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GRALLATORES: WADERS OR STILTED BIRDS.

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The group of birds to which our attention is now directed has always been distinguished by naturalists and has been as little uncertain as to its limits as almost any leading division. It was marked out by Belon in the first attempt at a natural ornithological system produced in 1555, and has in some form been retained by all his successors. In truth, the birds of prey, the game and poultry birds, the waders, and the swimmers with the perching birds have almost always been recognized as orders, and the only question respecting the climbers has been whether they constituted a distinct order or ought to be accounted a suborder of perching birds. Other leading divisions occasionally proposed by writers of eminence are either founded on somewhat insulated families, or are artificially defined and founded on intermediate forms which there is no real difficulty in reducing under one or other of the orders above enumerated. One of the systems most copious in its divisions is that of the celebrated Temminck who gives no less than 16 orders of birds, but no less than half of these are but divisions of perching birds, three of these containing each one family. Of the remainder, three which have a strong natural affinity have been frequently included under the common name of Gallinaceous birds, (game and poultry), and of three more one is but a family of swimming birds and another is an intermediate group between swimmers and waders, containing some forms belonging to each, and combined by an altogether artificial character. Thus we get back without difficulty to the six great orders indicated above, and all the differences among systematists will be explained and removed if we only avoid confusing families with orders, and take such pains in ascribing to the orders their *true distinctions* as not to admit transition groups founded on inferior and merely artificial characters. We must, however, in receiving the six orders of birds, observe the peculiar position which one of them occupies in respect to the others. The perching birds (Insessores) are more numerous than all the other orders of birds taken together; they present to us the true type of bird-life from which the other orders are deviations, and their suborders or great sections are quite as well distinguished as the other orders and present such remarkable analogies with them that we seem, on the whole, to have two circles exhibiting different degrees of development, but having corresponding divisions of about equal importance. It may be convenient at present to count Insessores as one order and its secondary groups as suborders, but whether we consider the value of the distinctions or the number of species included it will be found to be really the case that whilst we collect under the name Insessores or perching birds, five orders well distinguished by external characters and modes of life, each of these is represented by one of the other five orders of birds which display more exaggerated forms of the same general structure. In adopting, therefore, six orders of birds we really receive ten arranged in *two* series the members of which analogically correspond one with another, each having its proper place necessarily resulting from the characteristic by which it is distinguished.

Now as to the series in which the orders of birds may be most naturally placed, all seem agreed that the rapacious birds (Raptores) should stand first, to which I cannot entirely assent, as I deem it necessary to keep the Perchers separate from all the others, and though it signifies little whether they stand first or last, if the latter position were chosen we ought in consistency to begin with the lowest forms ascending to the higher, in which case the Swimmers (Natatores) would be first, whilst if we adhere to the commonly adopted descending order, the Insessores must be first as the truest and highest expression of the Bird-type. To the modern practise of making the Insessores or *Passeres*, as they are often called, follow the Raptores, interrupting the series of the more deviative forms of birds, there are very strong objections, and I cannot see how it can be supposed to be natural. Dr. George Gray's plan of making the Goat-suckers follow the owls may seem plausible because each family being the lowest in its own series, the one among Raptores, the other in the Insessorial suborder Fissirostres, and both being night-flying birds, with the kind of plumage belonging to that character, there is a certain analogy between them, and the same might be as justly said if the Hawks had been placed last amongst Raptores, and the Dentirostral Insessores had followed. Such relations of analogy may be found in abundance and are very interesting, but they should not be allowed to turn us from that true series in which groups of the same degree are placed in the order of the faculties and natural characteristics specially developed in each. I have on other occasions endeavored to show what this true series is, and to trace it out in particular cases, at present I only compare with it the methods most deserving of notice, so far as to establish the proper position of the order of birds which I would on this occasion specially examine. Belon's series was, after the Raptores, the Waders, then the Swimmers, and then the remaining birds in a great miscellaneous assemblage. Had he discriminated the Climbers and the Game and Poultry from the Insessores, and introduced them between Raptores and Grallatores he would have excelled any series since proposed. Willughby did not approach the merit of Belon who had preceded him by more than a hundred years, and though his work is still valuable to the student of ornithology, his method requires no notice. Linnæus had six orders, which, if we sent back many members of his Picae, which is an arbitrary unmeaning collection, to Passeres (Insessores of the best later authorities) and made the remaining Picae represent Scansores, would give what I take to be the true list of orders, but the series is decidedly unnatural, as he makes Anseres (Natatores, Swimming birds), the 3rd order, followed by Grallae (Grallatores), then Gallinae (Rasores, Game and Poultry). Had he made this latter exchange places with the Swimmers his series would have been a good one though we might wish to place Insessores first instead of last. Latham improved in some respects the Linnaean series, placing the Waders in their proper relations, but he multiplied orders unnecessarily from six to nine, and inserted the Passeres (Insessores) next to Picae, which he retained in the Linnaean sense, an arrangement totally inadmissible. The great Cuvier adopted the six true orders, only leaving Insessores in the second instead of the first place, and to him we owe the suborders of Insessores, excepting that later writers generally, and I believe justly, reject his Syndactyli, for which I have substituted Serratirostres, occupying the second position. Since Cuvier's time the Waders have always retained their position immediately before the Swimmers. They appear to represent the suctorial or extractive form of nutrition, with a figure elongated in the beak and limbs, and with the habit of frequenting chiefly marshes and sea-shores. I shall next endeavour to determine the proper limits of the Grallatores.

From its striking external characters it is an order the true members of which would pretty readily find their place, but these same characters, attracting attention wherever they occur, might easily cause families representing the Grallatorial tendency but really belonging to other parts of the system to be hastily placed in this order, and it is not without considerable care that we can keep it free from such intrusions. I shall enumerate the principal instances in which an error of this kind has been committed in order to illustrate the principles upon which our judgment must be formed in such cases.

The secretary bird (Gypo geranus) is a bird of prey, remarkable for the length of its legs, and possessing in the spur on its wing another character which may be accounted Grallatorial. It is probable that this genus itself constitutes a family and represents the Grallatorial tendency among Raptores, being thus next in affinity to the Vultures, amongst which it has often been placed, and which constitute the Rasorial family in the same order. It is not unnatural that when first made known it should have been mistaken for a Wader, but with our present knowledge of its structure and mode of life, there is no difficulty in referring it to the order Raptores. Cuvier placed the Ostrich and its allies, forming the family Struthionidae, amongst the Waders, notwithstanding the important external and anatomical characters which connect these birds with the Rasores; and it appears as if hesitation as to which characters should be deemed most important had led others to the compromise of elevating the family to the rank of a separate order placed between Rasores and Grallatores. I have considered this subject in a former paper, in which I have shown that the family Struthionidae represents the Grallatores in the order Rasores, and I have endeavoured to bring together the subfamilies, several of which had been allowed to remain in very unsuitable places. Among these was Psophinae, the Trumpeter birds representing the Rasores in the family, but which even Dr. George Gray regards as a subfamily of Ardeidae. Cuvier likewise retained among the Grallatores the Flamingo (Phaenicopterus), whose long legs undoubtedly give it the aspect of a wader, so that one might plausibly maintain that it is the representative of the Natatores among Grallatores were it not that the Duck-like beak and the internal structure corresponding with the Duck family, prove that it is really but a long-legged form of Anatidae representing in that great family the Grallatorian type. Dr. G. Gray has rightly perceived its family connection, but has placed it first among the subfamilies of Anatidae, in order to meet the last of the Grallatores. I must, nevertheless, presume to think that its relation to the Grallatores is strictly one of analogy and implying no immediate affinity should not affect its position. Dr. Gray makes the Rallidae (the Rail and Water hen family) as the last of the Grallatores join the Anatidae which he makes the first family of Natatores. The real connection I should maintain to be that the Rallidae represent the Rasorial tendency among Grallatores, the Anatidae among Natatores, each being the third family in its order, whilst Phaenicopterinae is the Grallatorial subfamily amongst Anatidae, and the coots which Dr. Gray places immediately before it, form the Natatorial representative among the subfamilies of Rallidae. This is a striking example of the way in which those analogies which so beautifully bind together the order of Nature may mislead us if we confound them with direct affinities. I cannot venture on this criticism which I submit to the judgment of the reflecting and candid reader, without, at the same time, bearing my humble testimony to the great value of Dr. Gray's work which displays not only the great knowledge which his position and resources might lead us to expect but an amount of skill and judgment rarely equalled, and which have materially contributed to advance the attractive branch of science to which he has devoted himself. His great work has for some years been my frequent companion in the museum and the study, and I gratefully acknowledge both the pleasure and the assistance which I have derived from it. I will now attempt a statement of the families and subfamilies of Grallatorial or Wading birds, in reference to their mutual relations and natural series. According to the theory of classification which I have on several occasions endeavoured to establish by various evidence, we expect to find first a family exhibiting the greatest power and the highest general development consistent with the Grallatorial type; secondly, one specially marked by active power, or, which in this case is the same thing, approaching most nearly the form and characters of Insessorial birds; thirdly, one imitating in its habits the Rasorial birds; fourthly, one preeminently Grallatorial, showing in its figure and mode of taking food a special tendency to the character of this order; and last, one making an approach to the Natatorial mode of life, and having relations of structure and habits with the last division of birds whose life is properly aquatic. Where the families admit of subdivision we expect also that the subfamilies shall conform to the same general law, but where any family or subfamily represents a structural tendency strikingly at variance with the common type, we usually observe it to be very limited in extent, often confined to a single genus or even to one or two species. Of this latter principle there is a good illustration in one of the families of the order now under our consideration, if, at least, I am right in a view which finds much favour with me though I am not supported in it by authority. Dr. G. Gray makes the Phaleropes a subfamily of the Scolopacidae (Snipe family), placing it last among his six subfamilies, under the name Phaleropodinae. Considering the adaptation of these creatures for swimming and their seeming to snatch at their food whilst moving in the water, so as to have eminently aquatic habits though manifestly within the Grallatorial order, I am disposed without at all changing their position immediately following Scolopacidae to elevate them to the rank of a family and regard them as the Natatorial representative in the order, a change which is indicated by calling them Phaleropidae. It is true that there are but three species in Gray's work, and they must be altogether very few, but this might serve as an objection to their being accounted a subfamily as much as a family. The number of forms found in a genus, subfamily, family, order or class is widely variable. We use those names to express our idea of the comparative importance of the characters or our perception of the relation of the particular form to others.

There will scarcely be a doubt that Ardeidae (Cranes, Herons, &c.)

occupy the first position among the families of Crallatores. Charadriadae (Plovers), will stand second. Ralliaae (Rails, water hens and Coots) come next. Scolopacidae (Snipes), follow, and Phaleropidae, as already explained, seem to me to complete the series, nor am I acquainted with any Grallatorial birds which do not fall within one or other of these families. I shall offer a few remarks on each of them in their order, endeavouring to determine the sub-families, and noticing what is most deserving of attention in respect to their habits and mutual relations as far as the necessary limits of this article will permit.

It is very difficult to give precise and clear definitions of groups of animals or plants, even when we plainly perceive the natural relationship, probably because there are various points of resemblance, some one of which fails in one example, another in another, leaving us none which holds in every member of the groups, though considering the whole structure, there are sufficient reasons for placing each in this position rather than any other. The consequence is, that we are obliged to distinguish each natural assemblage by all its well marked characters, and we must not be too rigid in expecting exact conformity to all of them in every individual case, though we must find a preponderance of the characteristics of the group, and expect to be able to assist our judgment by other relations between the particular object and known members of the group. This is the difficulty which interferes with the good working of our systematic tables, and which making extended knowledge and experience often requisite for ascertaining the objects of natural science, is apt to discourage beginners from a pursuit in other respects most interesting and delightful. We have probably at length reached a just view of the limits of the Order Grallatores the Wading birds, and can now see how certain characters ought to have prevented mistakes which prevailed for a time; but the fact that Cuvier was led by their long necks and legs to place the Ostrich and its allies, the Bustards, and even the Flamingo among the Waders, whilst lessening our discouragement at our own difficulties, will show what various considerations carefully weighed, and studied under every possible light, gradually lead even men of the most extensive knowledge and the greatest genius to the perception of truths, which when once established meet with ready acceptance, and only excite wonder at their ever having been doubted. Perhaps the difficulty of distinct definition in natural science is no where more felt than in the class Birds. I must, however, endeavour from the best authorities to characterize in the first place the five families of the waders already enumerated and placed in what I regard as their natural order. First come Ardeidae, the Herons, birds of the greatest size and power which this order affords and exceeded in this respect by very few in the whole class. They often feed on fish and small Amphibians or Reptiles, or even Mammals. These they snatch with their long and usually strong beaks out of water, or in marshy spots. The whole order tends to elongation of the beak, neck, legs and wings, the lower part of the femur as well as the tibia being naked, and the food being sucked up, extracted or snatched in a manner highly characteristic. *The Ardeidae have the bill longer than the head, thick, strong, usually compressed, rarely expanded, and more or less depressed. Feet tetradactylous, with the toes joined at the base or semi-palmate.* This character is often rendered more vague by the awkward necessity for including in it the Trumpeter, (Psophia) and the Caraima forming a small sub-family, which I am strongly persuaded that we ought to refer to the family among the Gallinaceous birds (Rasores), which represents the Grallatores. Without them the character applies to a considerable number of birds varying a good deal amongst themselves, and in their differences so clearly exhibiting the prevailing tendencies in analogy with the Orders, and the families under each, that they may properly constitute sub-families.

First we place Ciconinae the Storks, which have straight conical pointed bills, stout legs and feet, the membrane connecting the front toes very manifest, the hallux, or hind toe raised so as only to touch the ground, the covering of the legs and feet reticulated seales. They are known from the next subfamily by their greater size and strength and by a peculiar habit or port, more easily recognised than defined constituting the popular distinction between Storks and Herons. The genera of this subfamily admitted by Dr. G. Gray, and characterised chiefly by the peculiar shape and comparative size of the beak, are Dromas, Ciconia, Leptoptilus, Mycteria and Anastomus. These birds belong to India and Africa, a few visiting Europe in their migrations, and one being known in South America, but no example occuring in North America.

The next subfamily Ardeinae, embraces the Herons, night Herons, and Egrets, with which are commonly placed the Spoonbills, Boatbills, and Balaeniceps, but considering the importance of the form of the bill as expressing habits and the frequent connection of its width and depression with the natatorial type, it seems better to treat these genera as a separate sub family, the fifth in the series, and the genus Platalea, the Spoonbills, which may give it a name, connects well with Ibis which would thus stand near to it.

The Herons are widely diffused and several among them are familiar to us as natives of our Country. They are though often large, lighter birds with a longer and more flexible neck than the Storks, and remarkable for the long loose plumes of their crest necks and wing coverts, which, notwithstanding what may seem to us some disproportion in the parts of the body make many of them remarkably beautiful birds. The long slender toes with the hallux usually lengthened, and almost or entirely on the same plane with the other toes show the arboreal habits which characterise most of the species, and which justify the position in which I have placed them. Gray admits the genera Europyga, Ardea, Tigrisoma, Botarurus and Scopas, besides those which I refer to the subfamily Plataleinae. In Canada we have four or perhaps even five species. The certain ones are Ardea Herodias, A. exilis, Botaurus lentiginosus and Nycticorax naevius, if Ardea virescens occurs within our borders it offers a fifth example.

The next subfamily Gruinae, Cranes, consists of birds with shorter and more arched beaks, the hallux only touching the ground, shorter and stouter toes, with the nostrils, guarded behind by a membrane placed near the middle, in a deep groove which is not produced to the tips; the tertiary feathers of the wings long and drooping, and in some instances the birds having large crests, ear-tufts, or caruncles. Their characteristics show them to represent the Rasores in this family. There are three Genera, Grus, Anthropoides and Balearica easily distinguished by their beaks. I have here substituted Viellot's name for the second genus, for Scops given by Moehring much earlier and adopted by Gray, because that word being an ancient name for an owl is sometimes applied to a genus of that family and is too near to Scopus a genus of the preceding sub family. In such cases the law of priority must be sacrificed in order to avoid confusion. We have at least one Canadian species of Grus, G. Americana Linn. G. Canadensis is usually considered as a synonyme, but in a paper in this Journal (Vol IV. 266) Mr. Cottle, of Woodstock, a very high authority on such a subject, offers reasons for believing that there are really two species, and until some further evidence is produced, the question must be considered as doubtful. The Cranes are followed by the Ibises (Tantalinae) whose narrow elongated and arched beak strikingly expressive of a suctorial mode of feeding at once refers them to the fourth position among the divisions of the family, the character of the subfamily is taken from the form of the beak, approaching the Limosinae. The tip of the bill is obtuse, the nostrils are linear aud naked in a groove, the Hallux is long enough to be spread upon the ground, and strong. There are three Genera, Tantalus, Ibis and Geronticus, together containing under 30 species. North America can illustrate the genus Ibis, but none of these birds occur so far north as Canada.

There remains the subfamily Plataleinae to complete our sketch of the Ardeidae. The swelled or expanded, sometimes depressed beak, supplies the character and being a frequent accompaniment of the Natatorial or Fissirostral type is here assumed as marking the fifth or lowest subfamily. The known generic forms are three: Platalea the Spoonbill, of which there is a species in the Southern United States, as well as a well known European one and several others, Balaeniceps an extraordinary bird from the interior of Africa, and Cancroma found in South America. They are all Strange Anomalous forms, well distinguished generically, but kept together by the much expanded bill.

The second of the great families of Grallatores is Charadridæ, Plovers, and the very reason, it is probable, which induces other zoologists to place it first or last in the order, according as their series is descending or ascending, is what influences me to assign to it the second place— namely, that the peculiarities of the order are less strikingly impressed upon it, and it makes a certain approach towards the ordinary character of bird-life. Hence it is the expression of that peculiarity which belongs to birds in the whole vertebrate series, to the Insessores or Perchers as compared with the more deviative orders, and in each of those orders to the family which is least marked by the special characteristics. In an attempt to form a series this would of course lead to their being made the joining points with the higher birds. When we reject any general series, and express our sense of relation by analogous positions, it leads to an arrangement of the families in each order, which shows the one nearest to birds in general, always occupying the second position, whilst that which displays the highest development consistent with the type has the first assigned to it. Charadridae have the bill of moderate length seldom longer than the head, with the basal portion of the culmen usually depressed and weak, the apical part strong and swollen; the nostrils in a deep groove: Feet elongate with rather short toes, more or less connected at the base by membrane; hallux resting on the point only or none.

The sub-families seem to be, 1st, Oedicneminae, Thick-knees and Oyster-catchers, with the longest and strongest bills, and with their stout legs covered with reticulated scales, the hallux entirely wanting.

2. Chionidinae, Sheath-bills, placed by some Zoologists among rasorial birds, but seemingly belonging to this group, remarkable for the short, strong, somewhat arched bill, compressed at the sides and its basal portion enclosed in a bony sheath concealing the nostrils. The gonys is angulated, the tarsi short and stout, the hallux present, but elevated so that only its tip touches the ground, the front toes with the connecting membrane well developed.

3. Charadrinae, Plovers, with the bill somewhat long and slender vaulted at the tip with the sides grooved and compressed, the hallux either absent or very small and elevated so as scarcely to touch the ground.

4th. Cursorinae, Coursers with the slender bill slightly arched towards the tip, the nostrils placed in a subtriangular membranous groove, the legs very long, scutellated before and behind, the hallux absent.

