards animals:—"How many very different races amongst our pigeons and fowls are produced by raising them under different conditions in different countries. We may look for them in vain in Nature."

Lamarck divided the Animal Kingdom into animals which are apathetic—those which move in consequence of the excitement of structural irritability. Others have sensations added. Others have irritability, sensation, consciousness, and the faculty of evolving certain ideas, and of using a will subject, however, to propensities definite in their object. Others form correct ideas, think, and have a free will and no overruling propensities. He distinctly relates these faculties to organs which have become evolved during ages with the other modifications of specific forms. Sensation, will, proclivity, capacity for evolving ideas and utilizing them are successive steps accompanying progressive complexity of organization.