

ART. VI. NATURAL HISTORY, AND ITS PLACE IN THE SCIENCES.

BY T. F. KNIGHT.

[Read March 8, 1869.]

IT is somewhat surprising that with the desire for knowledge and the faculty of inquiry inherent in man, the ancients, while they apprehended the philosophy of nomenclature* and the true principles of classification, † penetrated so little into the domain of nature, which to them was in reality a *terra incognita*. The reason of this is summarily accounted for by the disciples of the inductive philosophy, from the doctrine that the process of induction or experiment was unknown to the ancient philosophers. It ought rather to be affirmed that it was known only in theory, and was never applied to the purposes of investigation and discovery.

The primitive names which were given to natural objects by the ancient civilized nations, were founded on the most marvellous fancies. The Greeks believed that “the narcissus which bends its head over the stream, was originally a youth who in such an attitude became enamoured of his own beauty; the hyacinth on whose petals the notes of grief were traced recalled the sorrow of Apollo for the death of his favourite Hyacinthus: the beautiful lotus of India which floats with its splendid flower on the surface of the water, was the chosen seat of the goddess Lackshmi, the daughter of Ocean. In Egypt too, Osiris swam on a lotus-leaf, and Harpocrates was cradled in one.” Although the powers of observation were employed in the earliest times to detect the external differences of objects, no step was made towards scientific arrangement.

Among the less fanciful Hebrews, we find from their earliest records that natural objects both organic and inorganic bore permanent and infallible distinctions that correspond to the conventional names now in use; ‡ and, after they were stripped of their poetic embellishment, we find the terms used in the language of common life, by all nations, retaining their place for ages.

Some steps were however made in the inviting path of Natural History ere the classic period shed its resplendent light upon the

* Cratylus of Plato.

† Topics of Aristotle.

‡ The oak, cedar, bramble, rose: brass, iron: precious stones in high priest's breastplate.

slowly advancing world. Egypt had long had her fish-ponds, and was practised in the art of pisciculture. Solomon among the other evidences of his being wiser than all men, “spake of trees” says the sacred record, “from the cedar tree that is in Lebanon, even unto the hyssop that springeth out of the wall?” Herodotus too, shows us that a taste for natural history had, in his time found a place in the minds of the Greeks.* But more certain, and abundant knowledge was at a later period transmitted to the west from the Macedonian colonies, respecting those products of nature and art which had hitherto been only imperfectly known from commercial intercourse, or from the narratives of travellers to distant countries. Humboldt remarks that “the knowledge of a greater portion of the earth may now be said to have been opened for the first time.” “The objective world” he adds, “began to assume a preponderating force over that of mere subjective creation, and while the fruitful seeds yielded by the language and literature of the Greeks were scattered abroad by the conquests of Alexander, scientific observation and the systematic arrangement of the knowledge already acquired, were elucidated by the doctrines and expositions of Aristotle.” How just an eulogy of this great mind, who in almost every department, may be looked upon as the representative of the highest stage of knowledge and system attained by the Greeks; and, in his peculiar sphere unapproached by the loftiest intellect of any age! His works on Natural History which have been rescued from the spoils of time, are a valuable monument of the state of such knowledge in his generation. His treatise on plants has never been recovered.

A great accession was made to the knowledge of Natural History under the Egyptian Ptolemies, during which dynasty a museum of Natural History was founded and endowed at Alexandria. The Romans in this as in other subjects were practical, not speculative. Amongst the celebrated names which Rome has added to the world’s *litterati*, the name of Pliny is held in veneration as an industrious compiler of the knowledge of Natural History current in his day. Pliny’s voluminous compilation acquired an almost unlimited authority, as one of the standards of botanical knowledge down to the Middle Ages.

* I. 193.