5th. Cinclinae, Turnstones and Pratincoles have the bill rather short and straight, generally vaulted towards the apex, the wings long and pointed, the tail rather short, sometimes forked, the hallux present, slender, touching the ground.

Dr. Gray makes six subfamilies of Charadridae though Chionidinae are excluded, being referred by him to Rasores. The combinations here proposed seem to me natural, but I am much in doubt as to the true order of the subfamilies, the best characters for determining the analogical tendencies appearing to me to be in this case unusually mixed.

Our Canadian examples of the family belong chiefly to Charadrinae. They are Squatarola Helvetica, the black-bellied plover, Charadrius vociferus, the Kildeer plover, Charadrius semipalmatus, the ring plover, Charadrius Virginicus, the American Golden plover. Oedicneminae may be represented by Haematopus palliatus, the American oyster catcher, as Cinclinae is by Cinclus melanocephalos the Am. Turnstone. The third Grallatorial family, manifestly representing the Rasores or Gallinaceous birds, is Rallidae the Rails and whilst its place in the order is certain and easily determined there is no family of birds which more beautifully illustrates in its subfamilies the plan of classification which I adopt. We have the Screamers (Palamedeinae) with their size, strength, and peculiar armature, giving the idea of power, the Rails, Rallinae, active and lively, approaching most nearly to the figure and appearance of Insessorial birds, the Water hens (Gallinulinae) whose popular name expresses the universal appreciation of their analogy with Rasores in a more special sense than the rest of the family, the Jacanas (Parrinae) with their long legs, enormous toes, and singular bill, peculiarly Grallatorial, and the Coots (Fulicinae) strongly resembling the Water hens, but their much shorter legs, and toes connected at the base and lobated at their sides, plainly showing the Natatorial tendency. The general character of the family may be thus expressed: *Feet tetradactylous, with elongate toes, the hallux being generally large and extended on the ground. Tarsi generally with transverse scutellae anteriorly. Wings moderate or short, usually rounded. Breast compressed with a narrow sternum.*

Palamedeinae are peculiar to tropical South America. Parrinae, inhabit warm climates where they walk on floating leaves in search of their food, their very long toes supporting them by extending the surface on which they press, much on the principle of our snow shoes. Rails, Water-hens and Coots are widely distributed, especially in more temperate and cooler regions, and supply the examples of the family found among our Canadian birds. There are four species of the subfamily Rallinae, Rallus Virginianus, R. crepitans, R. elegans, and Ortygometra Carolina; one of the subfamily Gallinulinae, Gallinula galeata; and one of Fulicinae, Fulica Americana Gmel.

We now come to the fourth family, Scolopacidae, the Snipes, which among Grallatorial birds most especially display the semiaquatic habits and the suctorial or extractive mode of securing food which are characteristic of the type, they are, therefore, properly placed in that position among the Grallatorial families, which indicates the representation of this particular structural tendency. They may be defined as follows: *bill mostly elongate, slender, soft; nostrils basal longitudinal, covered by a membrane in a groove of the bill; wings long, pointed, the first feather generally longest; toes long, slender, hallux short, much elevated, touching the ground, sometimes wanting.*

Dr G. Gray makes six subfamilies of these birds, but he includes among them Phaleropodinae, which, on account of their peculiar feet and specially aquatic habits, I think better regarded as the fifth or Natatorial family in the order. The remaining five subfamilies are probably best placed in the following order: 1. Totaninae, Long-shanks; 2. Tringinae, Sandpipers; 3. Scolopacinae, Snipes and Woodcocks; 4. Limosinae, god-wits; 5. Recurvirostrinae Avocets. In the first of these subfamilies there are five species of Totanus and two of Tringoides, belonging to North America and very possibly to be found in Canada. Of the Sandpipers (Tringinae) thirteen species belonging to four genera are North American, of which probably not less than ten are found in Canada. Of the Snipes and Woodcocks (Scolopacinae) six North American species are enumerated by Gray, ranking in three genera. I have good authority for three of these being Canadian. Of Limosinae three species of Numenius and two of Limosa are North American, of which several certainly occur in Canada; one of each genus is in Mr. McIlwraith's Hamilton list. The small subfamily of Recurvirostrinae gives us one Recurvirostra, the American Avocet, and one Himantopus.

I need add nothing to what I have already said of the family Phaleropodidae, which, though very small, se^ms the true natatorial representative among Grallatores, and one of the natural links between the two o^ders. All the three species of Phaleropus recognised by Gray are North American, and one of them is often seen in Canada.

The purpose of this paper was to determine the true limits of the Grallatorial Order, and the proper series and mutual relations of its families and sub-families. I will not, however, conclude without a few words on its characters, especially those which, whilst only occasionally met with, seem to be always connected with this kind of structure, and therefore, whether occurring in true Grallatores or in Grallatorial representatives, in other orders or families, will, in doubtful cases, assist the observer, by furnishing pleasing indications of analogies, which are real, but not obvious to every eye. No Grallatorial character is more striking and universal than elongation of the bill, neck and legs; it is indeed one of the commonest marks of the representation of this structure in other orders and families, so that where the principle of the existence of a certain set of tendencies repeating themselves under each distinct type, and thus producing relations of analogy among forms otherwise remote, is not well understood, confusion always arises between the true members of a group and its representatives or analogues in other groups. It was thus that Gypogeranus, the Struthionidae and Phœnicopterus have come to be ranked among Grallatores, being really the representatives of this order each in its own group. It will occur to every one that it is not only among birds that the Suctorial or lower nutritive type is marked by elongation of the body, and especially of the head, neck or snout. Where this elongation existing in any considerable degree is joined with semi-aquatic habits, the food being extracted from water or mud, no doubt remains as to the genuineness of the grallatorial character. An occasional but very remarkable characteristic of this particular tendency in birds, is the pencilled tongue for sucking in the juices of flowers. I do not know of this occurring in any true Wader, but it is found in several families representing the lower nutritive type, and as far as I have observed in no other case. Thus the Ramphastidae probably constitute the family representing this position among Scansores, and have a feathered tongue. The same, or some similar anomalous development of the tongue is found in the sub-family of Parrots, which takes the same place in its own series, and it is again remarked in Meliphagidae the family of Tenuirostres which most specially exhibits the suctorial character of the Order.

It is difficult to explain the use of the bend of the bill in Recurvirostrinae, and from the situation of that sub-family a question might be raised, whether the peculiarity is grallatorial or natatorial, but it occurs again in two species of Humming birds belonging to the specially tenuirostral sub-family, and Swainson brings into comparison with Avocetta the gliriform quadruped Nasua, the recurved snout of the latter exhibiting an almost ludicrous resemblance to the former which is the more important, because the Glires are the Tenuirostres of quadrupeds, and the analogy suggested is in every way proved to be a real one.

Another character apparently connected with the suctorial type, but the connection of which with its other characteristics is quite inexplicable, is the spur on the wing, this is found in several Charadridae and Rallidae, and elsewhere always in Grallatorial representatives in other orders and families, with no exception that occurs to my recollection, excepting the form of Geese, called by some Zoologists Plectrophorinae. I had concluded from various reasons, that this is not a true sub-family of the great and important family Anatidae. I believe these sub-families to be, Fuligulinae, marine ducks; Anatinae, fresh water ducks; Anserinae, geese and swans; Phaenicopterinae, Flamingoes; and Merginae, Goosanders. Some of these however, are large and have striking structural variations that would admit of further representative subdivision, and if any thing of this kind were attempted in the case of Anserinae, the long beak and toes, as well as the spurs, would without question place Plectrophoreae in the fourth position representing the Grallatores. A probable order might be 1 Cygneae, 2nd, Bernicleae, 3rd, Ansereae, 4th, Plectrophoreae, 5th, Nettapeae. It may thus appear probable that even in this instance the spurs on the wing are connected with a grallatorial position, and should always point our attention in that direction. Its occurrence in the grallatorial representative among Raptorial birds, and the use said to be made of it as a weapon of offence, are very interesting facts, but further observations are required. There are certainly many instances in which peculiarities of structure, which are at first judged to belong to a species are found to prevail in small groups occurring in different parts of a general system, all which, however important their differences, have a mutual relation of which this peculiarity is one of the signs, and to the intelligent naturalist often a very valuable indication.

I need hardly say, in conclusion, that in the order Insessores, which is equivalent in extent and importance to the whole five other orders of birds, the Suborder Tenuirostres represents the order Grallatores, displaying throughout all its families the same arrangements for the suctorial or extractive method of obtaining food under modifications, which again distinctly represent the five Suborders of Insessores, and consequently also the five orders of other birds. If we look further and inquire after the corresponding groups in other parts of the animal kingdom many interesting relations are brought under our notice, of which I shall refer to a very few. Among the Gyrencephalous Mammals, a great division, whose separation from the lower mammalia seems to me strikingly natural, we have the Carnivora manifesting power and ferocity; the Qudrumana activity and arboreal habits; the Ruminantia are the analogues of Rasorial or Gallinaceous birds; the Pachydermata, a truly natural assemblage detected by the sagacity of Cuvier, and the attempts to divide which otherwise than into the families composing it, has only obscured the subject, represent the Grallatores, as the Cetacea obviously do the Natatores. The protruded and highly sensitive snout, used for discriminating the food in the ground or amidst dirt, and the semiaquatic habits, some actually frequenting water, others delighting in wet mire, show the general tendency in its application to the higher mammalian structure. Among the Lissencephala the claviculated Rodentia are in many respects like Pachydermata on a small scale, and correspond with them much as the Tenuirostral birds do with the Grallatores, nor is there much difficulty in finding the analogous group among the Lyencephala, the lowest great division of Mammals. We may also note that as Ruminantia correspond with Rasorial birds so the family Struthionidae, among the latter, corresponds with Camelidae among the former, this real analogy in position and relations justifying the the popular comparison of the Ostrich with the Camel. If again we look to the highest order of Gyrencephala the Carnivora, whilst the first place is given to the Felidae, and the Ursidae may probably claim the second. The social habits and tendency to carrion feeding seem to fix the Canidae in the third position, corresponding with Vulturidae among Raptorial birds, the blood-sucking, long and flexible-bodied Mustelidae, which only admit secondary divisions according to the structure of their feet, certainly represent in this order the lower nutritive type, like the Grallatorial birds—and thus lead us on to the Natatorial seals. The worm-like figure of the Ophidians among Reptilia and their correspondent groups among Amphibia, repeated in the Eel-like forms of fishes, remind us that these animals in their several classes represent the great class Annulata in the Articulate subkingdom, whilst it may probably appear that each class of this subkingdom has a specially suctorial order. I might point to the flies in a higher, the Bugs in a lower series of Insecta, and very strikingly to the Icthyopthira among the primary divisions of Crustacea. The same thing might be illustrated in the Molluscous and Radiate subkingdoms, but that I am wandering too far from my immediate subject, and I have recently pointed out the special suctorial type even among the Protozoa. It is by considerations such as have now engaged us, as it appears to me, that we rise above the elementary and technical in Natural Science to the perception of infinitely varied relations, opening to us a magnificent general system. Our insulated observations are connected and harmonised, order and beauty open more and more to our delighted view, and whilst recognising every where unity of plan and perfection of design, the raptured thought rises from the wonders of creation to the adoring contemplation of the God of Nature, infinite in power, Supreme in Wisdom and Benevolence.

ON THE ABORTIVE TREATMENT OF CHOLERA, AND THE SPECIAL TREATMENT OF ITS SEVERAL STAGES.

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At the present time when the great pestilence, *par excellence* of modern times may be daily expected among us, the ports of Halifax and New York having been already visited by it; the subject of cholera in any point of view must possess great interest to all intelligent minds, but to Medical men who may be called upon to use their best endeavours to withstand the inroads of this great destroyer, the subject of treatment must be especially interesting.

Those of us who have in former epidemics been placed in positions of direct contact with cholera, have felt how impotent were our efforts in many cases to save the victim or relieve the sufferer, and the conviction that not unfrequently mistakes and want of preparation on the part of both physician and patient may have led to the loss of valuable lives, induces me to bring the subject before the Section, that the discussion I hope to provoke may assist us in forming an opinion as to the rational treatment of cholera.

The literature of the subject is "*vast and perplexing.*" The most varied and contradictory opinions have been formed as to the nature of cholera, and still more numerous and conflicting are the modes of treatment recommended. But the great bulk of evidence thus brought before us is surely capable of being sifted, and if we can separate some grain from the chaff a little good will be done.

I assume that cholera depends upon a poison, communicated in many instances from man to man, by contagion, it may be frequently, or more generally, by what are called epidemic influences, but it is foreign to the object of this paper to advocate the views of either the contagionists or the non-contagionists. I only allude to the theoretical, that I may better approach the practical. Taking it for granted that the poison of cholera, like that of other zymotic diseases when received into the human system under circumstances favourable to its developement, goes on to reproduce itself, and become capable of affecting other similarly placed bodies, and so on *ad infinitum*; I would argue that like other diseases of its class it has a period of incubation more or less prolonged; a period in which, after the reception of the poison, into a system more or less suitable for its developement, catalytic changes are progressing; changes which will, unless arrested, end in confirmed cholera, whilst yet the more usually recognized features of the disease are in complete abeyance.

It is well known that a premonitory stage is very generally recognized, and is spoken of as the stage of *cholerine*, of *choleraic diarrhœa* or the premonitory diarrhœa. The writer believes that in temperate climes, and in the European race this stage of cholerine is very generally present, though not constantly so is very certain; yet among the Asiatic races it is perhaps more frequently absent, and in the latter it is common for a victim to fall down suddenly with the collapse of cholera, the premonitory stages having passed by without notice.

In our own country we frequently find that a premonitory stage has passed by unnoticed by the patient, or if feelings of illness or *malaise* have been present, their connection with cholera has been repudiated. This is especially manifest when there is no diarrhœa present, nor any uneasiness referrible to the abdomen. Under such circumstances even intelligent people deny that there is anything wrong with them, although, on careful examination, it may be found that the tone of the system is manifestly lowered. The poison is working, though not yet very manifest.

I would then divide the period between the reception of the poison and its developement into what may be called the stage of *invasion*, (i. e. the stage preceeding collapse) into two grades, the first of incubation, and the second of premonition, the latter being a condition usually recognized at any rate by the physician, but the former usually being overlooked. Nevertheless its existence may frequently be detected, and as it may proceed to the period of *invasion*, without the occurrence of usual premonitory diarrhœa, attention to the symptoms that may denote it, is of great importance. An acute observer in the East Indies observes that:—

"The premonitory stage of Asiatic cholera is characterized by a very peculiar appearance of the person about to be affected. The countenance is said to wear the expression seen immediately before the accession of the cold stage of intermittent fever, but I think it is more like that of a person who has some vague, undefined, central impression of the bowels being about to move. He seems involuntarily to wish to be quiet, though he has no sick feeling, and does not complain.

"When cholera is known to be at hand, there cannot be an excuse for neglecting to attend to this peculiar warning, and not discerning its significance."

"The powers of life appear, indeed, often to be almost annihilated immediately after this premonitory stage, and sometimes even before the state has had time to be fairly developed, and deafness and weakness of the voice may be remarked even from the first appearance of perturbation in the countenance."

Dr. Poznanski, in a communication to the Academy of Sciences, in 1857, makes the following propositions:—

"1. That, during the prevalence of cholera, it frequently happens that the pulse is extremely low, and reduced to 45, or even 42, in persons apparently in perfect health.

"2. That this symptom is unaccompanied by any other denoting a morbid state.

"3. That, when the pulse is low, the blood becomes dark and viscous; while, in persons whose pulse is in a normal state during the epidemic, the blood is perfectly healthy.

"4. The cholera only attacks those that have previously experienced a diminution in their pulse.

"5. That this diminution, which often occurs weeks before the regular attack, may be considered a pathognomonic symptom of the approach of cholera.

"6. That those who have experienced the diminution in question had always escaped the disease whenever they have followed a regimen calculated to accelerate the circulation.

"7. That the falling-off of the pulse and, therefore, the predisposition to the disease, are, in general, proportional to the want of energy in the circulation of the blood, and to the excess of atmospheric pressure.

"8. That this diminution of the pulse does not occur in healthy subjects, when the epidemic has ceased."

In reference to these propositions, it may be observed that, if the 3rd one is true, it cannot be correct to say that a diminution of the pulse is "unaccompanied by any other symptom denoting a morbid state," for the blood changes here noticed must necessarily be attended by other phenomena, which, though probably not obvious to a superficial observer, would be discoverable to careful enquiry.

Cases of confirmed cholera have been known to occur in which there were pre-existing debility, languor, lassitude, and general malaise, without any positive sickness, or any diarrhœa, or other symptom referrible to the bowels.

The attention of the writer is the more drawn to Dr. Poznanski's propositions, in respect to the state of the pulse in incipient cholera, from a case witnessed within the last three years. A patient who was seen almost daily by the writer, had occasion to visit some family relatives, at a considerable distance from his home, during hot weather, and whilst they were suffering from a malignant form of an eruptive fever. The gentleman in question found the air of the house so unpleasant that he rose in the night and spent the remainder of it in the open air. Returning home, he felt so exceedingly weak that he had to maintain the recumbent position for many days, without any obvious symptoms more than a pulse depressed to 36 or 40, a tendency to syncope on getting up, and an eruption of about six spots of a measles character on the chest. Under the use of brandy, quinine, and animal broths, he slowly convalesced. Some of the family he had been visiting had died after about 24 hours illness of what was termed malignant measles. The patient whose case is now related had previously had measles in its usual form.

Dr. Bell, of Philadelphia, says of a patient in the first stage of cholera, that "His countenance is sharp and dark. He knows not of this symptom, and it is only recognizable to the eye of experience." Physicians have occasionally observed it in persons well-known to them, during the period preceding an attack, and have noticed, in connection with it, that the subjects were particularly irritable on being taxed with illness, and refused to submit to treatment. In many cases, a fatal result follows such obstinacy. A case was related to the writer, which occurred in this city, in the epidemic of 1849, where the patient had some undefinable feeling of illness, but without diarrhœa, for one day; on retiring to rest, at night, he took a glass of punch, and, falling asleep, was wakened, in the morning, by cramps drawing up his legs and flexing his thighs strongly on the abdomen. His voice was nearly lost, and collapse, with all its symptoms, was actually on him. With prompt treatment, he recovered, and is still living. A distinguished writer on cholera states that collapse has even come on before any evacuation by stool had taken place.

Very lately, M. DeWouves has published a memoir, in which he states that albuminuria is present, in the urine of patients, some days before cholera sets in: this symptom serving as a means of diagnosis between this disease and common diarrhœa. Observations on this subject ought to be carefully made and recorded.

Without going more minutely into details, it may be conceded that in cholera, as in other zymotic diseases, the period which, in the latter, is called the stage of incubation, may present phenomena varying in different persons, races, climates, and epidemics.

