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THE

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NEW SERIES.

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ON THE HYPOSTOMA OF ASAPHUS CANADENSIS, AND ON A THIRD NEW SPECIES OF ASAPHUS FROM CANADIAN ROCKS.

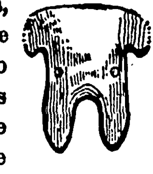
BY E. J. CHAPMAN,

PROFESSOR OF GEOLOGY AND MINERALOGY, UNIVERSITY COLLEGE, TORONTO.

Read before the Canadian Institute, December 18th, 1858.

I. ASAPHUS CANADENSIS.

In our recent description of this new species (Canadian Journal, vol. 3, p. 230; and Annals of Natural History, July, 1858), we were unable to give any definite information respecting the form of the hypostoma. Since the publication of this description, however, Mr. J. F. Smith, of Toronto, has found a well preserved hypostoma (evidently belonging to the species in question), in the Utica slate of Whitby, in Canada West—one of the principal localities of the species. By the kindness of Mr. Smith, whose zeal in the service of Canadian palæontology we have already had occasion to acknowledge, we are enabled to lay before our readers a figure of this hypostoma, somewhat enlarged. In its outline, the hypostoma of *Asaphus Canadensis*, as in all the recognised species of the genus *Asaphus*, exhibits the well-known fork or "horse-shoe" at its lower or buccal extremity. The upper margin or so-called "base" is partially obscured, and the wings, or ascending processes by which the hypostoma was attached to the under side of the glabella, are also in part concealed. Delicate, irregular striæ are seen on each side of the hypostoma; and two small pits occur, one on each side, at about two-thirds of the distance between the buccal points and the base—our specimen agreeing in this respect with the hypostoma of *Asaphus platycephalus* (= *Isotelus gigas**). The space in the centre, between the pits, is somewhat raised.



Hypostoma of *Asaphus Canadensis.*

This hypostoma is chiefly interesting as proving our species to be a true *Asaphus*, and not an Ogygia, with which in other respects it has certain affinities. In the Ogygia type, the hypostoma presents an oval outline at its buccal extremity.

II. ASAPHUS HINCKSII.

(A New Species.)

Our colleague, the Rev. William Hincks, Professor of Natural History in University College, Toronto, having been lately on a botanical excursion to the Blue Mountains near Collingwood, in Canada West, collected at the same time a few fossils; and these he has had the kindness to place in our hands. Together with the more common or typical species of the Utica slate (*Graptolithus priodon*, *Triarthrus Beckii*, *Asaphus Canadensis*, &c.), there is a nearly perfect specimen—so far as regards its outline—of a trilobite closely related to *Asaphus platycephalus*. It occurs in a piece of limestone, a portion apparently of one of the calcareous bands interstratified amongst the bituminous shales of the Utica slate. For the information of distant readers, and those unfamiliar with our geology, it may be stated that the Utica slate belongs to the Lower Silurian series—beyond which, with us, as in Europe, the genus *Asaphus* does not appear to pass. Although exceedingly opposed to the extreme multiplication of species, so prevalent amongst palæontologists of the present day, we are compelled, almost against our will, to regard this Collingwood trilobite as new. We beg therefore to name it after the Rev. Professor Hincks, from whom we received the specimen. The general form is that of a narrow oval, with the longer to the shorter or transverse axis about as 5 to 3. The length, in proportion to the breadth, appears somewhat greater than this,

* Also with that of *A. tyrannus*, Murchison, and other European species.

on account of the side lobes being strongly arched. The crust is entirely removed from the thorax, and is only present in traces on the head-shield and pygidium. The latter, like that of *A. platycephalus* (=*Isoletus gigas*), is destitute of segment-markings except in faint traces on the surface below the crust, and the axis is but slightly pronounced. The body-axis, with eight segments, is about as broad as each of the side lobes, or perhaps a little broader—agreeing also, in this respect, with *A. platycephalus*. The pleuræ curve *backwards* (or towards the caudal extremity) at their points; and on each pleura—at about one-third of the distance from the point to the axial furrow, and close to the upper margin—there is a *small but deeply indented pit*. Unfortunately, the stone is broken away for a short space along the outer side of each axial furrow, so that the grooving on the pleuræ (if any be present) is not seen. The outer halves of the pleuræ (speaking always as to the surface under the crust) are however, quite free from any traces of a furrow. If ever present, accordingly, the furrows could only have extended a short distance from the axial groove. The surface of the head-shield is much destroyed, but the lower end of the facial suture is seen to correspond with that of *A. platycephalus*; and the genal extremities terminate in very slightly rounded angles. The usual asaphus-striæ are shewn on the margin of the shell, on both the head shield and pygidium.

OUTER EXTREMITIES OF THREE PLEURÆ OF *Asaphus Hincksii*.

Asaphus Hincksii differs thus from *A. platycephalus* by the peculiar and strongly marked indentations on the pleuræ; and by the ends of the pleuræ curving backwards instead of forwards, and terminating in well-developed points. In *A. platycephalus* they curve forwards, and are rounded off in conformity with the rounded genal angles of the head-shield. The annexed tabular distribution of the four species of Asaphus occurring in Canada, brings out these points of difference more distinctly.

Caudal shield with segment furrows	Head-angles terminating in long points.—*A. Canadensis*.
	Head angles rounded.—*A. Halli*.
Caudal shield smooth.	Pleuræ curving forwards.—*A. platycephalus*.
	Pleuræ curving backwards.—*A. Hincksii*.

Or :—

Pleuræ curving backwards.	Head-angles terminating in horns; pygidium furrowed.—*A. Canadensis.*
	Head-angles slightly rounded; pygidium smooth.—*A. Hincksii.*
Pleuræ curving forwards.	Pygidium furrowed.—*A. Halli.*
	Pygidium smooth.—*A. platycephalus.*

The characters given above, and more especially those founded on the grooving of the pygidium and the direction of the pleuræ, may be thought by some palæontologists to be of little specific value. The segment-markings on the pygidium may be deemed by these observers as characteristic rather of age than of species; but our specimens of *Asaphus Canadensis*, for example, are quite as strongly furrowed when of large as when of small dimensions; and all the perfect specimens of *Asaphus platycephalus* that we have examined, small as well as large, present on the caudal shield an equally smooth surface. The isolated caudal shields hitherto considered to belong to young individuals of the latter species, should be referred, properly, we believe, to *Asaphus Halli*. Secondly, as to the direction of the pleuræ. As this character is more or less related to the genal conformation of the head-shield, it ought certainly to be regarded as one of no mean value. If two species of Asaphi, with forward-curving and backward-curving pleuræ respectively, be examined side by side, the distinction becomes most obvious. The entire conformation of the pleura is affected by it. The pits or row of single indentations on the pleuræ of *Asaphus Hincksii*, constitute, moreover, a peculiar character.

ON PARASITES.

BY LUCIUS OILLE, M.B.

Read before the Canadian Institute, Dec. 4th, 1858.

With the powerful aids which the collateral sciences afford him, and his own habits of careful observation, the modern student of natural history in ranging over the domain of vitality could not fail to notice this numerous and widely distributed class of organisms. Accordingly, these forms of life have received a degree of attention commensurate with their numbers and importance, and this with decided advantage to the progress of natural science generally.

No more important or welcome contributions have been made within the last few years to the common stock of scientific information than those concerning parasites, whether regarded for their brilliant illustration of the theory of types, the general principles of classification, and the doctrines of physiology, or their practical bearing upon important industrial pursuits, and the science and the art of medicine and veterinary surgery. Although all departments of this extensive subject are full of interest, yet inasmuch as the entozoa and especially those infesting the human subject have been investigated with the most satisfactory results, and present points of singular novelty in their history. I am especially attracted towards them in collecting materials for this article.

Accordingly after a few general observations which the subject naturally suggests, and some necessary brief allusions to individual species of vegetable parasites, which by their singularity or important relations to man especially engage attention, I propose to take into consideration the human entozoa and exhibit as nearly as possible the present condition of scientific knowledge concerning them.

Some allusion will necessarily be made during the course of the investigation to entozoa found only in the lower animals, in order to illustrate more clearly the history of those infesting the human subject. Some important facts I have myself been privileged to verify; the most of them are given upon the authority of Von Siebold Kuchenmeister, and other distinguished and accurate observers. Whatever theories may be broached must be taken for what they are worth.

The rightful study of natural phenomena induces speculation but does not permit the imagination to run away with the judgment, for it continually induces the mind to trace effects back to their causes, and *felix qui potuit rerum cognoscere causas*. It continually submits the results of previous observation to the trial of new facts. Hence, as the field of positive knowledge widens opinions and theories which once seemed correct are found to be erroneous. The ideas of the previous year are continually revolutionized by the discoveries of the present one, until a primitive fact or law is discovered, which then becomes a foundation for the particular branch of science in which it is found, and as far as it extends gives to that branch the character of exactness. "The mathematician prescribes conditions for solution and forms of result. He thus dictates to existence,—he determines beforehand what means are wanted and what form the result shall appear in." The natural philosopher on the other hand dictates nothing, he only endeavors to distinguish between what is essential and what is not, in the train of apparent causes to which any given result may be attributed. Confined to study and observation only, he creates nothing—changes nothing. The great field of the actual is spread before him. It embraces facts only with which he is to become acquainted. He reads natural phenomena right onward and takes them in all their significancy as he finds them. Guided by the light of experience the modern enquirer eschews all theories except such as are based upon unmistakable facts. These he collects on every side, and although they should not bear upon the particular subject of investigation which he may have in hand he does not reject them as worthless, but stores them up for future use, confident that they occupy some position of importance in the economy of nature. Thus whilst investigating a point in the physiology of respiration Dalton discovered a rare species of Spiroptera in the right cavity of a dog's heart. Donné discovered in a similar manner the Trichomonas vaginalis, an infusorial animalcula in the morbid vaginal secretion of a female laboring under gonorrhoea. Accident directed Claude Bernard's attention to the glycogenic function of the liver. Numberless additional examples might be adduced, illustrative of the importance of neglecting nothing in a physical examination.

But a simple observation of great numbers of disconnected and disjointed facts, although it may cause astonishment at the versatility of nature, will afford small insight into the hidden laws which regulate their occurrence.

Facts to be of real value must be estimated comparatively and in their proper connection. Such is especially the case in the subject of inquiry which I have proposed to myself. Nowhere is the necessity of carefully conducted and connected observations of more importance than among parasites, and of these the Entozoa *par excellence*. In one place a parasite is seen to reproduce by gemmation, in another by fissation, and still a third by ovulation. Disconnected observation would never establish a connection between all these three forms, and yet nothing is more certain than that they occur in the same animal at different stages of its existence. A microscopic ovule enclosing a simple organism whose only members are a few small hooklets, is accidentally discovered upon a blade of grass or in a drop of water from a ditch, a cesspool, or stream. Has such a defenceless little creature any relation with the formidable tapeworm that devours the sustenance of the unfortunate victim whose intestines it infests? It was the crowning triumph of German assiduity and skill to establish the fact. In the interior of the tissues and upon the free mucous surfaces of the human and other organisms, secondary organisms of a low grade of development are found, apparently formed in the locality that they inhabit. Whence do they come, and how do they originate? The ancients explained them as freaks of nature, creatures of equivocal or spontaneous generation, *i. e.*, simple results of the concurrent action of the forces at work in the place where they were developed, upon matter collected there. And even since the new era in embryology inaugurated by Redi and Vallisneri there have been, and still are physiologists who maintain the *generatio equivoca* of these beings. Thus we quite recently have Beauchier and Viguier gravely declaring that, "in the predisposition to entozoa the thick mucus of the intestine comes under our consideration, in the first place, as being acid itself it cannot purify the blood from acids. From a portion of the mucus the worms are produced with the assistance of asthenia and adynamia by the *generatio equivoca.* The worms produced are as the analysis shews, still more acid than the mucus from which they are produced. Emetics, drastic purgatives, mercury, antimony and arsenic certainly kill the worms, but weaken the constitution, and thus actually rouse the *generatio equivoca* into activity, and cause the formation of worms," &c., &c. Of such physiologists we must say *scientia non docet.* The zealous researches now prosecuted everywhere in the embryology of the lower animals and especially the entozoa, have, however, routed the partizans of the *generatio equivoca* from their last field of contest, and conclusively established the universal correctness of the doctrine *omne vivum ex ovo.*

The metamorphoses and habits of many of these creatures surpass in strangeness those exhibited by inhabitants of the outer world. Although of simple structure and no particular beauty of form to the eye, the microscope invests them with the fairest proportions and a complexity of structure often surpassing that of higher animals. Active investigations are being conducted among these interesting beings, and new species are continually added to those already known, some of which latter, however, it is found necessary to consolidate. It is seen that there is hardly a species of plant or animal that does not at some time support one or more species of parasite, yet until a recent period very little positive knowledge was possessed concerning them. That a class of organisms so intimately connected with human welfare as these are found to be, should have remained so long without scientific inquiry, might seem strange, were it not that many of the phenomena connected with them are exceedingly obscure, that their habits are often repulsive, and that they are deficient in those qualities which compel attention to the denizens of the desert and forest, the flocks and herds, the lofty forest trees, the feathered tribes and useful plants.

A few hours, a single night often, has sufficed to usher into being worlds of parasite cryptogams upon the cereal crops, to the entire destruction of the farmer's hopes. Famine even has resulted from their malign luxuriancy of growth. Yet amazement and grief until recently were the only emotions excited by these cryptogams. Their effects were seen and deplored, but no rational investigation was made into the nature and cause of the *blight*, as they were called. With characteristic regard only for the cares and necessities of the present, and carelessness of the future, agriculturists plodded on the daily round of toil, hoping that some time the "blight" would cease to destroy, and plenteousness again repay their labors. Not a year passes that millions of dollars are not paid for the maintenance of such cryptogams as the Uredo, Puccinia, Botrytis, Oidium, and many other fungi, yet it is only now that the history of these parasites is being investigated. In time, with the aid of collateral sciences, among which, not the least important is meteorology, a strong hope may be entertained of protecting plants from their destructive ravages.

The investigations of naturalists have been equally successful among animal as vegetable parasites. These creatures are found in vast abundance upon vegetation from the proud forest tree to the humble blade of grass. Of the many hundred species already known which prey upon vegetation the aphides may be particularly alluded to on account of their puny size, terrible voracity and powers of increase. With a single grasp of the hand thousands of these insects may be annihilated, so helpless are they in their own defence, yet by sheer force of numbers they often thwart the most determined effort to stay their ravages. The strange metamorphoses of this species of parasite will be noted hereafter. Seuckart says: "Whenever an animal is too small and too imperfectly armed to overawe and destroy that which its instinct leads it to seek for nourishment, it must be content with robbing it by feeding upon its juices and solid parts." Thus the sheep in pasturing in certain localities swallows unconsciously a dreadful enemy—the six-hooked embryo of the Cœnurus cerebralis encased in its coat of mail: for such in truth may be called in its particular case the eggshell in which it is securely developed, amid the hazardous vicissitudes to which it is exposed. Set free from this ovular envelope by the action of the digestive juices in the alimentary canal, the cœnurus commences an active-passive migration to the brain, where it causes the disease well known as the "staggers," from a prominent symptom manifested. The disease called the "measles" in the hog depends upon a similar cystic worm the cysticercus cellulosæ. Carnivora like the wolf, the dog, and man himself, feeding upon these infected herbivora, become themselves infested with tape worms.

From the preceding observations it may be gathered, that parasites exert a very decided influence over man's natural well-being, through their ravages upon his means of support. Yet the discoveries that have been made regarding them are among the crowning triumphs of the scientific skill, industry, and acumen of the observers of the present day, in contradistinction to those of the past.

But still farther. The science and the art of medicine have for many centuries been cultivated with zeal and assiduity by a class of men who specially devoted their attention to the subject. The diseases which affect the human frame have always been regarded as worthy of special attention, and honors and emoluments have been heaped upon the successful physician. But strange to say, until the present century the parasites infesting the human subject remained in almost total obscurity. By some fatality the small number of disconnected facts with which the elder physicians *were* familiar, received a false interpretation. Their production, mode of nutrition, and anatomy, were all misunderstood, and the symptoms supposed to indicate their presence were vague, trivial, and incongruous. There was a general opinion among medical men of their vast abundance which, as may be easily imagined, found an exaggerated reflection among the laity. In fact *worms* were the bugbear of old women and anxious mothers. Even at the present day the physician who practises much among the common class of people will often find the question of entozoa gravely mooted in his presence. In those palmy days of empiricism as soon as a child presented any of the incongruous symptoms supposed to indicate the presence of these dire destroyers of juvenile health and comfort, straightway, in the quaint language of Kuchenmeister, "the time-honored worm medicine was administered with one hand, under terror of the wholesome birch wielded by the other." If the domestic remedies did not succeed in expelling the unwelcome intruders, or in curing the cachexia upon which they were supposed to depend, the family physician, or perhaps some great specialist upon worms, was summoned, who skilfully directing his medication to the supposed indications, either removed the causative cachexia; or, by a *coup de maitre*, killed the entozoa without injuring the living covers that they infested; or, by altering the character of the intestinal secretions, rendered them no longer acceptable to their despoilers; or, lastly, by such mechanical irritants as the enema, drove the intruders out of the intestines. Often after the administration of powerful drastic and chologogue cathartics, the copious digestions of blood-altered bile, and intestinal mucus, were triumphantly pointed to as the mangled remains of animals, whose very presence was problematical. All this is happily altered now. Although entozoa are as abundant as of yore, yet the improved knowledge which present physicians possess of their pathology and treatment, has greatly humanized this department of medicine. To cause dangerous mucoenteritis in the expulsion of entozoa would now be considered mal-practice.

The wonderful discoveries that have heen made by means of the microscope among parasites infesting the human subject constitute a basis for startling speculation. Thus, diseases that used to be attributed to other causes are now boldly referred to a parasitic origin, although the parasites may not be discovered. The Cholera Asiatica of the present century, the Black Death, and Sweating Sickness of former periods, present many features and analogies favorable to this supposition. The highest powers of the microscope have failed to define the limits of vitality, so vastly minute are some of the animalcular inhabitants of the earth. Hence, although we should fail to detect them, microscopic organisms may still be the cause of disease. Their presence in such a case would need to be determined by negative evidence,—the diagnosis made by exclusion. The probability of success is, under the circumstances, sufficiently dubious. Speculations based upon negative evidence, though interesting and supported by numerous analogies, are not reliable, from the impossibility of knowing all the circumstances that bear upon the case in point. It seems proved, however, that the germs of future organisms float in myriads through the air and in the water, and that they lie everywhere upon the surface of the earth.

Man is accustomed to pride himself upon his position at the head of animated nature, yet in the exercise of those powers which are his prerogative he exposes himself to vicissitudes and dangers that he often does not appreciate, and from which the inferior animals are more or less exempt. Accustomed from his birth to one climate he rushes into a very different one, and retaining his original habits under very different circumstances, he pays a double penalty for his rashness: first, of disease; secondly, of the entozoa to which that disease supplies a suitable nidus for development. In [illegible] his pleasure wherever and whenever he lists, fortunate indeed is [illegible] for him that he affords so few conditions as he does for the development of parasites. For does he scent the perfumed gales from the orange groves of the south, or snuff the cold air from off the icebergs at the north, he takes into his aerial passages the invisible germs of future organisms. Does he tickle his palate with the delicious fruits of the tropics, or make a frugal meal like the Esquimaux, of train oil and tallow, on the shores of the Arctic sea, down his throat by thousands go the dormant seeds of future evil. Insinuated into his lungs, nose, mouth, and cutaneous follicles, and scattered over his whole body, the microscopic germs await their destiny.

This much, the microscopic and other observations absolutely demonstrate. That single experiment of Schultz of Berlin, is conclusive upon this point, and at the same time confutes most of the arguments in favour of the *generatio equivoca*. He took a flask and placed in it a vegetable infusion. A cork with an apparatus of two tubes bent to a suitable form and with bulbs blown upon them, was carefully inserted into the flask, sulphuric acid was placed in the one tube, and in the other caustic potash. Air from time to time was sucked through the tubes and consequently through the flask also. After a couple of months the infusion remained free from cryptogams and infusoria. The cork was then removed and the infusion exposed to the air, in a few days the infusion swarmed with life. During the first part of the experiment the invisible spores and ovules in the air sucked through the tubes were exposed to the action of the acid and alkali, and killed. In the latter part, the air freighted with the invisible germs came in direct contact with the infusion, and those germs finding there a suitable nidus for development, gave origin to the living beings witnessed. If then it is established that each one of us breathes an air laden with the germs of organisms that only want a nidus for development; that with the food we eat, and especially the water we drink, additional germs are introduced into our system by another channel; if as we know positively by abundant observation, we ourselves as well as the lower animals and plants are the actual habitat of parasites; let us by all the means at our command, ascertain the conditions of existence and ways of life of those beings, that as far as possible the material well-being of our race, and the interests of natural science may be promoted. The discussion that is still open as to the origin of numerous cutaneous diseases demonstrates the necessity of eliminating all causes of error from investigations of such obscurity. Gruby, Gulliver, and other careful observers positively maintain the parasitic origin of *porrigo favosa*. Wilson in an article, every page of which is the expression of careful researches, denies the presence of any cryptogam in the crust, and shows that the first named observers were misled by deceptive appearances. Both parties thus investigate the same result but trace it to different causes.

The vastness of the obscurity which rests upon the subject of parasites naturally leads to much speculation. Facts here as elsewhere are made the basis of undue generalization.

The domain of reason which is the result of experience lies beside that of imagination, and many avenues lead from one into the other. The ascertained fecundity of parasites, the new species continually discovered in the most unexpected places with the various morbid symptoms which they are *known* to cause, easily lead to the supposition of the parasitic origin of diseases which really arise from other causes. Thus with the growth of natural science do its requirements for additional investigation augment. Questions are perpetually reopened that were once supposed to be definitely settled, and new ones are raised. From each rugged summit upon the hill of science that its devotee attains, he sees others still more difficult of access rising above him. But still he struggles on although often with naught but the beacon light of hope to guide him,—the *n 'ns conscia recti* to invigorate him. Although great additions have been made within the present century to the list of known parasites, it is still far from complete: vide *Rudolphi Synop. Ent.* The migratory habits of animal parasites are a source of much difficulty in tracing their history. In fact it is the greatest impediment in the way of investigation. The condition of their existence being so much specialized, so dissimilar and often so far asunder from one another. Innumerable abortive experiments require to be made before those conditions are all examined, and the entire history of the particular organism which is the subject of investigation ascertained. Impelled by instinct they traverse the organisms which they infest, or leave them for the outer world. They also are transferred passively from place to place, from organism to organism. For example the six-hooked embryo of the cestoid entozoa having been set free in the interior of the alimentary canal of various animals, migrates actively into a portal vessel, then passively floating in the circulating blood it lodges in some remote capillary and renews the active migration, passing into the interior of the tissues which its instinct leads it to select for its dwelling place, preceding its development into a cystic worm.

How many observations required to be made to determine this single fact? A six-hooked animal was seen in the intestine of a cystic worm in a distinct tissue, a strong imagination would hardly have suggested any relation between them.

A cercaria without sexual organs and two thirds tail, swims freely in the water among little mollusks like the paludina. In the interior of one of these mollusks is found a distoma with several organs, but without tail, and in no respect resembling the cercaria. It would not be expected that these two animals had any relation, yet the cercaria is developed into the distoma. In this connection, mention need but be made of Kuchenmeister who for four years was vainly on the look out for a tænia belonging to the cysticercus of the meal-worm; of Filippi, who opened hundreds of animals to trace the development of the eggs of distoma into cercaria. Simple in apparent structure though they be, rude and loathsome to the eye, not from any special deformity but from association, these entozoa afford a deep insight into the mysteries of vitality. The higher organisms that inhabit the outer world, are opaque, and consequently present insuperable obstacles to the ocular examinations of their vital functions, no light however powerful can pierce the outer envelope of their digestive passages and permit a view of the digestive process as it actually occurs. In impenetrable darkness is that great problem worked out continually, and glimpses of it only, are caught by the experimentalist, who establishing fistulæ at various places in the course of the intestine, withdraws at will the materials in the neighborhood, for purposes of examination.

The ovaries and testes form ovules and zoosperms, the precious depositories of the vital principle for perpetuation of species. The highest interest is therefore attached to them. But the action of these organs can only be judged of by their effect, withdrawn from the body from time to time. To trace the successive stages of the formation of ovules and zoosperms *in situ*, is impossible.

But in the entozoa, and the simple animals that dwell in the depths of the seas, provision is made for those examinations which in the higher animals are impossible.