We now reach a period of darkness and mental lethargy, when commentators and mystics succeed the naturalists of better times. The only important service rendered to human knowledge during this period was the preservation and transmission to more enlightened times of the intellectual treasures of antiquity. Pliny and Aristotle now assumed an Arabic dress, and were the foundation of instruction in all the Arabian academies, from Bokhara in the east to Cordova in the west. The flourishing commerce of the Arabians made them practically acquainted with the products of lands unknown to the Greeks and Romans; but they never learned the art of converting their practical into speculative knowledge. They treated of plants only in so far as their use in medicine was concerned, and indulged the most superstitious notions respecting their healing properties.

The revival of Learning gradually dissipated the mist of superstitious erudition which characterised the Middle Ages. Ingenious and vigorous writers exposed the errors of the Arabians and even of Pliny; and the powers of observation were called into active exercise. Aristotle had divided animals into Quadrupeds, Birds, Fishes, Cetaceous, Testaceous, Crustaceous, Mollusks and Insects; and established the distinction in some of these classes of viviparous, oviparous, vermiparous, and had marked the differences in the teeth of animals. He had also a clear perception of the distinction between genera and species. He thus seems to have indicated in Zoology the founding of a system of nature. The division of vegetables into trees, shrubs and herbs, and their properties into aromatic, alimentary, medicinal, and vinous, now gave place to a more scientific classification founded on their structure. Hence, plants having a tubular flower, of which the mouth is divided into lips, are for the first time termed *Labiatae*; others whose blossoms contained four petals arranged crosswise were called *Cruciferae*; others, whose flowers were more complex were called *Compositae*. Thus far we arrive at *species* included in *genera*, and genera grouped into *families* or *orders*.

We have come now to the latter part of the sixteenth century. We see the dawning of systematization based on observation of the physiological characters of organic nature. The recently discovered continent excited the curiosity of the observers of nature. Indus-

trious explorers both Dutch and English had traversed the East Indies; Hans Sloane (whose Museum in London is an object of interest to botanists to this day,) collected the plants of Jamaica; and other collectors both in the West Indies and the American continent found objects new and interesting. About this time public botanical gardens were established all over Europe. The wars and troubles which prevailed over Europe during the greater part of the seventeenth century greatly checked the progress of science. At length, when a period of tranquillity succeeded, science shone forth with a new lustre. Contemporary with Newton flourished the celebrated English naturalist John Ray, who was the model of the systematics long after his death in 1705. Ray added many natural families to the science of Botany. He constructed his system partly on the fruit and partly on the flower. Tournefort, a French naturalist, who published his method in 1700, succeeded in giving to the characters of genera a degree of exactness never before attained; and inserted in his work a figure of the flower and fruit belonging to each genus. In Zoology, important strides were made in the seventeenth century from the causes already adverted to, especially in Ichthyology. On this sub-science Ray and Willoughby in England and Artedi in Sweden, poured the light of their genius.*

We now come to the period when flourished the greatest naturalist of that or of any age—*Linnæus*. As his life and labors can become familiar to any lover of books, I will defer a notice of his contributions to the cause of science to the second section of my paper; and that must be brief. The permanency of Linnæus' influence, even on the minds of this generation brings us almost down to the present hour, and exalts him to contemporary fame.

Before discussing the subject of classification, in which I purpose to treat of the antagonism which is maintained between the Artificial and the Natural method, it is incumbent upon me to refer to Cuvier the great expounder of the latter system, as Linnæus is recognized as the inventor of the Artificial system. The Artificial method is allowed to be Natural as to the narrowest members of the system, viz.—species and genera; but is called artificial as respects the wider groups. Hence Linnæus' method is pronounced to be artificial

* Whewell—Hist. Induc. Sciences.