Believing that much more can be done in cholera, in the way of early and abortive treatment, than is generally attained, the writer would suggest that, where any condition of things is recognized, during the approach or actual existence of the epidemic, as may be indicated by perturbation of countenance; some headache; ringing of ears; dulness of hearing; slight giddiness; weakness of voice; diminution of pulse, or any similar derangement or indication of the lessening of vital power, with or without the diarrhœa or nausea so usually present, that an attack of cholera be apprehended, unless other causes of disturbance can be distinctly recognized. This consideration is much enforced by the circumstance that, in many places, an outbreak of cholera displaces other diseases than those allied to itself; so that *any indisposition may be the precursor of, and be merged in, the prevailing epidemic.*

So far as these premonitory symptoms only are concerned, we are not justified in pronouncing any individual case, one of cholera, and before its outbreak, and even during its prevalence, many may be inclined to doubt the actual connection in every case between the causes of confirmed cholera and the cases of minor indisposition that are so prevalent at the time, but it seems to the writer that as some premonition of an attack is so very generally present, it would be exceedingly unwise to relax in vigilance, but on the contrary it becomes a duty to endeavour by every means in our power to preserve the community, or such portion of it as may be in our charge, unharmed from the visitation. Some have contended that the diarrhœa that so frequently precedes actual cholera, is neither part nor parcel of disease; for that where it subsides, cholera may set in; that where it continues or recurs, cholera does not necessarily follow; and, consequently, it is unphilosophical to regard the one as the forerunner of the other.

It is desirable to set at rest as many of the points of dispute in reference to this question as we can, so soon as observation and experience give us the necessary data. If every practitioner would keep a record of his cases and tabulate them, valuable information could be afforded on this and kindred subjects.

The attention of the profession in this city has been already directed to the subject of the means of prevention or prophylaxy, and the excellent memorandum of the Central Board of Health affords most valuable information and suggestions to physicians, and the public alike; yet a great deal more may be done by the timely counsels of Medical men to their patients and the circles in which they move, as the influence of each one is more manifest there than elsewhere. In this connection it may not be amiss to call to mind the urgent necessity for Medical men and nurses to maintain perfect cleanliness of hands, and person generally, having water and towels in readiness for use after visiting every sick room, and enforcing the propriety of domestics and others not handling food without washing the hands. Dr. Beck recommended that all provisions be carefully washed on being brought into the house, or else exposed to a temperature of 212°.

In reference to what is termed abortive treatment, it may be premised that efforts in this direction have often met with success. A notable instance of it occurred Newcastle, on the outbreak of cholera there in 1853. The commanding and medical officers in charge of the garrison there, (comprising 14 officers, 391 men, 44 women and 70 children,) after consultation devised certain measures of a sanitary nature such as are universally recommended, but a special feature in their plan was to have the water closets watched by the non-commissioned officers, and whenever a man was discovered to visit them more than once a day he was placed under medical treatment.

In addition every man, woman, and child was inspected by a medical officer at least once, and in the case of those who lodged outside the barracks, in affected districts, twice a day. By this rigid system diarrhœa was discovered and treated without a single life being lost, the cases being more numerous than the whole strength of the force, while of the population surrounding, the deaths amounted to 1500.

For full details in this notable instance reference can be had to the Report of a Commission appointed to inquire into the circumstances connected with the outbreak and published by the Home Government.

In addressing Medical men on this subject it is scarcely necessary to do more than allude to the principles that should regulate the mode of procedure in treating abortively the incipient stages of cholera, as due reflection and study of the peculiarities of each class of cases will lead to proper medication and regimen. The office of the intelligent physician is surely not to be discharged by prescribing one routine of treatment for all cases in any one stage, however unlike the individual circumstances of each; yet of all the diseases that "flesh is heir to," of none have so many unreasoning plans of treatment been proposed and practised as is the case with respect to cholera.

An anonymous writer who had seen the disease in the East Indies, writing in 1848, recommended as useful in warding off an attack a combination of Quinine, 6 grs., Calomel, 4 grs., Opium, 2 grs., followed by a glass of brandy and hot water. This dose he had been in the habit of giving in all cases of early stages. But, it may be observed, supposing that these four remedies are the ones selected to fulfil recognized indications, one or more of which may be present in any given case, would it not be much better to prescribe those only which are really needed, and not to administer a mere nostrum.

While there is neither pain nor abdominal disturbance the opium can not be called for in full doses, and so with other remedies, which are only to be given when indications demand them.

Debility, diarrhœa, depressed circulation, disturbed sensation, require treatment when severally present, and the subject of any one of them ought to seek comparative quiet of mind and body as well as appropriate medication.

As it has been assumed that in incipient cholera a poison is present in the system, a poison of the zymotic or catalytic class, the question of endeavouring to eliminate it by emesis or by purgation has often been raised and a suitable treatment devised, while latterly it has been proposed to antagonise the catalytic action of the poison in the blood, by exhibiting remedies of a class having power in certain circumstances, of arresting catalytic action.

In the premonitory stage where diarrhœa is present, it is conceived that nature may be seeking an outlet for the poison, but as experience teaches us that such diarrhœa, if unchecked, will terminate in collapse, no one would allow it to proceed unrelieved.

Attempts to assist such natural efforts by purgatives have not resulted favourably, and remedies of that class, from Croton Oil, down, are rarely now proposed or used. Calomel, however, a purgative to some extent, but more, it may be asserted as an excitant of secretions often suspended, has numerous advocates. Of its powerlessness in collapse to produce any immediate effect there is reason to be convinced, and Dr. Headland's statements on this subject, in his work on the action of remedies in the system would seem to be conclusive. Yet in the early stages where the depurating organs are not acting sufficiently, mercury in some of its forms may be found useful. The stage of reaction may be modified by the active presence of mercury in the system, for the early appearance of urine and biliary stools is an exceedingly good augury.

The eliminative action of emetics is more generally approved of. Although emetic tartar has its advocates, its depressing effects are to be feared; and, therefore, the exhibition of milder evacuants is more to be recommended. Some writers speak favourably of ipecacuanha, in full doses; and, many more, of the domestic emetic of mustard, with or without the addition of table salt. Twenty-five grains of ipecacuanha, in powder, was the usual dose of Mr. Greenwood, and others; and their mode of treatment was found to be very successful. In cases where nausea is present, the action of a mild emetic would appear to fulfil a natural indication. After its operation, the patient should keep his bed, and be subject to carefully regulated diet, until reaction has passed over, and convalescence is fairly established.

In those cases of languor and debility, with few or none of the usual concomitants of the preliminary stage present, tonics and rest, with good digestible food, and all the usually recommended hygienic accessories, will be very desirable, as they would be at any season, but, in cholera times, it may be well to ascertain the value of medicines that may be called anticatalytics. Medicines of this class have the power of arresting fermentive changes in organic solutions; *par exemple,* that of vinous fermentation in the juices of fruits: hence it is concluded that they may be a vast benefit in diseases of a zymotic character. Such remedies are from inorganic sources, and include some of the salts of Iron and Manganese; several compounds of Chlorine, and of Sulphur in its lesser state of oxidation.

The Tincture of the Sesquichloride of Iron is, latterly, in extensive use in erysipelas; and is, certainly, in combination with Quinine, a very useful preparation. Its action seems to depend mainly on its power of modifying the blood crasis known to exist in that disease. and its efficacy in arresting the development of a crop of boils is known in the profession.

The same preparation has been used in cholera as long ago as 1848, but the object in prescribing it was with a view to its styptic effect: to retard the excessive secretion of approaching collapse.

Subsequently, the per-nitrate of iron (the persesquinitrate of Kerr) being introduced as a remedy in diarrhœa, was recommended, by some, in cholera, as likely to be useful. It does not appear that any other preparation than the tincture of the sesquichloride was ever used largely; but those who have used it extol it very highly. From its tonic and antiseptic powers, and its being easily obtained, it is likely to prove highly beneficial in those early stages of disease where an anticatalytic would be indicated. In cases where there is debility more or less marked, this remedy alone, or combined with Quinine, would appear entitled to favour.

Another remedy of the class of anticatalytics is the Hyposulphite of Soda. In Sarcina ventriculi, its efficacy in preventing the usual fermentive process is undoubted; and, by analogy, it might be used in the incipient stage of cholera; but it does not appear to have been introduced in this way. Although the alkaline permanganates, which are said to possess the power of antagonising organic poisons, have been recommended in cases of poisoning by Strychnia, Veratica, Hydrocyanic acid, and others of that class, it does not appear that they have been used in zymotic diseases, other than typhoid fever and scarlatina, and little is known of their effects, beneficial or otherwise.

The bisulphite of soda has been used, in medicine, as an anticatalytic, by Professor Polli, of Milan, and Dr. Mapother, Health Officer of Dublin; and Dr. DeRicci, of the latter city, relates four cases of catalytic diseases, as he prefers to call them, rather than zymotic, in which the Bisulphite appears to have accomplished what was expected of it by the original proposer, Prof. Polli. In a case of infection from an animal poison, DeRicci gave to a lady one scruple of the Bisulphite, in infusion of Quassia, with tincture of bitter orange-peel, and a little Battley's solution. This dose, repeated every hour at first, was given less frequently afterwards. In other cases—two of them being severe ones of measles—the same salt was depended on, and rapid recovery followed.

In incipient cholera, a recipe containing the Bisulphite in scruple doses, with a bitter tincture, and some opiate, where diarrhœa may exist, would, probably, be satisfactory treatment—especially in those cases where the individual cannot leave an infected district. Dr. De-

Ricci's article on this subject may be seen in Braithwaite's Retrospect, Part 50; and in Dublin Quarterly Journal for August, 1864.

Of chlorine preparations the hypochlorite of Soda (Labarraque's Solution) has been recommended but does not appear to have been much used internally. A watery solution of chlorine, the aqua chlorinii of the Edinburgh pharmacopœia was given by one practitioner in doses of one dram, with a little sulphate of soda in nearly one hundred cases of choleraic diarrhœa, with favourable results in all but two, who were in collapse before the remedy was applied.

In considering the abortive treatment of cholera, it is well to bear in mind that when the disease breaks out in any place people have an instinctive desire to escape fram the infected or tainted district, and in certain races of man, this amounts to an irresistible impulse. Thus during the late epidemic in Barcelona, 40,000 persons are said to have left that city. In many places where such an exodus has taken place, the panic and fatigue of travelling, with the abandonment of the comforts of home, and the accessible conveniences of a town or city have concurred in rendering such a stampede most disastrous. The panic-stricken take the taint with them, and fatigue and fright give it potency. Whilst we can recommend the quiet and orderly removal to safe localities of those whom neither duty calls nor narrow means compel to stay in their usual places of abode, it must not be forgotten that even physicians, nurses and others, brought close in contact with the dreaded pestilence, escape as well as others.

Unless the hygienic condition of a locality or house is not only bad, but at the time unimproveable, it need not be deserted or abandoned.

There are some individuals, however, whose removal from a cholera district is very desirable. Such are persons with disorder of the excretory organs; whose blood is not ordinarily depurated; those with disease of the mucous membrane of the intestine, or with liver or kidney disease.

Certain districts of country, elevated, naturally well drained, sparsely peopled, and possessing abundant and pure water supply, are well known to be healthy localities, and safe places of resort, although persons from a tainted district may remove thither, and die from the pestilence. But in such instances it is not usual for the disease to attack any but the specially predisposed, and the poison is soon lost where there is little to lend intensity to it.

But even in towns and cities there appear to be places that are comparatively safe, though statistics are wanting in regard to them. It has long been said that the atmosphere of tanneries is prophylactic against the disease, and the same is said of the vicinity of gas-works. In the latter case the evolution of carbolic acid in a gaseous form from the tarry products of the distillation of coal, may account for the immunity enjoyed, *carbolic acid being a very effectual disinfectant*, but in the former instance the reason is not apparent. Very recently, it is urged, by continental professors, that carbolic acid and its preparations are destructive to the cholera-poison, while chlorine compounds are not so, but are, nevertheless, useful in their place, from their power of removing offensive odours.

It may not be amiss to observe that, in the same vicinity, elevated spots are more safe than low ones, and upper apartments of the same house than the lower rooms. These considerations should have their influence in relation to the prophylaxy and treatment of the disease.

In the same connection it may be observed that when an outbreak occurs a "privy atmosphere" is especially noxious. Every thing that can be done to prevent and neutralize emanations from human *excreta*, both in-doors and out, should be attended to, and the ordering of the domestic use of safe disinfectants, by practitioners, in the houses of their patients, whether disease be present or not, is a great means to this end.

In houses where the disease exists every excretion, and all soiled clothes, should be at once disposed of; the former be received into vessels containing some disinfectant and then buried, and the latter at once soused in water containing some carbolic acid or its preparations, or some permanganate of potass, as in the cholera disinfectant made in this city, or its kindred preparation, Condy's red fluid.

The latrines used by the healthy must not be contaminated by the discharges from the sick, and the nurses and attendants must be fully instructed as to the proper modes of disposing of all excreta and soiled clothing.

In approaching the subject of the treatment of the more decided stages of cholera, I shall adopt the usual mode, and speak of them as the *period* of invasion or *confirmed cholera*, *the blue or cold stage*, or *stage of collapse*, and the stage of *reaction* or *consumptive fever*.

The *stage of invasion* usually occurs in the night or early morning; its more usual symptoms are well known, nausea, vomiting, emptying of the intestinal tube, indescribable faintness or sinking, peculiar rise, watery-stools following the more fœcal excretion, cramps of voluntary muscles, chiefly of the clonic or permanent rind, pulse at first small, weak and accelerated, becoming rapidly less perceptible, and finally lost in the extremities, while there is yet strong pulsation of the cœliac axis and abdominal aorta, coldness of the surface supervenes, the bronzed flush of countenance and skin giving place to it, and a clammy cold sweat, often very profuse, is every where present. This state of things, if not speedily arrested, ushers in the stage of collapse.

Collapse may come on without any evacuation by the stool taking place, though sometimes in such cases, the intestinal tube is filled with the secretions peculiar to cholera. Cramps of voluntary muscles may likewise not occur, and it is considered a sign of peculiar malignancy when either of these is absent. During the cold stage the voice is changed, the lips, the nails and skin become blue or livid, the surface collapsed, the skin corrugated and sodden in appearance, and insensible to the action of chemical agents; the patient cold to the touch and pulseless, yet complaining of heat; demanding cold drinks and rejecting them by vomiting, or at any rate not absorbing the liquid by the stomach, and assuming a strikingly cadaverous aspect. No symptom is so invariably present to the full extent as sinking of the circulation, and no morbid post mortem phenomenon more constant than the alteration of the blood in colour and consistence; the darkness and thickness being extreme, and observable in direct ratio with the duration of the disease and the quantity of gastro-intestinal discharge. When death occurs in this stage, the venous system, the right side of the heart and the pulmonary artery with its branches are found loaded with dark thick blood, while the lungs are comparatively bloodless, and the systemic arteries quite empty. This would indicate that either from inspissation of the blood, from spasm of the pulmonary arterial vessels, or from both these causes combined, the blood does not reach the air-cells to get rid of its carbon and absorb the due amount of oxygen. In natives of India where collapse often happens, without intestinal discharges taking place, the blood is found to be dark likewise.

The experiments of Dr. John Davy and others, have demonstrated that the respired air of cholera patients, contains a much smaller proportion of carbon than is sufficient for the proper purification of the blood; respiration is apparently going on well, it is the vital changes that are not performed, the exchange of carbonic acid gas for oxygen not being effected. Viewing this fact in the light of the discovery that ozone, the more active form of oxygen, is absent from the atmosphere in cholera times, we may ask if in any degree, and how far these facts are related, and whether especially they stand as cause and effect. At any rate it may be useful to set on foot some plan for the developement of ozone in cholera sheds, and in the rooms of patients threatened with the severe stages of the disease. It has often been advanced that the want of oxygen in the blood is the cause of cholera, but if this be not conceded, we must acknowledge that, the effect of such want must be to exaggerate vital depression. The *secretion of bile and urine, both of which require oxygen for their formation,* is arrested in collapse, and their reappearance is a proof of oxidization being re-established, and is consequently a most favourable sign in the following stage.

As fever follows the cold stage of ague, where life is not lost already, so the blue stage of cholera is followed by one of *reaction* or *consecutive fever,* ushered in usually by returning warmth and circulation, injected conjunctivæ, restlessness, and symptoms more or less severe of cerebro-meningeal congestion or inflammation. Yet some cases are more insidiously fatal in this stage, the patient settling down into a sleepy state, which while apparently refreshing and salutary, ends in coma, or death.

The modes of death in cholera are not uniformly identical. When it occurs with little or no gastro intestinal discharge, and before the reactive stage has come on it is probably due chiefly to spasm of the pulmonary artierial system, actively preventing the process of blood aeration. This form, a malignant one, should be met by chloroform, inhalation to the point of relaxing the spasm, but not carried so far as to prevent the inhalation of sufficient air to effect the necessary blood changes.

Where the blood has become highly inspissated from loss of serum, and this thickening of the vital fluid is considered to be the cause of the obstruction, any means that will even partially restore its wonted fluidity, is certainly indicated. In this way, the free exhibition of liquids by the mouth, while grateful to the patient may prove very useful.

The patient's demand for cold water is very great, and it is cruel to deny it. If vomiting is severe, small lumps of ice given frequently, and swallowed, may be better than copious drinks for allaying it, but if ice is not at hand the patient should have cold water freely allowed him when confirmed cholera has supervened: for irrespective of the comfort given, the power of absorption by tne veins of the stomach, may not be altogether lost.

Stevens' treatment consisted in giving previous to and during collapse, large quantities of water with saline ingredients to replace those lost in the dejections. The injection of liquids into the veins to replace directly the lost serum has been often adopted, and has sometimes appeared successful. Some writers urge that its usefulness depends on the degree of heat of the injected liquid, and its consequent power of relaxing the spasm of the pulmonary circulation, and there appears some ground for the opinion, although it may be equally due to the replacing of some of the lost watery parts of the blood.

Dr. George Johnson argues in favonr of the former view, and it does appear that if the inspissation of the blood were the sole cause of the obstruction, restoration from collapse should be almost impossible, except where venous injection is performed.

Various liquids have been injected; the blood of healthy subjects. the milk of cows, the sp. gr. of which is about that of serum, and more frequently solutions at a blood heat, containing salts to replace those supposed to have been lost in the evacuations.

It has been proposed, by Dr. Johnson, to use the liquids at the temperature of from 106° to 120° F., under the impression that the heat itself will relieve the obstructive spasm of the minute pulmonary arteries.

The exhaustion consequent upon excessive discharges must be considered an element in the production of death, and should be steadily met as the exhaustion is manifested. Stimulants are indicated, and especially those of an antispasmodic class: as chloroform with brandy, in small quantities, with a little opium in some soluble form, so as to be available at once. Turpentine and creosote have been highly recommended, in the stage of *invasion*, to arrest discharge, and are worthy of extended trial. Astringents: Acetate of lead, in scruple doses, with opium, was Dr. Graves' favourite; and large injections of dilute solutions of Catechu have been used in the East. There can be no doubt that any means of checking excessive serous *hœmorrhage*, and of rousing the system, is most desirable, if it can be accomplished by remedies that cause no difficulty when reaction comes on. It is at this latter stage that the mischief resulting from the previous administration of free doses of opium and brandy is made manifest.

But, for the purpose of rousing the system from collapse, the most powerful means appears to be *cold affusion*. The shock of cold water upon the head and upper part of the body has a most decided effect in restoring a patient from collapse. It should be repeated many times in quick succession, if found beneficial, until a sufficient effect is produced, whilst, at the same time, the rest of the body and extremities must be kept moderately warm. In hot weather, in India, it was not found necessary to use warmth, but friction only, to the limbs.

The application of ice to the spine would seem to be a remedy of the same character, though the theory of Dr. Chapman, that cholera depends upon hyperamia of the spinal cord and its membranes, would give a different explanation to its utility. It has long been known that there is congestion found in the meninges after death; but this may be an effect of the deficient exhalation of carbon, and of the retarded circulation, and not the cause. If the application of ice to the spine has the effect of rousing a patient from collapse, it has the advantage of not disturbing him so much as the cold affusion, and may prove a better remedy in the consecutive fever.