These creatures, passing their lives away from the light, are quite diaphanous. Their simple cellular structure also favors examination. Placed in suitable media, in the living state, all the details of their structure and functions can be examined from the beginning to the close of their existence. They, as it were, invite science to the study of life under sufficiently simple forms for comprehension. Each atom of food may be traced through all the changes that it undergoes. Thus, in the interior of man's own organism, in that very digestive passage whose functions are such a mystery, a structure is formed which will yet serve to explain the very function which produced it. At the culminating point of animal development the simplest living forms appear, and extremes meeting on a common ground, reveal a general law: the identity of digestion throughout the animal scale. Such nematode entozoa as the ascaris mystan (parasite to the cat,) possessing a genital system exactly fitted for the purpose, have served to reveal the entire process of formation in ovules and zoosperms, the impregnation of the former by the latter, and their subsequent history. Placed beneath the microscope they assume a magnitude suitable for examination. It may further be remarked in this place that many of these creatures so slightly disturb the health of the animals they inhabit, and are so constantly present, that the experimentalist soon ceases to regard them as morbid phenomena.

Are these creatures then unworthy of scientific enquiry? Let the indefatigable zeal with which modern helminthologists pursue their favourite study answer. Consider Rudolphi who consecrated a life to the collection and classification of parasites; Bremser who collected in his *Atlas* the greatest number of facts upon the subject known at his time; Dujardin who in five years explored 3000 animals in search of parasites; Leuwenhoeck, who maintained two pediculi in his stockings for two months, to ascertain their power of increase. To form the museum of helminthology at Vienna and collect 368 specimens, in five years, forty-five thousand vertebrata were opened.

Ignoring the prejudices of the vulgar mind, the modern naturalist pushes his researches into the most remote localities, the most forbidding places, confident that his labours will not be fruitless. Their functions, numbers, history, intimate relation with industrial pursuits, and with medicine, all combine to give interest to parasites.

Each tissue in plants and animals seems adapted to support some special inhabitant. Among vegetables, the root, bark, duramen, and above all, the leaves, support a numerous secondary existence; and animals are equally liable to the encroachment of parasites. One species infests the cellular tissue, another the brain, another the liver, and so on.

The aphides, from their numbers and peculiar embryology, merit special attention. One species at least, and often several, of these diminutive creatures belong to every species of plant. The sensibilities of some of them are so acute that only a single species of plant will serve for their food. Others are not so susceptible, but subsist upon all leaves that they light upon. The procreative powers of these creatures are so enormous, that Reaumur estimated 5,904,900,000, as the possible offspring in the fifth generation from a single aphis. This fecundity sufficiently accounts for the enormous destruction of plants which they yearly inflict. Not unfrequently they have caused such fearful ravages over large regions of country, that governments have adopted compulsory measures for their destruction. They constitute many of the blights spoken of in common parlance. Their embryology as far as I know has no parallel among the rest of the insect world, but finds its analogies among the entozoa.

Provision is always carefully made to keep each species of animal in due bounds. Those creatures that are most liable to destruction have the greatest powers of reproduction.

The codfish lays its 9,000,000 eggs, the shark its dozens. Those of the codfish are naked and defenceless, whilst the others are carefully protected by a horny and persistent covering. The cercaria marginata leaves its sporocyst and the body of the paludina where it was generated, and swims in the surrounding water. Although numerous animals have been examined, the particular species in which it can develope into a distoma has not yet been discovered. Hence the chances for the destruction of this parasite vastly exceed those favorable to its final development. Accordingly this species of cercaria is produced in great abundance, so great indeed, that they often completely fill the testes and ovaries of the paludina in which they are developed.

Pathological conditions as well as those that are physiological afford a nidus for the development of parasites.

The class of parasites infesting the animal creation, to which by far the greatest interest is attached, are the Entozoa. They have received a corresponding degree of attention. The perfect adaptation of all living beings to the circumstances in which they are intended to pass their existence, is a never ending source of admiration to the scientific observer.

Turning to these Entozoa, we see purpose or function just as strongly manifested as elsewhere. High intelligence has been provided for in the conditions of the air and dry land. Here, in the interior of organisms, enshrouded in darkness, and in relation with vitalized structures, what sort of organization would be expected? The intelligence required for the obtaining of their food is a minimum, for their food is prepared at hand; muscular activity of any kind is as unnecessary as intelligence, with the absence of muscular development a nervous apparatus is unnecessary. Food is prepared already elaborated, hence no digestive apparatus, or only a simple one is required.

Accordingly upon examination of these creatures we find no definite nervous system, no muscular development or a feeble one, no brain, no digestive canal, (with exceptions.) Eyes these animals have not, for they could see nothing if they possessed them. Ears they have not, for no waves of sound ever approach them, a general sense of touch it is to be presumed they have. They must be amenable to the great law of *omne vivum ex ovo; i. e.* they have a very complete generative apparatus, which is always present in the perfect individual. Their history has been examined with great care by modern observers, and some departments of the subject have been investigated wit great success.

Of all the classes, the Cestoidea are best understood. Many interesting facts in connection with the Trematoda are known, but others still require elucidation; and the same remark is applicable to the Nematoidea.

All sorts of animals have been opened in search of Entozoa, and when discovered, their anatomy and physiology have been carefully scrutinized, so as to determine their affinities.

When it is recollected that Helminthology as a science dates from a very recent period, that the metamorphoses of Entozoa are extraordinary, and without apparent analogy among the animals inhabiting the outer world, as they were known to the older naturalists, there is abundant reason for satisfaction at the position which this department of Zoology at present occupies. The facts discovered are *new;* the mind has not habitually contemplated them, hence their due value as yet, may not be accurately determined. In Linnæus' Natural System, 12th edition, eleven species of intestinal worms are described. In Rudolphi's Synopsis entozoorum, nearly one thousand are catalogued. Since his time, some of his species have been corrected and consolidated, but others have been discovered.

Here as elsewhere, presumption has impeded the acquisition of positive knowledge. Nature has often been interrogated in a wrong spirit. Observers have not invariably manifested a single-hearted desire for the truth, irrespective of preconceived notions. False impressions acquired by one sided and too hasty observations have not unfrequently been pertinaciously maintained, with an unfairness highly reprehensible. When Von Siebold established the identity of the scolex of the cystic worms with the head of the tape-worms, he did good service to the cause of science. But his pertinacious maintenance of his opinion that the cystic worms were strayed and degenerate or monstrous cestoids, long stood in the way of the acceptance of the true explanation concerning these two forms.

Many of the older naturalists, because they could not *see* certain entozoa spring from eggs, although sexual, considered their origin spontaneous.

The identity of the scolex of the cystic worm, with the head of the cestoid having been ascertained, an important question yet remained for investigation, viz: whether the caudal vesicle of the former was to be regarded as the result of circumstances, or a stage in the ordinary development of the perfect animal from the six hooked embryo. It will be seen that this is a part of the general question, how far external circumstances modify the growth and development of an organism. Do types change? A question of the highest importance, and which lies at the base of all physiological science. It bears upon the important subject of classification, without which, zoology and botany would be a mere jumble, what in fact chemistry was, until the discovery of homologies. It therefore may justly be considered before proceeding to the classification of the entozoa.

An extended survey of the animal kingdom establishes positively the fact that there is a progression which is quite regular, from the simplest infusory animalcule, up to man. Cuvier's observations prove that animals after the precise types of the present, were in existence 4,000 years ago, and that the fossil animals were of different species. If present types have existed so long and fossil ones have perished with the cessation of the conditions necessary for their maintenance, the conclusion seems irrefragable that types are constant. This constancy is preserved through the medium of a continual succession of individuals, that find suitable conditions always for their development. When those conditions terminate, the succession also terminates, and with new arrangements of matter appears a new type that goes on as before. It may be here observed that all man's efforts at the so called improvement of useful plants and animals have merely resulted in modifications of growth, and not in development.

I shall now give the classification of entozoa as it is generally adopted at present.

Being the expression of actual fact it is reliable. The general characteristics of the species of entozoa infesting at some time the human subject will then be given, and afterwards, their embryology.

ENTOZOA (*Helminthes.*)

Class I.

No intestines.......	Sexes united ... Soft integument	Order 1. Cestoidea.
No mouth or anus	Sexes separate... Soft integument	Order 2. Acanthocephala.

Class II.

Intestine terminating in a cæcal extremity, without anus .... Sexes united..................................	Order 3. Trematoda.

Class III.

A perfect intestine Sexes distinct......	Mouth situated on the ventral surface provided with four retractile hooks...	Order 4. Acanthotheca.
	Mouth at or near the anterior extremity and without retractile hooks	Order 5. Nematoidea.

It will be observed that sexuality is an essential characteristic of all the classes with the order beneath them. All such transitory forms, as cystic worms, cercaria, &c., which are mere stages of development from the egg to the perfect animal, are struck out of the general classification and placed among the characteristics of species. The consideration of their embryology will shew that there would be as great impropriety in classifying cercaria, as a larva or chrysalis of insects. Such names as cercaria, redia, &c., will be retained, but with the proviso that they do not indicate species, but different *stages* of species.

The general characteristics of the orders infesting man will now be given. In their embryology such additional particulars will be given as are necessary to elucidate the subject.

Order 1. Cestoidea.

The body is soft, elongated, flattened, jointed, terminated anteriorly in a cephalic enlargement to which it is mostly united for some time. The whole together constitutes a strobila. The head or scolex is pyriform in shape, and furnished with four (or two) sucking discs often also supplied with hooklets.

The joints or proglides are destitute of external organs and have embryos armed with hooks. They have no intestine The cestoidea have no true alimentary canal. In the tænia there are merely two small longitudinal excavations in the solid tissues of these animals terminating anteriorly in the minute pore in the centre of the head and united by cross excavations in the joints. The heads of the cestoidea being so constantly armed with hooklets and sucking discs they must be designed to fasten upon the intestinal mucous membrane and absorb therefrom a portion at least of their nourishment.

Five metamorphoses are observed in this order:—1. The mature or perfect animal (proglottis). 2. The hooked embryos. 3. The resting scolex, appearing, (*a*) with vesicular appendages; (*b*) a hand like appendage; (*c*) no appendage. 4. The active scolex. 5. strobila.

Family I. Bothriocephali.

These animals are furnished with two lateral depressions or sucking discs upon the head, which is more or less tetragonal. The depressions are usually naked. The head is obtusely conical.

The strobila has a dorsal and ventral surface. Four margins are defined on each segment,—the two lateral free,—the anterior and posterior unite the segment to its anterior and posterior neighbors.

The genital pores are situated in the mesian line. It is most common in Russia and Poland. Numerous other members of the family have been described, but as they do not occur in the human body, and their cystic worms have not been discovered, I omit further allusion to them and proceed to the

Family II. Tæniæ.

This family is a very extensive one, finding its especial habitat in fishes, the perfect animal being most abundant in the predacious ones. It occurs also in piscivorous raptorial birds. Among mammals it occurs to a certain extent when they live on the sea shore at the north. Those living inland are exempt, except man, in whom only is found the Taenia solium. He being omnivorous, there is a strong presumption that he introduces along with his marine food the scolices of this parasite.

The experiments of Eschricht seem to prove that a species of ligula is one stage of its development. This ligula is found in large quantities in the flesh of the dorse and other fish inhabiting the northern seas.

The head is usually somewhat square shaped, with four (rarely six) lateral sucking discs placed symmetrically round the central pore which represents the mouth. This central pore is the anterior termination of the two lateral excavations in the parenchyma of the body already alluded to. It is surrounded by a crown of hooklets arranged in one or more rows, and of various sizes and shapes in the different species. The design of these hooklets in combination with the sucking discs is to anchor the animal firmly to the intestinal mucous membrane, so as to enable it to nourish itself with the alimentary juices of the animal which it infests.

The hooklets probably fall off with age.

The body is ribbon-like, very long, white, marked by transverse lines dividing it into joints.

The mature joints or proglottides are bisexual, rupturing successively one after another. The joints nearest the head are always younger than those more remote. Each new joint budding from the posterior aspect of the head or scolex pushes backward the next in age. The transverse striations are very obscure among the newer joints.

The genital pores are usually alternate, the males larger and more anterior, the females smaller and more posterior. Male and female organs perfect. The resting scolices according to species assume the cystic forms, that with a hand-like appendage or that without any appendage.

The active scolices vary much with the strobila in length and breadth. The embryos are armed with six hooklets, small and active.

The eggs of those species assuming the cystic form are very small, yellow. Those of the species assuming the two latter forms are larger and lighter in colour. Habitat of mature animal, the intestines. This family is very extensively distributed, being frequently found in the human intestines and in mammalia generally. The resting scolices are found in the serous cavities and various tissues of the smaller and more defenceless animals of whatever species which are preyed upon by the larger and more formidable ones. They also undoubtedly occur occasionally in the same animal whose intestines are infested by the perfect tape worm. In the former case the six-hooked embryos are cast into the outer world enveloped in their egg-shells and subsequently swallowed. In the latter they escape from the egg shells in the intestine of the animal subject to the mature worm, and take up the requisite migration to the wished for tissue or locality. These remarks apply to the cystic form of resting scolex. The other two forms probably pass through the stage of resting into active scolex in the intestines of the same animal.

The perfect tape worms found in the alimentary canal of man are the Tænia solium (passim) Tænia mediocanullata, in various parts of Europe; a variety found at Cape of Good Hope, which possibly may be identical with the Tænia mediocanullata and the Tænia nance. This latter is probably the mature animal from the Echinoccus hominis.

The Cysticercus cellulosae found so abundantly in the pig, sheep and rabbit, and also in man, is the cystic worm corresponding to the Tænia solium. The scolex of Tænia mediocanullata is unknown to Kuchenmeister.

The Cysticercus termicellis is occasionally found in the abdominal cavity of man, more frequently in the sheep, ox, hog, ape, goat. The tape worm or tænia ex cysticercus termicelle is the tænia marginalis of Batsch, found in the intestine of the dog and wolf.

The Tænia Solium

is misnamed, as undoubted examples are known of several individuals growing simultaneously in the same intestine.

The head varies in size, but is never seen larger than a millet seed. When magnified it is square shaped. The hooks are arranged in two rows and are 24–28 in number. They are planted in little sacs whose depth corresponds with the stem of the hooks in length.

The points of all the hooks fall in tho same circle. The most characteristic mark of this species, says Kuchenmeister, is the lunate notch in the stems of the hooks, on their posterior surface.

The length of the first series of hooks varies from 0,175—215 mil. Of the second series from 0,117—126 mil.

The sucking discs, four in number, are nearly circular. From each of the discs a canal descends, which all unite with the two longitudinal ones. The neck is quite short and smooth. Behind the neck is the body or strobila, which consists of joints which are larger and more strongly marked as they approach maturity. From about the 280th segment the genital apparatus begins to appear. These organs will be described with the embryology. The individual joints present at their anterior extremity a transverse canal connecting the longitudinal ones, a chitirious epidermis, longitudinal and transverse muscular fibres, the uterus and its appendages, with the ova and the male apparatus.

The scolex of the tænia solium and the cysticercus cellulosæ are identical. This is apparent from the similarity in anatomical structure and from experiment. It has now been determined beyond controversy that by feeding the hog, rabbit and sheep with the eggs of the tænia solium those animals became infested with the cysticercus cellulosæ, and by feeding the dog and man with those cystic worms, tape worms were produced in their intestines. The abundance of cysticerci in the hog is well known. Statistics abundantly prove the frequent occurrence of tape worm in butchers who are accustomed to handle raw meat and are not over careful or cleanly, but often by their hands or knives rubbed in their mouths introduce the cystic worms into their system. It is also common among those who eat in any manner raw or imperfectly cooked meat contaminated with the cysticerci. The Hottentots in the Caffir wars demonstrated the mode of translation of the cystic worms into the suitable nidus for the final stage of development, namely, the intestine. Those people in the invasion of the enemy's territory feasted according to their barbarous fashion upon the cattle and sheep that were captured, and became greatly infested with tape worm, whilst previously they were mostly exempt.

The cysticerci occur most abundantly in the muscles of the hog, giving the meat, it will be recollected, the common name of measly. They are found frequently in man. Five cases are certainly known of the occurrence of this creature in the anterior chamber of the eye floating free. It has been found in the eyelids, in the orbit, under the sclerotic conjunctiva, in the vitreous humour, and in the retina. It has been found in the brain, muscles, cellular tissue, &c. When seated in the subcutaneous cellular tissue it is harmless, in the muscles also it usually causes no inconvenience. In the eye the pathological conditions induced are of more importance.

The Tænia medio-canellata of Kuchenmeister is not sufficiently well known to deserve a detailed description. Of its existence he is positive, and he gives some facts connected with its habits. Its scolex is unknown.

The cysticercus visceralis or tumicellis occurring occasionally in the abdominal cavity of the human subject, is remarkable for its enormous caudal vesicle, which in animals has been seen as large as a child's head. The hooks are arranged in two rows upon the tetragonal head; the neck is somewhat slender, whence the name. A tænia in all respects like the tænia marginata has been produced in the dog by feeding that animal with the cystic worm.

The second order is not found in the human subject. The best known representative is the Echinorhynchus gigas, which occurs in the small intestine of the hog and various other animals. The metamorphoses of the order are not yet known.

I omit a description of this order and proceed with that of the third.

Order III. Trematoda.

These are solitary animals, mostly hermaphrodite. They have median or lateral suctorial pores. The alimentary canal is usually branched (rarely single). Evolution is mostly accomplished by metamorphoses, and very often by alternate generation.

This is a very extensive and very interesting order, but does not find its habitat to any great extent in man. Two families only have been found in man.

Family 1. Monostoma.

The body is soft, elongated, polymorphous, flattened, or slightly rounded. The head is continuous or discrete with a neck. The mouth is terminal or anterior, acetabular, crenulate, armed or unarmed. The genital aperture is distinct and double, the male anterior to the female acetubular. The penis is protractile. The female aperture is small and inconspicuous. Habitat: Mammals, birds, amphibia and fishes. Always outside the alimentary tract, and either free or enclosed in sacs. Metamorphoses and alternate generation occur as in the next.

Family 2. Distoma.

The body is flattened or somewhat rounded. Anteriorly there is a circular sucker or disc in which the mouth opens; posteriorly there is another sucker. The two suckers serve to enable the animal to attach itself firmly to the vascular structures, from which it derives nutriment. The posterior disc is sessile or pedunculated, and placed at various distances from the caudal extremity. The generative organs occupy a large portion of the body.

The genital apertures are approximated.

The perfect animal is completely hermaphrodite.

The ovules contain embryos rarely like their parents. In the miniature state their embryos wander free in the outer world or remain enclosed in the parenchyma of organs, especially in the inferior animals. In this miniature or larva condition these animals are called cercariæ. They are sexless invariably. Observation upon the monostoma mutabile demonstrates, that from the eggs of the Trematoda issues a simple saccular structure or organism, to which the name sporocyst has been applied. In the interior of this sporocyst, a number of second cysts are formed and in the interior of these cercariæ. The cercaria escapes from its "nurse" or sporocyst, and finding its requisite nidus for development produces a trematode worm.

The Monostoma lentis, Distoma hepaticum, Distoma haematobium and Distoma lanceolatum are the Trematoda thus far found in the human subject.

The fourth order, Acanthotheca, does not occur in the human subject. It includes the gordiacea or hair like worms which infest the frog, among other animals. I omit further mention of it and proceed to the 5th order, the Nematoidea. This order is the highest of the Entozoa in the scale of organization, as is seen from the table. The muscular system being now clearly developed, a corresponding supply of innervation must be provided. Accordingly nervous filaments connect the various fasciculi together so as to secure greater power of locomotion and prehension. The intestinal tube is limited by a special membrane and is lodged along with other organs in an abdominal cavity. The animals are, however, destitute of special senses and nervous centres, so that common sensation is still their highest attribute.

Many points connected with the history of this order are still in obscurity. The Trichina spiralis which occurs in the muscular system of man so abundantly, is classified in this order, although without sexual system. It is probably a stage of development of some one of the sexual worms, and the Trichocephalus dispar is as likely as any other.

Order V. Nematoidea.

The body is rounded, attenuated more or less, thread-like, elastic, with anal orifice, central or subcentral. The intestines perfect, anus distinct. The Nematoidea occurring in the human subject are Trichocephalus dispar, Oxyuris vermicularis, Strongylus gigas, Filaria medinensis, Ascaris lumbricoides, Spiraptera hominis, Ancyclostoma duodenale.

Trichocephalus dispar.

The body is long and formed of two parts. The anterior is quite thin and thread like; the posterior is thick and contains the genital organs. The male is smaller than the female. The testicle and spermatic cord are simple. The latter opens with the intestine into a common cloaca. The penis is simple.

The caudal extremity is supplied with an auxiliary copulatory organ. The zoosperms are globular.

The female is straighter, somewhat broader, less elastic and flexible than the male. The caudal extremity is acuminate. The vagina is muscular and opens on the ventral surface, both uterus and ovary are simple. The ovules are brownish—oblong—provided at each extremity with a small but distinct wart-like prominence. Generation—oviparous.

Oxyuris.

The body is cylindrical or fusiform. The head is unarmed—the mouth is terminal orbicular or triangular. The æsophagus is muscular. The gastric cavity is triangular. The intestine in the female opens anterior to the acuminate tail. In the male it opens in the centre of the tail which is obtuse.

The males are almost microscopic in size, mostly seen curled in spirals blunted at the posterior extremity, The females are larger than the males and have a sharp tail; a bilocular uterus with two ovaries, the vagina always in the anterior part of the body, where the external genital orifice is also situated. Length 5-6 lines.

This worm inhabits the larger intestines of children, causing sometimes much irritation.

Ascaris.

The body is white, sub-cylindrical, attenuated on each side, marked with four whitish longitudinal lines. The skin is transversely striated. The anterior extremity is marked by three convex or hemispherical valves. They serve as lips to aid the animal in fixing itself on the spot where it is to derive its nourishment.

The æsophagus is strongly muscular, cylindrical or claviform. The ventral cavity is triangular. The male is smaller than the female. The caudal extremity somewhat curved and involuted.

The much convoluted testis terminates at the tail in a retractile penis.

The female is larger than the male. The tail is straighter and longer. The vagina is simple and is situated anteriorly to the middle of the ventral surface. The uterus is single and large, the ovarian apparatus double, extensive and convoluted. The variety found in man infests the small intestines.

The Filaria Medinensis as it is found in the subcutaneous cellular tissue of the human subject is about as thick as a crow's quill, several feet in length, white in color and commonly single, although there may be several worms at the same time in different parts of the body. In tropical regions of the East it infests both natives and Europeans, although the latter much more rarely. It has the ordinary characteristics of a Filaria. A round elastic elongated body, a terminal orbicular mouth. The body continuous with the head, the œsophagus is short and tolerably straight. The anus terminal or anterior to the caudal extremity. The skin is striated. The males of this Filaria are not known. The vagina in the female is anterior, near the mouth, double, as is the uterus. It is viviparous.

The common tank worm of the East is probably the Filaria M. in an earlier stage of existence. This tank worm, brought into contact by whatever means with the naked skin, insinuates itself into a cutaneous follicle, which it may well do from its small size, and boring its way into the subcutaneous cellular tissues, in time becomes the Filaria. The origin of the tank worm is unknown. It is a significant fact that whilst the pus from the abscess formed by the Filaria often abounds in small so-called Filariae; they never develope themselves into animals like the parent. This would seem to indicate that the so-called viviparous female is a mere sporocyst, like that of the Distoma.

The Ancyclostoma Duodenale occurs along the river Nile in vast numbers; it is quite small, but provided with a most effectual oval apparatus for fastening upon the intestinal mucous membrane, whose small bloodvessels it often cuts across and thereby causes hæmorrhage that is not unfrequently fatal. It subsists upon blood—at least that fluid is to be seen in it. The prominent symptoms that result from its attacks are those of anæmia with intestinal irritation.

Having briefly given the prominent characteristics of the Nematode worms infesting the human body, I proceed to consider the embryology of the entozoa, especially the Cestoids.

EMBRYOLOGY OF ENTOZOA.

These beings which are so universally distributed that there is hardly an animal exempt from their attacks at some time in the course of its life: whence do they come? how do they develope and how multiply? Are they the spontaneous result of the concurrence of physiological and pathological conditions in which they are produced? or do they originate from parent organisms in the usual way of generation that obtains among the higher animals? If so, how far do surrounding circumstances affect their growth and development? The six-hooked embryo of a Tænia gets into a serous cavity or into cellular tissue and becomes a vascular worm, a Tænia head or larva with a caudal vesicle, instead of the strobila which should develope from that head larva or scolex, were it in the alimentary canal. Is that vesicle the result of the abnormal conditions in which this strayed embryo has fixed itself?

A cercaria swims freely in the water without sexual organs, digestive cavity, or aught but a propulsive tail; when transferred to the interior of a mollusk it so radically changes itself that analogy is lost between the two forms that it has assumed. Is this change due to circumstances?