as respects his classes and orders, founded upon the number of the stamina and pistils, which in many instances is maintained to the injury of natural alliances ; and which Linnæus himself was compelled, in not a few instances to depart from, so as to preserve the obvious association of certain genera. Linnæus was eminently successful in detecting good characters for an artificial system whose principal use is the ready identification of allied genera. It was he who introduced into the characteristics of classification the number of rays of the fins in fishes. A Natural method is an attempt to provide positive and distinct characters for the *wider* as well for the *natural groups*. This principle which was but dimly seen in the study of vegetables, was more readily perceived in the study of animals, in which physiological relations of the parts are so manifest that they cannot be overlooked. Hence the superiority of natural systems in Zoology may be more generally allowed than in Botany ; and no arrangement of animals which, in a large number of instances, violated strong and clear natural affinities, could be tolerated because it answered the purpose of enabling us easily to find the name and place of the animal in the Artificial system.* This incongruity was apparent to the inquiring mind of Cuvier ; and in his *Regne Animal* first published in 1817, he introduced a new arrangement in the orders of *fishes* on the principle founded, not on their external parts but on their internal structure. But we witness the most attractive of his achievements in the recognition of the four great natural divisions of the animal Kingdom—the *vertebrata*, the *mollusca*, the *articulata*, and the *radiata*. This arrangement has maintained its ground, amidst all the varieties of minor classification ; and it is not likely to be disturbed by any new discovery. This is a signal proof of the excellence of natural arrangement that being founded on internal structure it must be permanent.

I have thus far traced Natural History to its culminating period ; I have now to deal with it as a science, to explain its laws and to define its boundaries. The only successful manner of showing the *rationale* of classification, is from a thoroughly philosophical standpoint. The objects which meet the senses, in the study of Nature are form and place, and the constitution and properties of

* Whewell.

bodies, *e. g.*, in the study of chemistry the objects of observation and investigation are the elements and constitution of bodies; of mechanics the powers of bodies; of organic nature the form, situation, structure, and functions.

There have appeared to me, the more that I have sought to penetrate the domain of knowledge, as well as to study the operations of the human mind in its pursuit of truth, that there are three grand instruments—*organa*—which every enquirer employs in the investigation of the moral and physical world around him. These are Language, Mathematics, and Experiment—language for the acquisition and communication of ideas, mathematics for the determination of number and quantity, and experiment as composed of the dual operations of analysis and synthesis. To accomplish analysis we observe, compare, and separate; to accomplish synthesis, we combine and re-organize. As soon as the phenomena which observation has discovered are defined and comprehended by the process of induction, general laws are established and true classification begins. (Any classification based on accident, or external marks, or locality as *Scomber* is no true classification.)

In observing any natural object we first discern a likeness to some object previously seen, and we at once pronounce it to be of a certain kind. (Aristot. genus). Next we examine more closely, and discover that it is capable of being narrowed into a more exact description and definition. Hence proceed the ideas in Natural History of *genera* and *species*; and these distinctions correspond with the best canons of the ancient philosophy. (In Aristotle difference is added to the genera and determines the species). To express this minute description, certain terms are used to define its features and properties, which are appropriate and intelligible, and this want creates a *terminology*. The terminology of the old naturalists was meagre and indefinite, and to Linnaeus is due the formation of an exact and descriptive language for botany which has shed clearness and precision over all parts of the science. Zoology, geology, and mineralogy, have each their descriptive language, gradually improved and perfected through the labours of successive naturalists.

Next comes the distinguishing of similar objects; and this gives

rise to what we call *nomenclature*. We probably gave the object at first sight the conventional name, which might be arbitrary and of accidental origin; if in the service of science we would give it a scientific name, corresponding to its external form or internal structure. This name will probably indicate the *genus*. We also find on a closer examination, that not only is there a likeness to the known objects which it resembles, but important differences; and this necessitates a new name to describe a narrower circle of objects having a *specific* difference. This we denominate *species*. The genus may be called the vestibule to scientific observation, and being determined by partial knowledge is not invariable. But in the species of organized bodies there is an invariability which nothing can change; and which is invaded only by death or extinction. By the same process of investigation a still narrower circle of *varieties* through accidental causes is discovered, and to this as to the other degrees of classification we apply the law of nomenclature.