The management of the stage of reaction must be conducted on general principles. It is the testimony of all writers, that those who have taken the least brandy or opium, previously, have the best chance of surviving this stage. On this question, I may refer to the treatment at Guy's Hospital, as it appears in the "Lancet" for August, 1849.

A mode of death, then, that may occur in this stage, is from congestion, caused by uræmia, to a great extent; and, as the action of alcohol and opium is, undoubtedly, to retard the secretion of oxydised products: bile, urine, &c., it may be seen how their free administration, when collapse is at hand, produces increased difficulty afterwards. Still, the judicious use of these powerful remedies, in the early stages, may be justified—especially with regard to small doses of a soluble form of opium—one that is immediately available. It is asserted by many that where, in such stages, a stimulant is needed, that a few minims of chloroform, in a suitable vehicle, repeated every ten minutes to an hour apart, form a better remedy of this class than ordinary alcoholic liquors. In reaction, urea is formed in the blood with great rapidity. The want of circulation, during collapse, has retained those matters which go to form it, in the tissues; but, when circulation is re-established, uræmic poisoning is soon perceived, unless the kidneys resume their function, and a tolerably free secretion from them takes place. The amount of urea present in the blood, in reaction, often amounts to 2 per 1000. In this connection, it will be seen how death follows, in cholera, upon a patient with diseased kidneys—a result so uniform that some have considered the condition of those organs, after death, the result of cholera, when it may be rather inferred that their condition prevented his recovery by occluding the outlets through which, only, urœa could be eliminated. Hence the drowsiness, coma, convulsions, it may be, and death. In less highly marked cases, remedies may be found in the use of diuretics and cholagogues—especially such of the former as are believed to have the power of expelling urea from the system.

The length of this paper precludes any further remarks on other remedies; but this will be unnecessary even to the junior members of the profession, who have no personal experience of cholera, if the plan of treatment instituted be rational, and in accordance with the indications of each case.

MARRIAGE AND INFANTICIDE IN CHINA IN THEIR RELATIONS TO POPULATION.

BY W. HENRY CUMMING, M.D.

It is neither possible, at the present time, nor necessary, on the present occasion, to determine the population of China. Whether the proper number be one hundred and fifty millions or four hundred millions, we need not now enquire. For the purposes of this paper it is only necessary to state that in many localities the people are so numerous that they are scarcely able to obtain a meagre subsistence. They "swarm" in every direction. In rich plains the villages are frequent and the cities populous. On the sea-coast, where the soil seems unable to support such multitudes, the ocean yields great quantities of food. Fishing-vessels are to be seen along the whole coast. Thousands are driven, by a storm, into a single port.

In these densely crowded regions, the mass of the people are extremely poor. They live in miserable houses; they wear very little clothing; they are scantily fed. At Amoy the ordinary daily wages of common labourers cannot exceed five cents. Sixteen labourers could readily be obtained for one dollar a day. Carpenters, joiners, masons, blacksmiths, and tailors earn only about one eighth of a dollar daily. In a country where rice costs two cents a pound; beef, five cents; and pork, seven, it is evident that the wages of mechanics can procure only very poor food. And, when it is remembered that, among the common people, house rent, and fuel, and food, and clothing, for wife and children, are to be procured, it is plain that the pressure is very great. It is, indeed, wonderful how life can be maintained in such circumstances.

One result of this extreme poverty is that the natural development of children is very slow and tardy. A rich man's son, at sixteen years of age, is evidently verging on manhood. The voice has changed, the larynx is enlarged, the shoulders are broad, the neck is thick, the full height is reached, the beard is appearing. It is not at all uncommon for the sons of the rich to be married before the age of eighteen.

Among the poor, on the other hand, at the same age, the stature is that of a child, and none of the signs of manhood have appeared. The voice is often unchanged at twenty, and the whole frame childlike.

It is thus evident that among the Chinese the experiment has been made shewing the minimum of food consistent with life and health. Many are unable to obtain even this, and use food unfitted to their wants and tending to induce disease. Putrid fish are often eaten. Salted vegetables constitute a large part of the food of the very poor. Hence permanent dyspepsia with all its serious consequences.

Such being the condition of the poor, we might naturally suppose that marriage would be confined to those in easy circumstances, and that the redundancy of population would thus, in a few years, disappear.

But in China marriage offers the only provision for old age. It is the "Savings' Bank" of the people. Sons are expected to support their aged parents. Every man, therefore, desires to marry, that he may have three or four sons to maintain him when he is old. But, in order to marry, money is needed. A wife costs eighty dollars, and a man, whose daily wages are five cents, will find it a tedious business to accumulate so large a sum. Even a mechanic, earning from ten to fifteen cents a day, must wait several years before this amount can be secured. A man who can save ten or twelve dollars a year will, in seven years, be able to buy a wife. It is worthy of note that, in Western Asia, 3,500 years ago, Jacob gave seven years service for a wife. It must not be forgotten that a large part of a young man's wages is often appropriated to the support of his parents, and that his "marriage-fund" grows very slowly. The hopelessness of his condition often leads to a relaxation of effort; and, looking forward to a desolate old age as the only issue of his exertions, he becomes disheartened and gives up the struggle.

Of course, when parents have the ability, they gladly purchase wives for their sons. Self-interest alone would induce them to do this, for they may hope thus to secure grandsons to support them in their old age, even if they should lose their sons. Just as, in France, a parent puts aside money to secure a son against the conscription, so, in China, does he strive to accumulate enough to purchase a wife for him at the earliest suitable age.

Another plan is often adopted, especially where there is only one son, and the parents feel doubtful of their ability to accumulate money enough to purchase a wife. A girl fully marriageable is worth eighty dollars, but a girl five years old is worth much less; and, indeed, may sometimes be obtained for nothing. A little girl is therefore obtained, and reared in the family, as a wife for the son A difficulty about this arrangement is that the children learn to love each other as brother and sister, and feel no disposition toward a conjugal union. Where this happens, the girl is sold to another, and the proceeds of the sale are expended in the purchase of a wife for the son. Where, however, the marriage does take place between persons thus brought up together, it is esteemed very satisfactory. The parents have a daughter-in-law whom they have long loved as their own child, and thus a fruitful source of domestic trouble is eliminated

After all the industry, economy, and contrivance to obtain a wife, the desired results do not invariably follow. In the first place, the wife may prove barren, and then the labour is all lost. In the next place, the wife may bear daughters, and no sons, and then the failure is equally complete; for daughters, when married, are lost to the family—having been, by the fact of marriage, entirely transferred

But, thirdly, the sons may be born and reared, and yet fail to perform the duties devolved upon them. They may be indolent, stupid, inefficient, or even dissolute, drunken, and utterly worthless. All these possibilities make it the more important to multiply the chances of success by a larger number of sons. It is generally supposed that, with four or five, there is very little danger of suffering in old age.

Let us consider the case of a man who, having been long married, has no son; or, of him who, at the age of forty, is still too poor to buy a wife. If the married man is really attached to his wife, he may be unwilling to take a concubine; or, he may be too poor to buy one. In such cases recourse is had to adoption. Yet it would be cheaper to buy a wife than a large, well-grown boy. At Amoy the adopted boys are brought from the Northern provinces. There the general destitution seems to be far greater than in the South. Inundations often produce wide-spread desolation; famines are more frequent. Boys are often brought from Tien-Tsin to Amoy who have been purchased at very low prices, or have even been given away by their parents, because they could no longer feed them. These boys are sold to men who have no sons, and who desire to adopt them. The highest prices are given for the youngest boys. The reason of this is obvious. A boy removed, at the age of five or six years, from his home to a distant province, growing up among a strange people, talking a different language, utterly forgets his home and kindred and country. If kindly treated, he learns to love his adopted father as if he were his own. Whereas, a boy of ten or twelve will always remember his own home; his parents, and the scenes of his early life. Unless very affectionate and grateful, there is danger that he will fail to adopt his new father.

Having thus briefly shown that, notwithstanding the great difficulties in the way of obtaining a scanty support, the poor are most anxious to marry, a serious question presents itself. "How does it happen that the population of China does not increase to an extent altogether exceeding the power of the country to sustain it?" If the learned Malthus had been requested to give counsel to a nation in the condition of the Chinese, he would have been greatly puzzled. "Self-restraint," "prudence," "forethought," are his great preventives of a too rapid increase of population. But the case of the Chinese is without the range of his philosophy. It is not an overmastering passion which urges on the infatuated Chinaman to marriage. He is now, at 25 years of age, calmly looking forward to the distant future, and trying to make provision for it. He is all "prudence," "forethought," and "discretion." He has eighty dollars in hand; shall he marry? He is not in love—he never expects to be in love—but he is anxious to make such an investment of his eighty dollars as will produce the best results thirty or forty years hence. He is as cool as possible—willing to listen to reason, and to take good advice. In Europe he would be advised to deposit his money in a Savings' Bank, and add to it from time to time as he had opportunity, with the assurance that he would thus secure the means of comfortable subsistence in old age. But in China there is no safe investment for money, where it will be secured from official rapacity or private fraud. The only mode of securing himself from want in his later years, that he can devise, is to buy a wife and rear sons. The security is not perfect, but he knows no better plan. Who can show a mode of investment more likely to secure the desired end? And yet imagine the horror with which the professor at Haileybury regards this mad scheme. "To have three boys grow up you must have three girls also. You propose then to rear six children to adult age, and you are one of fifty millions of young men in the country. You expect then to add three hundred millions to an already redundant population. And the next generation; what will become of it? And what will become of the empire? How are you all to be fed? And yet what better can you do? You are right in providing against want in old age."

Suppose that while the matter was under consideration, and the case looking more and more hopeless, a clever physician should approach and whisper in the professor's ear to this effect: "Sir, I have a remedy for this difficulty. This man wishes to have three sons to work for him when he is old. Now, I have discovered a way by which the sexes may be produced at will. In having three sons he need not have three daughters, as you suppose. I will tell him how he may have three sons and only one daughter." The professor is delighted with this new plan. "This is just what we want. If you can manage to keep down the number of women, the work is done; there can be no redundant population. Let each family have only one daughter, and it can be succeeded by only one family through all generations."

Now, the Chinese have adopted a plan which secures to them the identical result proposed by this imaginary physician. They have not learned how to procreate the sexes at will. They cannot have three sons and only one daughter *born;* but they can have only one daughter *reared.* They have learned to destroy the girls at birth, and have thus secured the country against an excessively redundant population.

How long female infanticide has been practised in China is not known, and there are no means of ascertaining it. Chinese books say nothing on the subject.

The proportion of infants killed probably varies in different places according to the poverty of the people. The rich never kill their daughters—they rear them all; and, in their households, there are as many girls as boys. To the rich, daughters have a special value. By giving them in marriage to men of rank and official position, they may hope to secure their aid in defending their wealth from the rapacity of others.

In the poorest villages the number killed seems to vary from a half to two thirds. In reply to the question, "How many girls do you rear?" the answer usually is "three tenths," "four tenths," "five tenths." In examining the mothers as to the sex of the children in their arms, it usually appears that three fourths of the whole number are boys. In such cases it is evident that two thirds of the girls have been killed.

The first economical result of this destruction of female children is that to which reference has already been made: the too rapid increase of the population is most effectually hindered.

Its next result is that it confines marriage to the more active, industrious, and vigorous men. Only thirty or forty men in a hundred can marry; and these, for the most part, at the age of thirty. Industry, frugality, and perseverance are needed in order to marry. The feeble, the indolent, the dissolute will fail to obtain wives. The influence of this constant elimination of the inferior individuals from the class of fathers must be powerful upon the race. Health, strength, activity, and energy are the conditions of marriage; the offspring must be beneficially affected.

The inability of most men to obtain a second wife tends to make them not only industrious but careful of their wives. It is said that the prohibition of second marriages to the clergy of the Greek Church makes them model husbands; so, in China, does the pecuniary hindrance make husbands anxious to provide every comfort for their wives.

Divorce in China is exceedingly rare.

The scarcity of women is also a great discouragement to polygamy. Every woman may be married; and, in most cases, the condition of a wife is considered decidedly preferable to that of a concubine. The price of a concubine is, therefore, much higher than that of a wife.

Prostitution is necessarily checked by the great scarcity of women, all of whom may find husbands.

The condition of widows is also much modified by this disproportion of the sexes. In most Asiatic countries, widows are, to a great extent, outcasts; neglected by their relatives and abandoned by those who should protect them. In China, widows are in demand as wives, and remain unmarried only because they choose to do so.

It follows, of necessity, from this extensive destruction of female infants, that a vast number of men are unmarried. But, in such a country, so densely peopled, there is no remedy for this but emigration. Multitudes of Chinese leave their native land and settle in the islands of the Indian Archipelago. This process will doubtless continue until the Chinese shall have occupied these uncultivated regions so vast and fertile. If China shall ever enjoy a good government, the results will be on so large a scale as to excite the utmost interest of the political economist.

MARY BRADLEY, THE DEAF AND BLIND MUTE.

Attention was called in a recent number to some features of special interest connected with the case of Laura Bridgeman, the pupil of Dr. Howe of Boston; we have now to note the death of Mary Bradley, an English Deaf and Blind Mute, with whom the same means of instruction had been employed, as have already been described in reference to Laura Bridgeman. The failure of her experienced and indefatigable teacher, in successfully applying to Oliver Oswell, another mute, destitute of sight and hearing, the method he had found so effective in communicating languages, and all consequent instruction to Laura Bridgeman, gives an additional interest to the case now referred to.

Painful, and seemingly irreparable, as were the privations of Laura Bridgeman, she passed her early years in a comfortable New England home, under her mother's care; and amid the kindly sympathy of friends and neighbours; one of whom especially, strove in various simple ways to convey to her some knowledge of the outer world. But it was altogether different with the unfortunate blind and deaf mute now referred to. Mary Bradley was deprived of sight and hearing when not more than five years of age, and was found by the English poor-law authorities, in a state of absolute destitution, in a cellar, where she had been abandoned by her heartless parents. She was placed, at first among the children training in Swinton School; but her complicated case of loss of senses seemed to place her beyond the reach of every available means of communicating knowledge, and she became a mere plaything and butt for the other children. She was not, however, long left exposed to such neglect. It fortunately chanced that Mr. Patterson, the master of the Deaf and Dumb Institution at Old Wafford, had his attention called to the case of Laura Bridgeman, chiefly through the statements set forth in Mr. Charles Dickens' "American Notes"; and he obtained the permission of the Governor of that Institution to have her placed under his care. She was accordingly removed to the Old Wafford Institution in July, 1846, and has continued to reside there until her recent death. But in her case bodily illness precluded her from that joyous perseverance in the use of what might not inaptly be called her recovered faculties, which renders Laura Bridgeman so pleasing a subject of study. Mary Bradley closed her life in June last, after nine years of almost continual suffering; so that, during a large portion of the period of her residence at Old Wafford, she has been an object of painful interest to her kind guardians in that valuable institution.

The following brief notice refers to the efforts for her instruction which immediately followed her removal from Swinton School; and, though it lacks the minute details which give so much interest to the narrative of Dr. Howe's training of Laura Bridgeman, a comparison of it with the facts already stated in reference to the latter, will suffice to show many points in common in the two cases:—

"Mr. Patterson had set himself a most difficult task, and many weeks elapsed before the slightest sign of intelligence was manifested. After six weeks of daily perseverance, however, her face suddenly indicated that her mind had received an impression. Notwithstanding her complete isolation from all the sources of enjoyment around her and the difficulties of communicating information to her, she by slow degrees made considerable progress in acquiring a knowledge of language, and was enabled not only to read the books printed in relief fo the blind, but was also able to communicate her thoughts in writing to others. This latter she performed by means of a tablet which Mr. Patterson invented for her, and by its aid she held correspondence with Laura Bridgman and others. She became quite an adept at the peculiar language of the deaf and dumb. She was also provided with a case of types, which she "set," and which was of great value to her, not only as a means of communicating but also as exercise in languages. Her favourite books were the gospels, which she frequently read, drawing comfort and satisfaction from them. Her temper was peculiar, probably from the peculiarity of her case; as a rule she was amiable and tractable, but she was from time to time subject to fits of sullenness and irritation, when nothing could please or pacify her, and she was left to herself until, as if exhausted, she would return to her usual mood, and continue tractable for weeks. Much of her time she spent in knitting and sewing small articles, which she generally gave to friends and those who were kind to her."

The generous zeal with which her humane instructor devoted himself to the rescue of this seemingly hopeless outcast from her lonely and dark prison-house is deserving of the highest encomiums; and none the less so from the quiet and unobtrusive manner in which his successful labours have been carried out. The remains of Mary Bradley have been laid to rest in Harpurhey Cemetery; and it is pleasing to be able to add that she died in the firm conviction that she was entering upon a life where the senses of which she had been deprived here would be fully developed.

NOTICES OF PAPERS RELATING TO NATURAL HISTORY RECENTLY RECEIVED.

First in order we place a paper by Professor Morse, of Portland, on *A Classification of Mollusca, Based on the Principle of Cephalization*, which appeared in the proceedings of the Essex Institute, Vol. IV., No. VI., and which has been in our hands for some time, but which seemed to us of such importance that we were anxious to bestow upon it a fuller consideration than other occupations at the time permitted; and we reserved it with the intention of expressing at large our views on the whole subject. We regret that this intention must still remain unfulfilled; but we will at least express our sense of the knowledge, thought, and original research displayed in the paper, and give a short account of its purpose and character, with a few critical remarks. The author makes it a special object to determine the common plan of the Molluscous sub-kingdom, which he regards as still remaining in obscurity :—

"Finding the universality of vertebration among the Vertebrata, of articulation among the Articulata, and similarly of radiation among the Radiata, I could not but believe that in the Mollusca some plan lay hidden, which, when unfolded, would as definitely convey their type, and unite them all, as in the other branches. It is not enough to call them soft bodied animals; for in considering their shell as a part of their organization, we have among them many of the hardest animals known, and we also have an equal number of soft bodied animals in the other branches. Their bilaterality, as expressing anything definite, is an equally unsatisfactory character. Prof Huxley has given an archetype, or common plan of the Mollusca, as he conceives it, with many truthful homologies, in the article 'Mollusca,' English Cyclopedia, Vol. III., p. 685 In his figure of the archetype, however, which is bilaterally symmetrical, we have details of structure only."

He adds :—

"Prof. Dana has been the first to publicly announce the plan of Mollusca, when he says, 'The structure essentially a soft, fleshy bag, containing the stomach and viscera, without a radiate structure, and without articulations.'" *

He then states that,

"In the year 1862, Mr. Alpheus Hyatt had independently worked out a similar result."

Adding :—

"Mr. Hyatt also proposes the name Saccata as more fully and truthfully expressing the type, than the unmeaning word Mollusca. This name not only ex-

* Dana's Manual of Geology, p. 148.

presses the plan, but is equivalent to the titles Vertebrata, *Articulata*, and Radiata, and is in no way a qualitative appellation."

It appears to us, however, that Prof. Dana's account of the Molluscan plan fully justifies the established name, which there would be great inconvenience, and no compensating advantage, in changing for that proposed by Mr. Hyatt.