Such questions as those necessarily arise in entering upon the study of helminthic embryology. And it is at once seen that they are of the highest importance, not only in regard to these worms themselves, but also for their bearing upon high principles of general physiology. A suitable reply can only be made to them by extended observation. By gathering facts for embryology from all parts of the animal scale, a rational scheme of the subject can be made. Such points as are obscure at one part of the animal scale may be explained by such as are of a similar nature, but in more obvious relations at another part. Positive knowledge of the higher animals rests upon and illustrates the obscurities of the helminthic worms, and these in turn bear upon the study of the creatures that rank above them.

The mystery which enshrouded the embryology of the higher animals has been well cleared up. With infinite labor a connected series of observations upon the subject has been made, from the concourse of the zoosperm and ovule to the evolution of the perfect animal.

The following laws are the result. They are positive. Laws of Generation:

I. All animals spring ultimately from eggs.

II. These eggs are spontaneously produced in the female.

III. These eggs are spontaneously discharged.

IV. Zoosperms are spontaneously produced in the male.

V. These Zoosperms must come in actual contact whilst living with ovules of the same species, whereby those ovules are fertilized.

VI. In the higher animals the spontaneous production of eggs is periodical.

These laws were established by observations among all classes of vertebrata.

Abundant observation among invertebrata establishes their applicability (with the exception of the sixth) to these animals as well.

The separation of male and female organs in different individuals is by no means essential. They may exist as well in the *same* individual. Many of the invertebrata are hermaphrodite. In some cases the concurrence of two individuals, as in the case of snails, seems to be necessary, but in others the male part, through an intromittent organ, brings the zoosperms in relation with the ovules in the female generative passages without any concourse of separate individuals. Fecundation having by whatever process been accomplished, development proceeds, through the primary step of segmentation of the vitellus and disappearance of the germinal vesicle. A blastodermic membrane is formed by the packing of cells against the vitelline membrane, and then fusing together more or less completely. This stage accomplished, an organised structure has been formed, myriads of such structures are to be seen floating in water, constituting the simpler infusoria. These have the power of generation by gemmation and fissation, but alternately both they and their progeny assume a more complex structure, and in a male and female apparatus of some kind produce zoosperms and ovules. Sooner or later the gemmation and fissation are exhausted, and a recurrence to the ovular generation takes place.

This principle lies at the foundation of all the complex phenomena that are manifested in the evolution of animal organisms.

But after the blastodermic membrane has been formed a special concentration of cells may take place at some part of the membrane, and an organism of higher type appear.

Specialization still going on, a well defined body with organs is evolved, and so through a succession of stages starting from the primal segmentation even man's most complex organism is produced.

Regarding the influence of surrounding circumstances upon the development of the entozoa, the reflected light from the higher animals must be serviceable. By simply observing the essential difference between the cystic and cestoid worms, many enquirers have felt compelled to refer the phenomena to external influence. The similarity of the heads of those two worms clearly indicated that they were of the same animal, and direct experiment proved that a cystic worm when introduced into the alimentary canal of a suitable animal developed into a cestoid, but how to account for the caudal vesicle, present as it was under one set of circumstances, and cast off under another, was the question. Let us see how far the observed development of some of the higher animals bears upon the question at issue. At first the fecundated ovules of all vertebrata have essentially the same characteristics. Let us follow the history of one in the human female. Having lodged upon the mucous membrane of the uterus that has undergone suitable preparation, pending the arrival of the expected guest, it passes through the stage of segmentation, then successively appear the various organs of the body, and after the suitable pitch of development has been attained, to fit the fœtus for another stage of existence, it is extruded from the habitation that it so long had occupied into the outer world. Now at one period of its intra-uterine life this fœtus was completely destitute of several organs, and of very simple structure generally. It therefore was in the same physiological condition as the cercaria, the trichina spiralis, the cystic and other sexless worms, except that the human fœtus was securely lodged always in the same locality, in the uterus of the mother, whilst those *other* animals are in the outer world or in the tissues of animals of different species from themselves. Yet the influence of surrounding circumstances is highly important in developmental history.

The cercaria which at one time finds its proper element in the water, would perish if transferred too soon into some other medium. The cystic worm if suddenly hurried from its home in the cellular tissues or a serous cavity would also perish. It is needless to say that *abortion* is necessarily followed by the death of the human ovum.

Again at certain stages of its existence the human embryo has special organs adapted to its requirements at the time. Thus at first it is nourished at the expense of the umbilical vesicle, a suitable communication is requisite for the purpose. Accordingly tbe omphalo merentine vessels are produced to carry the needful supplies from the vesicle to the embryo. But soon this source of nourishment becomes exhausted, and the now enlarged and more developed fœtus needs a more abundant supply than the umbilical vesicle could afford at any time; moreover an apparatus is required to remove from it effete matter, for there is a destructive metamorphosis of tissue in development as in maintenance. To meet this want, there buds out from the cloacal extremity of the alimentary canal, which by this time has assumed shape, the *allantois* which continually and rapidly enlarging fore and aft and laterally inside the chorion, and approaching nearer and nearer to that outer envelope, finally comes into immediate contact with it. This accomplished, it insinuates its terminal capillary loops of bloodvessels, which by arteries and veins are perpetually in anastomatic connection with the fœtal vessels, into the villosities of the chorion. These in time being insinuated into the continually enlarging and divaricating tubular follicles of the hypertrophied uterine mucous membrane, an intimate relation is established between the maternal vessels on the one hand, and the fœtal ones on the other. Whilst the fœtal and maternal vessels are brought into the closest relation by this wonderful contrivance, no anastomosis takes place between them. That would defeat the whole matter. Now by endosmose nutriment is transferred through the intervening walls from the maternal vessels to the fœtal ones. Of all contrivances in nature for the accomplishment of any purpose this is among the most perfect. Upon it alone the defenders of our inherent vital force might take their stand. At the same time it is seen that material conditions and their affections concur in the final result.

This subsidiary circulation becomes the placental, and continues until birth. Then the embryo no longer needing its use, it is cast off, and a new circulation established that holds during the rest of life. Now compare this apparatus with the caudal vesicle of the cystic worm. If it were required to construct a nutrient apparatus in which a tænoid scolex should safely develope in the interior of a serous cavity or in cellular tissue, could a more appropriate one be made than that same caudal vesicle? There could not. It completely meets its requirements as a protecting and nutrient apparatus, and no more can be demanded.

It, as well as the placenta, is an apparatus developed to meet a certain purpose, and that purpose accomplished it atrophies and is removed.

If the caudal vesicle were a monstrosity it could not be so uniformly produced as it is. Monstrosities are rare exceptions and not a rule.

But the human organism affords further analogies. At one time the foetal liver is the largest organ in the body,—later it assumes a subordinate position. During foetal life the thymus gland is quite large and highly vascular. After birth it atrophies and often disappears.

At one time the function of kidneys is performed by the Woolfian bodies, by and by these atrophy and disappear, whilst the true kidneys simultaneously develop and take their place. Hence it is shewn that the requirements of the human organism at any time are met by the development of organs to meet those requirements, and when they have discharged their function and are no longer required they assume a subordinate position or disappear, whilst new ones take their place. The same principle holds good among the Entozoa. The embryo of the frog at one time is as simple in structure as any entozoon. After a time it becomes a tadpole, breathes by gills like a fish, and with its enormous tail sculls through the water. Later, its caudal appendage and gills atrophy, lungs take the place of the latter, feet and legs that of the former, and the fish has become a reptile. Yet it is the same offspring of the same egg.

If the batrachian ovule were deposited on the land it would never develope a tadpole; cast into the outer world the human ovule soon perishes.

The preceding considerations demonstrate the existence of a typical force from within, that in necessary connection with external circumstances projects into existence whatever organ is required for the accomplishment of a function.

Turning now to the Entozoa we are prepared to find them obeying the same laws that regulate the development of the higher animals. No metamorphoses which they manifest are without an analogy elsewhere. No greater difference in type exists in the various phases of their development than are seen in the human or batrachian embryo.

It is in the vicissitudes of their career that they differ chiefly from the higher animals. They have to make migrations both active and passive to find the suitable conditions for development. Hence arises the enormous difficulty of following them continuously shewing their progress from the egg to the perfect animal. The necessary conditions cannot be *inferred*, they need to be ascertained by actual observation. All the metamorphic changes which mammalian embryos undergo are performed in a single locality, viz., the maternal generative passages. Their identity is always certain. The metamorphoses of the entozoa occurring in different localities and in widely different organisms, identity is always in doubt.

Were the case different,—did the mammalian embryo at that early period, when its identity could not be determined from the closest examination, find its nidus for development elsewhere than in the maternal uterus, its embryology would become vastly more difficult.

Therefore the determination of locality is an important element in the embryology of Entozoa. And often when the right animal has been found for the development of an entozoon a stage, and the creature in the preceding stage has been placed in the desired locality, development does not proceed. Thus Kuchenmeister fed a pig with mature proglottides of the tænia, no cysticerci apppeared in the flesh of the pig. A second pig was fed in a similar manner and still no result followed. Three sucking pigs were fed with proglottides and in due time vast numbers of cysticerci were found in their bodies.

Hence it is not merely the particular species of animal that must be known to supply the requisite nidus for development, but also one with the proper idiosyncracy, so to speak, or at any rate the proper physiological conditions. Of the nature of those precise physiological conditions we as yet are profoundly ignorant. How many men there are who unconsciously swallow live six-hooked embryos and resting scolices, and escape infection we know not.

Having thus invoked the aid of comparative physiology to elucidate the subject, I proceed to trace the development of the *cestoid entozoa.*

A few notes of additional points in the anatomy of the perfect animal are desirable before proceeding with the subject.

The Proglottis

is hermaphrodite. The two sets of generative organs are entirely distinct. The male apparatus consists of a testis, vas deferens, and an intromittent organ, which last, when not in use, is retracted in an inverted manner into a sac. The female apparatus is complicated and peculiar. It consists of one external genital orifice or vagina,—copulatory vesicle (receptaculum spermatozoorum),—matrix or uterus, and a complicated ovary. One part of the ovary forms the germinal vesicle, the other forms the vitelline substance. The germigine and vitelligine are both double. The two parts of the vitelligine unite in a common canal, into which open the two divisions of the germigine.

At the suitable period the intromittent organ is everted from its sac and introduced into the vagina; the zoosperms are then deposited in the vagina whence they are conveyed into the copulatory vesicle. Intromission having been accomplished the penis is restored to its sac. Now the germinative vesicles may be seen passing successively towards the matrix. When they arrive at the opening of the vitelligine they receive a covering of vitelline substance which is coincidently injected into the canal of the germigine. Enveloped in vitellus the germinative vesicle passes on, and the two elements being combined, the resultant ovule is prepared for fecundation. As the ovule passes onward toward the matrix it appears before the orifice of the copulatory vesicle, then one or more zoosperms are coincidently ejected from the vesicle and coming into actual contact with the ovule fecundate it, as it continues its course towards the uterus. The uterus gradually fills with fecundated ovules, d as it enlarges by excentric pressure it encroaches upon the parenchyma of the proglottis, so that finally the proglottis becomes little more than an egg sac. The ovulation being complete. the proglottis either separates from its younger neighbours anteriorly or remains in connection with them. In either case when the suitable conditions for development are presented, and they are in the intestines and the outer world, the segmentation of the vitellus and disappearance of the germinative vesicle take place precisely as in other animals. The mulberry appearance in due time appears, and the variously hexagonal cells divided from the segmentation of the vitellus, form the layer beneath the vitelline membrane which is called the blastodermic membrane. The remnants of the vitellus with some serous fluid occupy the interior of this membrane. Now the *area germinativa* appears, and cells heaping and condensing together in this area gradually assume the shape of the famed six-hooked embryo. The mature proglottides, *i. e.* those with developed embryos, singly or several united together, escape into the outer world with the fæces, and unruptured (occasionally ruptured). In the outer world they migrate in various directions, appearing upon grass, in the water, &c. If they have been deposited by birds with their fæces upon the foliage of trees they will be found in such localities. Also, if the proglottides fall into the water they swell up and rupture, strewing the eggs about. Thus in various ways the eggs are distributed in the outer world, some exposed, others still in the proglottides. If a proglottis chance to rest upon a morsel of food of any animal, it is swallowed, and passing into the stomach the outer envelope of the eggs is digested off. In this case numerous cystic worms will be generated in the same animal. If single eggs are swallowed there will only be one cystic worm.

Having discharged its contents the function of the proglottis ceases.

The Six-Hooked Embryo.

The egg having arrived in the intestine of its destined host, either singly or in company with others, its shell ruptures and the six-hooked embryo issues forth.

ITS ANATOMY.

A globular naked vesicle, varying in size from 0, 022 to 0, 05 mim. without internal organs, and provided on its anterior extremity with six, (occasionally four,) microscopic hooklets, whose points are directed downwards. The rupture of the egg shell takes place chiefly in the stomach.

PHYSIOLOGY.

It is nourished by imbibition,—is not acted upon by the intestinal juices of its host,—is capable of voluntary motion.

ITS DESTINY.

Whether in the stomach or intestine, after the escape from the shell, the embryo fastens by means of its hooklets upon the structure of its host, and according to Van Beneden, it brings together the central pair of hooklets like a wedge and by thrusting and twisting begins to force them forward. Having thus made some progress, it assists itself by the use of the two lateral pairs of hooklets. By this boring movement it penetrates into the tissues and into the portal vessels. Having thus entered the circulation, it is carried to distant parts of the body. After a passive migration in this manner, it sticks fast in a capillary somewhere, and again commences an active migration or encysts itself there. Having migrated to the locality which is favourable for its future development it fixes itself.* Having

* The embryos of some species migrate actively only.

fixed itself in a suitable locality, it enters the third stage of its development—the formation of the resting scolex.

THE RESTING SCOLEX.

This stage consists in the formation of cestoid heads from the embryonal vesicle, in a state of rest. The heads, or scolices, may be formed in the interior of the vesicle or upon its outer surface. The embryonal vesicle acting as a foreign body excites an abnormal vascular activity round it, and plastic matter being thrown out, it finally becomes encysted. The cyst is the result of the ordinary processes that are adopted in the organism to repair injury. If the embryo is in a serous cavity it may not have the cyst formed around it.

The embryo begins to dilate by the absorption of liquid nourishment.

It is now requisite to follow separately, the three modes of development of scolices, from cystic worms.

1st. *Cysticercus.* A single scolex is formed on the anterior part of the globular vesicle. At its anterior extremity, where the six hooklets are situated, a depression is formed in the enlarged embryonal vesicle. This depression deepens, and the inverted anterior portion of the limitary membrane looks toward the inner surface of the posterior part of the vesicle. In the bottom of the depression the scolex is formed inverted. That part of the enlarged embryonal vesicle which is not implicated in the metamorphic changes connected with the head, becomes the well known caudal vesicle. There is a thickening and condensation of cells at the bottom of the cephalic pit. These gradually assume the form of cestoid heads, always inverted. The sucking discs, usually four in number, and the proboscis with its crown of hooks. If examined, the head may be seen as it were sitting at the bottom of the pit in which it is formed, and may be everted by pressure when it assumes precisely the appearance of the cestoid head.

The hooks are usually completed in the fifth or sixth week. The size of the caudal vesicle may be considered on the average about that of a small pea. The scolices or hookless tæniae are formed in the same manner as the others, with the exception of hooks.

THE CÆNURI.

The globular enlarged embryonal vesicle, instead of forming a single scolex anteriorily, forms several, upon various parts of its surface. All the steps of their formation are the same as in the cysticerci. The scolices may be everted by pressure in the same manner. They also have sucking discs and a corona of hooklets, like the preceding. The term caudal vesicle is not appropriate in this condition.

THE ECHINOCCI.

The embryonic globular vesicle is still more active among these worms than in the preceding two. It is a true maternal vesicle. The prolification is from the internal surface of the mother vesicle. Upon this internal surface there are formed conical nodulations which develope into daughter vesicles, and these united to the mother vesicle by a footstalk, prolificate vesicles after the manner of cænuri. The maternal vesicle varies in size with the growth of the daughter vesicles. The stem remains permanent in E. scoliciparens. In E. attriciparens it separates from the mother vesicle.

When the mother vesicle is cut, the daughter vesicle, upon being squeezed, exhibits the scolices in the usual way i. e. by eversion.

The formation of the suckers and hooks is similar to what holds among the cysticerci and cænuri.* In addition to the three forms of scolex generating cystic worms, there are what may be called scolices without caudal appendage, and those with a band-like appendage. The scolices develope from the six-hooked embryos with all the usual appendages,—suckers and hooks, but the caudal appendage atrophies into the band-like process or disappears.

THE ACTIVE SCOLEX.

The scolices of all the forms of the third stage, having entered, by whatever means, into the intestines of a suitable animal, pass into a state of activity. The head becomes everted, the suckers and hooks change their position,—the hooks projecting forward and outwards. The scolex now fastens by the suckers and hooks upon the intestinal mucous membrane, and casting off his caudal appendage, commences the process of gemmation from the posterior surface. After a time the buds become transversely striated, marking the future divisions into joints, the oldest and most developed being necessarily furthest from the scolex. This process of gemmation comprizes the last stage in the developement.

*All three of these forms of cystic worms, if by any means they become sterile the vesicle is called an Acephalocyst, a structure that has so much puzzled the ingenuity of medical men.

THE STROBILA

matures posteriorly, and as the joints separate they are called proglottides. They contain in their interior eggs for a new generation.

The question has been raised whether a proglottis ought to be called an individual or not.

Each proglottis possesses distinct male and female organs,—fecundates itself—possesses the power of independent motion. It possesses the characteristics of an individual and may be called one.

The formation of joints by this process of budding may go on indefinitely, special circumstances only putting an end to the act. The number of eggs set free from them in the outer world is prodigious, each strobila furnishing many millions. But for the specialized conditions necessary for the development of these worms, they would starve the larger animals by robbing them of their food. A sufficient number of species of cystic and cestoid worms have been found to pass through the preceding metamorphoses, to afford a sufficient proof of the generality of the laws which regulate the development of entozoa.

The liver of the mouse, when affected with Cysticercus fasciolaris, if fed to cats will infest those animals with the Tænia crassicollis.

The Cysticercus pisiformis of hares and rabbits is converted into the Tænia crassiceps of the fox. The Cysticercus tenuicollis becomes the Tænia serrata and the Cysticercus cellulosæ, the Tænia solium. From the Cænurus cerebralis, comes the Tænia cænurus, and from the Echinoccus veterinorum a Tænia echinocci.

The chief difficulty is prosecuting investigations upon those entozoa, is to obtain the right animals to experiment upon. But with that skill, which only comes from experience, *i. e.* observations of a large number of similar facts, it is to be expected that increased facility in artificially propagating these creatures will be acquired.

With adequate knowledge of the history and habits of the entozoa will come an improved method of prophylaxis against them, and skill in their treatment, both of which are yet quite rudimentary.

The Nematoidea still remain in great uncertainty, with regard to their embryology.

The formation of the ovule and zoosperm, and the fecundation of the former by the latter have been observed with much care by Nelson, Meissner, Thomson, Leuckart and others; but the subsequent history of the eggs, after impregnation is quite imperfect. The eggs are doubtless cast into the outer world with the excrements; and lie upon dungheaps, in cess pools, in pastures, &c., and as they fall into conditions favorable for development, that process goes on until finally, in the intestines of animals similar to those the parent occupied before, they attain the state of the perfect individual. The discoveries which have already been made, are sufficient to stimulate to fresh exertions, and although the field of investigation is very extensive, still a difficulty is a thing to be *overcome.* Among the parasites infesting marine animals, will be found the greatest difficulty in unravelling the tangled threads of life, owing to the enormous extent at which animal life is maintained, at the expense of animal life, beneath the surface of the sea. When, as has happened within the short space of an hour, four lives have been successively sacrificed to maintain one, by the stronger and larger swallowing a weaker and smaller one, and this in turn another still more defenceless, and so on for four degrees, it is clear that any parasite which should happen to infest the weakest of the prey, will have undergone a good many vicissitudes, and found the conditions for its development greatly complicated. From the fecundation of the egg, to the development of the perfect individual, parasites of different species infesting marine animals are passing through their alimentary canals, and small wonder would it be, if not a single egg ever came to maturity. But so perfect is the adaptation of these creatures to the circumstances in which they are placed, that enough of them pass unharmed through the stages of development, to maintain perpetually the original type, free from all danger of extinction. Similar, but in a less degree, are the conditions upon land. The stronger individuals always maintain themselves at the expense of the weaker, and as they gratify their destructive propensities, render themselves the prey of creatures still more defenceless, whose very insignificance is their best security. Each animal under the motor influence of its will, which in turn is stimulated by necessity, seeks to maintain the requisite conditions, for its own existence at the expense of its neighbours, and is, as it were parasitic to them. Remove those conditions, and at once the animal ceases to be. The entire world of animal life is parasitic to itself, and to the vegetable, which, in turn, depends upon the animal for its supplies,—mutual dependance binds together animated nature, and this rests upon the material substratum, brute matter with its forces.

Life, a grand totality, perpetually destroyed and perpetually renewed, maintains the grand design in nature, through a succession of conscious and unconscious individuals, ever working out ends, approved by supreme wisdom, though by us at best imperfectly, if at all, discerned.

ON THE APPEARANCE AND DECLINE OF MALARIOUS DISEASE IN THE VALLEY OF THE LOWER GRAND RIVER.

BY ARTHUR HARVEY.

Read before the Hamilton Association.

The appearance in particular localities of peculiar forms of disease forms a highly interesting subject for study and research. Without alluding to the malaria of the Romagna, a district formerly salubrious, or to the encroachments which the yellow fever is yearly making on northern regions, or to other similar cases far from home, we will point to a tract of country, situated close by our doors: the Valley of the Lower Grand River, which, from a healthy settlement, became one of the most unhealthy in America, and has recently recovered its pristine condition. The Grand River, previous to 1834, was allowed to pursue its natural course unimpeded, to Lake Erie; but in that year the Grand River Navigation Company built dams upon the river in several places, making it navigable as far as Brantford. These dams are in some instances so high as to throw back the water for a distance of sixteen or seventeen miles. Previously to their erection, there had not been a single case of fever and ague in the neighbourhood of the river. Neither did this disease manifest itself to any considerable extent for three or four years after their being built. But from 1839 to 1847 malarious disease of the nature above referred to, and of a culiarly malignant character, was universally prevalent, from Brantford downward. It attacked, especially, recent immigrants, whether they came from Europe or from the Lower Provinces. In the tract between Caledonia Bridge and the dam at that place, a space of but a few yards, there were, in six weeks of 1844, nine deaths from this cause; while the rate of mortality among the population living between Caledonia and Danville was greater than that at New Orleans, from all causes combined. Of late years, however, the number of cases of disease, as well as the intensity of its virus, have diminished. In the small tract near Caledonia, above referred to, not a single death has occurred for the last five years, while on the whole there is, according to the medical gentlemen resident in the Grand River Valley, no healthier part in Canada than this same locality. The prevalence of disease materially retarded the settlement of the country, since who would occupy land where, in spring or fall, to be ill was the rule, to be well the exception? Now, however, the cause being removed, the country may be settled without danger to health, and an almost desert tract of great fertility be made to add its abundant harvest to our already ample annual agricultural produce.

It would appear, at first sight, that the construction of dams on the Grand River could have as little to do with the production of disease as the erection of Tenterden steeple had with the formation of the Goodwin Sands. But, on second thoughts, we may conceive that the river water, "backing up" into, and becoming stagnant in the various creeks, and being comparatively tranquil even in the main channel, would allow of the deposition of putrescent and vegetable substances in places where previously the running water would not have allowed it to remain. Thus we can trace one possible cause of the malaria. But how shall we account for the removal of the cause, while the dams yet remain? One answer, at least, suggests itself to the enquirer. The country near the source of the Grand River and its feeders, as well as along its upper valley, has been rapidly cleared of its timber. The snows there are now quickly melted, and the water resulting therefrom, or from any great downfall of rain, is no longer retained for months among the roots of the trees or in the mossy swamps. It pours down at once in a sudden and violent freshet, which only lasts three or four days, instead of feeding the river and maintaining it at an even height for a month or two. This has a tendency to carry away all floating or deposited vegetable matter into Lake Erie, instead of allowing it to remain and be exposed to the sun's rays; and thus it may now counteract the effect the dams at first produced.

It is matter for reflection, whether the geological characteristics of the country may not have had something to do with the development of disease to the extraordinary extent, and of the malignant character above referred to.

The rock immediately below the surface is sandstone, and the primary as well as the secondary formation of limestone crops out in the beds of at least one, possibly of several, of the creeks. Between the strata of limestone there is often a deposit of gypsum, sulphate of lime, and, in places, this deposit is so great that it forms the basis of a considerable commerce with Pennsylvania and Ohio, coal being generally brought thence in exchange.