Nomenclature is so far extended to genera, species, and varieties. It is now applied to a wider classification; and it is from this point that the antagonism of systems may be said to begin. For a readier identification of a great multitude of objects which have something in common, *genera* are grouped into *families*—*families* into *orders*—*orders* into *classes*—*classes* into *divisions*—and these into *kingdoms*—the widest generalization; but in the progress of scientific discovery, a closer examination of those forms of organic bodies which are near the boundary lines of the Animal and Vegetable kingdoms reveals that these artificial distinctions are often imperfect; and even the distinctions that unite the orders into classes, and the families into orders. I have described the characteristic features of the antagonistic systems—the artificial and the natural—in my remarks upon the two eminent naturalists Linnæus and Cuvier, and I need not repeat the description. It has been said of the natural system that it is based on types, not on definitions, and the main ground of objection to an artificial system is, that it is anti-progressive—that it stops at a given stage of progress, and dogmatically determines a fixed nomenclature. After all that has been urged by the respective adherents of the two systems, it must be admitted that every classification is to some extent artificial. Terminology is art.

Nomenclature is art. Linnæus himself fully comprehended the natural system as the goal of the explorer. Besides the recognition of the two primary divisions of the vegetable kingdom, he taught that the artificial classes are a substitute only for natural, until natural are detected. And the title of his great work "*Systema Naturæ*" indicates the inseparability of the two constituents in every system—*art* and *type*.

Any discussion of those respective methods would be imperfect without a reference to the Jussieus, father and son, who were the acknowledged inventors of the Natural System of Botany. This system in France and the United States has very generally displaced the Linnæan system; but it is not favourably entertained by German and English botanists. "The object of the Jussieus," remarks Dr. Whewell "was to obtain a system which should be governed by the natural affinities of the plants, while, at the same time, the characters by which the orders were ostensibly determined, should be as clear, simple, and precise, as those of the best artificial system." Linnæus' system, while it accepts the natural genera, does not seek natural families. The largest divisions, or classes, are arranged according to the number of the stamens, as *monandria*, *diandria*, *triandria*, &c., and the orders of each of these classes by the number of styles as *monogynia*, *digynia*, &c; but this system, though it regards natural characteristics, leaves certain natural affinities untouched. The Jussieus', on the contrary is founded on a larger number of natural affinities of organization and function. The fame of Linnæus, however, can never be obscured, as respects his exact terminology, the determination of genera, and the binary nomenclature—or the addition of the specific name instead of a descriptive phrase, to distinguish the species. And it is due to Linnæus to acknowledge that, in the last and highest division of the vegetable kingdom into Phenogamia and Cryptogamia, he indicated the natural method which was perfected by these two distinguished botanists.

In the Mineral Kingdom, although its division into classes and orders and even genera has been attempted, it is difficult to conceive how any system of natural classification can be introduced. Because there is no perpetuation by propagation, species is excluded; but affinities might become a basis of classification if the laws of

combination of their elements could be accurately discovered. The knowledge which we principally seek concerning minerals is their chemical composition; but we must classify by other than chemical characters, if we would establish for minerals a natural system. Dr. Whewell has pertinently remarked, "If chemistry be called upon to supply the definitions as well as the doctrines of mineralogy, the science can only consist of identical propositions." As a guide to the recognition of mineral substances, their external characters were first compared, then chemistry was applied to analyze their properties, and thus a mixed system of classification was early in vogue. And indeed, this is the method, which in its general principle has been continued to our own time. (First were *earths, stones, metals*; then earths into *calcareous, siliceous, argillaceous* and *the like*; and stones and metals into their several component characters.) To relate the attempts and failures at systematic reforms in the science of mineralogy would be tedious. Suffice it to say, that the elevation of this science to the beautiful generalizations which characterize zoology and botany, is a triumph reserved for future naturalists—if ever accomplished.