Proceeding, now, to the main object of the essay, we endeavour to select what is most necessary for conveying a just idea of the author's views, in a series of short quotations :—

"In the following considerations, all preconceived ideas regarding the relative positions of the dorso-ventral, and antero-posterior diameters of the animal must be laid aside, and the essential structure of the animal if rightly understood, must be our guide. The gradual morphological changes of the contents of the sac, and all other relations, are based on the principle of Cephalization. In the plate presented (Series I) I have given a typical figure of the six prominent groups of the Saccata ;* namely, Polyzoa, Brachiopoda, Tunicata, Lamellibranchiata, Gasteropoda, and Cephalopoda.

"For obvious reasons, only the intestine, head, and pedal *ganglia within the* sac are represented. These six figures are placed in their normal position, anterior pole downward, the dorsal region is turned to the left. Commencing with the Polyzoa (Series I, P) we have the sac closed, while the mouth and anus terminate close together at the posterior pole of the sac ; the mouth occupying the extreme posterior position, and by a dorsal bend of the intestine upon itself, terminate dorsally. The nerve mass is found between the oral and anal openings.

"In the Brachiopoda (Series I, B) we have a permanent invagination of the sac, and the mouth, as in Terebratula, already occupies a position some distance from the posterior edges of the overlapping shells, and the brachial coils permanently occupy the space thus made.†

"We have in this group a dorsal flexure of the intestine, and a tendency to terminate as in the Polyzoa. In Lingula it terminates posteriorly and at one side. By the permanent inversion of the sac, the mouth makes a great advance toward the anterior pole.

"(The manner in which I view the Brachiopoda, if true, will entirely reverse the accepted poles of their structure. What has been considered as dorsal, is here regarded as ventral, and what has been considered as anterior, is here regarded as posterior. Further remarks on this will be made hereafter).

"Thus far the balance of structure has been thrown to the posterior pole of the sac, and though we see a cephalization, or concentration of the muscular system and viscera, toward the anterior pole in Brachiopoda, yet that pole being

* These figures are diagrammatic outlines, enabling the reader more readily to follow the author's ideas.

† "Terebratulina caput-serpentis, and Crania anomala, projected their cirri beyond the margin of the open valves, and moved them as the Polyzoa move their oral tentacles, but in no instance were the arms extended." Woodward's Treatise, p. 466.

essentially closed, we have no function manifested at that end, except the degradational one of adhesion. In the Tunicata (Series I, T) we have, through continued cephalization, the mouth thrown to the bottom of the sac, or nearer the anterior end, and now the anus terminates behind the mouth, and posteriorly.

"The heart has also followed the intestine in its rotation and becomes anterior, and partially dorsal. The nerve mass is still posterior, and occupies a position between the two openings as in Polyzoa.

"In these three classes; namely, Polyzoa, Brachiopoda, and Tunicata, the sac is essentially closed at the anterior end, and consequently the mouth opens toward the posterior end, and with few exceptions all are attached by the anterior end.

"This makes a natural division, corresponding to the Molluscoidea of Milne-Edwards, the Anthoid Mollusks of Dana, and a portion of the neural division of Huxley. In the Lamellibranchiata (Series I, L) we have the sac opening anteriorly, and the mouth permanently occupying the anterior region, though in the lower forms pointing posteriorly, and in all cases the tentacular lobes pointing in that direction, and the mouth bent downward (ventrally), and partially obstructed by the anterior adductor, or by the undivided mantle.

"In Gasteropoda (Series I, G) the posterior end of the sac becomes essentially closed, and the ambient fluid now finds access to the gills through the anterior (though partially ventral) portion of the sac, while with Cephalopoda (Series I, C) the opening is all anterior. Thus far we have traced the gradual cephalization of the contents of the sac, and of the sac itself. The dotted lines X X, running through the oral opening of each figure in Series I of Plate, show the gradual advance of this opening from the lower to the higher classes. In the lowest class all the display of structure, with the oral and anal openings, lies at the posterior pole of the sac. In this highest class, all this display of structure lies at the anterior pole. Advancing from the Polyzoa, by the gradual advance of the mouth, the posterior pole becomes less prominent. Even when the sac opens anteriorly as in the Lamellibranchiata, the posterior end of the sac remains open, and the mouth, partially inclined that way, receives its food from that end; the food being conducted to the mouth by ciliary motion as in the three lower classes. The nature of their food is also identical, being of an infusorial character, and as such it is obvious that masticating organs, or biting plates, such as we find in the two higher classes, are not needed.

"So long also as the posterior end of the sac remains open, the anus terminates at that end; when this opening becomes closed, as in the higher classes, the anus seeks an outlet through the anterior opening, and the mouth, that before received its food from the posterior end of the sac, and by ciliary motion, now distinctly points the opposite way, and is furnished with the proper organs to procure food, the nature of which requires separation and trituration.

"In nearly all the foregoing homologies, and also the position in which I place the Tunicate sac, I am sustained by the writings of eminent naturalists. With the Brachiopoda, however, my views completely reverse the accepted poles of the body, though, even here, according to "Woodward's Treatise on Mollusca," page 204, Forskahl and Lamarck "compared *Hyalea* with *Terebratula*;

but they made the ventral plate of one answer to the dorsal valve of the other, and the anterior cephalic orifice of the pteropodous shell correspond to the *posterior* byssal foramen of the bivalve!" And, if the views I advance prove correct, they were precisely right. In all my previous attempts to homologize the different classes, I had always met with an obstacle in the apparently aberrant characters of the Brachiopods: never for a moment doubting the truth of the accepted views, that indicated the regions to be called dorsal and ventral, as such, I labored in vain. When I undertook to interpret the relation of these classes on the principle of cephalization, I found that these accepted views must be doubted, and it was with amazement that I beheld such unlooked for results: that the so-called dorsal region is really the ventral region."

To us the view entertained by the author, of the dorsal and ventral surfaces of Brachiopoda, or Palliobranchiata, does not appear to be the greatest difficulty. We suspect that the Molluscoidea of Milne-Edwards—the Anthoid Mollusks of Dana—though by no means judiciously separated as a sub-kingdom, really form together one class. The Monomyarian Lamellibranchiates, on the other hand, need by no means be separated from the rest of that class; but we are well persuaded that no natural and useful view of Molluscan animals can ever be given without treating Pteropoda as a distinct class. The special organs which mark them out as the expression in their sub-kingdom of motory power are highly characteristic. The comparatively small extent of the class, which really indicates that motory power is opposed to the Molluscan plan of structure, is certainly no argument for uniting it with Gasteropoda; and if the detection of certain homologies of parts were so we might soon compress the whole sub-kingdom into a single class. The structure and arrangement of the suckers, in some species, would of itself alone go far with us to confirm Cuvier's view of the position of the class, as next to Cephalopoda.

We thus arrive at five classes, representing five tendencies of structure, which we believe to be everywhere observable throughout the animal kingdom; and our great difference from Mr. Morse, in our conception of the true classes in this sub-kingdom, interferes with our power of immediately estimating and applying some considerations offered by him, which deserve attention, and possess interest His speculations respecting polarity we could not make intelligible in few words without the convenience of figures. His concluding remarks are rendered obscure and repulsive by Prof. Dana's peculiar and highly objectionable terminology. Taking it as a whole, this short essay is of considerable importance, and proves its author to be an able as well as earnest cultivator of Malacological Science.

Among contributions to Natural Science, published in various periodicals which we have received through the kind attention of their authors, we name "Notes on the Embryology of Star-fishes," from the Annals of the Lyceum of Natural History of New York, by Mr. Alexander Agassiz, who follows up, with great credit to himself and advantage to science, the labours of his distinguished father. "Notes on Certain Terrestrial Mollusca, with Descriptions of New Species," extracted from the same work, by Thomas Bland; "Remarks," by the same naturalist, eminent for his knowledge of Terrestrial Mollusks, "on the Origin and Distribution of the Operculated Land-shells which Inhabit the Continent of America and the West Indies," extracted from the American Journal of Conchology; two parts. This is a highly interesting and valuable paper. We may observe that the author explains that in using the term *origin*, applied to families, &c., he refers to the country in which there is the maximum specific representation.

Again, we have from Leo Lesquereux, a paper "On Fucoides in the Coal Formations." This must prove attractive not only to the Geologist and the Botanist; but, in its discussion of the origin of petroleum, will excite the curiosity of the practical man, who would expect to be enabled to judge more satisfactorily of the probable durability of the supply, if he had some good information respecting the origin and history of the substance. Though our quotation must be of some length, we expect our readers will be pleased to see the portion of Mr. Lesquereux's paper which relates to the origin of petroleum:—

"*Does Petroleum Originate from the Decomposition of Marine Plants?*—Considering the question of the origin of our deposits of petroleum, some geologists have expressed the opinion that they might be due to the decomposition of marine plants, as coal is the result of the decomposition of a terrestrial vegetation. This conclusion is but natural, for there exists an evident correlation between the formation of both kinds of deposits of bitumen. But this relation cannot be, or at least has not yet been, established by direct proofs or experiments, and that is probably the cause why the subject has not been studied more in detail.

"*Fecundity of the Marine Vegetation at the Palæozoic Ages.*—There is no doubt that the marine vegetation of the Palæozoic ages can be compared, for luxuriance, and in some measure for its composition also, to the terrestrial vegetation of the coal epoch. From the Upper Devonian down to the Lower Silurian, some strata of shales are not only covered, but indeed filled, sometimes for hundreds of feet in thickness, with fossilized forms of Hydrophytes. These evidences of a primordial vegetable world are far more numerous than the remains of land plants in the shales of the Coal Measures. Nevertheless, they appear to belong to plants of a soft tissue, mere cellular, probably mostly unicellular vegetables, the debris of which had not by much the same chances of fossilization.

"The superabundance of vegetation testified by fossil remains in Palæozoic ages is in accordance with one of nature's most evident laws. The amount of carbonic acid gas is acknowledged to have been, at the Palæozoic times, far greater in the atmosphere, and also in the water of the seas, than it is now The prodigious luxuriance of the vegetation of the coal period is rightly ascribed to this fact. It cannot be supposed that in the sea the vegetation, which is there also the intermediate agent between animal life and unorganized bodies, gaseous or mineral, should have been in a diminutive state when its action was the most in demand, like its development, for the purification of the water and the transformation of the superfluous carbonic acid gas into organism and oxygen.

"We have no proofs from fossil remains that the Hydrophytes of old attained a very large size. The largest circular fronds of *Fucoides Cauda-galli* show a diameter of about one foot; the greatest length of the branching Fucoides in the Chemung is from two to three feet. But we cannot judge all the vegetable representatives of an epoch from a few fossilized specimens. These may have belonged to a species of a more compact organization, or to some kind of Corallines, which had their surface covered with a hard crust of lime, while other groups of a soft, mere cellular tissue, which had representatives of large size, have been totally decomposed and destroyed. There is no need however of this hypothesis, on the size of the Palæozoic Algæ, to argue by comparison on the fecundity of the marine vegetation of old. Small species of Hydrophytes, in our time, afford sufficient analogies. The great bank of *Sargassum*, which extends between the 20th and 45th parallel of latitude, covers, according to Humboldt's computation, a space of more than 260,000 square miles. In places this floating bank is so thick as to arrest the progress of vessels, and it appears at present to be of the same extent and to occupy the same place as when it was first noticed by navigators. What can we then infer to have been the result of a vegetation whose force was at least double of what it is now, and which has written its history in whole strata of great thickness?

"*Analogy of Life and Functions in both the Terrestrial and the Marine Vegetable World.*—It cannot be presumed that this whole vegetable world of Palæozoic seas has left nothing after it but useless petrified remains. In the march and development of nature's productions, nothing of the materials employed is ever lost. The smallest atom of matter is preserved in some way, if not constantly remodelled. Thus we find the key of a new life, of a new creation, in the remains of a destroyed one. Thus, some leaves, preserved by fossilization, in the shales of the Coal Measures, open to our view not only the whole world of an ancient vegetation, but its predestinated result, coal deposits, slowly laid up by its agency. Thus also the remains of marine plants, in the shales of the

Devonian point out, I think, not only the fecundity of an ancient marine vegetation, but its result in the contemporaneous deposits of petroleum. Indeed, both kinds of vegetation have great analogy of life, if not of organism. The plants of the coal, by their structure, the form of their long pointed leaves or indefinitely divided fronds, were shaped for the absorption and the transformation from the atmosphere of the greatest amount of carbonic acid gas into woody tissue. The Chlorosperms of the Palæozoic times, with their simple bladdery conformation and their green color, were undoubtedly prepared to perform in the water the same functions as the coal plants performed in the atmosphere. As the result of terrestrial vegetation has been, first woody tissue, and then, by its decomposition, coal, so the result of marine vegetation has been, first cellular tissue, filled with a kind of liquid carbon, and as the carbon is unalterable, the decomposition of the plant has left it free as fluid bitumen or petroleum.

"*What Chemistry Indicates on the Subject.*—We cannot follow, in our day, by means of the accumulated remains of Hydrophytes, the slow process of carbonization, and compare its results at different stages of its development, as we can by help of the remains of land plants, in the formation of peat bogs, lignites, &c. This only has been observed: When marine vegetables are thrown upon bogs and mixed with terrestrial plants as compound of the peat, they do not leave any trace of organism or primitive form, and the peaty matter, then of a deeper black color, is a softer, more homogeneous compound, richer in bitumen. When, detached by storms or tides, Algæ are heaped in great masses on sandy shores, they promptly decompose, passing first to a black, soft paste, and then to a glutinous fluid of the same color, which exhales a strong disagreeable odor, and penetrates the sand. Chemistry has not analyzed these matters resulting from the decomposition of Hydrophytes, nor even species of marine Algæ;* and therefore it is not proved that there exists a direct relation between them and petroleum. Chemistry demonstrates, however, that petroleum and coal are both compounds of the same elements; and the former matter being proved of vegetable origin, the second is neccessarily, by induction, referred to the same.† And as some substances, like iodine, which was formerly procured from marine plants only, are now more abundantly obtained from petroleum, chemical analyses, I think, confirm in that way the relation between petroleum and Hydrophytes.

"Though chemistry is not directly interested in it, it is but right to refer here to a peculiar fact which bears upon the subject. The Algæ, especially the group of the *Caulerpæ*, feed some of the animals of the seas, remarkable for the

* Prof. Liebig, to whom I wrote a *résumé* of my opinion on the subject, with the request that he would point out to me the result of chemical analysis of marine plants, if there were any, either in support or discredit of my ideas, kindly answered: "That there were unhappily no analyses of species of Fucus, or of other Hydrophytes, which could be used as affording support to my views. But that my arguments, based on exact researches, were so conclusive, that for himself, at least, they had removed any doubt of the truth of the theory.

† See, on this subject, a very remarkable and most instructive paper, by Sterry Hunt, in the American Journal of Science and Arts (2), pp. 156 to 171.

size and the prodigious fatness of their bodies. The green fat of the turtles, says Harvey,‡ so much prized by aldermanic palates, may possibly be colored by the unctuous green juice of the Caulerpæ, on which they browse. The same could be said of the color of the Devonian petroleum, which is exactly that of the Chlorosperm Hydrophytes. It is not positively ascertained, I believe, if whales and other marine mammifers of this kind, whose bodies are large reservoirs of oily matter, are true Algæ-feeders; but when killed, the stomachs of these animals are always found mostly filled with marine weeds.

"*Geological and Geographical Distribution of Petroleum Deposits and Fucoidal Remains.*—A last argument, no less conclusive on the subject, is taken from the geological and also from the geographical relation between deposits of petroleum and Fucoidal remains.

Oil-bearing strata are seen in the Coal Measures mostly inferior to the big bed of coal No. 1, which is often a cannel coal; and sometimes also, but rarely, at a higher horizon, as, for example, below coal No. 3, and also coal No. 12, generally in more or less evident connection with cannel coal. This has probably led to the opinion, still admitted by some geologists, that all the deposits of petroleum owe their origin to a slow decomposition of coal, under some peculiar influences. As there has not heretofore been observed any indications that remains of marine plants might have existed at some places mixed with the aerial plants of the bogs of the coal epoch, it was not easy to account for such a phenomenon as that of the formation of coal and petroleum at the same horizon and under the same circumstances. But this curious fact, I think, is explicable now. When the combustible matter has been formed, especially from the remains of aerial plants, whose tissue was mostly vascular, or vascular and cellular, like that of the *Lepidodendron*, *Sigillaria*, ferns, etc., it becomes by mineralization a hard coal, with thin layers or distinct laminas, sometimes shining, sometimes mixed with opaque layers and flakes of charcoal, and giving by combustion, a proportion of ashes according to the nature of the wood. When it has been formed merely by floating fresh-water vegetables, like *Stigmaria* and its leaves, the compound, originally half fluid and more easily decomposed, becomes, by the slow process of combustion, compact, homogeneous, without apparent layers, tending to mere bitumen, thus forming the different varieties of cannel coal. Now, I believe that when this floating vegetation has been more or less densely intermixed with marine plants, and perhaps also influenced by marine water, the almost total absence of woody fibres has casually prevented the bedding of the material, and so, by slow maceration, part of it has been transformed into fluid bitumen. It is probably for this reason that we see, sometimes, as at Breckenridge, in Kentucky, a bed of cannel coal so nearly decomposed into petroleum that it can scarcely be used as coal, and at a lower level, even in close proximity, and where every trace of coal has disappeared, inferior strata of sandstone, strongly impregnated with petroleum.

"In descending from the base of the Coal Measures into the Devonian, we find deposits of oil nearly in the whole thickness of this formation, with the exception of the old red sandstone, equivalent of the Ponent and part of the Vespertine of Pennsylvania. All the plants of this formation, and they are numerous enough, belong to swamp or land plants, and no trace of petroleum has been seen in these measures. But down from this red sandstone, the Chemung is full of remains of Fucoides, and where they are found all the sandstone strata of this formation are more or less impregnated with oil.

"Still lower the black shales of the Hamilton group are so much charged with bitumen that they have often been considered as the true source of the Devonian petroleum. There the remains are nearly, almost totally, obliterated. A few teeth of fishes and small shells, very rarely large trunks of *Lepidodendron*, nothing more, at least in those extensive deposits, generally of great thickness, which border our Western coal basins. The color of these shales, and the bitumen which they contain, indicate a formation under water, under the influence of a powerful vegetation; and a marine vegetation, without doubt; else, besides the well-preserved trunks of *Lepidodendron*, which have probably been brought floating, we should find there other remains of aerial plants. At Worthington, in Ohio, where I have spent much time in searching for fossil remains in these black shales, I have seen them often covered with round spots of coaly matter, varying in diameter from half an inch to one foot, showing no trace of organism, and resembling some kind of round, hard Ulvaceæ, like those which are seen in great quantity attached to the muddy shores in shallow water.

"Descending further down in the Lower Devonian and Upper Silurian, we see there also the rocks saturated with petroleum, and generally marked by an abundance of Fucoidal remains. It is probably from the rocks of the Upper Silurian that Prof. Brogniart obtained his Fucoides from Canada. In Ohio and other Western States, where the Upper Silurian limestone is barren of remains, it does not show any deposits of petroleum. In Canada the same rocks have both Fucoides and fluid bitumen Prof. Lesley, after an examination of the east end of Canada, Gaspé, wrote me (5th January, 1866): "All sorts of marine vegetation of Upper Silurian and Devonian ages seem there in great abundance, and petroleum everywhere in the Devonian, and oozing from the lower Helderberg limestone formation.