Whether or not the sulphate of lime, although a very insoluble salt, affects the water of the natural springs, this is certain, that they are all impregnated with sulphuretted hydrogen to a very great extent. Indeed the water in the creeks which these springs supply (Boston Creek, McKenzie Creek, Decomèr's Creek, and others) is so strongly charged with the gas, that it offends the senses very perceptibly to travel along their banks. The water in the well of Cayuga gaol is slightly impregnated with the same offensive gas, and there are few, if any, springs in that neighbourhood, in the water of which it cannot be detected, even by the taste. The springs between Cayuga and Canboro' are, in addition, strongly charged with carbonic acid gas (free), which gives it a distinctly pungent flavor, and renders it pleasant and palateable. The wells are here very deep, in some cases sixty feet. The diminished pressure of the atmosphere may have an effect in allowing the carbonic acid gas to escape, which it does, in numerous bubbles, some of which rise as soon as the water is poured out, others gradually form and remain clinging to the side. If a glass of this water be allowed to stand for about twelve hours, all the carbonic acid gas will have escaped, and the sulphuretted hydrogen alone remaining, its characteristic and offensive taste becomes plainly perceptible.

REVIEWS.

Figures and Descriptions of Canadian Organic Remains: Decade III. [Issued by the Geological Survey of Canada.] Montreal, 1858.

It has long been a subject of regret to Canadian and other workers in the field of Palæontology, that the valuable and instructive collections, brought together by the Geological Survey, should be deprived of half their utility, by remaining without befitting illustration. In our evidence before the Committee of Inquiry, appointed by the House of Assembly, in reference to the survey in the autumn of 1854, we were happy in being able, in conjunction with Sir William Logan and Professor Hall, to urge the earnest consideration of this subject upon the attention of the Committee. The House having afforded to Sir William Logan the means to carry out his long cherished views in regard to this matter, he set to work with his usual energy and discrimination, and subdivided the task amongst those best fitted for its execution. One portion was put into the hands of Mr. Salter, of the Geological Survey of the United Kingdom, a gentleman of the first rank amongst English palæontologists. Professor James Hall, the distinguished author of the "Palæontology of the State of New York," took charge of another portion; and in the person of a Canadian naturalist of rising reputation, Mr. Billings, Sir William Logan has found a most able coadjutor for the accomplishment of a third portion of the work. The assistance of other palæontologists will also be called into request, as the occasion may arise for their more special services; and thus, indeed, in the Number or Decade before us, we find a short but able notice (with illustrations) by Mr. T. R. Jones, of the London Geological Society, on the Bivalve Entomostraca of the Palæozoic Rocks, a department of palæontology which that gentleman has made more especially his own.

Mr. Billings having completed the first portion of the work allotted to him, it has been thought advisable to issue this at once; as, although registered "Decade III.," the part in question is complete within itself, and is altogether distinct from the first and second decades, now on the eve of publication. It comprises, first, a preface or introductory notice by Sir William Logan, in explanation of the character of the work and the plan of publication; secondly, a long and very elaborate essay on the Cystideæ of the Lower Silurian Rocks of Canada, by E. Billings, Esq.; thirdly, a paper on the Asteridæ of the same rocks, also by Mr. Billings; fourthly, a paper on a new genus (Cyclocystoides) of Echinodermata, by Messrs. Salter and Billings; and, lastly, an article on the Bivalve Entomostraca of Canada, by T. R. Jones, Esq., Assistant-Secretary to the Geological Society of London: the whole illustrated by wood engravings, and by eleven plates executed by some of the most eminent lithographers. Of these plates, seven are in illustration of the memoir on the

Cystideæ, by Mr. Billings. To this paper we invite more especially the attention of our readers, as it contains a preliminary dissertation, with many illustrative wood-cuts, in addition to the lithographed plates, on the general history and organization characters of this extinct and interesting type of ancient life. Mr. Billings has thus kept in view the wants of the general student, whilst affording information of a new and purely original character to those already familiar with these details. It would scarcely be fair to our author to quote from this introductory portion of his work, as the necessarily restricted length of our quotations, combined with the absence of explanatory wood-cuts, would fail to convey a just idea of the perspicuous and comprehensive manner in which the various details of the subject are classified and set before the reader. This, however, we regret the less, since, in accordance with the suggestion of Sir William Logan, whilst a certain number of copies of these decades is to be reserved for members of the Legislature, the remaining copies of the issue are to be offered to the general public at a merely nominal cost. By this wise innovation, which we trust to see carried out with regard to the other publications of the Survey, the work will be accessible to all who may desire to possess it; in place of being distributed, as in the case of the Reports already published, amongst a few persons only, and of whom the majority, perhaps, would take but little interest in it.

One of the more interesting points discussed by Mr. Billings in his general review of the structural characters of the lower echinodermata, relates to the so-called ambulacral system in the extinct crinoids. As in these ancient forms, the ambulacral grooves occur only in the arms (apart from the pseudambulacra of the Pentremites and other Blastoidea), the aquiferous and other vessels of the ambulacral system—which in the star-fishes and recent crinoids, issue from the mouth and pass outwards along the grooves—must, in the opinion of Mr. Billings, have entered the body *through special pores situated at the respective bases of the arms.* The truth of this happy suggestion—difficult of general proof, from the imperfection of specimens—has been established by Mr. Billings, and also independently by Professor Huxley, in several species of crinoids belonging to different genera. With regard to the much-disputed position of the oral aperture in the true cystideans, Mr. Billings agrees with De Koninck and others—in opposition to the older view of Von Buch, and to the, perhaps, still general opinion (see Pictet, McCoy, &c.), based on certain analogical relations to recent crinoids—that the lateral aperture usually regarded as the ovarian orifice, was the true mouth*; and he supports his opinion by a train of argument not easily to be set aside. The series of small triangular valves with which the orifice in question is provided in many species, may be looked upon as the homologues of the "lips" or buccal apparatus of the living Pentacrinus (*P. caput Medusæ*) of the West Indian seas.

In his section on the Lower Silurian species of Canadian cystideæ, Mr. Billings describes nineteen new forms, belonging to his genera, Pleurocystites, Glyptocystites, Comarocystites, Amygdalocystites, Malocystites, Palæocystites, and Ateleocystites. The genus Pleurocystites is a very remarkable one. It is chiefly characterised by the dissimilar structure of the two sides of the body; a series of comparatively large plates covering the dorsal side, whilst the ventral side consists of an open space protected by an integument covered with numerous small plates. The genus, with us, appears to range from the Chazy to the Hudson River group; and geographically from Canada to Wales (Caradoc group), and Bohemia (Barrande's *étage D.*) Six species are enumerated: *P. squamosus* (plates plane or slightly concave; pectinated rhombs, with obtuse angle above); *P. robustus?* (plates concave); *P. filitextus* (pectinated rhombs with acute angle above; plates on ventral side fewer and larger than in *P. squamosus*); *P. elegans; P. exornatus;* and *P. Anticostiensis* (plates probably smooth). *P. elegans* and *P. ornatus* may perhaps prove eventually to be mere varieties of *P. filitextus.* The genus Glyptocystites is characterised chiefly by its cylindrical body, enclosed in four series of plates (=4 basal +5+5+5), some with re-entering angles; and by the presence of *ten or more* pectinated rhombs, a strikingly peculiar character. It ranges from the Chazy to the Trenton group, and comprises the following species: *G. multiporus* (arms 4+1, extending down the sides of the body); *G. Logani* (plates with stellar ridges, arms not developed: Trenton): *G. gracilis; G. Forbesi* (plates large and strong, with numerous ridges and striæ: Chazy). Of the genus Comarocystites only one species, *C. punctatus*, has been recognised. It occurs in the Trenton group, and may be readily distinguished by its deeply-concave plates. The basal plates are three in number, succeeded by from

* Except in the genus *Malocystites* (Billings), in which the apical orifice is regarded as the mouth.

eight to eleven irregular rows; the mouth is provided with a valvular apparatus, and there are *free arms.* The genus Amygdalocystites possesses the same plate-formula as Comarocystites, and the mouth is also furnished with a valvular apparatus; but, in addition to other distinguishing characters, the arms are recumbent, and composed of a double in place of a single series of joints. Three species are enumerated. One of these, however, may belong to a distinct genus, and the other two may perhaps be united. They comprise: *A. florealis*, *A. tenuistriatus* (?), and *A. radiatus*. In both Comarocystites and Amygdalocystites the plates are without pores, at least on the unworn external surface. The genus Malocystites has likewise an indefinite number of non-poriferous plates.* The arms are recumbent, and the mouth is nearly at the apex of the cup. Two species are described: *M. Murchisoni*, with eight long and winding arms, and *M. Barrandi*, with two short arms. In the genus named Palæocystites, the plates are numerous and also poriferous, or rather crypto-poriferous, as the pores do not extend directly to the outer surface, but communicate with the interior through the sutures, on the edges of which they open. Nothing is known respecting the arms, orifices, and stem. Three species are enumerated: *P. tenuiradiatus*,† *P. Dawsoni*, and *P. Chapmani*, but their specific characters are necessarily somewhat obscure. Finally, in the genus Ateleocystites, a single species, *A. Huxleyi*, is mentioned. The calyx in this form appears to have, as in Pleurocystites, a dorsal side made up of comparatively few plates, with numerous small plates on the ventral side. In other respects, however, the genus is a very peculiar one, and perhaps referable to a distinct group.

In his enumeration of our Canadian star-fishes, besides two species of McCoy's, or Salter's, Palasterina, Mr. Billings describes several new genera: Stenaster, Petraster, and Tæniaster, amongst ordinary star-fishes, and Edrioaster belonging to the abnormal sessile group. The latter genus was named Cyclaster in Mr. Billings' Report for 1856; but it was subsequently found that the same generic name had been applied in France, just previously, to a new genus of

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* As subsequently shown, however, by Mr. Billings, the pores in Comarocystites appear to open out on the sides of the plates at the sutures, as in the genus Palæocystites. May not this be the case, also, with regard to Cryptocrinus (Von Buch), and the other so-called non-poriferous types? E. J. C.

† This is the *Actinocrinus tenuiradiatus* of Hall. The other species appertaining to the different genera enumerated in the text, belong entirely to Mr. Billings.

Echinida. A description (with figures) of the sessile species, *Agelacrinites Dicksoni*, mentioned in the Report for 1856, is also given under this section. Beyond this, we have a detailed description by Messrs. Salter and Billings, of two species of their new and very remarkable genus, Cyclocystoides, a type apparently intermediate between the crinoids and the asteridæ. Finally, the memoir already alluded to, on the Bivalve Entomostraca of Canada, by Mr. T. R. Jones, concludes the volume.

Our brief analysis of the contents of this "Decade" will be sufficient, we trust, to show the rare value of the work thus given to the Canadian student, and to palæontologists generally, by the Director of our Geological Survey. Without doubt, in a scientific point of view, this publication must be regarded as the most important that has yet issued from the Canadian press.

E. J. C.

A Monograph of the Trochilidae, or Humming Birds: By JOHN GOULD, F.R.S., &c. Parts 1 to 16, fol.: 240 plates. London: Published by the author, 20 Broad St., Golden Square.

Mr. Gould has published various splendid ornithological works which rank among the very best for the beauty of their illustrations, whilst they also contain a great deal of accurate and valuable information. Their artistical qualities are truly admirable. The aid they afford to the scientific ornithologist is varied and important. Their great expense, the unavoidable accompaniment of the kind of excellence they possess, limits their usefulness and provokes an occasional grumble from the student of moderate means, as it often excludes them even from respectable public libraries, and makes them the privilege of wealth, instead of the companions of the earnest seekers after the knowledge of nature.

Under these circumstances, in our remote situation, and in a country not yet overflowing with wealth, we should hardly have thought ourselves called upon to notice the latest and perhaps most beautiful and attractive of Mr. Gould's works, had we not enjoyed opportunities in England of examining the splendid collection of preserved specimens of Trochilidae, which was the foundation of the work, as well as that formed by the late excellent Mr. G. Loddiges, with whom we have often conversed on the characters and peculiarities of this most interesting family, which few have ever studied as he did—and had we not considered that the fine library of our Parliament, which is wisely and liberally made accessible to all who desire to consult it, contains copies of all Mr. Gould's works which are now attainable; whilst the truly beautiful one of which we propose more particularly to speak, has been also placed in the library of the Canadian Institute by one of our fellow citizens, whose liberality and discriminating taste in science and art dignify and adorn the high position which fortune and personal qualities have secured to him. We need scarcely name the Hon. Geo. W. Allan, to whom the Canadian Institute is also in other ways deeply indebted.

The Humming birds long continued to form only a single genus, and when the increasing numbers that from year to year were made known suggested the expediency of subdivision, still for a time only subgenera were proposed, or at least genera were created with great caution. Mr. George Gray was led by his plan to devise the formation of sub-families, and accounting the old genus Trochilus as equivalent to his family TROCHILIDAE, he has enumerated three sub-families *Gryphinae*, or Wedge-tails, *Trochilinae*, or curve-bills, and *Mellisuginae*, or Straight-bills. Under each family are several genera, yet he did not altogether exceed ten, a number which, considering the many species now known, seems very moderate. It must be confessed, however, that his genera have not always a natural aspect, great differences of form being included in the same genus, so that those who had consented to the genera sanctioned by him would be well prepared to listen to the proposals of ornithologists of eminence both on the continent of Europe and in England for yet further sub-division. Prince Bonaparte introduced various genera, and it was well known that Mr. Loddiges, though his great diffidence, and his desire of increasing his knowledge before he gave a decided opinion, had prevented his publishing his views, was prepared to recommend additional ones, and had adopted certain principles respecting the characters proper to be employed. With these materials before him, and having in his hands the finest collection yet formed, Mr. Gould has possibly carried to an extreme the formation of genera. He does not indeed give his readers the means of forming a correct judgment, since his beautiful figures, though accompanied by copious synonymes and a useful description, are without generic and specific characters. He may probably intend—v hope he does—to give at the conclusion of his work a careful digest of his views and a synopsis of the order, with the requisite characters of genera and species. Whilst waiting for this it is hardly possible for us fairly to discuss the goodness of generic groups of which we have to collect the distinctions for ourselves, or search them out, scattered through various works.

The most obvious character for dividing the Humming birds is perhaps found in the bill, which is straight, slightly curved, sickle-shaped, recurved, and in a few instances furnished with recurved teeth along one portion of both mandibles. Then we have the various forms of the tail, the crests, tufts, and other appendages, the position of the gem feathers, to which we believe Mr. Loddiges attached much importance, and the pretty downy boots or muffs on the feet of many species, besides size, general distribution of colouring, and peculiar habits or instincts. From all these sources we may expect combinations of good and sufficient characters. What is needed is to form the numerous species into natural groups, as many as may be found necessary to express our observations on their resemblance and differences, but taking care that these shall be of real importance, minor distinctions only constituting sections of genera and having no claim to burden science with additional names. When we think we clearly perceive which species must stand together, we then observe carefully whatever is common to them all, and select from what is thus collected concise characters, sufficient to exclude all other species. It would be a manifestly wrong course to contrive characters from abstract principles in relation to the number of genera that must be found in a family, or the points that must be deemed important, since these will differ in different families and are in each case to be learned from observation. Every apparent distinction must not be assumed to be a good generic mark. To combine well is more useful as well as more difficult than to divide. The tendency to make much of small distinctions and to elevate minor sections into genera is the bane of Natural Science, and it is not always understood how much easier a task it is than to find out the true boundaries of natural groups. We have fallen into this train of thought in reflecting on the eighty-eight genera of Trochilidae already given in Mr. Gould's sixteen numbers, containing two hundred and forty species, giving two and a fraction species for each genus, and, as many of those genera are of some extent, leaving many with only a single species. Many perhaps of these genera we think we perceive to be natural and sound, of many others we have great doubts. When the principles on which they are founded are fully explained every thoughtful naturalist who is interested in this department of science, and who does not fancy that he displays his learning by adopting as many new names as possible, can judge for himself, and after such consideration the best founded opinions will ere long prevail. At present we are willing to extend great candour to Mr. Gould's labours, sensible as we are of the merit which certainly belongs to him. We cannot conclude without reverting to the extreme beauty of the coloured lithographic plates. Some of the loveliest objects in nature are represented with such correctness and spirit, and the metallic lustre of the gem feathers is so successfully imitated, that in order to feel any deficiency the real object must be brought into comparison with its image, and even then we rather wonder how much has been accomplished than feel disposed to complain of what may be wanting. The book is so very beautiful that it is a privilege to be able to look at it. Those who have the means and have any taste for nature should hasten to acquire it. As in several of the best modern works on ornithology and entomology, we have here the flowers drawn and coloured with the same care as the birds, and selected from the flora of the country to which they belong, so that the sources of pleasure and instruction are multiplied, and the botanist has his share in the benefit to be derived from the work. The XVth part contains an exquisite delineation of our own charming Canadian humming bird, with a very interesting account of the author's observations upon it during his recent visit, and of his success in conveying a pair alive to Europe, though unfortunately he failed to prolong their lives there. Mr. Gould's work cannot be known without being admired both for its pre-eminent artistic qualities and for the genuine love and faithful observation of nature which it displays. When it is completed naturalists can with real advantage study the species of Trochilidae; whether they will acquiesce in all Mr. Gould's genera formed or adopted by him, seems to us, with our present means of judging, somewhat doubtful.

W. H.

Annaler for Nordisk Oldkyndighed og Historie. Copenhagen, 1858.

We have received the following notice of a new volume of the Scandinavian Annals of Northern Archæology and History, from a Danish correspondent, and insert it in the form transmitted to us. It furnishes glimpses of a new source of light relative to the Ante-Columbian discovery of America, by the Northmen, from an exceedingly interesting and independent source; and will thus constitute an important supplement to the *Antiquitates Americanæ*, published by the Royal Society of Northern Antiquaries, at Copenhagen, in 1837.

The new volume, now issued after an interval of twenty years, opens with a voluminous and instructive historical and geographical inquiry, by A. F. Mehren, "On the general Geographical Knowledge possessed by the Islamitic Peoples, particularly with respect to the Southern and Northern Coasts of the Hemisphere known to them."

At a time when that flame of science, which had shone so brightly over Greece and Rome, was gradually sinking and expiring, its last rays were preserved in the beginning of the middle ages by a nation hitherto overlooked—the Arabs. This race, after having received from the creative genius of Mohammed a zealous faith and an ordered civil polity, for many centuries occupied the first place among the nations, both for deeds of arms and for careful and high-minded devotion to study; and for a time were at the head of that Europe which was sinking into barbarism. By translations from the Greek, their knowledge nearly reached a classical height, and by their own independent inquiries they acquired well-grounded claims to be reckoned among those nations which have most actively labored in the field of scientific development.

The distinguished French Professor, Reinaud, and the illustrious geographers, Malte-Brun and Lebwel, have particularly directed our attention to the merits of the Arabs in geographical study. The present treatise is a continuation of the labors of those and other scholars.

We have first a classical sketch of the most important Mohammedan geographers, from the eighth to the sixteenth century, according to our era. We have next, separate chapters on the oldest un-scientific ideas of the Arabians of the Universe; their conceptions of the form of the earth; their mathematical division of the earth; their measurement of the degrees; and the division of the habitable globe into seven regions or climates. Another chapter treats at length of the terrestrial system of seas; the limitation of the earth by the ocean, and the parts of the latter; the Southern Ocean, with its coasts and islands, and the several seas connected therewith; the Eastern Ocean; the Western Ocean, and its connected seas; the Mediterranean, with the Black Sea and the Caspian; the isles in the Western Ocean, and the coasts of the same; and the Northern Lands, known to the Arabs, surrounding the Varenger Sea.

Among the many local names here mentioned as occurring in the works of the Arabian geographers, there is one of especial interest. It affords a supplement to Rafn's *Antiquitates Americanæ*, published by the Society in 1837. The result of th geographical inquiries in this work on the situation of the Northmen's Helluland (Newfoundland), Markland (Nova Scotia), and Vinland (New England), has been taken up, with full approval, by Alexander Humboldt, in his *Kosmos*. A more southern land the Northmen named Hvitramannaland (the land of the White Men); or, Irland it Mikl. Great Ireland). This was supposed by Rafn to be North and South Carolina, Georgia, and Florida. The oldest historian of Iceland, Are Frode, states that his stam-father, Are Marson, came to this land about the year 983, and was baptized there. This same land—*Irland it Mikla, Irlandeh El-Kabirah*—is also mentioned by an Arabian geographer of the 12th century, *Abû-Abdallah Mohammed Edrisi*, who was born in Ceuta, in 1099, and had studied in Cordova. He drew up his work at the desire of Roger II., King of Sicily (1130-1154.) The above geographical name, as well as several other notices of the North, were doubtless derived by the Arabian author from his intercourse with the Northmen, at the court of this sovereign, in Palermo.

It is most interesting to follow the often highly successful identification of the local names mentioned by the Arabian geographers, especially those of several islands in the Western Ocean; places in France and England; and also in Scandinavia, particularly Denmark, where Slesvig is mentioned in a curious manner; and also in Sweden. The same thing applies to Russia. An extract from a voyage in the twelfth century (1132), by *Abû-Abdallah Hamid*, of Granada, gives an undoubted description of a whale-fishery on the coast of the land Wisu. This, according to the admirable explanation of Frähn, is the locality of the tribe Weg, spoken of in the Russian annals, north of Novgorod, by the White Sea (Bielo Osero), thus identified with a bay of the Arctic Ocean. D. W.

SCIENTIFIC AND LITERARY NOTES.

GEOLOGY AND MINERALOGY.

"RIB-FORMULÆ" IN BRACHIOPODS.

In the specific determination of fossil brachiopods, the palæontologist has to content himself in most instances with external characters. Amongst these may be enumerated the ribs or plaits occurring so frequently on the shell. These plaits, in adult forms, are either constant in their number, or vary only within slight limits. Hence, when present, their number is commonly stated. We suggest, for this purpose, the adoption of a numerical plan or formula, shewing the number of ribs on each side of the sinus, and within it, or upon the mesial fold, where this exists. Thus, when there is a sinus, we may state, RF = (*m*|*m*|*m*), or (*m*||*m*); and when there is no sinus, RF = (*m*). In many forms, of course, RF = 0; and in the forms with an indefinite number of plaits, RF = (00), or (00||00), or (00|*m*|00). As a general rule, the *Spiriferidæ*, exclusive of the smooth forms, show the rib-formula (*m*||*m*); whilst the *Rhynconellidæ* exhibit (*m*|*m*|*m*). The following are some examples:—

Spirifer Niagarensis, Conrad (adult form), RF = (10–15||10–15); *S. sulcatus*, Hisinger, RF = (4–7||4–7); *S. macropleura*, Conrad, RF = (3–4||3–4); *Rhynconella (Hemithyris) nucula*, Sowerby sp., RF = (6–8|3|6–8); *R. formosa*. Hall, RF = (9–10|2–4|9–10). In the latter species, as in many others, the ribs within the sinus are much coarser than those at the sides, a peculiarity which might be indicated by larger or darker figures in the formula.

As the plications on the mesial fold differ usually from those in the sinus, it is perhaps preferable, in these cases, to write the formula in two lines, one above the other; the numbers in the upper line referring to the valve which bears the fold or elevation; and those in the lower line, to that in which the sinus occurs. Thus, in *Atrypa (Rhynconella) increbescens*, Hall, RF = $\left(\frac{4\text{-}6}{4\text{-}6}\middle|\frac{4\text{-}5}{3\text{-}4}\middle|\frac{4\text{-}6}{4\text{-}6}\right)$; or, more simply $\left(4\text{-}6\middle|\frac{4\text{-}5}{3\text{-}4}\middle|4\ 6\right)$.

It is not of course to be supposed, that the method which we have here ventured to suggest to the attention of palæontologists, can be at all times very rigorously applied; but it is thought that, in many instances at least, it will be found a convenient one. The student, for example, would find his labor much facilitated, in the determination of an unknown species by reference to special works on palæontology, if he were to write in the margin against each species the rib formula as here shewn. The eye would then be able to take up at a glance the relations, in this respect, of the described species to the one under examination —due reference being made to any difference that may exist between young and adult forms.

ARTIFICIAL FORMATION OF CRYSTALLIZED MINERALS.

By the volatilization of metallic fluorides and boracic acid in covered charcoal or clay crucibles, H. Ste.-Clair Deville and H. Caron*, have succeeded in forming, without difficulty, a considerable number of crystallized minerals. Amongst those cited, we may mention: the ruby, sapphire, and other varieties of corundum; chrysoberyll, with the radiating striæ and other characters of the American specimens; gahnite, in beautiful octahedrons; staurolite; zircon; magnetite, &c. In reference to the latter (the magnetic iron ore, which was obtained in the form of long needles, made up of regular octahedrons attached to one another), the authors state that the first formed sesqui-oxide of iron was in this case evidently reduced in part by the high temperature, as confirmed by some of their other experiments.