So much as to the *rationale* of Natural History—properly so called. I will now offer a few observations on its place in the sciences. There seems to be something indefinite in the term Natural History, even as comprehending the several sciences which are usually associated under this title. In the earlier ages, when the observation of the natural world was comprised within a few isolated facts—a mere record of the conventional name and locality of natural objects, as well as their use—the term would seem applicable, and would present an analogy to the term history as applied to the lives and actions of men. But inasmuch as in later times, the discovery of the principles which are deduced from human actions has given rise to another title distinct from the mere record of human deeds, viz: the philosophy of History—the great advance which Natural History (so called) has made in regard to classification and the discovery of general laws, the ancient title applicable to the meagre collocation or researches of early times is no longer appropriate. The observations of the ancients, as I have shown, had scarcely reached the incipient stage of classifica-

tion, much less the more advanced stage of general laws ; and with respect to the latter stage, it is admitted by the most enlightened writers on science of the present day, that no aggregation of phenomena is entitled to the appellation of a science until it has advanced beyond the stage of mere classification.

The definitions of Natural History are in most instances so vague and contradictory, that we look here in vain for any clear conception of the true boundaries of this interesting department of knowledge. Natural History has been defined as “that part of natural knowledge which teaches us to distinguish and describe the objects of nature—examine their appearance, structure, properties and uses—and to collect, preserve, and arrange them.” This is the range of ideas generally associated with the study of Natural History. There is a more comprehensive definition than this—“that which considers under a single point of view, all natural bodies and the common result of all their actions in the great whole of nature. It determines the laws of the co-existence of their properties ; it establishes the degrees of resemblance which exist between different bodies ; and it classes them according to their degrees.” This definition also admits of the distinctions of general and particular as to degree of minuteness in description. If we were to understand by the term Natural History, the history of nature, our sphere of investigation and discovery would be unbounded, but the technical meaning of the term confines it to a description of animals, plants, and minerals. The sphere of observation is thus partitioned into three great divisions—the Animal Kingdom—the Vegetable Kingdom—and the Mineral Kingdom. But it is evident, that as the several objects of investigation are better comprehended, and reach successively the stages of classification and science, a new and well defined name is attached to each sub-division. Thus we have under animals—Ethnology, Zoology, Comparative Anatomy ; under plants—Botany and Vegetable Physiology ; under minerals—Geology, Mineralogy, Comparative Geology, Crystallography and some other *ologies*.

But I want in my *ideal* to embrace the whole of visible nature ; and thus I consider, Mr. President, that the title which you have given to the Society whom I have the honor to address to-night is the most appropriate that could have been conceived. It indicates

the true scope of natural investigation. The lamented Humboldt was the first who employed such wonderful powers of generalization in comprehending the vastness and oneness of nature. He himself acknowledges in the second volume of the *Kosmos* that the elder Pliny is entitled to the merit of first embracing nature in this wide generalization. Quoting the ancient naturalist, he writes, "The path on which I am about to enter is untrodden; no one amongst my own countrymen, or amongst the Greeks, has as yet attempted to treat of the whole of nature under its character of universality. If my undertaking should not succeed, it is at any rate, both beautiful and noble to have made the attempt." He adds, "He (Pliny), in his *Historia Naturalis*, (composed in a true spirit of cosmical description) recognises the necessity of representing the forces and the glory of nature as a great and comprehensive whole." "A grand and single image floated before the mind of the intellectual author, but suffering his attention to be distracted by specialities, and wanting the living contemplation of nature, he was unable to hold fast this image." Not so the distinguished modern. He traversed every continent, and laid all lands under contribution to illustrate the laws which govern the harmonious and sublime phenomena of the visible creation.

In the brief survey of nature which I have attempted, I have not, it will be seen, by any means traversed the extent of this grand conception. There are many topics of interesting enquiry that I cannot touch. Of Geology and its cognate sciences I have said nothing, because it is so vast in itself that, the merest outline would exceed the limits of a single paper. And further, of Astronomy or Meteorology, incompetent as I should feel to undertake their exposition, I dare not if I could essay any description.