"Still deeper the Lower Silurian has small deposits of bitumen in cavities of limestone, even when every trace of organism has disappeared. This fact again is, I think, another indication of the relation of petroleum to a marine vegetation. For it is well understood that vegetable life has ruled the seas in its minute representatives, Diatomaceæ, Desmidiaceæ, long before animal life could be supplied or sustained by it. These diminutive and primitive oil reservoirs are attributable to the concentration and decomposition of a local surplus of that primordial vegetation.

"The geographical distribution of petroleum and that of the remains of marine Algæ present the same remarkable coincidence. At Oil Creek, Slippery Rock Creek, in the Chemung of Virginia, Ohio, Kentucky, everywhere indeed where oil has been seen, either in cavities or saturating the rocks, and where the strata were open to view, a remarkable amount of Fucoidal remains has been observed. This cannot be a mere casual coincidence.

"The discussion presented in the last part of this paper may then be closed by this assertion: That though the theory of the origin of petroleum from marine vegetables is not yet supported by direct experiments and conclusive proofs, the reasons in favor of it are weighty enough to merit due consideration. The more so, that if recognized as true, the theory presents an important chapter of the history of petroleum, and may prove of great value in its application."

We pass next to some productions of Dr. W. Lauder Lindsay, from the proceedings of the Royal Society of Edinburgh, the Edinburgh New Philosophical Journal, and other sources. We can only name a paper on the Tertiary coals of New Zealand; but we cannot name it without praise as a concise, yet full, clear, and well arranged summary of information on its subject. Of more general interest and in more immediate relation with our condition, as a great Colonial Government, is the essay entitled "The place and power of Natural History in Colonization, with special reference to Otago (New Zealand)," which is an excellent exposition of the practical value of the several branches of Natural Science in a newly settled country; the evils that may arise from ignorance, and the agencies by which knowledge may be collected and diffused; which, therefore, should be put in operation by a wise government; not because such knowledge is in itself interesting, ennobling, and deserving of cultivation, but on account of the practical benefits having a direct money value, which it confers on a community. Our statesmen would do well to consider such views, and an intelligent public ought not to disregard them. We have, perhaps, advanced beyond the need of some of the suggestions offered; but there are others well deserving of consideration; as, for example, the public importance of a botanic garden; and that not merely as a useful aid in College botanical instruction, but with a view to the improvement of society at large, and the diffusion of much important practical knowledge.

Dr. W. Lauder Lindsay is eminently a practical naturalist as well as a man of real science. Among the subjects which he has ably treated, we find "The Dyeing Properties of Lichens;" "Economical Applications of British Lichens;" "Substitutes for Paper Material;" "Botany, in its Applications to Common Life;" and (which we wish could meet with due attention here), Illustrations of the Value "Of a Knowledge of Vegetable Histology to the Medical Student and Practitioner." One of these subjects, which is of very great public interest, forms the subject of a popular lecture delivered with great success at Perth, and elsewhere, the syllabus of which is so suggestive and instructive that we have no hesitation in copying entire in this place, notwithstanding that it is not very recent. We refer to the lecture on the "Substitutes for Paper Material." We wonder how it happened that, in naming the families of plants which may be tried with most promise for paper material, the Asclepias family escaped Dr. Lindsay's notice; perhaps the list would have been most conveniently given in a botanical arrangement, but the syllabus gives an excellent idea of the matter, and is full of instruction:—

PART I.—1. *Nature of present Paper Material.* Linen and cotton rags, hempen ropes and canvas;—that is, debris of fabrics made of flax, hemp, and cotton; re-use of old or waste paper: English Patent.—2. *Scarcity and high price of present Paper Material.*—Causes: 1. Increased demand for—*a.* Packing Papers; rapid extension of British commerce.—*b.* Writing Papers; postal reforms and extension.—*c.* Printing Papers; progress of the cheap press and popular literature; abolition of newspaper stamp duty; rise of colonial literature. (One Victoria paper circulates 12,000 copies daily.) Rise and progress of Paper Maché manufacture. Prospective abolition of paper duty; paper duty arrests development of paper trade; effect of abolition of the tax in creating increased demand. Increase on paper made in 1853, over that made in 1852, in Britain, was 23 millions lbs; consumption in 1855 was double that in 1845; average annual increased demand is 10 per cent; price of best rags has risen from 26s. to 34s., and that of other qualities in proportion.

2. Diminished supply of rags, &c., in consequence of—*a.* American competition in continental markets: no paper duty in America; three times as much paper used in America as in Britain.—*b.* Continental nations printing more books and newspapers, and requiring home produce.—*c.* Use of cotton and flax-waste, &c., for Railway purposes.

3. *Necessity for providing substitutes for present Paper Material.*—Limitation of supply of crude material the great obstacle to reduction of price of paper. Inducements to discovery of cheap, abundant, and good substitutes: "*Times*" prize of £1000.—Experiments and Patents in Scotland, England, Ireland, France, Germany, the United States, West and East Indies, &c.—Schaffer's "Sammtliche Papier-Versuche," 1772.—Hering's "Paper and Paper making,—ancient and modern," 1855.—Impetus given to study of economic applications of vegetable fibre by establishment of—*a.* Permanent Museums of Economic Botany, or of local or national Industry.—*b.* Temporary Exhibitions of local, national, or universal industry.

4. *Essentials of a good Paper Material: must consist of woody fibre; character of latter; "bast tissue."*—*a.* Cheapness.—*b.* Abundance and readiness of supply.—*c.* Ease of preparation; little loss in process of conversion.—*d.* Facility of being bleached.

5. *Accessory advantages in Manufacture of a cheap and good paper.*—*a.* Improved machinery for separating and pulping fibre.—*b.* Improved processes for

bleaching.—*c.* Economical applications of refuse, *e.g.*, as manure. Non-attention to these essentials or accessories the general cause of failure in experiment. cost and difficulty of pulping and bleaching chief obstacles to use of abundant and cheap fibres.

6. *Abundance of fibre-producing plants throughout the world.*—*a.* Home resources.—Present non-utilisation of properties and products of common weeds. —*b.* Our colonies as new fields of produce and export. "West India Hemp and General Fibre Company";. "Guiana Textile Association"; resources of India, Australia, New Zealand, Canada, Brazil, &c.

PART II.—ILLUSTRATIONS OF PLANTS YIELDING FIBRE SUITABLE FOR PAPER MAKING.—I. FLOWERING PLANTS. (*Phanerogamia.*)—1. *Flax Family.*—Flax, lint; tow; flax cotton; Jackson's flax paper.—Cultivation of flax in Scotland and Ireland; Irish Flax Co.—Proposed cultivation in India: memorial of Chamber of Commerce, Dundee.

2. *Nettle Family.*—*a.* Common hemp; Russia and Poland as chief fields of export; proposed cultivation in our colonies.—*b.* Indian hemp.—*c.* Common nettle; nettle muslin in Ireland; use of fibre in Holland and Germany.—*d.* Common hop; hop-bine.—*e.* China grass fibre.—*f.* Neilgherry nettle of India.

3. *Mallow Family.*—*a.* Cotton; scarcity in America; proposed cultivation in India, Africa, &c.—*b.* Garden hollyhock; patents of Mr. Niven of Keir Gardens, Stirling.—*c.* Marsh Mallow of Jamaica.—*d.* Common Mallow; tree Mallow.—*e.* "Cuba bast" of gardeners.

4. *Grass Family.*—*a.* Straw of oat, wheat, and other cereals. Straw printing and wrapping papers; straw note paper; disadvantages of straw paper Coupier's and Mellier's patent; Drayton's patent.—*b.* Twitch or couch grass; Jeyes' patent.—*c.* Mat grass; cord grass; mountain melic grass; rye grass or darnel; oat-like grass; cock's foot grass; canary grass: crested dog's tail grass; sea reed, marram, or matweed.—*d.* Common hay; Antisell's patent.—*e.* "Esparte" of Spain.—*f.* Bamboo.—*g.* Sugar-cane; "megass" or "spent cane;" "cane trash."—*h.* Chinese sugar cane.—*i.* Maize or Indian corn.—*k.* Rice straw; China.—*l.* Tussac grass of Falkland Islands.

5. *Lime Tree Family.*—*a.* Common lime or linden tree: "Russian bast."—*b.* Basswood of United States and Canada.—*c.* Jute; Gunny or rice bags of India; Smith and Holdsworth's patent.

6. *Thistle Family*—*a.* Common thistle; cotton thistle; Lord Berriedale's patent; thistle paper in France.—*b.* Burdock; coltsfoot; Irish patent.—*c.* Cudweed, or "everlasting flower," of United States and Canada; Andres' patent. —*d.* Common Mugwort.—*e.* Sunflower; experiments at Erith.—*f.* Jerusalem artichoke.—*g.* Ragweed, or groundsel.

7. *Pea and Bean Family.*—*a.* Common field pea and bean; stalk or straw "pea shells;" everlasting pea.—*b.* Common broom; Niven's patent.—*c.* Common field clover.—*d.* Liquorice root of Pontefract.

8. *Plantain or Banana Family.*—*a.* Common plantain.—*b.* Common banana, of West and East Indies.—*c.* Manilla hemp: West Indies and United States.

9. *Mezereon Family.*—*a.* Nepal paper plant.—*b.* Lace bark.—*c.* Leather-wo of North America.

10. *Fir Family.*—*a.* Scotch fir: cones; leaves; pine-wool of Germany; M. Panewitz's patent; shavings and saw dust; Roth's wood paper; Hartmann and Schlesinger's wood pulp.—*b.* Norway spruce fir; Gross' patent.—*c.* Red Cedar of America.—*d.* Larch.

11. *Oak Family.*—Wood of oak; beech; Spanish chestnut; shavings and saw dust; "spent tan;" Horton's patent; M. Vivien's leaf paper.

12. *Willow Family.*—*a.* Common willow or osier; catkins; bark; wood; Burch's patent.—*b.* Aspen and black poplar; shavings and saw dust.

13. *Goosefoot Family.*—*a.* Red and white beet-root; Collyer's patent; use of fibre in France.—*b.* Mangold wurzel; Irish patent.

14. *Cabbage Family.*—*a.* Cabbage and its congeners,—broccoli, cauliflower, &c.; "kail-runts."—*b.* Swedish and Aberdeen Turnip; Irish patent.—*c.* Mustard; Jeyes' patent.—*d.* Horse radish; water cress.

15. *Sedge Family.*—*a.* Papyrus, or bulrush of the Nile.—*b.* Clubrush.—*c.* Common Galingale.—*d.* Cotton grass.

16. *Heather Family.*—*a.* Common ling; peat in Italy and Germany; Lallemand's and Clarke's Patent.

17. *Potato Family.*—Common Potato; "shaws" or stalks; rind and pulp; potato disease no material objection to use of fibre in paper making.

18. *Vine Family.*—Common grape vine; tendrils; "vine blight" no material objection to use of fibre in paper making.

19. *Iris or Cornflag Family.*—Common yellow water Iris or cornflag; Irish patent.

20. *Rose Family.*—*a.* Common hawthorn or May.—*b.* Common bramble.

21. *Crowfoot Family.*—Common traveller's joy.

22. *Cucumber Family.*—Common bryony.

23. *Bulrush Family.*—Common bulrush or reed mace.

II. Flowerless Plants—(*Cryptogamia.*)—Consisting, as they do, wholly, or in great measure, of cellular tissue, may be practically disregarded as fibre-producers.

1. *Fern Family.*—Common Bracken Fern; Captain Brown's Patent.
2. *Horse-tail Family.*—Dutch rush; common ditch horse tail.
3. *Moss Family.*—Bog Moss, &c.
4. *Lichen Family.*—Beard Moss, &c.
5. *Seaweed Family.*—"Water Flannel."

The above classification is merely one of convenience, and not botanically accurate.

The fibre of many of the plants above enumerated is equally suitable for the purposes of the rope spinner, and cloth weaver.

The Lecture will be illustrated by Specimens of—1. Papers made from the fibre of a variety of plants,—British and Foreign.—2. The crude fibres separated from the said plants, and suitable for the purposes of the paper maker, rope spinner, or cloth weaver.—3. The plants which either yield fibres as above, or which might—under appropriate manipulation—be made to do so.

THE REV. GEORGE CLARK IRVING, M.A.

We have to record the recent death, under peculiarly sudden and painful circumstances, of an old and highly esteemed member of the Canadian Institute. The Rev. George Clark Irving, M.A., a distinguished graduate of the University of Cambridge, was selected to fill the Chair of Mathematics and Natural Philosophy, on the establishment of Trinity College, Toronto; and, at an early period after his arrival in the province, he began to take an active interest in the affairs of the Canadian Institute. For years he was a member of its council, and one of the editing committee of this journal. By his affability and courtesy he won the good-will of all with whom he was thus brought in contact; and, at a period when such questions as the abolition of Clergy Reserves, and the rights and privileges properly assignable to Provincial and Denominational Colleges, tended to intensify the bitterness of political and sectarian jealousies, and to impede cordial co-operation even within the peaceful arena of literary and scientific research, Professor Irving stood aloof from all narrow-minded display of party-spirit, and was esteemed no less for his conciliatory and courteous frankness in his intercourse with men of all parties, than for the firmness with which he maintained his own opinions on every fitting occasion. In 1857, Professor Irving resigned his Chair in Trinity College, and returned to England; but, after a comparatively brief interval, the high estimation in which he was held by the Council of the College was evinced by his being invited by that body to resume the duties of the professorship, along with others of a still more onerous and responsible nature, connected with the oversight of the resident students.

The return of Professor Irving to Toronto was welcomed by many friends, and by none more so than by his old colleagues in the Canadian Institute; but his active connection with the Educational and Literary Institutions of Toronto was speedily terminated by his promotion to the Principalship of the Collegiate School of Bishop's College, Lennoxville, rendered vacant by the election of his predecessor to the See of Quebec. In his new sphere, Mr. Irving's pleasing manners, and high acquirements, added to the reputation of the College; and its last session terminated amid the most gratifying evidences of the success of the department under his charge.

He had accepted the invitation of Bishop Williams to spend part of the long vacation with him, at Riviere du Loup; and, while still his guest, was drowned while bathing there, on the 15th of August last. The painful circumstances attending this melancholy event were intensified by the presence of Mrs. Irving, who witnessed the fatal occurrence, and vainly exerted herself to save her husband's life. Chief Justice Meredith, Mr. Brydges, and others, then resident at Riviere du Loup, hastened to the spot on learning the painful news, and every means was resorted to with the view of restoring animation, but in vain. Mr. Irving was in ill health, and is supposed to have been seized with a fit while in the water. As he was no swimmer, he was quite within his depth; and, but for some sudden, disabling cause, he could readily have reached the shore. He was only in his 38th year, and was fondly believed to have many happy and useful years before him, when thus suddenly cut off in the prime of life, amid the affectionate regrets of a numerous circle of pupils and friends.

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST,—APRIL, 1866.

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

Day.	Barom. at temp. of 32°. 6 A.M.	2 P.M.	10 P.M.	MEAN.	Temp. of the Air. 6 A.M.	2 P.M.	10 P.M.	ME'N	Excess of mean above Normal.	Tens. of Vapour. 6 A.M.	2 P.M.	10 P.M.	M'N	Humidity of Air. 6 A.M.	2 P.M.	10 P.M.	M'N	Direction of Wind. 6 A.M.	2 P.M.	10 P.M.	Resultant Direction.	Velocity of Wind. 6 A.M.	2 P.M.	10 P.M.	Resul't.	ME'N	Rain in Inches.	Snow in Inches.
					°	°	°	°	°																			
1	29.510	29.738	—	—	34.0	38.8	—	—	—	.177	.135	—	—	87	57	—	—	W b N	W N W	Calm.	N 50° W	3.0	12.0	0.0	5.70	5.92		
2	.840	.841	29.840	29.8637	32.7	38.1	33.4	35.28	— 1.35	.165	.135	.134	.146	88	58	70	71	N	E b N	NE b E	N 74 E	2.8	8.2	2.0	4.86	5.03	...	...
3	.620	.780	.638	.7587	34.2	42.1	41.7	39.87	+ 2.86	.147	.110	.148	.138	75	40	56	56	E b N	E	E b N	N 74 E	7.6	13.0	7.6	8.24	8.29	...	...
4	.679	.642	.577	.6323	37.8	51.1	42.8	43.77	+ 6.43	.165	.246	.250	.221	72	65	90	77	E N E	E	E b N	N 88 E	2.2	2.0	2.6	3.04	3.08	...	...
5	.516	.495	.681	.5777	33.8	61.2	45.0	46.75	+13.03	.173	.387	.239	.281	89	71	80	77	Calm.	S W b S	W b N	S 78 W	0.0	4.0	5.0	6.30	7.89	...	...
6	.809	.786	.880	.8325	26.0	40.3	33.4	36.35	— 1.68	.153	.150	.120	.131	73	59	62	61	W b S	W b S	W N W	N 83 W	5.0	14.4	11.5	10.39	11.00	...	...
7	.921	.831	.826	.8537	30.6	35.3	30.9	32.02	— 6.40	.144	.089	.134	.119	85	43	77	67	W N W	N N W	N N W	N 40 W	5.2	5.2	5.8	6.34	7.32	...	...
8	.798	.826	—	—	29.5	40.2	...	—	—	.136	.099	—	—	83	30	—	—	N b W	S b W	N N W	N 38 W	8.8	5.2	7.4	2.50	6.23	...	...
9	.938	.950	.914	.9312	29.8	45.0	31.3	36.40	— 2.63	.088	.098	.700	.094	52	33	56	46	N b W	S S W	Calm.	S 8 W	5.0	5.6	0.0	1.49	2.58	...	...
10	.866	.740	.643	.7400	32.0	46.4	39.6	40.53	+ 1.12	.121	.148	.176	.151	66	46	72	60	S S E	E b S	E b S	S 70 E	1.0	9.4	0.5	3.07	4.07	...	...
11	.661	.668	.679	.6728	39.2	55.1	43.2	46.25	+ 6.52	.171	.207	.209	.203	72	46	74	65	Calm.	S b W	Calm.	S 10 W	0.0	3.0	0.0	0.96	1.13	Inp.	...
12	.679	.505	.401	.5187	39.2	56.2	54.7	51.60	+11.47	.190	.202	.392	.245	79	44	91	64	E b N	E S E	W b S	S 54 W	0.4	5.8	16.8	4.53	8.50	...	...
13	.718	.886	.882	.8335	41.0	49.3	36.8	42.15	+ 1.72	.184	.193	.181	.181	71	54	83	68	W N W	S S W	Calm.	N 64 W	17.4	5.8	0.0	3.50	6.01	.215	...
14	.748	.498	.611	.6103	37.8	43.2	39.2	40.48	— 0.25	.173	.190	.155	.166	76	68	64	65	E b N	E b N	Calm.	N 73 E	11.2	2.2	0.0	2.84	3.94	...	...
15	.788	.824	—	—	34.9	45.4	—	—	—	.167	.170	—	—	83	59	—	—	W b S	S b E	W	N 56 W	1.0	5.6	2.1	2.04	4.06	...	...
16	.867	.804	.870	.8682	37.1	49.7	43.5	44.43	+ 2.05	.174	.141	.186	.172	78	38	66	59	N E	E b N	E b N	N 80 E	4.5	18.2	11.0	11.40	11.46	...	...
17	.912	.914	.920	.9100	42.8	56.5	45.4	48.90	+ 7.15	.240	.280	.253	.259	87	62	83	75	E b N	E	Calm.	N 89 E	8.2	8.0	0.0	4.28	4.30	...	...
18	.906	.803	.726	.8022	45.7	59.1	52.6	53.77	+11.70	.268	.322	.332	.312	87	64	84	76	Calm.	E b S	E b S	S 71 E	0.0	4.8	1.0	2.66	2.78	...	...
19	.737	.759	.732	.7368	52.6	64.8	49.0	56.42	+14.07	.364	.403	.320	.308	92	75	94	87	Calm.	N N E	E	N 78 E	0.0	3.0	12.2	6.16	6.88	.010	...
20	.600	.477	.393	.4790	47.9	59.4	54.0	52.52	+ 9.68	.301	.353	.346	.324	90	69	82	82	E N E	E b S	S W	S 84 E	5.0	3.2	0.5	0.59	1.02	.160	...
21	.307	.172	.242	.2353	50.0	64.1	51.5	56.35	+13.25	.345	.260	.220	.274	96	44	58	64	S W	S W b S	N N W	S 58 W	2.0	18.2	3.2	7.07	9.00	.210	...
22	.282	.278	—	—	44.3	61.2	—	—	—	.239	.211	—	—	82	37	—	—	Calm.	W b N	N b W	N 42 W	0.0	15.0	8.4	4.68	6.75	...	...
23	.258	28.982	28.920	.0352	42.1	42.1	36.0	40.00	— 3.10	.204	.223	.206	.213	76	83	97	85	N N E	N N E	N W b N	N 15 W	11.2	19.0	28.5	21.90	24.31	...	...
24	28.928	29.021	29.105	.0268	33.8	46.1	36.7	38.87	— 5.13	.157	.154	.098	.132	81	48	43	56	N W	N W b W	W	N 61 W	34.0	29.0	12.6	19.45	20.37	1.080	...
25	29.125	.168	.336	.2170	32.0	45.0	34.0	37.65	— 6.75	.121	.081	.181	.114	66	27	65	52	W b N	N W b W	W N W	N 56 W	7.0	15.5	5.0	13.95	14.46	...	Inp.
26	.427	.506	.588	.5123	34.5	45.4	37.0	39.16	— 5.63	.163	.111	.141	.135	82	35	64	58	W N W	N W	N W	N 44 W	13.6	24.2	5.0	11.74	11.81	...	...
27	.685	.639	.560	.6231	38.9	49.3	43.2	43.02	— 1.10	.159	.164	.182	.170	67	46	64	59	N b W	S S W	S S W	S 89 W	4.5	5.2	0.5	0.10	2.67	...	Inp.
28	.407	.216	.474	.3632	42.1	53.6	45.3	47.50	+ 2.10	.178	.214	.155	.190	66	51	50	57	E N E	E	W N W	N 59 W	4.0	4.8	26.0	8.26	12.52	Inp.	...
29	.626	.551	—	—	39.6	53.6	—	—	—	.150	.063	—	—	61	14	—	—	W b N	W b N	W N W	N 68 W	4.5	33.0	9.3	18.49	18.70	...	...
30	.665	.581	.546	.5898	33.8	50.0	39.9	41.97	— 4.08	.129	.130	.078	.115	66	36	32	43	N W b W	S b W	N	N 49 W	11.5	6.0	5.0	3.29	5.92	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
M	29.6415	29.5886	29.6028	29.6094	38.30	49.94	41.64	43.86	+ 2.87	.187	.203	.196	.195	77	52	71	65	....	....	....	....	6.02	10.28	6.32	... ...	7.95	1.675	Inp.