HYGROSCOPIC PROPERTY OF THE ZEOLITES.

Damour (Annales de Chimie et de Physique: aôut, 1858) has confirmed his earlier experiments with reference to the property possessed by the various zeolites, to a greater or less extent, of losing a portion of their contained water in a dry atmosphere, and re-absorbing the same under ordinary atmospheric conditions. The water is even re-absorbed, after the mineral has been exposed to a slight degree of artificial heat, amounting in some cases to dull redness.

IRON OXIDES.

The number of *Poggendorff's Annalen* for September, 1858, contains a long and very valuable communication, by Rammelsberg, on the composition of Titaniferous Iron Ore, Red Iron Ore, Martite, and Magnetite. The most important fact, perhaps, shewn in this communication, is the presence of an essential percentage of magnesia in many specimens of these ores, and, more especially, in the octahedral specular-iron of Vesuvius. The following is a condensed translation of the summary given at the close of the Paper:—

(1) The greater number of Titaniferous Irons contain equal atoms of Titanic Acid and Protoxide of Iron (including MnO and MgO).

(2) Magnesia is an essential constituent of all Titaniferous Iron Ores. In the crystallized Titaniferous Iron of Layton, U. S., it amounts to 14 per cent.

(3) According to Mosander's view, Titaniferous Iron Ore consists simply of FeO, TiO^2, with isomorphous replacement of titanate of magnesia (Gastein, Layton); or, otherwise, of the same, in union with sesqui-oxide of iron, mostly in simple proportions.

(4 & 5) The theory of H. Rose, making Titaniferous Iron Ore to consist of the isomorphous sesqui-oxides of iron and titanium, requires the assumption of a

* Journal für Praktische Chemie No. 11, 1858; and Comptes Rendus, t. XLVI, p. 764.

sesqui-oxide of magnesia. Mosander's opinion, consequently, appears to be, by far, the more preferable of the two.

(6) Certain specimens of the granular variety called Iserine, consist of FeO, TiO^2 and Fe^2O^3, $3TiO^2$.

(7) Titaniferous Iron in regular octahedrons is unknown. The amorphous masses and imperfectly-octahedral grains which contain titanium, appear to be mixtures.

(8) Crystallized Magnetic Iron Ore does not contain titanium. It consists of $FeO+Fe^2O^3$.

(9) All the Elba specimens of Specular Iron do not contain titanic acid; but these specimens, as well as the specular iron from Vesuvius, always contain FeO and MgO.

(10) The strongly-magnetic octahedrons (accompanied by rhombohedral iron-glance) from Vesuvius, hitherto looked upon as octahedral sesqui-oxide of iron, contain a large amount of magnesia in some specimens, and protoxide of iron in others. They consist either of Magnetic Iron Ore, partly changed into sesqui-oxide and combined with the isomorphous compound MgO, Fe^2O^3; or, and more probably, the two monoxides are isomorphous with the sesqui-oxide of iron; and this latter is, in itself, dimorphous.

NEW FORM IN THE CRYSTALLIZATION OF HEAVY SPAR.

The museum of the University of Toronto possesses a crystal of Heavy Spar (BaO, SO^3) from Auvergne, in which we have detected the presence of the side polar or brachydome $\frac{5}{8}\breve{P}$, hitherto, we believe, unnoticed. The crystal in question is made up principally of the front and side polars $\frac{1}{2}\bar{P}$ and $\breve{P}$, with a slight development of the basal form, B; or, in Dana's notation, of $\frac{1}{2}\bar{i}$, $\breve{i}$, and o. The new form lies, of course, between $\breve{P}$ and B; and it exhibits a series of horizontal striæ parallel to the combination edge of these; or rather, perhaps, parallel to that of $\breve{P}$ and $\frac{1}{2}\breve{P}$, but the latter form is not present in our crystal. The new form measures, by hand goniometer, 84° 30′ ove~ the base. The striæ prevent the application of the reflective goniometer. Taking the three axes (a, $\bar{a}$, $\breve{a}$;) in the protaxial form of Heavy Spar, to be as 1.135 : 1 : 0.8141—axis $\bar{a}$, in the form $\frac{5}{8}\breve{P}$, should be to axis a, as 1 : 1.095. The latter (omitting seconds) = cot 42° 24′; making the angle over the base = 84° 48′. The symbol P used in this notation, has no reference to Naumann's symbol. It merely indicates a polar or pyramidal form, of which there are three general kinds: Front polars, $m\bar{P}$; polars, mP and mPm; and side polars, $m\breve{P}$. In like manner there are three general kinds of vertical forms: front verticals, $\bar{V}$; verticals, Vm; and side verticals, $\breve{V}$. Besides these polars and verticals, we can only have the basal form B, parallel to the horizontal or secondary axes.

E. J. C.

PHYSIOLOGY AND NATURAL HISTORY.

PUBLIC NATURAL HISTORY COLLECTIONS.

The following correspondence has recently passed with the British Chancellor of the Exchequer :—

"SIR,—As one of a body of working Naturalists deeply interested in the fate of the Natural History Collections now in the British Museum, I am requested to transmit for your consideration the enclosed Memorial, which we believe to express the views of a large number of persons engaged in the pursuit of science, although it has not been considered necessary to send it round for general signature. We also understand that it has the full concurrence of Sir William Hooker and others whose official situation prevents their actually joining in it.

"Should you desire to receive any personal explanation of our views we shall be happy to form a deputation to wait upon you at whatever time you may be pleased to appoint.

"I have the honour, &c.,
(Signed) "JOHN LINDLEY."

To the Right Honourable the Chancellor of the Exchequer.

SIR,—The necessity of the removal of the Natural History Departments from the British Museum having been recently brought prominently before the Public, and it being understood that the question of their reorganisation in another locality is under consideration, the undersigned Zoologists and Botanists, professionally or otherwise engaged in the pursuit of Natural Science, feel it their duty to lay before Her Majesty's Government the views they entertain as to the arrangements by which National Collections in Natural History can be the best adapted to the twofold object of the advancement of Science, and its general diffusion among the Public—to show how far the Scientific Museums of the Metropolis and its vicinity, in their present condition, answer these purposes,—and to suggest such modification or additional arrangements as appear requisite to render them more thoroughly efficient.

The Scientific Collections or Museums, whether Zoological or Botanical, required for the objects above stated, may be arranged under the following heads :—

1. A general and comprehensive *Typical* or *Popular Museum*, in which all prominent forms or types of Animals and Plants, recent or fossil, should be so displayed as to give the Public an idea of the vast extent and variety of natural objects, to diffuse a general knowledge of the results obtained by Science in their investigation and classification, and to serve as a general introduction to the Student of Natural History,

2. A complete *Scientific Museum*, in which Collections of all obtainable Animals and plants, and their parts, whether recent or fossil, and of a sufficient number of specimens, should be disposed conveniently for study; and to which should be exclusively attached an appropriate *Library*, or Collection of Books and Illustrations relating to Science, wholly independent of any general Library.

3, A comprehensive *Economic Museum*, in which Economic Products, whether

Zoological or Botanical, with Illustrations of the processes by which they are obtained and applied to use, should be so disposed as best to assist the progress of Commerce and the Arts.

4. Collections of Living Animals and Plants, or *Zoological* and *Botanical Gardens*.

The *Typical* or *Popular Museum*, for the daily use of the general Public, which might be advantageously annexed to the *Scientific Museum*, would require a large building, in a light, airy, and accessible situation. The Collections should be displayed in spacious galleries, in glass cases so closed as to protect them from the dirt and dust raised by the thousands who would visit them; and sufficient room should be allowed within the cases to admit of affixing to the specimens, without confusion, their names, and such Illustrations as are necessary to render them intelligible and instructive to the Student and the general Public.

The *Economic Museums* and *Living Collections* in Botany might be quite independent of the Zoological ones.

The *Scientific Museum*, in Zoology as in Botany, is the most important of all. It is indispensable for the study of Natural Science, although not suited for public exhibition. Without it, the Naturalist cannot examine or arrange the materials for the *Typical*, *Economic*, or *Living Collections*, so as to convey any useful information to the Public. The specimens, though in need of the same conditions of light, airiness, &c., as, and far more numerous than, those exposed, in the *Typical* or *Popular Museum*, would occupy less space; and they would require a different arrangement, in order that the specimens, might without injury, be frequently taken from their receptacles for examination. This *Scientific Museum*, moreover, would be useless unless an appropriate Library were included in the same building.

The union of the *Zoological* and *Botanical Scientific Museums* in one locality is of no importance. The juxtaposition of each with its corresponding *Living Collection* is desireable, but not necessary—although, in the case of Botany, an extensive Herbarium and Library are indispensable appendages to the Garden and Economic Museum.

The existing Natural History Collections accessible to Men of Science and to the Public, in or near the Metropolis, are the following:—

In Botany—The Kew Herbarium, as a Scientific Collection, is the finest in the world; and its importance is universally acknowledged by Botanists. It has an excellent Scientific Library attached to it; it is admirably situated; and being in proximity with, and under the immediate control of the Head of the Botanic Garden, it supersedes the necessity of a separate Herbarium for the use of that Garden and Museum. But a great part of it is not the property of the State; there is no building permanently appropriated for its accommodation, and it does not include any Collection of Fossil Plants.

The Botanical Collection of the British Museum, consisting chiefly of the Banksian Herbarium, is important, but very imperfect. It is badly situated, on account of the dust and dirt of Great Russell Street: and the want of space in the existing buildings of the British Museum would prevent its extension, even were there an adequate advantage in maintaining, at the cost of the State, two Herbaria or Scientific Botanic Museums so near together as those of London and Kew. The

British Museum also contains a valuable Collection of Fossil Plants, but not more readily available for Science than its Zoological Collections.

There exists no Typical or Popular Botanical Museum for public inspection.

The efficiency of the Botanical Gardens and Museum of Economic Botany at Kew as now organized, and the consequent advantages to Science and the public, are too generally recognized to need any comment on the part of your Memorialists.

In Zoology.—The British Museum contains a magnificent Collection of Recent and Fossil Animals, the property of the State, and intended both for public exhibition and scientific use. But there is no room for its proper display, nor for the provision of the necessary accommodation for its study—still less for the separation of a *Popular Typical* series for public inspection, apart from the great mass of specimens whose importance is appreciated by professed Naturalists. And, in the attempt to combine the two, the Public are only dazzled and confused by the multiplicity of unexplained objects, densely crowded together on the shelves and cases; the man of science is, for three days in the week, deprived of the opportunity of real study; and the specimens themselves suffer severely from the dust and dirt of the locality, increased manifold by the tread of the crowds who pass through the galleries on Public Days,—the necessity of access to the specimens on other days preventing their being arranged in hermetically closed cases.

A Museum of Economic Zoology has been commenced at South Kensington.

There is an unrivalled Zoological Garden or living Collection, well situated in the Regent's Park, but not the property of the State, nor receiving any other than indirect assistance, in the terms on which its site is granted.

The measures which your Memorialists would respectfully urge upon the consideration of Her Majesty's Government, with a view to rendering the Collections really available for the purposes for which they are intended, are the following:—

That the Zoological Collections at present existing in the British Museum be separated into two distinct Collections,—the one to form a *Typical* or *Popular Museum*, the other to constitute the basis of a complete *Scientific Museum*.

These Museums might be lodged in one and the same building, and be under one direction, provided they were arranged in such a manner as to be separately accessible; so that the one would always be open to the Public, the other to the man of science, or any person seeking for special information. This arrangement would involve no more trouble, and would be as little expensive as any other which could answer its double purpose, as the *Typical* or *Popular Museum* might at once be made almost complete, and would require but very slight, if any, additions.

In fact, the plan proposed is only a further development of the system according to which the Entomological, Conchological, and Osteological Collections in the British Museum are already worked.

That an appropriate *Zoological Library* be attached to the *Scientific Museum*, totally independent of the Zoological portion of the Library of the British Museum, which, in the opinion of your Memorialists, is inseparable from the General Library.

That the *Scientific Zoological Museum* and *Library* be placed under one head directly responsible to one of her Majesty's Ministers, or under an organization similar to that which is practically found so efficient in regard to Botany.

That the *Museum of Economic Zoology* at South Kensington be further developed.

Your Memorialists recommend that the whole of the Kew Herbarium become the property of, and be maintained by, the State, as is now the case with a portion of it—that the Banksian Herbarium and the Fossil Plants be transferred to it from the British Museum—and that a permanent building be provided for the accommodation at Kew of the Scientific Museum of Botany so formed.

This consolidation of the Herbaria of Kew with those of the British Museum would afford the means of including in the *Botanical Scientific Museum* a Geographical Botanical Collection for the illustration of the Colonial Vegetation of the British Empire, which, considering the extreme importance of vegetable products to the commerce of this country, your Memorialists are convinced would be felt to be a great advantage.

Your Memorialists recommend further, that in place of the Banksian Herbarium and other miscellaneous Botanical Collections now in the British Museum and closed to the public, a *Typical* or *Popular Museum* of Botany be formed in the same building as that proposed for the *Typical* or *Popular Museum* of Zoology, and, like it, be open daily to the Public.

Such a Collection would require no great space; it would be inexpensive, besides being in the highest degree instructive; and, like the *Typical* or *Popular Zoological Collection*, it would be of the greatest value to the public, and to the Teachers and Students of the Metropolitan Colleges.

That the *Botanical Scientific Museum* and its *Library*, the *Museum of Economic Botany* and the *Botanic Garden*, remain, as at present, under one head, directly responsible to one of her Majesty's Ministers.

The undersigned Memorialists, consisting wholly of Zoologists and Botanists, have offered no suggestion respecting the very valuable Mineralogical Collection in the British Museum, although aware that, in case it should be resolved that the Natural History Collections generally should be removed to another locality, the disposal of the Minerals also will probably come under consideration.

November 18, 1858.

George Bentham, V.P.L.S.

George Busk, F.R.S. and Z.S., Professor of Comparative Anatomy and Physiology to the Royal College of Surgeons of England.

William B. Carpenter, M.D., F.R.S., and Z.S., Registrar of the University of London.

Chas. Darwin, F.R.S., L.S., and G.S.

W. H. Harvey, M.D., F.R.S. and Z.S., &c., Professor of Botany, University of Dublin.

Arthur Henfrey, F.R.S., L.S., &c., Professor of Botany, King's College, London.

J. S. Henslow, F.L,S. and G.S., Professor of Botany in the University of Cambridge.

Thomas Huxley, F.R.S., Professor of Natural History, Government School of Mines, Jermyn Street.

John Lindley, F.R.S. and L.S., Professor of Botany in University College London.

MISCELLANEOUS.

DR. GEORGE PEACOCK.

Among recent blanks in the circle of English Science and Literature, the death of the late Dean of Ely is one which cannot fail to be deeply felt by all who appreciate knowledge, learning, and the practical power of a cultivated intellect in their less showy, but most substantial forms. We abridge from a biographical sketch in the pages of the Athenæum some notes regarding the career of this ditinguished English mathematician, who has contributed in some very important respects to the advancement of his favorite studies, and their practical bearing on the progress of his age.

Dr. George Peacock was a student of Trinity College, Cambridge, and took his B.A. degree at that University in 1813, with peculiar distinctions, Sir John Herschel being the senior wrangler of that year, and George Peacock the second. One familiar with the Cambridge system, and with the recent history of the science in which he so distinguished himself, thus sketches the ingenuous student in his earlier contact with the formal tests and stimulants of University competitions for honors:—Peacock's mind was, in some respects, differently framed from those of the young men who usually distinguish themselves. The University examinations cultivate two kinds of power: acquisition of knowledge, called *bookwork*, and solution of such applications as can be done by good heads in a few minutes, dignified by the name of *problems*. It is of course impossible in the hurried examinations, to try how the student stands, upon points which would give a finished mathematician an hour or two of thought. Accordingly, those young men, however deeply they may think, who do not possess, or cannot acquire, a certain trick which we call *problem-knack*, cannot show themselves among the highest wranglers, unless their amount of digested reading be very great indeed. We once knew a young aspirant who was in despair at finding that comrades, to whom he used to explain first principles and elucidate difficulties, could *do problems* much faster and better than himself: by practice, however, he caught problem-knack, and took a high degree. Peacock was on of those who, as stories ran in our undergraduate day, "never did a single problem." A sarcastic review of Cambridge men and things, which made some noise at the time, reckoned him up thus:—"He has read three times as much mathematics as any man in Europe but has not a spark of originality." He lived to shew the highest and the rarest originality of speculative thought: the power of seeing a whole science as it is to be, and lending aid in placing it upon its proper basis. Hundreds of those who would have beaten him hollow at Cambridge problems are wholly unfit to attempt the formation of any the least idea of the scope and meaning of his works on algebra.

At the time when Peacock took his degree, the public mind of Cambridge was stirred on the question of the University mathematics. The English school, following Newton's notation of fluxions, had almost lost the power of reading the continental treatise. There were two undergraduates, Herschel and Peacock, who were well read, in the foreign writers. There was a third, Babbage, who, without the same depth of reading, had trained a rare genius for analysis in the same school. A fourth was Maul (afterwards Judge), who might have been among the first of mathematicians, if he had chosen that career. Woodhouse, an older man, had opened the way by a treatise in 1803. The younger men determined to act in concert, for the introduction of the continential mathematics. They formed an *Analytical Society*, and published a volume of Memoirs in 1813. They translated the work of Lacroix on the Differential Calculus, and prepared a volume of examples, of which Peacock compiled the larger part, in a manner which showed very extraordinary reading for a man of his age. This translation, and these examples, carried the day: and Peacock, when he became Moderator in 1817, completed the victory by introducing the modern language and notation into the public examinations. His colleague did not join him in the alteration; and the Moderators of 1818 returned to the old system. Peacock was again Moderator in 1819 with a colleague of his own cabal (Mr. Gwatkin), and from that year the change was fully accepted. There are those who like to know the precise time and manner of all things: let them stand informed that the official recognition of the continental school of mathematicians at Cambridge dates from nine o'clock in the morning of Monday, January 13, 1817, when Peacock put into the hands of each candidate for honours a printed paper, the fourth question of which stands thus:—

$$\text{“Find the integral of } \frac{dx}{1 + x^3}.\text{”}$$

Peacock became a tutor of the college, and gained a high reputation as a teacher and as a guardian of his pupils. His temper was kind, his knowledge of the world, and especially of the young world, was ample, and his manner was pleasant. Some amusing peculiarities of idiom, brought from the north, and—to speak the truth—a peculiar physiognomy, which would have been visited in vengeance upon a disagreeable and *donnish* superior, were but additions to his popularity. He had a strong, active, practical turn for administration, and college affairs prevented him from making science his whole object, though he was always a student, not only of mathematics, but of literature. In 1826 appeared in the Encyclopædia Metropolitana his article on the history of Arithmetic, the most learned essay on the subject which exists. He was at the same time continually occupied with thought on the nature and first principles of algebra. A syllubus of Trigonometry in which he fixed—for Cambridge, at least—the character of the fundamental forms, which had been fluctuating between the old and new, was a slight digression. We cannot undertake to describe in full what he did for algebra. That science, like logic, ought to be purely formal: up to our own day it has been troubled with apparent exceptions, arising from insufficient amount of generality in its fundamental definitions. Peacock concentrated what had been done towards amendment, and augmented it into a system, imperfect indeed, but presented in such a manner as to show what was wanted, and what are the rational principles on which the supply of the want must be attempted. This work was published in 1830; and in 1842-45 appeared another digestion of the subject into two volumes, the first containing solely arithmetical algebra,—the best work on this preliminary which has appeared,—the second containing symbolical algebra. These works show that thought which the mathematical *workman* scorns, and the mathmatical philosopher prizes. A report on the recent progress of Analysis, made to the British Association in 1833, contains an acute discussion of difficulties, and shows that the wide reading of the author of the Examples was continued down to the day in which he wrote.

All Peacock's works have thought, labour, and finish. In none are these more conspicious than in his life of Dr. Young (1855), and his collection of Young's miscellaneous works, in three volumes. Young was a man of very varied pursuits and knowledge. These volumes occupied Peacock during many years; and are a monument both to Young and his editor which is worth many a statue. Dr. Peacock's last writing was a collection of short, pithy, and effective answers to Lord Overstone's questions on the decimal coinage. He was a steady and thorough-going supporter of the system approved by the House of Commons, called the *pound-and mil* system: and he had, as usual, read deeply and thought long on the subject, both in writing the history of arithmetic, and as one of the Royal Commission on weights and measures.

Peacock steadily upheld the liberal side in politics during the times of greatest discouragement; and, considering how powerful an influence he had exercised in Cambridge, it would not have surprised the world if he had received some speedy advancement. But our liberal statesmen, though rather conspicious than otherwise for their early attention to family claims, have always appeared to think that support given to their principles is but a secondary ground of patronage. Accordingly, it was not till 1839, or thereabouts, that Peacock was made Dean of Ely. His attention was new especially directed to his new station: and the cathedral, the town, and the surrounding country bear marks of his zeal and of his skill in the management of men. For many years previous to his death he had to contend with ill health, frequently acute in its symptoms. His writings on University reform, and his labours on the Cambridge Commission, are perhaps the things by which he is best known to the world at large. He held the Lowndean Professorship for many years, and he attempted to lecture. But there was no audience for a philosophical mathematician in the University of book-work and problems. Dr. Peacock was fully aware of the tendency of the existing system, the end of which is, in nine out of ten, examination and nothing beyond. He is lost to Cambridge at the time when Cambridge most wants him.

Dr. Peacock exercised grest influence over his contemporaries by soundness of judgement, extent of knowledge, and suavity of manners. His various qualities and attainments were perfectly blended, and lent force to each other: the combination was one of power; for he was a man of business, of science, of learning, and of character.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The admirable and comprehensive Presidential Address delivered by Professor Owen, at the opening meeting of the British Association in August last, has been delayed appearing in our pages,—along with an abstract which we had prepared of the papers read in the sections,—by the space claimed for original communications. But the Address contains such a valuable resumé of work accomplished in the various departments of science in recent years, as our readers will still be glad to have placed on record here; and we, accordingly, find room for it, with some unimportant omissions in our Scientific Appendix:—

THE PRESIDENT'S ADDRESS.

We are here met, in this our twenty-eighth annual assembly, to continue the aim of the Association, which is the promotion of Science, or the knowledge of the laws of Nature; whereby we acquire a dominion over nature, and are thereby able so to apply her powers as to advance the well-being of society and exalt the condition of mankind. It is no light matter, therefore, the work that we are here assembled to do. God has given to man a capacity to discover and comprehend the laws by which His universe is governed; and man is impelled by a healthy and natural impulse to exercise the faculties by which that knowledge can be acquired. Agreeably with the relations which have been instituted between our finite faculties and phenomena that affect them, we arrive at demonstrations and convictions which are the most certain that our present state of being can have or act upon. Nor let any one, against whose prepossessions a scientific truth may jar, confound such demonstrations with the speculative philosophies condemned by the Apostle; or ascribe to arrogant intellect, soaring to regions of forbidden mysteries, the acquisition of such truths as have been or may be established by patient and inductive research. For the most part, the discoverer has been so placed by circumstances,—rather than by predetermined selection,—as to have his work of investigation allotted to him as his daily duty; in the fulfilment of which he is brought face to face with phenomena into which he must inquire, and the result of which inquiry he must faithfully impart. The advance of natural as of moral truth has been and is progressive: but it has pleased the Author of all truth to vary the fashion of the imparting of such parcels thereof as He has allotted, from time to time, for the behoof and guidance of mankind. Those who are privileged with the faculties of discovery are, therefore, to be regarded as pre-ordained instruments in making known the power of God, without a knowledge of which, as well as of Scripture, we are told that we shall err. Great and marvellous have been the manifestations of this power imparted to us of late times, not only in respect of the shape, motions and solar relations of the earth, but also of its age and inhabitants. In regard to the period during which the globe allotted to man has revolved in its orbit, present evidence strains the mind to grasp such sum of past time with an effort like that by which it tries to realize the space dividing that orbit from the fixed stars and remoter nebulæ. Yet, during all those eras that have passed since the Cambrian rocks were deposited which bear the impressed record of creative power, as it was then manifested, we know, through the interpreters of these "writings on stone," that the earth was vivified by the sun's light and heat, was fertilized by refreshing showers and washed by tidal waves. No stagnation has been permitted to air or ocean. The vast body of waters not only moved, as a whole, in orderly oscillations, regulated, as now, by sun and moon, but were rippled and agitated here and there successively by winds and storms. The atmosphere was healthily influenced by its horizontal currents, and by ever-varying clouds and vapours rising, condensing, dissolving, and falling in endless vertical circulation With these conditions of life, we know that life itself has been enjoyed throughout the same countless thousands of years; and that with life, from the beginning, there has been death. The earliest testimony of the living thing, whether shell, crust, or coral in the oldest fossiliferous rock, is at the same time proof that it died. It has further been given us to know, that not only the individual but the species perishes; that as death is balanced by generation, so extinction has been concomitant with creative power, which has continued to provide a succession of species; and furthermore, that as regards the varying forms of life which this planet has witnessed, there has been "an advance and progress in the main." Geology demonstrates that the creative force has not deserted this earth during any of her epochs of time; and that in respect to no one class of animals has the manifestation of that force been limited to one epoch. Not a species of fish that now lives, but has come into being during a comparatively recent period: the existing species were preceded by other species; and these again by others still more different from the present. No existing genus of fishes can be traced back beyond a moiety of known creative time. Two entire orders (Cycloids and Stenoids) have come into being, and have almost superseded two other orders (Ganoids and Placoids), since the newest or latest of the secondary formations of the earth's crust. Species after species of land animals, order after order of air-breathing reptiles, have succeeded each other; creation ever compensating for extinction. The successive passing away of air-breathing species may have been as little due to exceptional violence, and as much to natural law, as in the case of marine plants and animals. It is true, indeed, that every part of the earth's surface has been submerged; but successively, and for long periods. Of the present dry land different natural continents have different Faunæ and Floræ; and the fossil remains of the plants and animals of these continents respectively show that they possessed the same peculiar characters, or characteristic *facies*, during periods extending far beyond the utmost limits of human history. Such is a brief summary of facts most nearly interesting us, which have been demonstratively made known respecting our earth and its inhabitants. And when we reflect at how late and in how brief a period of historical time the acquisition of such knowledge has been permitted, we must feel that vast as it seems, it may be but a very small part of the patrimony of truth destined for the possession of future generations.