If I could so far overstep the bounds of modesty as to criticise the literature of science, I should be tempted to assail the existing inconsistency of trivial names applied to species, though sustained by the example of the renowned Linnæus. Although it is a dangerous experiment to alter unnecessarily the nomenclature of science, the natural system of nomenclature it is to be hoped will be generally applied to the narrowest distinctions of natural objects. It is no guide to the novitiate in scientific research to be supplied with signs that have their origin in accident only; but on the con-

trary, a nomenclature founded on some dominant type of organization or of function would be a ready guide to *every* explorer in the boundless field of nature. There are also contending theories that are of the profoundest interest from a psychological point of view, but they are for separate treatment, and will not I trust be excluded by the well defined title of the Society should any one attempt at any future time their discussion.

There are other topics obviously suggested to the mind in the study of natural science; but I have necessarily devoted so much space to the subjective, that the objective or natural science outside of itself, can have but a brief notice. Indeed, I can no more than indicate its scope.

1. It suggests to the human mind the idea of a great first cause or intelligent artificer of nature; and under this head might be discussed the doctrine of *final causes*.

2. Its study enlarges and strengthens the intellect; and is thus an important branch of education.

3. Its economic uses; and here a vast field opens to the view, and which would embrace almost every pursuit of art and industry amongst mankind.

I have not in this brief survey of natural science applied my enquiries to the discoveries and improvements of the present century. It was not essential to my purpose to do so, and so wide a field of research would have daunted the most confident, as well as the most acute of investigators. The great principles which lie at the basis of natural science had their solution at the close of the last, or at the beginning of the present century. Even Geology and Paleontology, the most recent of the natural sciences, had attained a solid foundation; when thus early the intimate connection that subsists between Zoology and the latter science was clearly demonstrated by the renowned Cuvier. Many and great conquests over ignorance and prejudice have however been made during this nineteenth century. By comparison of synonyms, and the agency of the press, and the industry of observers, countless interesting and instructive objects have enriched the public and private museums of all countries; and by the ever evolving power of induction, new laws have been promulgated, and have contributed to the perfection of these sciences. It is a pleasing reflection to the lover

of nature, that while in the field of politics men are still engaged in intrigue, and in the theatre of war dynasties are still created or destroyed, the friends of natural science, each in his several sphere, are with loving hands assisting to erect an enduring temple that even Time cannot destroy. The objects that furnish material for thought may perish; but the immortal fruits are lasting as the mind itself.

If then, the observation and study of nature be so elevating, so profitable, and so enduring; and if we fully comprehend the sphere of natural science, we shall not restrict ourselves to contemplation only of the earth beneath our feet with its wealth of life and wonder and beauty; but we shall assert the dignity of our origin, and lift our gaze to the atmosphere that envelopes us, and even penetrate with the aid of its cunning implements the mysterious depths of the illimitable space. We shall not be content with pursuing our investigations only for the gratification which they afford; but we shall endeavor to discover new appliances for the promotion of industry, and wealth, and the happiness of the human race.

ART. VII. ON THE METEOROLOGY OF THE GLACE BAY COAL DISTRICT. BY HENRY POOLE.

[*Read April 13, 1869.*]

THE accompanying register of the weather observed here in the year 1868, is in continuation of the Meteorological Register forwarded for the year 1867.

The mean barometrical readings for the two years vary very little: 29.8854 inches in 1868, against 29.8524 in 1867. The readings are corrected to the freezing point, and for an elevation of 60 ft. above the sea level, and also for the force of vapour. The force of vapour is an important element in the barometrical pressure, and during the year it gave a mean difference of 0.193 or nearly the fifth of an inch. The highest corrected reading was 30.611 on the 7th March. The lowest was 28.809 on the 6th February.

In February the greatest variations in pressure and temperature were observed. On the morning of the 5th the barometer stood at