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR APRIL, 1866.

NOTE.—The monthly means do not include Sunday observations. The daily means, excepting those that relate to the wind, are derived from six observations daily, namely at 6 A.M., 8 A.M., 2 P.M., 4 P.M., 10 P.M., and midnight. The means and resultants for the wind are from hourly observations.

Highest Barometer .... 29.972 at 8 a.m. on 2nd } Monthly range =
Lowest Barometer .... 28.927 at mid. on 23rd } 1.045 inches.

Self-regist'ing Thermom.
- Maximum Temperature ....71°0 on 21st } Monthly range =
- Minimum Temperature ....28°5 on 9th } 42°5
- Mean maximum Temperature ....52°87 } Mean daily range=
- Mean minimum Temperature ....36°01 } 16°86
- Greatest daily range......36°2 from a.m. to p.m. of 5th.
- Least daily range .... 6°1 from a.m. to p.m. of 6th.

Warmest day.........19th...Mean temperature..............56°42 } Difference = 24°40
Coldest day......... 7th...Mean temperature..............32°02 }
Maximum Radiation. { Solar..........................113°0 on 22nd } Monthly range =
{ Terrestrial.......................... 15°0 on 30th } 98°0
Aurora observed on 1 night, viz:—17th.
Possible to see Aurora on 18 nights; Impossible on 12 nights.
Snowing on 2 days; depth inapp; duration of fall 1.6 hours.
Raining on 7 days; depth 1.675 inches; duration of fall 20.3 hours.
Mean of cloudiness = 0.58.
Most cloudy hour observed, 8 a.m.; mean = 0.67; least cloudy hour observed, 10 p.m.; mean = 0.47.

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

North.	South.	East.	West.
2342.03	566.89	1365.59	2990.32

Resultant direction N. 42° W.; Resultant velocity 3.34 miles per hour.
Mean velocity............................7.95 miles per hour.
Maximum velocity.........................38.5 miles, from 8 to 9 p.m. of 28th.
Most windy day.........23rd...........Mean velocity, 24.31 miles per hour. } Difference=
Least windy day.........20th...........Mean velocity, 1.02 ditto } 23.29 miles.
Most windy hour ...... 1 p.m.........Mean velocity, 11.20 ditto } Difference=
Least windy hour...... 2 a.m.........Mean velocity, 4.70 ditto } 6.50 miles.

April 10th. Solar halo during forenoon. 12th. Solar halo. 19th. Fog at midnight. 20th. Fog 6 a.m. 21st. Dense fog 6 a.m. 21st. Solar halo, lunar halo at midnight, wind in strong warm gusts during afternoon. 23rd. Very stormy day, wind and heavy rain. 25th. Solar halo at noon, lunar halo during evening. 30th. Solar halo, lunar halo at midnight.

April 5th. Robins numerous. 11th. Butterflies observed. 14th. Swallows observed. 18th. Frogs heard.

April was on the whole dry and warm. The latter part, however, was cold and windy.

COMPARATIVE TABLE FOR APRIL.

YEAR.	TEMPERATURE. Mean.	Excess above aver'ge	Max. observed.	Min. observed.	Range.	RAIN. No. of days.	Inches	SNOW. No. of days.	Inches	WIND. Resultant. Direction.	V'y.	Mean Force or Velocity.
	°	°	°	°	°							
1840	42.4	+ 1.4	65.9	25.3	40.6	14	3.420	2	...	...	...	....
1841	39.2	— 1.8	62.9	22.1	40.8	3	1.370	3	...	...	...	0.51 lbs.
1842	43.1	+ 2.1	89.5	21.6	67.9	8	3.740	2	...	...	...	0.57
1843	40.9	— 0.1	70.0	15.1	54.9	7	3.185	3	0.1	...	...	0.46
1844	47.5	+ 6.5	74.5	17.2	57.3	10	1.515	1	Inp.	...	...	0.24
1845	42.1	+ 1.1	66.0	14.8	51.2	11	3.290	4	1.5	...	...	1.00
1846	44.0	+ 3.0	79.4	24.4	55.0	10	1.300	2	1.3	...	...	0.55
1847	39.2	— 1.8	65.6	8.4	57.2	8	2.870	2	4.0	...	...	0.59
1848	41.3	+ 0.3	65.4	26.5	38.9	5	1.455	1	0.5	N 77° W	1.46	4.89mls.
1849	39.0	— 2.0	70.9	23.2	47.7	10	2.655	2	1.7	N 43° W	3.14	7.50
1850	37.9	— 3.1	63.2	18.2	45.0	7	4.720	2	1.1	N 39° W	1.12	7.64
1851	41.3	+ 0.3	59.2	25.8	33.4	11	2.295	3	1.2	N 14° E	2.52	8.07
1852	38.2	— 2.8	53.8	19.8	34.0	6	1.990	4	0.4	N 23° E	2.44	6.68
1853	41.9	+ 0.9	65.7	27.0	38.7	10	2.625	1	1.0	N 12° W	1.95	5.20
1854	41.0	0.0	65.1	22.3	42.8	12	2.685	4	2.7	N 50° E	2.57	6.81
1855	42.4	+ 1.4	63.8	12.2	51.6	8	2.030	3	1.6	N 36° W	3.99	7.57
1856	42.3	+ 1.3	69.8	15.1	54.7	13	2.780	3	0.1	N 29° E	1.64	6.05
1857	35.4	— 5.6	51.9	10.0	41.9	10	1.755	11	12.9	N 60° W	4.15	10.24
1858	41.5	+ 0.5	61.5	23.8	37.7	13	1.642	2	0.1	N 14° W	1.64	9.57
1859	39.5	— 1.5	62.1	23.9	38.2	9	2.527	8	1.2	N 36° W	2.33	10.79
1860	39.5	— 1.5	60.7	19.7	41.0	11	1.282	5	0.3	N 37° W	4.10	10.30
1861	42.0	+ 1.0	62.3	26.2	36.1	12	1.619	4	6.9	N 37° E	2.31	8.90
1862	39.6	— 1.4	64.1	20.1	44.0	10	2.235	4	0.2	N 50° E	2.48	9.77
1863	42.0	+ 1.0	67.7	8.9	58.8	8	2.210	4	1.6	N 14° E	3.75	9.20
1864	40.9	— 0.1	58.3	29.5	28.8	16	3.633	3	3.5	N 41° E	3.39	7.77
1865	43.1	+ 2.1	60.5	25.2	35.3	17	3.972	6	2.0	N 84° W	2.11	8.39
1866	43.9	+ 2.9	69.2	29.5	39.7	7	1.675	2	Inp.	N 42° W	3.34	7.95
Results to 1864.	40.96	...	65.57	20.04	45.53	9.7	2.433	3.3	2.40	N 7° W	2.07	8.06
Excess for 1866	+ 2.90	...	+ 3.63	+ 9.46	— 5.83	— 2.7	— 0.758	— 1.3	— 2.40	....	...	— 0.11

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO CANADA WEST,—MAY, 1866.

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 Normal.	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 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.	Resul't.	ME'N		
1	29.474	29.269	29.280	20.3242	36.3°	41.7°	37.8°	39.15°	− 7.27°	.123	.125	.217	.155	56	46	95	65	N E b N	E N E	Calm.	N 43° E	1.4	14.6	0.0	6.41	10.03	0.075	...
2	.374	.437	.520	.4627	37.0	45.9	37.0	39.73	− 6.98	.183	.130	.149	.153	84	43	67	63	NW b N	N N W	W b N	N 48 W	14.2	21.5	9.0	14.60	15.28	...	...
3	.552	.505	.480	.5078	36.0	47.2	37.0	40.80	− 6.25	.144	.087	.124	.115	68	24	56	47	W N W	W b N	Calm.	N 69 W	1.2	19.0	0.0	10.93	11.05	...	...
4	.456	.406	.441	.4335	39.2	56.5	45.0	47.93	+ 0.52	.147	.118	.149	.135	61	25	49	42	W b N	NW b W	NW b N	N 53 W	3.4	21.6	9.8	12.27	12.97	...	...
5	.466	.481	.579	.5198	38.1	55.8	44.3	46.37	− 1.37	.179	.177	.194	.176	77	38	67	57	N N W	NW b N	NW b N	N 47 W	4.0	16.0	7.4	9.24	11.04	...	...
6	.630	.655	—	—	41.7	57.6	—	—	—	.123	.193	—	—	46	40	—	—	NW b N	N N W	N N W	N 27 W	9.0	17.0	14.7	12.83	13.15	...	...
7	.842	.824	.756	.8020	44.6	52.2	44.3	48.12	− 0.30	.162	.164	.157	.160	54	42	53	48	N	S E b S	Calm.	S 47 E	3.8	7.8	0.0	2.28	2.62	...	...
8	.722	.567	.375	.5353	43.5	53.3	49.0	50.03	+ 1.25	.177	.168	.287	.212	62	41	82	60	Calm.	E N E	N E b E	N 37 E	0.0	5.2	8.6	4.65	6.73	0.270	...
9	.372	.402	.485	.4260	46.8	56.5	49.3	50.52	+ 1.35	.285	.291	.303	.280	83	63	86	76	NW b W	S b W	Calm.	S 69 W	8.5	9.0	0.0	4.29	6.14	...	...
10	.577	.559	.519	.5452	45.0	58.3	46.8	49.78	+ 0.28	.258	.236	.245	.248	86	48	76	70	Calm.	S E b S	E	S 58 E	0.0	7.0	2.6	2.23	3.60	...	...
11	.527	.488	.490	.5067	45.7	67.0	52.6	56.35	+ 6.45	.211	.309	.279	.277	68	47	71	62	Calm.	S E	Calm.	S 66 E	0.0	5.8	0.0	1.36	1.56	...	...
12	.514	.459	.412	.4537	47.2	68.8	63.4	60.62	+10.45	.279	.274	.356	.309	86	38	61	60	S E	S b W	W b S	S 44 W	0.5	16.0	5.4	5.84	9.77	0.165	...
13	.376	.460	—	—	46.1	46.8	—	—	—	.273	.180	—	—	87	55	—	—	NW b N	N W	Calm.	N 41 W	17.0	24.2	0.0	12.24	12.38	0.315	...
14	.682	.657	.658	.6640	38.1	51.5	37.8	43.30	− 7.58	.161	.101	.183	.149	69	26	80	56	Calm.	N W	S S W	N 68 W	0.0	19.6	1.0	3.62	5.29	...	...
15	.610	.419	.282	.4155	38.5	49.7	47.2	46.87	− 4.42	.173	.278	.249	.232	74	77	76	71	S S W	S	S S W	S 14 W	0.5	10.4	10.5	3.23	7.40	0.125	...
16	.383	.571	.628	.5408	43.9	49.0	10.3	43.90	− 7.68	.244	.225	.150	.201	86	65	59	69	N N W	S E	N W	N 1 W	13.6	3.0	2.0	4.35	6.94	...	...
17	.650	.625	.529	.5930	38.1	50.0	42.1	44.37	− 7.62	.153	.173	.152	.169	66	47	56	57	NW b N	E b S	E	S 82 E	5.2	7.5	4.6	5.61	5.79	...	...
18	.469	.383	.422	.4245	44.3	53.3	53.6	51.07	− 1.22	.184	.251	.329	.260	63	61	80	68	E	E	N N E	N 80 E	1.0	11.6	1.2	3.85	5.02	...	...
19	.485	.482	.440	.4627	52.2	63.7	54.4	57.62	+ 5.00	.275	.318	.288	.299	70	54	67	63	N	S E b S	S E b S	S 62 E	3.8	6.0	5.8	2.53	3.73	...	...
20	.425	.246	—	—	53.6	65.9	—	—	—	.297	.437	—	—	72	68	—	—	E	E	NW b W	N 39 W	3.0	7.0	7.8	4.39	10.58	0.180	...
21	.402	.463	.517	.4652	48.6	50.4	43.2	47.03	− 6.28	.202	.142	.198	.170	58	38	70	53	W N W	W N W	W N W	N 60 W	15.5	27.0	10.2	22.03	22.18	inap.	...
22	.583	.617	.640	.6167	40.7	47.5	39.2	42.87	−10.83	.170	.126	.147	.142	66	36	61	52	N W	NW b N	W b N	N 49 W	24.2	28.2	4.4	17.51	17.86	...	...
23	.651	.641	.700	.6623	40.7	51.5	39.9	44.08	− 8.98	.170	.202	.198	.193	66	52	80	64	W N W	W b N	NW b W	N 64 W	12.0	22.4	8.2	13.24	13.70	...	...
24	.696	.589	.490	.5852	41.0	63.7	54.0	54.28	0.00	.167	.133	.180	.150	63	22	42	39	W b N	W S W	W S W	S 72 W	4.0	20.0	8.0	10.43	11.27	...	...
25	.469	.381	.383	.4107	48.2	55.5	48.6	49.98	− 4.70	.216	.274	.222	.231	64	61	64	63	W S W	S S W	NW b W	S 76 W	5.0	10.4	4.0	2.36	4.77	0.090	...
26	.365	.336	.287	.3235	47.2	54.4	51.5	51.80	− 3.18	.202	.287	.263	.260	61	67	68	67	N	E	N E	N 71 E	4.4	9.0	5.0	10.16	10.77	inap.	...
27	.115	28.959	—	—	53.6	51.5	—	—	—	.238	.326	—	—	57	85	—	—	E N E	N E b E	N E b E	N 47 E	20.5	19.0	8.4	12.14	14.73	1.290	...
28	28.950	29.172	.241	.1353	47.2	51.8	47.1	48.33	− 7.32	.279	.271	.250	.260	86	70	77	77	NW b N	N W	W	N 48 W	18.0	28.5	3.2	11.24	11.59	0.085	...
29	29.205	.263	.333	.2677	41.0	50.8	46.8	47.63	− 8.32	.184	.313	.264	.264	71	84	81	79	W	S W	N W	S 84 W	0.5	5.6	6.8	3.70	5.39	0.110	...
30	.317	.255	.353	.3213	46.1	55.5	49.2	50.95	− 5.30	.234	.305	.277	.280	75	69	82	75	W b S	S W	N N W	N 87 W	5.8	7.8	7.8	5.17	7.45	0.115	...
31	.581	.683	.735	.6755	45.5	55.5	47.1	49.63	− 6.92	.233	.262	.212	.233	76	60	65	65	NW b N	S	N b W	N 51 W	8.6	8.2	8.0	2.21	6.42	...	...
M	29.4946	29.4790	29.4808	29.4845	42.99	53.89	46.20	48.30	− 3.18	.200	.213	.223	.212	71	50	69	62	....	....	....	....	6.73	14.06	5.30	......	9.26	2.820	......

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR MAY, 1866.

NOTE.—The monthly means do not include Sunday observations. The daily means, excepting those that relate to the wind, are derived from six observations daily, namely, at 6 A.M., 8 A.M., 2 P.M., 4 P.M., 10 P.M., and midnight. The means and resultants for the wind are from hourly observations.

Highest Barometer . . . . 29.866 at 8 a.m. on 7th. } Monthly range=
Lowest Barometer . . . . 28.910 at 6 p.m. on 27th. } 0.947 inches.

Self-registering Ther.:
- Maximum temperature . . . 73°.4 on 20th. } Monthly range=
- Minimum temperature . . . 33°.4 on 15th. } 40°0
- Mean maximum temperature . . 57°55 } Mean daily range=17°76
- Mean minimum temperature . . 39°79 }
- Greatest daily range . . . . 31°8 from a.m. to p.m. of 24th.
- Least daily range . . . . 4°8 from a.m. to p.m. of 13th.

Warmest day . . . . 12th ..Mean Temperature . . . 60°62 } Difference=21°.47
Coldest day . . . . . 1st ..Mean Temperature . . . 39°15 }

Maximum Radiation { Solar . . . . 117°0 on 11th } Monthly range=
{ Terrestrial . . . . 21°0 on 17th & 24th } 96°.0

Aurora observed on 7 nights, viz.:—on 3rd, 4th, 6th, 12th, 14th, 18th, and 19th.
Possible to see Aurora on 24 nights; impossible on 7 nights.
Snowing on 00 days; depth 0.0 inches; duration of fall 0.0 hours.
Raining on 13 days; depth 2.820 inches; duration of fall, [illegible] hours.
Mean of cloudiness=0.54; Most cloudy hour observed, 2 p.m.; mean=0.67; least cloudy hour observed, 10 p.m.; mean=0.39.