In reviewing the nature and results of our proceedings during the last twenty-seven years, and the aims and objects of our Association, it seems as if we are realizing the grand Philosophical Dream or Prefigurative Vision of Francis Bacon, which he has recounted in his 'New Atlantis.' In this noble Parable the Father of Modern Science imagines an Institution which he calls "Solomon's House," and informs us by the mouth of one of its members, that "The end of its Foundation is the Knowledge of Causes and Secret Motions of Things; and enlarging of the bounds of Human Empire to the effecting of all things possible." As one important means of effecting the great aims of Bacon's "six days' college," certain of its members were deputed, as "merchants of light," to make "circuits or visits of divers principal cities of the kingdom." This latter feature of the Baconian organization is the chief characteristic of the "British Association;" but we have striven to carry out other aims of the 'New Atlantis,' such as the systematic summaries of the results of different branches of science, of which our published volumes of 'Reports' are evidence; and we have likewise realized, in some measure, the idea of the "Mathematical House" in our establishment at Kew. The national and private observatories, the Royal and other Scientific Societies, the British Museum, the Zoological, Botanical, and Horticultural Gardens, combine in our day to realize that which Bacon foresaw in distant perspective. Great, beyond all anticipation, have been the results of this organization, and of the application of the inductive methods of interrogating nature. The universal law of gravitation, the circulation of the blood, the analogous course of the magnetic influence, which may be said to vivify the earth, permitting no atom of its most solid constituents to stagnate in total rest; the development and progress of Chemistry, Geology, Palæontology; the inventions and practical applications of Gas, the Steam-engine, Photography, Telegraphy: such, in the few centuries since Bacon wrote, have been the rewards of the faithful followers of his rules of research. After dwelling on the importance of direct observation as illustrated in the history of Astronomy, he referred to the discovery of Galileo, the application of his discovery by Kepler and Horrocks, and continued—Without stopping to trace the concurrent progress of the science of motion, of which the true foundations were laid, in Bacon's time, by Galileo, it will serve here to state that the foundations were laid and the materials gathered for the establishment by a master-mind, supreme in vigour of thought and mathematical resource, of the grandest generalization ever promulgated by science—that of the universal gravitation of matter according to the law of the inverse square of the distance. The same century in which the 'Thema Cœli' of Lord Verulam and the 'Nuncius Sidereus' of Galileo saw the light, was glorified by the publication of the 'Philosophiæ Naturalis Principia Mathematica' of Newton. Has time, it may be asked, in any way affected the great result of that masterpiece of human intellect? These are signs that even Newton's axiom is not exempt from the restless law of progress. The mode of expressing the law of gravitation as being "in the inverse proportion of the square of the distances" involves the idea that the force emanating from or exercised by the sun must become more feeble in proportion to the increased spherical surface over which it is diffused. So indeed it was expressly understood by Halley. Prof. Whewell, the ablest historian of Natural Science, has remarked that "future discoveries may make gravitation a case of some wider law, and may disclose something of the mode in which it operates." The difficulty, indeed, of conceiving a force acting through nothing from body to body has of late made itself felt; and more especially since Meyer of Heilbronn first clearly expressed the principle of the "conservation of force." Newton, though apprehending the necessity of a medium by which the force of gravitation should be conveyed from one body to another, yet appears not to have possessed such an idea of the uncreateability and indestructibility of force as that which, now possessed by minds of the highest order, seems to some of them to be incompatible with the terms in which Newton enunciated his great law, viz, of matter attracting matter with a force which varies inversely as the square of the distance. The progress of knowledge of another form of all-pervading force, which we call, from its most notable effect on one of the senses, "Light," has not been less remarkable than that of gravitation. Galileo's discovery of Jupiter's satellites supplied Römer with the phenomena whence he was able to measure, in 1676, the velocity of light. Descartes, in his theory of the rainbow, referred the different colours to the different amount of refraction, and made a near approximation to Newton's capital discovery of the different colours entering into the composition of the luminous ray, and of their different refrangibility. Hook and Huyghens, about the same period, had entered upon explanations of the phenomena of light conceived as due to the undulations of an ether, propagated from the luminous point spherically, like those of sound. Newton, whilst admitting that such undulations or vibrations of an ether would explain certain phenomena, adopted the hypothesis of emission as most convenient for the mathematical propositions relative to light. The discoveries of achromatism, of the laws of double refraction, of polarization circular and elliptical, and of dipolarization rapidly followed: the latter advances of optics, realizing more than Bacon conceived might flow from the labours of the "Perspective House," are associated with and have shed lustre on the names of Dollond, Young, Malus, Fresnel, Biot, Arago, Brewster, Stokes, Jamin, and others. Some of the natural sciences, as we now comprehend them, had not germinated in Bacon's time. Chemistry was then alchemy; Geology and Palæontology were undreamt of: but Magnetism and Electricity had began to be observed, and their phenomena compared, and defined, by a contemporary of Bacon in a way that claims to be regarded as the first step towards a scientific knowledge of those powers. It is true that, before Gilbert, ('De Magnete,' 1600), the magnet was known to attract iron, and the great practical application of magnetized iron—the mariner's compass—had been invented, and for many years before Bacon's time had guided the barks of navigators through trackless seas. Gilbert, to whom the name "electricity" is due, observed that that force attracted light bodies, whereas the magnetic force attracted iron only. About a century later the phenomena of repulsion as well as of attraction of light bodies by electric substances were noticed: and Dufay, in 1733, enunciated the principle, that "electric bodies attract all those that are not so, and repel them as soon as they are become electric by the vicinity of the electric body." The conduction of electric force, and the different behaviour of bodies in contact with the electric, leading to their division, by Desguliers, into conductors and non-conductors, next followed. The two kinds of electricity, at first by Dufay, their definer, called "vitreous" and "resinous,"—afterwards, by Franklin, "positive" and "negative," formed an important step, which led to a brilliant series of experiments and discoveries, with nventions, such as the Leyden jar, for intensifying the electric shock. The discovery of the instantaneous transmission of electricity through an extent of not less than 12,000 feet, by Bishop Watson, together with that of the electric state of the clouds, and of the power of drawing off such electricity by pointed bodies, as shown by Franklin, was a brilliant beginning of the application of this science to the well-being and needs of mankind. Magnetism has been studied with two aims: the one, to note the numerical relations of its activity to time and space, both in respect of its direction and intensity; the other, to penetrate the mystery of the nature of the magnetic force. In reference to the first aim, my estimable predecessor adverted, last year, to the fact, that it was in the committee-rooms of the British Association that the first step was taken towards that great magnetic organization which has since borne so much fruit. Thereby it has been determined that there are periodical changes of the magnetic elements depending on the hour of the day, the season of the year, and, what seemed strange, intervals of about eleven years. Also, that besides these regular changes there were others of a more abrupt and seemingly irregular character—Humboldt's "magnetic storms,"—which occur simultaneously at distant parts of the earth's surface. Major-General Sabine, than whom no individual has done more in this field of research since Halley first attempted "to explain the change in the variation of the magnetic needle," has proved that the magnetic storms observed diurnal, annual, and undecennial periods. But with what phase or phenomenon of earthly and heavenly bodies, it may be asked, has the magnetic period of eleven years to do? The coincidence which points to, if it does not give, the answer, is one of the most remarkable, unexpected, and encouraging to patient observers. For thirty years a German astronomer, Schwabe, had set himself the task of daily observing and recording the appearance of the sun's disc, in which time he found the spots passed through periodic phases of increase and decrease, the length of the period being about eleven years. A comparison of the independent evidence of the astronomer and magnetic observer has shown that the undecennial magnetic period coincides both in its duration and in its epochs of maximum and minimum with the same period observed in the solar spots.

A few weeks ago, during a visit of inspection to our establishment at Kew, I observed the succesful operation of the photo-heliographic apparatus in depicting the solar spots as they then appeared. The continued regular record of the macular state of the sun's surface, with the concurrent magnetic observations now established over many distant points of the earth's surface, will ere long establish the full significance and value of the remarkable, and, in reference of the observers, undesigned, coincidence above mentioned. Not to trespass on your patience by tracing the progress of Magnetism from Gilbert to Oersted, I cannot but advert to the time, 1807, when the latter tried to discover whether electricity in its most latent state had any effect on the magnet, and to his great result, in 1820, that the conducting wire of a voltaic circuit acts upon a magnetic needle, so that the latter tends to place itself at right angles to the wire. Ampère, moreover, succeeded, by means of a delicate apparatus, in demonstrating that the voltaic wire was affected by the action of the earth itself as a magnet. In short, the generalization was established, and with a rapidity unexampled, regard being had to its greatness, that *magnetism and electricity are but different effects of one common cause.* This has proved the first step to still grander abstractions,—to that which conceives the reduction of all species of imponderable fluids of the chemistry of our student days, together with gravitation, chemicity, and neuricity, to interchangeable modes of action of one and the same all-pervading life-essence. Galvani arranged the parts of a recently-mutilated frog so as to bring a nerve in contact with the external surface of a muscle, when a contradiction of the muscle ensued. In this suggestive experiment the Italian philosopher, who thereby initiated the inductive inquiry into the relation of nerve force to electric force, concluded that the contraction was a necessary consequence of the passage of electricity from one surface to the other by means of the nerve. He supposed that the electricity was secreted by the brain, and transmitted by the nerves to different parts of the body, the muscles serving as reservoirs of the electricity. Volta made a further step by showing that, under the conditions or arrangements of Galvani's experiments, the muscle would contract, whether the electric current had its origin in the animal body, or from a source external to that body, Galvani erred in too exclusive a reference of the electric force producing the contraction to the brain of the animal: Volta in excluding the origin of the electric force from the animal body altogether. The determination of "the true" and "the constant" in these recondite phenomena, has been mainly helped on by the persevering and ingenious experimental researches of Mateucci and Du Bois Reymond. The latter has shown that any point of the surface of a muscle is positive in relation to any point of the divided or transverse section of the same muscle; and that any point of the surface of a nerve is positive in relation to any point of the divided or transverse section of the same nerve. Mr. Baxter in still more recent researches, has deduced important conclusions on the origin of the muscular and nerve currents, as being due to the polarized condition of the nerve or muscular fibre, and the relation of that condition to changes which occur during nutrition. From the present state of neuro-electricity, it may be concluded that nerve force is not identical with electric force, but that it may be another mode of motion of the same common force: it is certainly a polar force, and perhaps the highest form of polar force:—

> A motion which may change, but cannot die:
> An image of some bright eternity.

The present tendency of the higher generalizations of Chemistry seems to be towards a reduction of the number of those bodies which are called "elementary"; it begins to be suspected that certain groups of so-called chemical elements are but modified forms of one another; that such groups as chlorine, iodine, bromine, fluorine, and as sulphur, selenium, phosphorus, boron, may be but allotropic forms of some one element. Organic Chemistry becomes simplified as it expands; and its growth has of late proceeded, through the labours of Hofmann, Berthelot and others, with unexampled rapidity. An important series of alcohols and their derivatives, from amylic alcohol downwards; as extensive a series of others including those which give their peculiar flavor to our choicest fruits; the formic, butyric, succinic, lactic, and other acids, together with other important organic bodies, are now capable of artificial formation from their elements, and the old barrier dividing organic from inorganic bodies is broken down. To the power which mankind may ultimately exercise through the light of synthesis, who may presume to set limits? Already natural processes can be more economically replaced by artificial ones in the formation ot a few organic compounds, the "valerianic acid," for example. It is impossible to foresee the extent to which Chemistry may not ultimately, in the production of things needful, supersede the present vital agencies of nature, "by laying under contribution the accumulated forces of past ages, which would thus enable us to obtain in a small manufactory, and in a few days, effects which can be realized from present natural agencies only when they are exerted upon vast areas of land, and through considerable periods of time." Since Niepce, Herschel, Fox, Talbot, and Daguerre laid the foundations of Photography, year by year some improvement is made,—some advance achieved, in this most subtle application of combined discoveries in Photicity, Electricity, Chemistry, and Magnetism. Last year, M. Poitevin's production of plates in relief, for the purpose of engraving by the action of light alone, was cited as the latest marvel of Photography. This year has witnessed photographic printing in carbon by M. Pretschi. Prof. Owen continued by alluding to the application of photography for obtaining views of the moon, of the planets, of scientific and other phenomena. After referring to the discoveries in Electro-magnetism, the President continued: Remote as such profound conceptions and subtle trains of thought seem to be from the needs of everyday life, the most astounding of the practical augmentation of man's power has sprung out of them. Nothing might seem less promising of profit than Oersted's painfully-pursued experiments, with his little magnets, voltaic pile, and bits of copper wire. Yet out of these has sprung the electric telegraph! Oersted himself saw such an application of his convertibility of electricity into magnetism, and made arrangements for testing that application to the instantaneous communication of signs through distances of a few miles. The resources of inventive genius have made it practicable for all distances; as we have lately seen in the submergence and working of the electro-magnetic cord connecting the Old and New World. On the 6th of August 1858, the laying down of upwards of 2,000 nautical miles of the telegraphic cord, connecting Newfoundland and Ireland, was successfully completed; and on that day a message of thirty-one words was transmitted in thirty-five minutes, along the sinuosities of the submerged hills and valleys forming the bed of the great Atlantic. This first message expressed—"Glory to God in the highest: on Earth Peace; Good will towards Men." Never since the foundations of the world were laid could it be more truly said, "The depths of the sea praise Him!" More remains to be done before the far-stretching engine can be got into full working order; but the capital fact, viz., the practibility of bringing America into electrical communication with Europe has been demonstrated; consequently, a like power of instantaneous interchange of thought between the civilized inhabitants of every part of the globe becomes only a question of time. The powers and benefits thence to ensue for the human race can be but dimly and inadequately foreseen. After referring to the labours of Ray, Linnæus, Jussieu, Buffon, and Cuvier, he said: To perfect the natural system of plants has been the great aim of botanists since Jussieu. To obtain the same true insight into the relations of animals has stimulated the labours of zoologists since the writings of Cuvier. To that great man appertains the merit of having systematically pursued and applied anatomical researches to the discovery of the true system of distribution of the animal kingdom; nor, until the Cuvierian amount of zootomical science had been gained, could the value and importance of Aristotle's 'History of Animals' be appreciated. There is no similar instance, in the history of Science of the well-lit torch gradually growing dimmer and smouldering through so many generations and centuries before it was again fanned into brightness, and a clear view regained, both of the extent of ancient discovery, and of the true course to be pursued by modern research." Rapid and right has been the progress of Zoology since that resumption. Not only has the structure of the animal been investigated, even to the minute characteristics of each tissue, but the mode of formation of such constituents of organs, and of the organs themselves, has been pursued from the germ, bud, or egg, onward to maturity and decay. To the observation of outward characters is now added that of inward organization and developmental change, and Zootömy, Histology and Embryology combine their results in forming an adequate and lasting basis for the higher axioms and generalizations of Zoology properly so called. Three principles, of the common ground of which we may ultimately obtain a clearer insight, are now recognized to have governed the construction of animals:—unity of plan, vegetative repetition, and fitness for purpose. The independent series of researches by which students of the articulate animals have seen, in the organs performing the functions of jaws and limbs of varied powers, the same or homotypal elements of a series of like segments constituting the entire body, and by which students of the vertebrate animals have been led to the conclusion, that the maxillary, mandibular, hyoid, scapular, costal and pelvic arches, and their appendages sometimes forming limbs of varied powers, are also modified elements of a series of essentially similar vertebral segments,—mutually corroborate their respective conclusions. It is not probable that a principle which is true for *Articulata* should be false for *Vertebrata:* the less probable since the determination of homologous parts becomes the more possible and sure in the ratio of the perfection of the organization.

After pointing out the distinction between Affinity, which indicates an intimate resemblance, and Analogy, which indicates a remote one, he continued—The study of homologous parts in a single system of organs—the bones—has mainly led to the recognition of the plan or archetype of the highest primary group of animals, the Vertebrata. The next step of importance will be to determine the homologous parts of the nervous system, of the muscular system, of the respiratory and vascular system, and of the digestive, secretory and generative organs in the same primary group or province. I think it of more importance to settle the homologies of the parts of a group of animals constructed on the same general plan, than to speculate on such relations of parts of animals constructed on demonstratively distinct plans of organization. What has been effected and recommended, in regard to homologous parts in the Vertebrata, should be followed out in the Articulata and Mollusca. In regard to the constituents of the crust or outer skeleton and its appendages in the Articulata, homological relations have been studied and determined to a praiseworthy extent, throughout that province. The same study is making progress in the Mollusca; but the grounds for determining special homologies are less sure in this sub-kingdom. The present state of homology in regard to the Articulata has sufficed to demonstrate that the segment of the crust is not a hollow expanded homologue of the segment of the endo-skeleton of a vertebrate. There is as little homology between the parts and appendages of the segments of the Vertebrate and Articulate skeletons respectively. The parts called mandibles, maxillæ, arms, legs, wings, fins, in Insects and Crustaceans, are only "analogous" to the parts so called in Vertebrates. A most extensive field of reform is becoming open to the homogist in that which is essential to the exactitude of his science —a nomenclature equivalent to express his conviction of the different relations of similitude. Most difficult and recondite are the questions in face of which the march of Homology is now irresistibly conducting the philosophic observer. Such for instance, as the following:—Are the nervous, muscular, digestive, circulating and generative systems of organs more tham functionally similar in any two primary provinces of the animal kingdom? Are the homologies of entire systems to be judged of by their functional and structural connexions, rather than by the plan and course of their formation in the embryo? It may be doubted if embryology alone is decisive of the question whether homology can be predicated of the alimentary canal in animals of different primary groups or provinces. It is significant, however, of the lower value of embryological characters, to note that the great leading divisions of the animal kingdom, based by Cuvier on Comparative Anatomy, have merely been confirmed by Von Baer's later developmental researches. And so, likewise, with regard to some of the minor modifications of Cuvier's provinces, the true position of the Cirripeda was discerned by Straus Durkheim and Macleay, by the light of anatomy, before the discovery of their metamorphoses by Thomson. If, however, embryology has been over-valued as a test of homology, the study of the development of animals has brought to light most singular and interesting facts, and I now allude more especially to those that have been summed up under the term "Alternate-generation," "Parthenogenesis," "Metagenesis," &c. John Hunter first enunciated the general proposition, that "the propagation of plants depended on two principles, the one that every part of a vegetable is 'a whole,' so that it is capable of being multiplied as far as it can be divided into distinct parts; the other, that certain of those parts become reproductive organs, and produce fertile seeds." Hunter also remarked, that "the first principle operated in many animals which propagate their species by buds or cuttings;" but that, whilst in animals, it prevailed only in "the more imperfect orders," it operated in vegetables "of every degree of perfection." The experiments of Trembley on the freshwater polype, those of Spalanzani on the Naids, and those of Bonnet on the Aphides had brought to light the phenomena of propagation by fission, and by gemmation or buds, external and internal, in animals to which Hunter refers. Subsequent research has shown the unexpected extent to which Hunter's first principle of propagation in organic being prevails in the animal division. But the earliest formal supercession of Harvey's axiom, "*omne vivum ab ovo*," appears to be Hunter's proposition of the dual principle above quoted. The experiments of Redi, Malpighi and others had progressively contracted the field to which the "*generatio æquivoca*" could with any plausibility by applied. The stronghold of the remaining advocates of that old Egyptian doctrine was the fact of the development of parasitic animals in the flesh, brain and glands of higher animals. But the hypothesis never obtained currency in this country; it was publicly opposed in my 'Hunterian Lectures,' by the fact of the prodigious preparation of fertile eggs in many of the supposed spontaneously developed species; and in suggesting that the *Trichina spiralis* of the human muscular tissue might be the embryo of a larger worm in course of migration, I urged that a particular investigation was needed for each particular species.

Among the most brilliant of recent acquisitions to this part of Physiology, have been the discoveries which have resulted from such special investigations. Kuchenmeister and Von Siebold have been the chief labourers in this field. After noticing some of the results of those labours, he said—Since the time when it was first discovered that plants and animals could propagate in two ways, and that the individual developed from the bud might produce a seed or egg, from which also an individual might spring capable of again budding,—since this alternating mode of generation was observed, as by Chamisso and Sars, in cases where the budding individual differed much in form from the egg-laying one—the subject has been systematised, generalized, with an attempt to explain its principle, and greatly advanced, especially, and in a highly interesting manner, in Von Siebold's late treatise, entitled 'Wahre Parthenogenesis bei Schmiterlingen und Bienen,' in which the virgin production of the male or drone bee is demonstrated. Von Siebold having subjected to the closest microscopic scrutiny and experiment the conclusion to which the practical Bee-master Dzierson had arrived relative to the cause of queen-bees with crippled wings producing a swarm exclusively of drones has demonstrated that the male bee is produced from an egg which has been subjected to no influence save that of the maternal parent; whilst such egg, if impregnated, would have produced a female or worker bee. The now well investigated phenomena of parthenogenesis in Hydrozoa have resulted in showing, as in the analogous case of Entozoa, that animals differing so much in form as to have constituted two distinct orders or classes, are really but two terms of a cycle of metagenetic transformations—the acalephan Medusa being the sexual locomotive form of the agamic rooted budding polype, just as the cestoid tænia is of the cysted hydatid. In Hydrozoa (hydroid polypes or sertularians) the young are propagated, as in plants, by "buds," and also, as in most plants, by "germs" or "seeds": these latter are contained in "germ-sacs" projecting from the outer surface, which is another analogy to the flowering parts of plants. The first acquaintance with these marvels excited the hope that we were about to penetrate the mystery of the origin of different species of animals; but as far as observation has yet extended, the cycle of changes is definitely closed. And, since one essential step in the series is the fertilized seed or egg, the Harveian axiom, "*omne vivum ab ovo*," if metagenetic phases be ascribed to one individual, may be still predicated of all organisms which bear the unmistakeable characters of plants or of animals. The closest observations of the subjects of these two kingdoms most favourable to clear insight into the nature of their beginning, accumulate evidence in proof of the essential first step being due to the protoplasmic matter of a germ-cell and sperm-cell; the former pre-existing in the form of a nucleus or protoplast, the latter as a granulose fluid. In flowering plants it is conveyed by the pollen-tube, in animals and many flowerless plants, by locomotive spermatozoids. The changes of form which the representative of a species undergoes in successive agamically propagating individuals are termed the "metagenesis" of such species. The changes of form which the representative of a species undergoes in a single individual, is called the "metamorphosis." But this term has practically been restricted to the instances in which the individual, during certain phases of the change, is free and active, as in the grub of the chaffer, or the tadpole of the frog, for example. In reference to some supposed essential differences in the metamorphoses of insects, it had been suggested that stages answering to those represented by the apodal and acephalous maggot of the Diptera, by the hexapod larva of the Caribi, and by the hexapod antenniferous larva of the Meloe were really passed through by the orthopterous insect, before it quitted the egg. Mr. Andrew Murray has recently made known some facts in confirmation of this view. He had received a wooden idol from Africa, behind the ears of which a Blatta had fixed its egg-cases, after which the whole figure had been rudely painted by the natives, and these egg-cases were covered by the paint. No insect could have emerged without breaking through the case and the paint; but both were uninjured. In the egg-cases were discovered,—1st, a grub-like larva in the egg; 2nd, a cocoon in the egg containing the unwinged, imperfectly-developed insect; 3rd, the unwinged, imperfectly-developed insect in the egg, free from the cocoon, and ready to emerge.

The microscope is an indispensible instrument in embryological and histological researches, as also in reference to that vast swarm of animalcules which are too minute for ordinary vision. I can here do little more than allude to the systematic direction now given to the application of the microscope to particular tissues and particular classes, chiefly due, in this country, to the counsels and example of the Microscopical Society of London. A very interesting application of the microscope has been made to the particles of matter suspended in the atmosphere; and a systematic continuation of such observations by means of glass slides prepared to catch and retain atmospheric atoms, promises to be productive of important results. We now know that the so-called red snow of Arctic and Alpine regions is a microscopic single-celled organism which vegetates on the surface of snow. Cloudy or misty extents of dust-like matter pervading the atmosphere, such as have attracted the attention of travellers in the vast coniferous forests of North America, and have been borne out to sea, have been found to consist of the "pollen" or fertilizing particles of plants, and have been called "pollen showers." M. Daneste, submitting to microscopic examination similar dust which fell from a cloud at Shanghai, found that it consisted of spores of a confervoid plant, probably the *Trichodesmium erythræum*, which vegetates in, and imparts its peculiar colour to, the Chinese Sea. Decks of ships, near the Cape de Verde Islands, have been covered by such so-called "showers" of impalpable dust, which, by the microscope of Ehrenberg, has been shown to consist of minute organisms, chiefly "Diatomaceæ." One sample collected on a ship's deck, 500 miles off the coast of Africa exhibited numerous species of freshwater and marine diatoms bearing a close resemblance to South American forms of these organisms. Ehrenberg has recorded numerous other instances in his paper printed in the 'Berlin Transactions'; but here, as in other exemplary series of observations of the indefatigable microscopist, the conclusions are perhaps not so satisfactory as the well-observed data. He speculates upon the self-developing power of organisms in the atmosphere, affirms that dust-showers are not to be traced to mineral material from the earth's surface, nor to revolving masses of dust material in space, nor to atmospheric currents simply; but to some general law connected with the atmosphere of our planet, according to which there is a "self-development" within it of living organisms, which organisms he suspects may have some relation to the periodical meteorolites or aërolites. The advocates of progressive development may see and hail in this the first step in the series of ascending transmutations. The unbiassed observer will be stimulated by the startling hypothesis of the celebrated Berlin Professor to more frequent and regular examinations of atmospheric organisms. Some late examinations of dust showers clearly show them to have a source which Ehrenberg has denied. Some of my hearers may remember the graphic description by Her Majesty's Envoy to Persia, the Hon. C. A. Murray, of the cloud of impalpable red dust which darkened the air of Bagdad, and filled the city with a panic. The specimen he collected was examined by my successor, at the Royal College of Surgeons, Prof. Quekett, and that experienced microscopist could detect only inorganic particles, such as fine quartz sand, without any trace of Diatomaceæ or other organic matter. Dr. Lawson has obtained a similar result from the examination of the material of a shower of moist dust or mud which fell at Corfu, in March, 1857; it consisted for the most part of minute angular particles of a quartzose sand. Here, therefore, is a field of observation for the microscopist, which has doubtless most interesting results as the reward of persevering research.

To specify or analyze the labours of the individuals who of late years have contributed to advance Zoology by the comprehensive combination of the various kinds of researches now felt to be essential to its right progress, would demand a proportion of the present discourse far beyond its proper and allotted limits. Yet I shall not be deemed invidious if I cite one work as eminently exemplary of the spirit and scope of the investigations needed for the elucidation of any branch of natural history. That work is the monograph of the Chelonian Reptiles (tortoises, terrapenes and turtles) of the United States of America, published last year at Boston, U.S., by Prof. Agassiz.

Observations of the characters of plants have led to the recognition of the natural groups or families of the vegetable kingdom, and to a clear scientific comprehension of that great kingdom of nature. This phase of botanical science gives the power of further and more profitable generalizations, such as those teaching the relations between the particular plants and particular localities. The sum of these relations, forming the geographical distribution of plants, rests, perhaps at present necessarily, on an assumption, viz., that each species has been created, or come into being, but once in time and space; and that its present diffusion is the result of its own law of reproduction, under the diffusive or restrictive influence of external circumstances. These circumstances are chiefly temperature and moisture, dependent on the distance from the source of heat and the obliquity of the sun's rays, modified by altitude above the sea level, or the degree of rarefaction of the atmosphere and of the power of the surface to wastefully radiate heat. Both latitude and altitude are further modified by currents of air and ocean, which influence the distribution of the heat they have absorbed. Thus large tracts of dry land produce dry and extreme climates, while large expanses of sea produce humid and equable climates. Agriculture affects the geographical distribution of plants, both directly and indirectly. It diffuses plants over a wider area of equal climate, augments their productiveness, and enlarges the limits of their capacity to support different climatal conditions. Agriculture also effects local modifications of climate. Certain species of plants require more special physical conditions for health; others more general conditions; and their extent of diffusion varies accordingly. Thus the plants of temperate climates are more widely diffused over the surface of the globe, because they are suited to elevated tracts in tropical latitudes. There is, however, another law which relates to the original appearance, or creation of plants, and which has produced different species flourishing under similar physical conditions, in different regions of the globe. Thus the plants of the mountains of South America are of distinct species, and for the most part of distinct genera, from those of Asia. The plants of the temperate latitudes of North America are of distinct species, and some of distinct genera, from those of Europe. The Cacteæ of the hot regions of Mexico are represented by the Euphorbiaceæ in parts of Africa having a similar climate. The surface of the earth has been divided into twenty-five regions, of which I may cite as examples that of New Zealand, in which Ferns predominate, together with generic forms, half of which are European, and the rest approximating to Australian, South African, and Antarctic forms; and that of Australia, characterized by its Eucalypti and Epacrides, chiefly known to us by the researches of the great botanist, Robert Brown, the founder of the Geography of Plants.

Organic Life, in its animal form, is much more developed, and more variously in the sea, than in its vegetable form. Observations of marine animals and their localities have led to attempts at generalizing the results; and the modes of enunciating these generalizations or laws of geographical distribution are very analogous to those which have been applied to the vegetable kingdom, which is as diversely developed on land as in the animal kingdom in the sea. The most interesting form of expression of the distribution of marine life is that which parellels the perpendicular distribution of plants. Edward Forbes has expressed this by defining five bathymetrical zones, or belts of depth, which he calls,—1, Littoral; 2, Circumlittoral; 3, Median; 4, Infra-median; 5, Abyssal. The life-forms of these zones vary, of course, according to the nature of the sea-bottom; and are modified by those primitive or creative laws that have caused representative species in distant localities under like physical conditions,—species related by analogy. Very much remains to be observed and studied by naturalists in different parts of the globe, under the guidance of the generalizations thus sketched out, to the completion of a perfect theory. But in the progress to this, the results cannot fail to be practically most valuable. A shell or a sea weed, whose relations to depth are thus understood, may afford important information or warning to the navigator. To the geologist the distribution of marine life according to the zones of depth, has given the clue to the determination of the depth of the seas in which certain formations have been deposited. Had all the terrestrial animals that now exist diverged from one common centre within the limited period of a few thousand years, it might have been expected that the remoteness of their actual localities from such ideal centre would bear a certain ratio with their respective powers of locomotion. With regard to the class of Birds, one might have expected to find that those which were deprived of the power of flight, and were adapted to subsist on the vegetation of a warm or temperate latitude, would still be met with more or less associated together, and least distant from the original centre of dispersion, situated in such a latitude. This, however, is not only not the case with birds, but is not so with any other classes of animals. The Quadrumana, or order of apes, monkeys and lemur, consist of three chief divisions—Caterhines, Platyrhines, and Strepsirhines. The first family is peculiar to the "Old World"; the second to South America; the third has the majority of its species and its chief genus (Lemur), exclusively in Madagascar. Out of twenty-six known species of Lemuridæ, only six are Asiatic, and three are African. Whilst adverting to the geographical distribution of Quadrumana, I would contrast the peculiarly limited range of the orangs and chimpanzees with the cosmopolitan powers of mankind. The two species of orang (Pithecus) are confined to Borneo and Sumatra; the two species of chimpanzee (Troglodytes) are limited to an intertropical tract of the western part of Africa. They appear to be inexorably bound by climatal influences regulating the assemblage of certain trees and the production of certain fruits. Climate rigidly limits the range of the Quadrumana latitudinally; creational and geographical causes limit their range in longitude. Distinct genera represent each other in the same latitudes of the New and Old Worlds; and also, in a great degree, in Africa and Asia. But the development of an orang out of a chimpanzee, or reciprocally, is physiologically inconceivable. The order of Ruminantia is principally represented by Old World species, of which 162 have been defined; whilst only 24 species have been discovered in the New World; and none in Australia, New Guinea, New Zealand, or the Polynesian Isles. The cameleopard is now peculiar to Africa; the musk deer to Africa and Asia; out of about fifty defined species of antelope, only one is known in America, and none in the central and southern divisions of the New World. Palæontology has expanded our knowledge of the range of the giraffe during Miocene or old Pliocene periods species of Cameleopardalis roamed in Asia and Europe. Geology gives a wider range to the horse and elephant kinds than was cognizant to the student of living species only. The existing Equidæ and Elephantidæ properly belong, or are limited to, the Old World; and the elephants to Asia and Africa, the species of the two continents, being quite distinct. The horse, as Buffon remarked, carried terror to the eye of the indigenous Americans, viewing the animal for the first time, as it proudly bore their Spanish conqueror. But a species of Equus, coexisted with the Megatherium and Megalonyx, in both South and North America, and perished apparently with them, before the human period. Elephants are dependant chiefly upon trees for food. One species now finds conditions of existence in the rich forests of tropical Asia; and a second species in those of tropical Africa. Why, we may ask, should not a third be living at the expense of the still more luxuriant vegetation watered by the Oronooka, the Essequibo, the Amazon, and the La Plata, in tropical America? Geology tells us that at least two kinds of elephant (*Mastodon Andium* and *M. Humboldtii*) formerly did derive their subsistence, along with the great Megatheroid beasts, from that abundant source. We may infer that the general growth of large forests, and the absence of deadly enemies, were the main conditions of the former existence of elephantine animals over every part of the globe. We have the most pregnant proof of the importance of Palæontology in rectifying and expanding ideas deduced from recent zoology of the geographical limits of particular forms of animals, by the results of its application to the proboscidian or elephantine family. But such retrospective views of life in remote periods, in many important instances, confirm the zoologists deductions of the originally restricted range of particular forms of mammalian life. The sum of all the evidence from the fossil world in Australia proves its mammalian population to have been essentially the same in pleistocene, if not pliocene times, as now; only represented, as the Edentate mammals in South America were then represented by more numerous genera, and much more gigantic species, than now exist. But Geology has revealed more important and unexpected facts relative to the marsupial type of quadrupeds. In the miocene and eocene tertiary deposits, marsupial fossils of the American genus Didelphys have been found, both in France and England; and they are associated with Tapirs like that of America. In a more ancient geological period remains of marsupials, some insectivorous, as Spalacotherium and Triconodon, others with teeth like the peculiar premolars in the Australian genus Hypsipromnus, have been found in the upper oolite of the Isle of Purbeck. In the lower oolite at Stonesfield, Oxfordshire, marsupial remains have been found having their nearest living representatives in the Australian genera Myrmecobius and Dasyurus. Thus it would seem, that the deeper we penetrate the earth, or, in other words, the further we recede in time, the more completely are we absolved from the present laws of geographical distribution. In comparing the mammalian fossils found in British pleistocene and pliocene beds, we have often to travel to Asia or Africa for their homologues. In the miocene and eocene strata some fossils occur which compel us to go to America for the nearest representatives. To match the mammalian remains from the English oolitic formations, we must bring species from the Antipodes. These are truly most suggestive facts. If the present laws of geographical distribution depend, in an important degree, upon the present configuration and position of continents and islands, what a total change in the geographical character of the earth's surface must have taken place since the "Stonesfield slate" was deposited in what now forms the County of Oxfordshire! These and the like considerations from the modifications of geographical distribution of particular forms or groups of animals, warn us how inadequate must be the phenomena connected with the present distribution of land and sea to guide to the determination of the primary ontological divisions of the earth's surface. Some of the latest contributions to this most interesting branch of natural history have been the result of endeavours to determine whether, and how many, distinct creations of plants and animals have taken place. But I would submit that the discovery of two portions of the globe, of which the respective Faunæ and Floræ are different, by no means affords the requisite basis for concluding as to distinct acts of creation. Such conclusion is associated, perhaps unconsciously, with the idea of the historical date of creative acts: it presupposes that the portion of the globe so investigated by the botanist and zoologist has been a separate and primitive creation,—that its geographical limits and features are still in the main what they were when the creative fiat went forth. But geology has demonstrated that such is by no means the case with respect to the portions of dry land now termed continents and islands. The incalculable vistas of time past, into which the same science has thrown light, are also shown to have periods during which the relative positions of land and sea have been ever changing.

Already the directions, and to a certain extent the forms of the submerged tracts that once joined what now are islands to continents, and which once united now separate or nearly disjoined continents by broad tracts of continuity, begin to be laid down in geological maps, addressing to the eye such successive and gradually progressive alterations of the earth's surface. These phenomena shake our confidence in the conclusion, that the Apteryx of New Zealand and the Red-grouse of England were distinct creations in and for those islands respectively. Always, also, it may be well to bear in mind that by the word "creation" the zoologist means "a process he knows not what." Science has not yet ascertained the secondary causes that operated when "the earth brought forth grass, and herb yielding seed after his kind," and when "the waters brought forth abundantly the moving creature that hath life." And supposing both the fact and the whole process of the so-called "spontaneous generation" of a fruit-bearing tree, or of a fish, were scientifically demonstrated, we should still retain as strongly the idea, which is the chief of the "mode" or "group of ideas" we call "creation," viz.: that the process was ordained by and had originated from an all wise and powerful First Cause of all things. When, therefore, the present peculiar relation of the Red-grouse (*Tetrao scoticus*) to Britain and Ireland—and I cite it as one of a large class of instances in Geographical Zoology—is enumerated by the zoologist as evidence of a distinct creation of the bird in and for such islands, he chiefly expresses that he knows not how the Red-grouse came to be there and there exclusively; signifying also by this mode of expressing such ignorance, his belief that both the bird and the islands owed their origin to a great first Creative Cause. And this analysis of the real meaning of the phrase "distinct creation," has led me to suggest whether, in aiming to define the primary zoological provinces of the globe, we may not be trenching upon a province of knowledge beyond our present capacities; at least in the judgment of Lord Bacon, commenting upon man's efforts to pierce into the "dead beginnings of things."

On the few occasions in which I have been led to offer observations on the probable cause of the extinction of species, the chief weight has been given to those gradual changes in the conditions of a country affecting the due supply of sustenance to animals in a state of nature. I have also pointed out the characters in the animals themselves calculated to render them most obnoxious to such extirpating influences; and on one occasion I have applied the remarks to the explanation of so many of the larger species of particular groups of animals having become extinct, whilst smaller species of equal antiquity have remained. In proportion to its bulk is the difficulty of the contest which, as a living organized whole, the individual of such species has to maintain against the surrounding agencies that are ever tending to dissolve the vital bond and subjugate the living matter to the ordinary chemical and physical forces. Any changes, therefore, in such external agencies as a species may have been originally adapted to exist in, will militate against that existence in a degree proportionate, perhaps in a geometrical ratio, to the bulk of the species. If a dry season be gradually prolonged, the large mammal will suffer from the drought sooner than the small one: if such alteration of climate affect the quantity of vegetable food, the bulky herbivore will first feel the effects of stinted nourishment; if new enemies are introduced, the large and conspicuous quadruped or bird will fall a prey, while the smaller species conceal themselves and escape. Smaller animals are usually also more prolific than larger ones. "The actual presence, therefore, of small species of animals in countries where larger species of the same natural families formerly existed, is not the consequence of any gradual diminution of the size of such species, but is the result of circumstances which may be illustrated by the fable of the 'Oak and the Reed;' the smaller and feebler animals have bent and accommodated themselves to changes which have destroyed the larger species." No doubt the type-form of any species is that which is best adapted to the conditions under which such species at the time exists; and as long as those conditions remain unchanged, so long will the type remain; all varieties departing therefrom being in the same ratio less adapted to the environing conditions of existence. But, if those conditions change, then the variety of the species at an antecedent date and state of things will become the type-form of the species at a later date, and in an altered state of things. Observation of animals in a state of nature is required to show their degree of plasticity, or the extent to which varieties do arise: whereby grounds may be had for judging of the probability of the elastic ligaments and joint-structures of a feline foot, for example, being superinduced upon the more simple structure of the toe with the non retractile claw, according to the principle of a succession of varieties in time. Observation of fossil remains is also still needed to make known the ante-types, in which varieties, analogous to the observed ones in existing species, might have occurred, so as to give rise ultimately to such extreme forms as the Giraffe, for example. The aboriginal laws of the geographical distribution of plants and animals have been modified from of old by geological and the concomitant climatal changes; but they have been much more disturbed by man since his introduction upon the globe. The serviceable plants and animals which he has carried with him in his migrations have flourished and multiplied in lands the most remote from the habitats of the aboriginal species. Man has, also, been the most potent and intelligible cause of extirpation of species within historic times. He alone, with one of the beasts which he has domesticated—the dog—is cosmopolitan. The human species is represented by a few well-marked varieties; and there is a certain amount of correspondence between their localities and general zoological provinces. But, with regard to the alleged conformity between the geographical distribution of man and animals, which has of late been systematically enunciated, and made by Agassiz, in Gliddon & Nott's 'Varieties of Mankind,' the basis of deductions as to the origin and distinction of the human varieties: many facts might be cited, affecting the conformity of the distribution of man with that of the lower animals and plants, as absolutely enunciated in some recent works. Nor can we be surprised to find that the migratory instincts of the human species, with the peculiar endowment of adaptiveness to all climates, should have produced modifications in geographical distribution to which the lower forms of living nature have not been subject. Ethnology is a wide and fertile subject, and I should be led far beyond the limits of an inaugural discourse were I to indulge in an historical sketch of its progress. But I may advert to the testimony of different witnesses—to the concurrence of distinct species of evidence—as to the much higher antiquity of the human race, than has been assigned to it in historical and genealogical records.

Mr. Leonard Horner discerned the value of the phenomena of the annual sedimentary deposits of the Nile in Egypt as a test of the lapse of time during which that most recent and still operating geological dynamic had been in progress. In two Memoirs communicated to the Royal Society in 1855 and 1858, the result of ninety-five vertical borings through the alluvium thus formed are recorded. In the excavations near the colossus of Rameses II. at Memphis, there were 9 feet 4 inches of Nile sediment between 8 inches below the present surface of the ground and the lowest part of the platform on which the statue had stood. Supposing the platform to have been laid in the middle of the reign of that king, viz. 1361 B.C., such date added to A.D. 1854 gives 3,215 years during which the above sediment was accumulated; or a mean rate of increase of 3½ inches in a century. Below the platform there were 32 feet of the total depth penetrated; but the lowest 2 feet consisted of sand, below which it is possible there may be no true Nile sediment in this locality, thus leaving 30 feet of the latter. If that amount has been deposited at the same rate of 3½ inches in a century, it gives for the lowest part deposited an age of 10,285 years before the middle of the reign of Rameses II., and 13,500 years before A.D. 1854. The Nile sediment at the lowest depth reached is very similar in composition to that of the present day. In the lowest part of the boring of the sediment at the colossal statue in Memphis, at a depth of 39 feet from the surface of the ground, the instrument is reported to have brought up a piece of pottery. This, therefore, Mr. Horner infers to be a record of the existence of man 13,371 years before A.D. 1854:—"Of man, moreover, in a state of civilization, so far at least, as to be able to fashion clay into vessels, and to know how to harden then by the action of a strong heat." Prof. Max Müller has opened out a similar vista into the remote past of the history of the human race by the perception and application of analogies in the formation of modern and ancient, of living and dead, languages. From the relations traceable between the six Romance dialects, Italian, Wallachian, Rhætian, Spanish, Portuguese, and French, an antecedent common "mother-tongue" might be inferred, and, consequently the existence of a race anterior to modern Italians, Spanish, French, &c., with conclusions as to the lapse of time requisite for such divisions and migrations of the primitive stock, and for the modifications which the mother-language had undergone. History and preserved writings show that such common mother-race and language have existed in the Roman people and the Latin tongue. But Latin like the equally "dead" language Greek, with Sanscrit, Lithuanian, Zend, and the Gothic, Sclavonic, and Celtic tongues, can be similarly shown to be modifications of one antecedent common language; whence is to be inferred an antecedent race of men, and a lapse of time sufficient for their migration over a tract extending from Iceland in the north-west to India in the south-east, and for all the above-named modifications to have been established in the common mother "Arian" tongue.

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST—OCTOBER, 1858.

Latitude—43 deg. 39.4 min. North. Longitude—5 h. 17 min. 33 sec. West. Elevation above Lake Ontario, 108 feet.