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

North.	South.	East.	West.
3237.72	902.11	1241.24	3633.46

Resultant direction, N. 46° W.; Resultant Velocity, 4.49 miles per hour.
Mean velocity 9.23 miles per hour.
Maximum velocity 32.3 miles, from 11 a.m. to noon of 21st
Most windy day 21st—Mean velocity 22.18 miles per hour. } Difference 20.62.
Least windy day 11th—Mean velocity 1.56 miles per hour. }

Most windy hour, 3 p.m.—Mean velocity, 14.85 miles per hour. } Difference
Least windy hour, 10 p.m.—Mean velocity, 5.44 miles per hour. } 9.41 miles.

2nd. Thin Ice 6 a.m. 10th. Sharp hoar frost a.m. 14th. Hoar frost. 17th. Hoar frost. 21st. Lightning and Rain during morning. 24th. Hoar frost. 24th. Solar halo.

May, 1866, was cold, dry and windy.

COMPARATIVE TABLE FOR MAY.

YEAR.	TEMPERATURE. Mean.	Excess above Average	Maximum observed.	Minimum observed.	Range.	RAIN. No. of days.	Inches.	SNOW. No. of days.	Inches.	WIND. Resultant. Direction.	Velocity.	Mean Force or Velocity
1840	53.8	+ 2.1	74.5	30.8	43.7	9	4.150	0	0.0	...	...	...
1841	50.5	— 1.2	76.2	26 6	49.6	11	2.350	1	...	...	...	0.35 lbs
1842	49.1	— 2.6	74.4	30.0	44.3	7	1.275	0	0.0	...	...	0.53 "
1843	49.1	— 2.6	79.6	28.9	50.7	5	1.570	0	0.0	...	...	0.52 "
1844	53.6	+ 1.9	77.7	29.0	48.7	14	5.670	0	0.0	...	...	0.30 "
1845	49.6	— 2.1	76.6	29.4	47.2	8	2.300	0	0.0	...	...	0.55 "
1846	55.5	+ 3.8	78.1	34.3	43.8	9	4.375	0	0.0	...	...	0.46 "
1847	54.4	+ 2.7	72.5	27.8	44.7	12	2.010	0	0.0	...	...	0.29 "
1848	54.1	+ 2.4	78.5	31.9	46.6	13	2 520	0	0.0	N 40 W	1.31	4.93 ms
1849	48.0	— 3 7	72.5	32.7	39.8	16	5.115	0	0.0	N 51 E	1 97	5.33 "
1850	47 6	— 4.1	76.3	31.1	45.2	7	0.545	1	inap.	N 64 W	2.05	6.32 "
1851	51.3	— 0.4	73.2	28.7	44.5	12	2.950	1	0.5	N 32 W	1.59	6.34 "
1852	51.4	— 0 3	73.3	34.5	38.8	7	1 125	1	inap.	S 82 W	0.99	4.00 "
1853	50.9	— 0.8	78.4	38.4	40.0	17	4.420	1	inap.	N 2 W	0.83	5.16 "
1854	52.2	+ 0.5	69.0	27.6	41.4	11	4.630	0	0.0	E	0.40	5.38 "
1855	53.1	+ 1.4	74.8	33.9	40.9	6	2.565	2	0.9	N 1 W	2.76	5.93 "
1856	50.5	— 1.2	80.1	35.5	44.6	14	4.580	1	inap	N 4 E	3.99	9.81 "
1857	48.9	— 2.8	72.5	27.9	44.6	15	4.145	1	inap.	N 23 W	1.14	8.13 "
1858	48.9	— 2.8	66.0	35.0	31.0	17	6.367	0	0.0	N 42 E	3.33	9.30 "
1859	55.2	+ 3.5	76.2	41.5	34.7	11	3.410	0	0.0	N 72 E	1.59	5.70 "
1860	55.5	+ 3.8	73.2	35.6	37.6	16	1.815	0	0.0	N 26 E	2.66	7.17 "
1861	47.5	— 4.2	72.0	29.1	42.9	12	3.380	1	0.5	N 47 W	3.60	9.17 "
1862	52.2	+ 0.5	77.8	38.1	39.7	8	1.427	0	0.0	N 52 W	2.80	7.87 "
1863	54.3	+ 2.6	77.1	38.1	39.0	14	3.363	1	0.1	N 56 E	0.41	5.89 "
1864	54.8	+ 3.1	74.2	35.3	38.9	18	4.070	0	0.0	N 7 W	1.86	5.64 "
1865	52.3	+ 0.6	76.0	33.8	42.2	11	4.005	0	0.0	N 3 W	1.65	5.48 "
1866	48.3	— 3.4	68.8	36.0	32.8	13	2.820	0	0.0	N 46 W	4.49	9.26 "
Results to 1864.	51.68	...	74.98	32.47	42.52	11.6	3.206	0.4	0.09	N 6 W	1.46	6.59
Exc. for 1866.	—3.38	...	—6.18	+3.53	—9 72	+ 1.4	— 0.386	— 0.4	— 0 09	...	...	+2.67

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST,—JUNE, 1866

Latitude—43 deg. 39.4 min. North. Longitude—5 h. 17.33 min. West. Elevation above Lake Ontario, 108 feet.

Day.	Barom. at temp. of 32°.				Temp of the Air.				Excess of mean above Normal	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Resul't. Direc-tion.	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	10PM	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-sult'.	ME'N		
1	29.812	29.763	29.714	29.7563	40.7	56.5	45.4	49.87	— 7.08	.153	.185	.225	.216	60	40	74	60	Calm.	S	Calm.	S 2 W	0.0	4.4	0.0	1.30	2.08	...	...
2	.669	.625	.556	.6122	50.4	59.0	49.7	55.38	— 1.88	.207	.301	.298	.281	56	60	83	64	Calm.	S E b S	Calm.	N 67 E	0.0	1.5	0.0	1.36	2.11	...	...
3	.491	.455	—	—	55.1	63 4	—	—	—	.237	.431	—	—	53	74	—	—	N E	E b N	E N E	N 76 E	2.6	10.0	10.7	9.42	9.48	inap.	...
4	.354	.374	.434	.3872	52.6	60.9	56.2	56.60	— 1.25	.374	.441	.394	.401	94	82	87	87	E b N	E N E	Calm.	N 70 E	6.0	6.6	0.0	4.20	4.28	0.140	...
5	.441	.417	.387	.4097	52.9	65.2	57.6	58.20	+ 0.05	.393	.550	.458	.463	98	88	97	95	E b N	Calm.	Calm.	N 86 E	3.0	0.0	0.0	2.13	2.17	.150	...
6	.360	.257	.267	2970	52.9	59.8	52.6	55.82	— 2.63	.372	.381	.348	.383	92	74	89	86	Calm.	S S W	S W b S	S 23 W	0.0	11.0	1.2	4.35	5.14	.140	...
7	.332	.402	.472	.4095	58.0	69.2	55.1	60.82	+ 2.07	.441	,380	.375	.391	92	53	86	75	Calm.	W b N	Calm.	N 78 W	0.0	23.8	0.0	10.15	10.22	...	...
8	.534	.535	.583	.5555	58.0	67.0	55.1	60.38	+ 1.32	.382	.460	.375	.396	79	69	86	75	Calm.	S E b E	E	N 88 E	0.0	2.8	10.5	6.44	7.77	...	...
9	.531	.533	.570	.5440	55.8	55.4	58.0	57.30	— 2.18	.365	.349	.452	.395	82	80	94	84	N E b E	S E b E	Calm.	N 89 E	3.8	3.5	0.0	1.53	2.22	...	...
10	.723	.751	—	—	57.6	72.4	—	—	—	.353	.562	—	—	74	70	—	—	N W b W.	S b W	N N W	N 40 W	1.5	2.8	8.3	4.20	6.04	...	...
11	.907	.877	.809	.8607	54.0	62 7	52.9	57.45	— 2.53	.250	.296	.274	.282	59	51	69	60	N	S b W	Calm.	S 36 E	9.0	2.5	0.0	0.64	2.12	...	...
12	.793	.705	.585	.6767	55.8	58.7	53.3	55.98	— 4.28	.290	.210	.323	.269	65	42	79	60	E b N	E b N	E b N	N 82 E	3.2	7.0	10.0	9.12	9.13	.710	...
13	.516	.372	.376	.3933	48.6	57.2	60.9	57.13	— 3.45	.322	.427	.503	.424	94	91	94	90	E b N	S b W	Calm.	S 41 E	4.0	1.0	0.0	0.68	1.20	.100	...
14	.339	.345	.396	.3607	61.6	74 0	58.0	63.18	+ 4.37	.428	.287	.337	.348	78	32	70	59	Calm	W b S	Calm.	S 78 W	0.0	17.0	0.0	6 65	6.85	...	...
15	.331	.374	.380	.3642	60.1	68.8	58.3	64.17	+ 3.05	.376	.310	.345	.330	72	44	70	57	Calm.	W b N	S E b S	S 89 W	0.0	13.0	2.0	6.90	7.32	inap.	...
16	.392	.388	.458	.4178	55 8	66.3	55.8	59.78	— 1.57	.388	.366	.333	.366	87	56	74	72	Calm.	S W b S	Calm.	S 20 W	0.0	5.2	0.0	2.87	3.20	.100	...
17	.470	.427	—	—	55.8	60.1	—	—	—	.400	.375	—	—	90	72	—	—	Calm.	N E b E	N E b N	N 62 E	0.0	3.8	11.4	6.53	7.52	.950	...
18	28.967	.056	.081	.0373	53.6	53.6	50.8	52.60	— 9.35	.384	.298	.294	.332	93	72	78	83	E b S	S b E	S E	S 29 E	8.0	15.0	15.0	10.26	12.77	.245	...
19	29.219	.462	.605	.4558	51.8	62.7	51.1	55.40	— 6.73	.353	.330	.342	.336	92	58	91	78	W N W	W b N	Calm.	N 76 W	10.5	14.2	0.0	7.52	7.60	inap.	...
20	.671	.660	.665	.6633	54.7	72.0	59.1	62.05	— 0.40	.315	.406	.379	.368	73	52	75	67	Calm.	S W b S	S W b W	S 30 W	0.0	[illegible]	0.3	4.33	4.38	...	...
21	.646	.528	.417	.5243	59.8	75.3	65.5	67.53	+ 4.87	.405	.553	.429	.472	78	63	68	69	Calm.	S b W	S W b S	S 26 W	0.0	12.5	5.8	6.57	6.90	...	...
22	.510	.543	.523	.5245	64.8	74.2	61.9	67.03	+ 4.08	.450	.457	.489	.443	73	54	88	68	W N W	S b W	Calm.	S 45 W	5.5	7.0	0.0	2.85	3.75	...	...
23	.540	.535	.552	.5425	64.5	75.7	64.5	68.75	+ 5.60	.494	.594	.532	.543	81	66	88	78	Calm.	S S W	Calm.	S 26 W	0.0	4.0	0.0	1.34	1.35	...	...
24	.623	.623	—	—	66.3	73.8	—	—	—	.548	.647	—	—	85	78	—	—	Calm.	E S E	Calm.	S 57 E	0.0	4.2	0.0	1.50	1.99	..	..
25	.608	.595	.631	.6328	71.7	89.4	64.8	74.10	+10.55	.661	.699	.476	.583	86	50	77	71	S W b S	W b S	S W	S 61 W	5.4	15.8	5.0	4.81	5 15	inap.	...
26	.594	.490	.412	.4932	65.6	76.4	68.8	68.93	+ 5.05	.478	.694	.557	.557	76	76	79	78	N N E	S	N E	S 15 W	5.0	5.8	2.0	3.02	4.92	.030	...
27	.335	.403	.504	.4263	66.3	70.2	60.1	64.77	+ 0.70	.549	.484	.366	.432	85	66	70	70	N W	S b W	N W b N	N 43 W	9.0	5.2	8.0	5.05	6.71	.130	...
28	.608	.653	.715	.6638	53.6	58.7	52.2	54.37	— 9.92	[illegible]	.339	.234	.278	72	68	60	65	N N W	S S W	N W b N	N 41 W	5.0	5.0	3.5	1.42	4 48	...	...
29	.752	.717	.727	.7317	51.1	60.9	52.6	55.70	— 8.75	.269	.254	.342	.292	71	47	86	67	N N W	S	Calm.	S 22 E	0.5	6.0	0.0	1.69	2.42	.025	...
30	.748	.785	.812	.7955	52.6	65.9	56.2	59.37	— 5.22	.310	.348	.285	.319	78	54	63	63	N E	S b E	Calm.	S 25 E	2.0	2.0	0.0	1.41	1.67	...	...
...	......	......	......	......	......	......	......	......	....	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
M	29.5196	29.5152	29.5250	29.5205	56.48	66.01	56.79	60.18	— 0.85	.373	.400	.376	.381	80	61	80	72	....	....	....	....	2.80	7.41	3.12	......	5.09	2.720	...

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR JUNE, 1866.

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Highest Barometer . . . . 29.907 at 6 a.m. on 11th. } Monthly range=
Lowest Barometer . . . . 28.967 at 6 a.m. on 18th. } 0.930 inches.

Self-registering Ther.:
Maximum Temperature . . . . . 90°.5 on 25th. } Monthly range=
Minimum Temperature . . . . . 40°.0 on 1st. } 50°.5
Mean Maximum Temperature . . 69°47 } Mean daily range=18°06
Mean Minimum Temperature . . 51°41 }
Greatest daily range . . . . . . 28°0 from a.m. to p.m. of 20th.
Least daily range . . . . 8°2 from a.m. to p.m. of 18th.

Warmest day . . . . 25th...Mean Temperature . . . 74°10 } Difference=24°.23
Coldest day . . . . . 1st...Mean Temperature . . . 49°87 }
Maximum Radiation. { Solar . . . . 134°.0 on 25th } Monthly range=
{ Terrestrial . . . . 25°.0 on 1st } 109°.0

Aurora observed on 1 night, viz.—12th.
Possible to see Aurora on 19 nights; impossible on 11 nights.
Snowing on days; depth inches; duration of fall hours.
Raining on 15 days; depth 2.720 inches; duration of fall 57.1 hours.
Mean of cloudiness=0.54; most cloudy hour observed, 4 p.m.; mean=0.58; least cloudy hour observed, 10 p.m.; mean=0.49.

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

North.	South.	East.	West.
724.54	1218.38	1240.05	1876.19

Resultant Direction, S. 15° W.; Resultant Velocity, 0.71 miles per hour.
Mean Velocity, 5.09 miles per hour.
Maximum Velocity, 27.7 miles, from 2 to 3 a.m. of 18th.
Most windy day, 18th—Mean velocity 12.77 miles per hour. } Difference,
Least windy day, 13th—Mean velocity 1.20 miles per hour. } 11.57 miles
Most windy hour, noon—Mean velocity 8.37 miles per hour. } Difference,
Least windy hour, 3 a.m.—Mean velocity 2.30 miles per hour. } 6.07 miles

4th. Fog at night. 5th. Dense fog a.m. Thunder storm at night. 9th. Solar halo a.m. 12th. Lightning at night. 13th. Thunder storm. 15th. Thunder storm. 16th. Thunder storm. 17th. Foggy. 25th. Very hot day. Thunder storm. 26th. Thunder storm. 29th. Thunder storm.

June 1st. Sharp hoar frost a.m. 22nd. Fire flies numerous. 27th. Pollen of plants fell during the storm this day.

[redacted] difference from the averages of preceding years.

COMPARATIVE TABLE FOR JUNE.

YEAR.	TEMPERATURE. Mean.	Excess above Average.	Maximum observed.	Minimum observed	Range.	RAIN. No. of days	Inches.	SNOW. No. of days.	Inches.	WIND. Resultant. Direction.	Velocity.	Mean Force or Velocity
1840	59.8	— 1.5	78.5	37.1	41.4	11	4.860	...	...	...	...	...
1841	65.6	+ 4.3	92.8	45.7	47.1	9	1.560	...	...	...	...	0.36 lbs
1842	55.6	— 5.7	73.9	28.0	45.9	15	5.755	...	...	...	...	0.31 "
1843	58.4	— 2.9	81.3	28.5	52.8	12	4.595	...	...	...	...	0.27 "
1844	59.9	— 1.4	82.8	33.1	49.7	9	3.535	...	...	...	...	0.19 "
1845	61.0	— 0.3	83.6	40.9	42.7	11	3.715	...	...	...	...	0.27 "
1846	63.3	+ 2.0	83.3	41.5	41.8	10	1.920	...	...	...	...	0.32 "
1847	58.4	— 2.9	78.3	36.7	41.6	14	2.625	...	...	...	...	0.30 "
1848	62.9	+ 1.6	92.5	38.3	54.2	8	1.810	...	...	N 61 W	1.90	4.51 ms
1849	63.2	+ 1.9	84.9	45.2	39.7	7	2.020	...	...	S 71 E	0.49	3.32 "
1850	64.3	+ 3.0	83.2	49.0	34.2	10	3.345	...	...	S 60 W	0.38	4.54 "
1851	59.2	— 2.1	79.2	41.2	38.0	11	2.697	...	...	S 2 W	1.26	4.42 "
1852	60.8	— 0.5	86.1	43.6	42.5	10	3.160	...	...	S 76 W	1.49	4.09 "
1853	65.5	+ 4.2	86.3	43.3	43.0	9	1.550	...	...	N 1 W	0.10	3.73 "
1854	64.1	+ 2.8	88.7	47.4	41.3	9	1.460	...	...	N 24 E	0.71	4.15 "
1855	59.9	— 1.4	90.7	40.6	50.1	17	4.070	...	...	N 69 W	1.33	5.70 "
1856	62.1	+ 0.8	82.6	48.3	34.3	13	3.200	...	...	S 21 W	0.90	5.30 "
1857	56.9	— 4.4	75.1	40.9	34.2	21	5.060	...	...	N 49 W	1.15	7.60 "
1858	66.2	+ 4.9	86.3	48.7	37.6	12	2.943	...	...	S 20 E	0.25	5.53 "
1859	58.3	— 3.0	85.2	33.9	51.3	16	4.085	2	Inp.	N 77 W	1.95	7.19 "
1860	63.2	+ 1.9	81.1	50.0	31.1	14	2.136	...	...	N 44 W	3.13	7.61 "
1861	61.3	0.0	86.5	48.2	38.3	13	2.329	...	...	N 39 W	2.29	6.11 "
1862	60.5	— 0.8	83.2	44.3	38.9	10	1.007	...	...	N 26 W	1.77	5.98 "
1863	60.1	— 1.2	79.3	45.0	34.3	13	1.665	...	...	N 50 W	2.26	5.24 "
1864	63.0	+ 1.7	92.6	41.7	50.9	5	0.570	...	...	N 55 W	1.72	4.53 "
1865	64.5	+ 3.2	83.2	49.0	34.2	7	2.005	...	...	S 30 W	0.60	4.06 "
1866	60.2	— 1.1	89.4	40.7	48.7	15	2.720	...	...	S 15 W	0.71	5.09 "
Results to 1864.	61.34	...	85.92	41.64	42.28	11.6	2.867	...	...	N 61 W	0.98	5.27
Exc. for 1866.	—1.14	...	+5.48	—0.94	+6.42	+ 3.4	— 0.147	...	...	...	...	— 0.18