Days.	Barom. at temp. of 32°.				Temp. of the Air.				Excess of mean above Average	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Resultant Direction.	Velocity of Wind.					Rain in Inches.	Snow in Inches.
	6 A.M.	2 P.M.	10 P.M.	MEAN.	6 A.M.	2 P.M.	10 P.M.	ME'N		6 A.M.	2 P.M.	10 P.M.	M'N	6 A.M.	2 P.M.	10 P.M.	M'N	6 A.M.	2 P.M.	10 P.M.		6 A.M.	2 P.M.	10 P.M.	Re-sul't.	ME'N		
					°	°	°	°	°												°							
1	29.419	29.483	29.645	29.5267	49.4	53.7	43.6	48.45	— 1.97	.312	.221	.221	.250	.88	.52	.77	.73	N N E	N W b N	N N W	N 23 W	5.0	18.0	1.4	7.75	8.18	0.010	...
2	.706	.630	.502	.5013	40.7	57.5	57.4	52.38	+ 2.45	.204	.294	.378	.300	.80	.61	.80	.75	Calm.	S E b S	S E	S 28 E	0.0	6.2	9.2	5.03	5.53	......	...
3	.269	.134	—	—	56.6	76.3	—	—	—	.423	.530	—	—	.93	.58	—	—	S S E	S W b W	W b S	S 60 W	1.2	14.0	10.0	7.24	7.70	0.035	...
4	.315	.406	.511	.4370	57.0	59.2	46.7	52.90	+ 3.87	.341	.321	.172	.276	.73	.64	.53	.66	W N W	W b N	Calm.	N 77 W	2.4	10.0	0.0	4.29	4.35	0.065	...
5	.665	738	.843	.7622	44.8	63.5	49.4	52.23	+ 3.62	.235	.167	.244	.226	.79	.28	.69	.62	W N W	W	Calm.	N 55 W	6.8	14.5	0.0	6.75	7 04	......	...
6	.868	.750	.513	.6900	41.8	56.0	54.1	51.65	+ 3.43	.236	.211	.282	.253	.89	.45	.66	.66	N W b N	E	E b S	S 82 E	1.0	8.0	11.0	6.33	6.62	0.155	...
7	.112	.071	.253	.1410	56.3	58.8	37.5	49.78	+ 1.93	.422	.252	.162	.277	.93	.50	.71	.73	S E b E	W b S	W b S	S 81 W	3.3	27.8	11.0	13.74	14.67	0.240	...
8	.201	.151	.178	.1727	35.7	45.9	40.9	41.52	— 5.93	.142	.148	.193	.161	.67	.46	.76	.61	S W b W	W b S	S W b W	S 69 W	9.2	15.3	9.4	11.75	11.93	0.032	Inap
9	.302	.479	.712	.5168	40.0	48.7	39.8	43.68	— 3.38	.205	.224	.200	.211	.83	.64	.81	.74	Calm.	N W b N	W b N	N 56 W	0.0	19.8	2.2	7.06	7.50	0.050	...
10	833	.856	—	—	42.5	52.7	—	—	—	.227	.215	—	—	.83	.58	—	—	W b N	W b S	W	N 83 W	2.0	9.6	1.0	3.79	3.93	......	...
11	.894	.838	.809	.8470	42.2	47.6	45.8	45.40	— 0.85	.240	.183	.193	.209	.89	.54	.62	.69	Calm.	E b N	E b N	N 72 E	0.0	7.8	7.3	7.56	7.82	Inap	...
12	.732	.639	.537	.6318	45.4	50.1	51.0	49.23	+ 3.27	.220	.303	.343	.292	.72	.83	.92	.82	E N E	E N E	E	S 84 E	13.5	7.8	2.2	6.09	8.10	0.080	...
13	.475	.393	.427	.4258	53.8	55.0	47.6	51.97	+ 6.40	.370	.366	.282	.322	.89	.85	.86	.83	Calm.	S S W	Calm.	S 33 W	0.0	11.0	0.0	4.60	4.96	0.500	...
14	.387	.479	.615	.5080	43.3	49.6	45.3	46.00	+ 0.73	.221	.229	.235	.226	.78	.63	.78	.72	S W b S	S W	W	S 55 W	4.0	11.0	5.0	6.73	6.83	......	...
15	.725	.810	.906	.8255	39.1	52.8	43.6	44.97	+ [illegible].12	.204	.261	.213	.226	.86	.65	.74	.75	Calm.	S W b S	N b W	S 82 W	0.0	1.4	1.2	0.42	1.14	......	...
16	30.014	.991	.936	.9838	44.3	48.5	50.1	48.42	+ 3.88	.230	.278	.292	.275	.79	.81	.80	.81	N N E	E N E	E N E	N 67 E	1.4	1.7	4.2	4.47	4.53	0.030	...
17	29.963	.935	—	—	48.0	62.1	—	—	—	.300	.326	—	—	.89	.58	—	—	Calm.	Calm.	Calm.	S 10 W	0.0	0.0	0.0	2.11	2.12	......	...
18	.984	.889	.832	.8980	42.9	62.2	50.6	52.57	+ 8.53	.248	.331	.316	.302	.89	.59	.85	.77	Calm.	S b W	Calm.	S 19 W	0 0	8.8	0.0	3.47	3.51	......	...
19	.823	.814	.838	8295	47.6	65.7	51.2	54.68	+10.90	.305	.413	.257	.328	.92	.65	.67	.76	Calm.	N W b N	N b W	N 10 W	0.0	1.4	9.0	5.50	5.91	......	...
20	.839	.702	.804	.8155	49.6	57.4	55.6	53.78	+10.25	.309	.317	.336	.309	.86	.67	.75	.74	N	E	E N E	N 71 E	7.8	10.0	7.0	7.00	7.35	......	...
21	.790	.792	.782	.7883	50.5	51.2	50.7	51.13	+ 7.88	.307	.335	.347	.321	.83	.89	.94	.86	E N E	E b N	E b S	N 77 E	12.6	1.5	2.0	3.65	3.69	0.390	...
22	.730	.712	.618	.6787	49.1	54.7	50.1	51.03	+ 8.07	.316	.272	.303	.298	.90	.63	.83	.80	S E b E	S	Calm.	S 15 W	2.2	5.4	0.0	1.77	3.33	0.020	...
23	.671	.701	.801	.7310	43.1	54.5	47.6	48.70	+ 5.05	.224	.244	.243	235	.80	.56	.74	.69	N W b W	N N W	N	N 23 W	1.0	4.8	6.2	3.57	5.69	......	...
24	.848	.851	—	—	46.9	51.6	—	—	—	.263	.203	—	—	.81	.77	—	—	N b E	E S E	E	N 49 E	1.8	5.8	7.5	4.54	5.62	......	...
25	.953	.940	.937	.9585	44.0	48.0	41.5	43.78	+ 1.50	.207	.108	.151	.157	.71	.32	.57	.55	N E	E	N E	N 61 E	4.2	12.2	8.2	6.34	7.04	......	...
26	.964	.932	.950	.9615	34.2	46.9	37.9	39.87	— 2.12	.110	.158	.135	.133	.55	.49	.59	.54	N N E	E b N	N E	N 57 E	6.0	12.5	3.2	5.04	5.64	......	...
27	.980	.954	.951	.9635	35.0	51.2	43.4	43.23	+ 1.45	.120	.156	.195	.154	.56	.42	.69	.54	N	E b S	E	N [illegible] E	4.8	3.5	3.0	2.35	2.74	......	...
28	.965	.892	.836	.8888	40.2	51.4	51.4	48.15	+ 6.67	.155	.250	.224	.218	.61	.65	.59	.63	N E b N	E b N	E	N 83 E	4.2	14.5	15.2	11.57	11.78	0.020	...
29	.755	.617	.573	.6130	48.0	51.0	51.9	50.65	+ 9.33	.300	.338	.362	.335	.89	.90	.94	.90	E b N	Calm.	Calm.	S 87 E	9.5	0.0	0.0	2.09	2.11	0.145	...
30	.493	.454	.557	.4985	52.3	56.5	49.8	52.47	+11.52	.357	.425	.286	.353	.91	.94	.79	.88	Calm.	S W b S	Calm.	S 46 W	0.0	9.0	0.0	3.31	4.05	0.025	...
31	.597	.610	—	—	45.3	53.6	—	—	—	.247	.268	—	—	.82	.65	—	—	S W b S	W b S	W	S 67 W	1.6	3.8	1.4	3.21	3.49	Inap	...
M	29.6843	29.6680	29.6880	29.6813	45.05	53.78	47.48	48.70	+ 3.75	.25[illegible]	.262	.252	.256	.80	.62	.75	.72	....	....	....	....	3.40	8.04	4.45	......	5.96	1.797	Inap

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR OCTOBER.

Highest Barometer........................ 30.042 at 8 a. m., on 16th } Monthly range=
Lowest Barometer .... 29.000 at 10 a. m., on 7th } 1.042 inches

Self-registering Thermom.
- Maximum Temperature........... 70°3 on 3rd at 2 p.m. } Monthly range=
- Minimum Temperature........... 31°5 on 26th at a.m. } 44°8
- Mean maximum Temperature .... 55°79 } Mean daily range=
- Mean minimum Temperature .... 43°41 } 12°37
- Greatest daily range .... 24°0 from a. m. to p. m. on 5th.
- Least daily range.................. 5°0 from a. m. to p. m. on 21st.

Warmest day......... 19th ... Mean temperature......... 54.68 } Difference = 14°81.
Coldest day........... 26th ... Mean temperature......... 39°87 }

Maximum { Solar.................................. 86°8 on p. m. of 3rd } Monthly range=
Radiation. { Terrestrial .... 25°1 on a. m. of 26th } 61°7.

Aurora observed on 10 nights, viz., on 1st, 2nd 4th. 5th, 9tb, 10th, 18th, 26th, 27th and 30th.

Possible to see Aurora on 15 nights; impossible on 16 nights.

Snowing on 1 day,—depth inapp inches; duration of fall 0.2 hours.

Raining on 17 days,—depth 1.797 inches; duration of fall 49.2 hours.

Mean of cloudiness = 0.60.

Most cloudy hour observed, 2 p. m., mean = 0.65; least cloudy hour observed 10 p. m., mean, = 0.56.

Sums of the components of the Atmospheric Current, expressed in miles.

North.	South.	East.	West.
1193.83	969.38	1597.49	1749.20

Resultant direction N. 34° W.; Resultant Velocity 0.56 miles per hour.

Mean velocity............................ 5.96 miles per hour.
Maximum velocity .... 27.8 miles from 1.30 to 2.30 p. m. on 7th.
Most windy day......................... 7th...Mean velocity 14.67 miles per hour.
Least windy day .... 15th...Mean velocity 1.14 ditto.
Most windy hour ... noon to 1 p. m. ....Mean velocity 9.39 ditto. } Difference
Least windy hour ....5 to 6 a. m. ....Mean velocity 3.81 ditto. } 5.58 miles.

Thunderstorm on 7th, from 6 to 8 a. m.
Distant Thunder on 19th, at 7 p. m. in N W.
Sheet Lightning on 2nd, at 7 p. m. in N W.
Haloes on 17th, imperfect Halo and Parhelia round the sun 4.15 p. m. On 17th perfect Halo round moon at 9 p. m. On 20th perfect Halo round moon at midnight.
Corona on 26th round the moon from 9 p. m.

First Snow on 8th, slight particles noted at 10.30 p. m.
First Ice on 8th, at 6 a. m. (½ inch thick).
Indian Summer from 18th to 28th (not well marked).
Donatti's Comet visible to the naked eye from 13th September to 18th October.
4th Shower of Hail and Sleet at 4 p. m. 7th Rainbow observed at 7.30 a. m. 13th very violent Squall of wind, rain and lightning from 7.05 to 7.35 p. m.
The Resultant Direction and Velocity of the Wind for the month of October from 1848 to 1858 inclusive, were respectively N 54° W and 1.34 miles.
The Mean Temperature of October was 3°4 above the average of the last 19 years, it was the warmest month of the series with the exception of 1854.

COMPARATIVE TABLE FOR OCTOBER.

Year.	Temperature.					Rain.		Snow.		Wind.		
	M'n.	Diff. from Aver.	Max ob'd.	Min. ob'd.	Range.	No. of days.	Inch's.	No. of days.	Inch's.	Resultant Direction.	Resultant V'y.	Mean Force or Velocity.
1840	44.4	—1.0	68.5	23.9	44.6	13	1.860	3	...	...	...	....
1841	41.6	—3.8	58.3	20.3	38.0	6	1.360	2	...	...	...	0.41 lbs.
1842	45.1	—0.3	68.5	30.0	38.5	8	5.175	0	...	...	...	0.35
1843	41.8	—3.6	65.7	24.5	41.2	12	3.790	4	2.5	...	...	0.54
1844	43.3	—2.1	69.6	17.8	51.8	7	impft.	4	12.0	...	...	0.43
1845	46.4	+1.0	62.7	20.0	42.7	11	1.760	1	inapp.	...	...	0.26
1846	44.6	—0.8	69.7	20.7	49.0	14	4.180	2	inapp.	...	...	0.44
1847	44.0	—1.4	65.0	20.3	44.7	13	4.890	2	inapp.	...	...	0.19
1848	46.3	+0.9	62.2	26.4	35.8	11	1.550	0	0.0	N 54° W	1.24	4.60 mls.
1849	45.3	—0.1	59.2	25.5	33.7	13	5.965	1	inapp.	N 12° W	1.27	4.70
1850	45.4	0.0	66.6	24.8	41.8	10	2.085	0	0.0	N 66° W	1.10	5.30
1851	47.4	+2.0	66.1	25.0	41.1	10	1.680	2	0.3	S 72° W	1.06	4.39
1852	48.0	+2.6	70.7	29.8	40.9	12	5.280	0	0.0	N 5° E	1.19	4.47
1853	44.4	—1.0	64.7	25.5	39.2	10	0.875	2	inapp.	S 88° W	1.74	4.77
1854	49.5	+4.1	74.2	29.8	44.4	15	1.495	3	inapp.	N 25° E	1.20	4.60
1855	45.4	0.0	64.3	28.0	36.3	14	2.485	5	0.8	N 82° W	4.91	9.88
1856	45.3	—0.1	70.1	23.3	46.8	10	0.875	2	0.1	N 76° W	2.15	6.07
1857	45.4	0.0	63.5	27.7	35.8	10	1.010	2	0.2	N 19° W	2.93	6.24
1858	48.8	+3.4	76.3	34.2	42.1	17	1.797	1	inapp.	N 34° W	0.36	5.96
M	45.39	...	66.63	25.13	41.49	11.4	2.647	1.9	0.99	....	...	5.55 Mls.

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST,—NOVEMBER, 1858.

Latitude—43 deg. 39.4 min. North: Longitude—5 h. 17 m. 33 s. West. Elevation above Lake Ontario, 108 feet.

Day.	Barom. at temp. of 32°.				Temp. of the Air.				Excess of mean above Average	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Resul't. Direction.	Velocity of Wind.					Rain in inches.	Snow in inches.
	6 A.M.	2 P.M.	10 P.M.	Mean.	6 A.M	2 P.M	10 PM	ME'N		6 A.M	2 P.M.	10 P.M.	M'N	6 A.M	2 P.M.	10 P.M.	M'N	6 A. M.	2 P. M.	10 P. M.		6 A.M.	2 P.M.	10 P.M.	Result'.	ME'N		
					°	°	°	°	°												°							
1	29.858	29.936	29.970	29.9310	46.9	52.0	45.4	47.93	+ 7.47	.276	.312	.201	.260	.86	.80	.66	.77	Calm.	E S E	E b N	N 69 E	0.0	7.0	14.6	9.07	10.06	inap.	...
2	.938	.842	.794	.8535	42.2	45.1	44.2	43.88	+ 3.62	248	183	209	219	92	61	72	77	N E b E	E b N	E b N	N 76 E	16.2	19.8	20.5	19.40	19.53	0.077	...
3	.769	.730	.719	.7383	44.2	43.5	45.8	44.42	+ 4.42	259	254	287	268	90	90	93	92	E	E	E b N	N 89 E	20.3	12.5	16.8	9.39	9.52	0.565	...
4	.672	.613	.633	.6385	45.8	47.2	46.5	46.37	+ 6.60	287	282	268	277	93	87	84	87	E b N	E N E	Calm.	N 49 E	0.3	1.8	0.0	0.54	0.77	0.020	...
5	.623	.608	.569	.6135	42.2	47.1	48.0	45.53	+ 6.05	252	263	289	266	94	83	86	87	N N W	NW b N	E	N 76 E	0.8	1.0	9.2	5.67	6.06	0.210	...
6	.464	.350	.317	.3760	44.7	43.8	36.4	41.40	+ 2.23	243	237	192	223	82	82	89	85	E N E	N E b E	N N E	N 51 E	13.6	9.2	7.7	7.06	7.69	0.842	...
7	.304	.308	—	—	36.4	44.5	—	—	—	200	237	—	—	93	81	—	—	Calm.	Calm.	NW b N	N 41 W	0.0	0.0	3.0	0.63	0.99	0.025	...
8	.389	.435	.534	.4605	37.1	42.9	36.4	38.73	+ 0.01	200	239	175	195	90	86	81	82	Calm.	N W	N	N 24 W	0.0	11.2	6.5	7.12	7.37	inap.	...
9	.568	.552	.540	.5540	33.5	35.7	33.0	34.02	— 4.38	138	136	150	144	73	65	80	74	N b W	N b W	N b E	N 6 E	5.4	8.8	4.4	5.40	5.57	...	0.1
10	.594	.699	.797	.7098	29.5	33.2	27.0	29.38	— 8.70	144	137	120	129	87	72	88	78	N b E	N b W	Calm.	N 1 E	4.9	4.8	0.0	4.59	4.76	...	inap.
11	.861	.801	.749	.8028	21.6	31.5	27.0	26.65	—11.13	087	134	093	097	75	75	63	67	N b E	S E b E	E b S	N 74 E	5.8	4.0	3.2	2.15	2.62	...	...
12	.709	.622	.493	.6030	25.9	38.2	38.2	34.53	— 2.97	113	125	205	147	81	54	89	73	N E b E	E S E	S S E	S 26 E	3.1	5.5	12.5	5.09	8.23	0.365	...
13	.319	.324	.618	.4355	36.4	33.2	22.7	30.30	— 6.88	209	166	080	143	97	87	66	81	W b S	NW b N	W N W	N 61 W	6.2	21.0	8.5	9.84	10.88	0.070	0.2
14	.676	.662	—	—	20.5	28.5	—	—	—	093	132	—	—	85	85	—	—	Calm.	NW b W	W b S	N 82 W	0.0	4.0	2.5	3.62	3.77	...	0.2
15	.605	.638	.664	.6303	23.4	25.4	20.5	23.47	—13.03	108	084	093	097	86	61	85	78	W b S	N W	W N W	N 54 W	3.0	12.8	2.5	9.04	9.31	...	0.1
16	.615	.554	.609	.5932	23.4	31.2	30.3	28.70	— 7.50	115	108	150	124	92	61	89	79	W N W	W N W	W b N	N 75 W	6.0	23.0	13.7	12.53	12.80	...	0.1
17	.702	.680	.661	.6833	26.7	38.2	33.9	33.10	— 2.70	133	105	128	120	92	45	65	65	W S W	W S W	S W b W	S 75 W	10.0	15.7	7.6	10.56	10.89	...	...
18	.602	.596	.640	.6185	29.2	36.8	35.3	33.85	— 1.63	132	151	139	139	81	69	67	71	W b S	W S W	W b N	S 88 W	3.1	15.2	15.6	13.51	13.83	...	inap.
19	.686	.755	.753	.7342	29.2	31.2	27.7	28.85	— 6.23	106	072	099	090	66	40	64	57	W	NW b W	W S W	N 80 W	17.3	18.3	11.5	11.70	13.01	...	inap.
20	.715	.502	.526	.6080	25.2	39.7	33.2	32.05	— 2.72	115	106	165	131	85	43	87	74	S W	N W	N W	N 42 W	8.5	4.9	4.0	3.39	6.64	...	...
21	.409	.428	—	—	34.6	38.9	—	—	—	146	168	—	—	74	70	—	—	N E b N	N E	N E	N 41 E	11.0	2.8	4.1	4.95	4.97	...	...
22	.634	.550	.448	.5290	27.7	39.5	38.6	35.40	+ 1.32	121	160	172	157	80	65	73	76	N b W	E	E	N 78 E	10.5	14.5	14.3	12.49	13.66	0.680	...
23	.312	.312	.367	.3353	35.0	33.5	31.2	32.95	— 0.72	193	173	152	170	95	90	87	91	E N E	N E	N N E	N 43 E	15.3	11.2	6.4	7.87	8.33	0.125	1.5
24	.406	.490	.580	.5042	31.0	29.5	30.6	30.17	— 3.10	147	129	134	136	85	78	78	81	N b W	NW b N	N W b N	N 32 W	1.0	19.5	21.5	14.77	14.94	...	0.2
25	.667	.688	.737	.7028	29.9	31.5	29.5	30.18	— 2.78	146	158	158	154	87	89	97	91	NW b N	W N W	W b N	N 52 W	14.2	18.0	8.8	12.09	12.33	...	...
26	.820	.864	.901	.8685	30.6	31.0	30.6	30.73	— 1.83	138	126	138	139	80	72	80	81	N W	N W	W N W	N 56 W	8.0	22.3	17.5	13.64	13.96	...	...
27	.803	.788	.658	.7708	23.4	33.2	32.6	29.37	— 2.82	101	143	151	137	81	75	81	82	W b N	W b N	W b N	S 89 W	3.0	2.0	0.4	1.66	3.05	...	0.8
28	.496	.339	—	—	32.4	34.1	—	—	—	153	148	—	—	83	76	—	—	S E b E	N E b N	N N E	N 41 E	4.5	6.5	9.0	6.33	6.90	...	...
29	.429	.308	.248	.3533	24.8	29.9	35.3	30.25	— 1.25	120	135	146	130	90	81	71	81	N b E	W N W	S S W	S 55 W	7.5	4.8	21.3	7.33	11.03	...	0.2
30	.340	.608	.871	.6152	30.3	27.0	22.7	25.97	— 5.12	156	121	095	121	92	32	78	84	W b S	NW b W	W b S	N 71 W	23.4	21.9	8.1	11.33	12.72	...	0.6
M	29.6223	29.6163	29.5311	29.6267	32.30	36.58	33.95	34.16	— 1.09	.165	.163	.161	.162	.86	.72	.79	.79	....	....	....	....	7.43	10.80	9.19	......	8.87	3.879	4.0

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR NOVEMBER, 1858.

Highest Barometer . . . . 29.970 at 10 p.m. on 1st, } Monthly range=
Lowest Barometer . . . . 29.190 at midnight on 29th } 0.780 inches.

Self-registering Ther.:
- Maximum temperature . . . . 53°0 on p. m. of 1st } Monthly range=
- Minimum temperature . . . . 15°3 on a. m. of 15th } 37°7
- Mean maximum temperature . . 37°90 } Mean daily range = 7°87
- Mean minimum temperature . . 30°03 }
- Greatest daily range . . . . 17°3 from a. m. to p. m. on 20th.
- Least daily range . . . . 3.2 from a. m. to p. m. on 23rd.

Warmest day . . 1st ... Mean Temperature . . . 47°93 } Difference=24°46.
Coldest day . . . . 15th ... Mean Temperature . . . 23°47 }

Maximum { Solar . . . . [illegible]°8 on p. m. of 1st } Monthly range=
Radiation { Terrestrial . . . . . . [illegible].9 on a. m. of 15th } 56°9

Aurora observed on 3 nights, viz.: on 7th, 10th, and 15th; possible to see Aurora on 10 nights; impossible on 20 nights.

Snowing on 13 days; depth, 4.0 inches; duration of fall 48.0 hours.

Raining on 12 days; depth, 3.879 inches; duration of fall, 84.9 hours.

Mean of cloudiness=0.81; most cloudy hour observed, 2 p. m., mean=0.91: least cloudy hour observed, 6 a. m., mean=0.71.

Sums of the components of the Atmospheric Current, expressed in Miles.

North.	South.	East.	West.
2571.97	530.91	2007.57	2980.98

Resultant direction, N 25° W; Resultant Velocity, 3.14 miles per hour.
Mean velocity of the wind 8.87 miles per hour.
Maximum velocity . . . 28.2 miles per hour, from 5 to 6 p.m. on 13th.
Most windy day . . . . 2nd—Mean velocity, 19.53 miles per hour.
Least windy day . . . . 4th—Mean velocity, 0.77 do
Most windy hour, 1 to 2 p. m.—Mean velocity, 10.93 do } Difference
Least windy hour, 7 to 8 a. m.—Mean velocity, 5.90 do } 5.03 miles.

Dense Fog from 2 p. m. of 3rd, continuing with but little intermission till 2 p. m. of 5th.

9th. First measurable snow of the season.
9th. Thin ice on the pools at 6 a. m.
15th. Corona round the moon from 7.30 p. m.
17th. Halo round the moon from 5 to 7 p. m.
23rd. Corona round the moon from 9 p. m.
27th. Halo round the moon at 6 a. m.
30th. Corona round Jupiter 8 to 9 p. m.

The Resultant Direction and Velocity of the Wind for the month of November, from 1848 to 1858 inclusive, were respectively N 75° W, and 2.04 miles.

The month of November, 1858, was cold, windy, wet and cloudy. The mean temperature having been 2°33 below the average; whilst the velocity of the wind was 1.88 miles; the depth of rain 0.886 inches, the depth of snow 0.68 inches, and the clouded sky .08 in excess of their respective averages.

COMPARATIVE TABLE FOR NOVEMBER.

YEAR.	TEMPERATURE.					RAIN.		SNOW.		WIND.		
	Mean.	Difference from Average.	Maximum observed.	Minimum observed.	Range.	No. of days	Inches.	No. of days.	Inches.	Resultant. Direction.	Resultant. Velocity.	Mean Velocity
1840	35.9	— 0.6	54.4	20.5	33.9	5	1.220	8	...	...	...	...
1841	35.0	— 1.5	63.2	7.6	55.6	8	2.450	5	...	...	...	0.91lbs
1842	33.3	— 3.2	50.6	7.6	43.0	9	5.310	10	...	...	...	1.22 "
1843	33.5	— 3.0	51.2	14.4	36.8	10	4.765	7	1.2	...	...	0.59 "
1844	34.9	— 1.6	49.8	12.0	37.8	8	Imp't	4	8.0	...	...	0.48 "
1845	36.8	+ 0.3	58.8	7.6	51.2	7	1.105	4	5.0	...	...	0.53 "
1846	41.3	+ 4.8	55.5	18.2	37.3	12	5.805	2	0.4	...	...	0.64 "
1847	38.6	+ 2.1	58.2	7.8	50.4	14	3.155	3	inap.	...	...	0.36 "
1848	34.5	— 2.0	49.3	16.5	32.8	9	2.020	3	1.4	N 81 W	1.81	4.81ms.
1849	42.6	+ 6.1	56.7	28.4	28.3	10	2.815	2	1.0	N 39 W	1.55	4.78 "
1850	38.8	+ 2.3	62.3	18.1	44.2	7	2.955	1	inap.	N 42 W	1.43	5.27 "
1851	32.9	— 3.6	50.1	16.5	33.6	5	3.885	6	6.7	N 50 W	1.25	4.70 "
1852	36.0	— 0.5	50.4	18.7	31.7	7	1.775	3	2.0	N 59 W	1.53	6.50 "
1853	38.7	+ 2.2	54.1	14.4	39.7	15	2.425	6	2.7	N 9 W	0.55	5.52 "
1854	36.8	+ 0.3	54.9	15.1	39.8	13	1.115	4	1.3	S 88 W	3.72	7.58 "
1855	38.6	+ 2.1	54.1	18.7	35.4	8	4.590	6	3.0	N 66 W	3.18	10.81 "
1856	37.4	+ 0.9	56.4	22.8	33.6	10	1.375	9	9.5	S 85 W	2.95	8.75 "
1857	33.5	— 3.0	57.8	—2.3	60.1	14	3.235	9	6.9	S 61 W	5.45	9.25 "
1858	34.2	— 2.3	52.0	20.5	31.5	12	3.879	13	4.0	N 25 W	3.14	8.87 "
Mean	36.49	...	54.73	14.90	39.83	9.6	2.993	5.5	3.32	...	...	6.99